**DEPARTMENT OF ENERGY**

**10 CFR Part 431**

**[Docket No. EE–2006–STD–0126]**

**RIN 1904–AB59**

# Energy Conservation Program for Commercial and Industrial Equipment: Energy Conservation Standards for Commercial Ice-Cream Freezers; Self-Contained Commercial Refrigerators, Commercial Freezers, and Commercial Refrigerator-Freezers Without Doors; and Remote Condensing Commercial Refrigerators, Commercial Freezers, and Commercial Refrigerator-Freezers

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

**ACTION:** Notice of proposed rulemaking and notice of public meeting.

**SUMMARY:** The Energy Policy and Conservation Act prescribes energy conservation standards for certain commercial and industrial equipment, and requires the Department of Energy (DOE) to administer an energy conservation program for this equipment. In this notice, DOE is proposing new energy conservation standards for commercial ice-cream freezers; self-contained commercial refrigerators, commercial freezers, and commercial refrigerator-freezers without doors; and remote condensing commercial refrigerators, commercial freezers, and commercial refrigerator-freezers. DOE is also announcing a public meeting on its proposed standards.

**DATES:** DOE will hold a public meeting on Tuesday, September 23, 2008, from 9 a.m. to 5 p.m. in Washington, DC. DOE must receive requests to speak at the public meeting no later than 4 p.m., Tuesday, September 9, 2008 DOE must receive a signed original and an electronic copy of statements to be given at the public meeting no later than 4 p.m., Tuesday, September 16, 2008.

DOE will accept comments, data, and information regarding the notice of proposed rulemaking (NOPR) before and after the public meeting, but no later than October 24, 2008. See Section VII, ''Public Participation,'' of this NOPR for details.

**ADDRESSES:** The public meeting will be held at the U.S. Department of Energy, Forrestal Building, Room 8E–089, 1000 Independence Avenue, SW., Washington, DC 20585–0121. Please note that foreign nationals visiting DOE Headquarters are subject to advance security screening procedures, requiring a 30-day advance notice. If you are a foreign national and wish to participate in the public meeting, please inform DOE as soon as possible by contacting Ms. Brenda Edwards at (202) 586–2945 so that the necessary procedures can be completed.

Any comments submitted must identify the NOPR for commercial refrigeration equipment, and provide docket number EE–2006–STD–0126 and/or RIN number 1904–AB59. 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: commercialrefrigeration.rulemaking@ee.doe.gov.* Include docket number EE–2006–STD–0126 and/or RIN 1904–AB59 in the subject line of the message.
- *Postal Mail:* Ms. Brenda Edwards, U.S. Department of Energy, Building Technologies Program, Mailstop EE–2J, 1000 Independence Avenue, SW., Washington, DC 20585–0121. Telephone: (202) 586–2945. Please submit one signed original paper copy.
- *Hand Delivery/Courier:* Ms. Brenda Edwards, U.S. Department of Energy, Building Technologies Program, 950 L'Enfant Plaza, SW., 6th Floor, Washington, DC 20024. Please submit one signed original paper copy.

For detailed instructions on submitting comments and additional information on the rulemaking process, see Section VII, ''Public Participation,'' of this document.

*Docket:* For access to the docket to read background documents 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.

**Please Note:** DOE's Freedom of Information Reading Room (Room 1E–190 at the Forrestal Building) no longer houses rulemaking materials.

**FOR FURTHER INFORMATION CONTACT:** Mr. Charles Llenza, U.S. Department of Energy, Building Technologies Program, EE–2J, 1000 Independence Avenue, SW., Washington, DC 20585–0121, (202) 586–2192, *Charles.Llenza@ee.doe.gov.*

Ms. Francine Pinto, Esq., U.S. Department of Energy, Office of General Counsel, GC–72, 1000 Independence Avenue, SW., Washington, DC 20585–0121, (202) 586–9507, *Francine.Pinto@hq.doe.gov.*

**SUPPLEMENTARY INFORMATION:**

## I. Summary of the Proposed Rule

The Energy Policy and Conservation Act, as amended (EPCA), specifies that any new or amended energy conservation standard the U.S. Department of Energy (DOE) prescribes for the equipment covered by this notice 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) and 6316(e)(1)) Furthermore, the new or amended standard must ''result in significant conservation of energy.'' (42 U.S.C. 6295(o)(3)(B) and 6316(e)(1)) In accordance with these and other statutory criteria discussed in this notice, DOE proposes to adopt new energy conservation standards for commercial ice-cream freezers; self-contained commercial refrigerators, commercial freezers, and commercial refrigerator-freezers without doors; and remote condensing commercial refrigerators, commercial freezers, and commercial refrigerator-freezers.[1] The proposed standards, shown in Table I–1, would apply to all commercial refrigeration equipment manufactured on or after January 1, 2012, and offered for sale in the United States. 42 U.S.C. 6313(c)(4)(A).

TABLE I–1—PROPOSED STANDARD LEVELS

| Equipment class[2] | Proposed standard level * ** | Equipment class | Proposed standard level |
|---|---|---|---|
| VOP.RC.M | 0.82 × TDA + 4.07 | VCT.RC.I | 0.71 × TDA + 3.05 |
| SVO.RC.M | 0.83 × TDA + 3.18 | HCT.RC.M | 0.16 × TDA + 0.13 |
| HZO.RC.M | 0.35 × TDA + 2.88 | HCT.RC.L | 0.34 × TDA + 0.26 |
| VOP.RC.L | 2.28 × TDA + 6.85 | HCT.RC.I | 0.4 × TDA + 0.31 |
| HZO.RC.L | 0.57 × TDA + 6.88 | VCS.RC.M | 0.11 × V + 0.26 |
| VCT.RC.M | 0.25 × TDA + 1.95 | VCS.RC.L | 0.23 × V + 0.54 |
| VCT.RC.L | 0.6 × TDA + 2.61 | VCS.RC.I | 0.27 × V + 0.63 |
| SOC.RC.M | 0.51 × TDA + 0.11 | HCS.RC.M | 0.11 × V + 0.26 |
| VOP.SC.M | 1.74 × TDA + 4.71 | HCS.RC.L | 0.23 × V + 0.54 |
| SVO.SC.M | 1.73 × TDA + 4.59 | HCS.RC.I | 0.27 × V + 0.63 |
| HZO.SC.M | 0.77 × TDA + 5.55 | SOC.RC.L | 1.08 × TDA + 0.22 |
| HZO.SC.L | 1.92 × TDA + 7.08 | SOC.RC.I | 1.26 × TDA + 0.26 |
| VCT.SC.I | 0.73 × TDA + 3.29 | VOP.SC.L | 4.37 × TDA + 11.82 |
| VCS.SC.I | 0.38 × V + 0.88 | VOP.SC.I | 5.55 × TDA + 15.02 |
| HCT.SC.I | 0.56 × TDA + 0.43 | SVO.SC.L | 4.34 × TDA + 11.51 |
| SVO.RC.L | 2.28 × TDA + 6.85 | SVO.SC.I | 5.52 × TDA + 14.63 |
| VOP.RC.I | 2.9 × TDA + 8.7 | HZO.SC.I | 2.44 × TDA + 9 |
| SVO.RC.I | 2.9 × TDA + 8.7 | SOC.SC.I | 1.76 × TDA + 0.36 |
| HZO.RC.I | 0.72 × TDA + 8.74 | HCS.SC.I | 0.38 × V + 0.88 |

* ''TDA'' is the total display area of the case, as measured in the Air-Conditioning and Refrigeration Institute (ARI) Standard 1200–2006, Appendix D.
** ''V'' is the volume of the case, as measured in ARI Standard 1200–2006, Appendix C.

[1] These types of equipment are referred to collectively hereafter as ''commercial refrigeration equipment.''

[2] For this rulemaking, equipment class designations consist of a combination (in sequential order separated by periods) of: (1) an equipment family code (VOP = vertical open, SVO = semivertical open, HZO = horizontal open, VCT = vertical transparent doors, VCS = vertical solid doors, HCT = horizontal transparent doors, HCS = horizontal solid doors, or SOC = service over counter); (2) an operating mode code (RC = remote condensing or SC = self-contained); and ( 3) a rating temperature code (M = medium temperature (38 °F), L = low temperature (0 °F), or I = ice-cream temperature (−15 °F)). For example, ''VOP.RC.M'' refers to the ''vertical open, remote condensing, medium temperature'' equipment class. See discussion below and chapter 3 of the TSD, market and technology assessment, for a more detailed explanation of the equipment class terminology.

DOE's analyses indicate that the proposed energy conservation standards, trial standard level (TSL) 4 (see Section V.A for a detailed description of TSLs), would save a significant amount of energy—an estimated 0.83 quadrillion British thermal units (Btu), or quads, of cumulative energy over 30 years (2012–2042). The economic impacts on commercial consumers (i.e., the average life-cycle cost (LCC) savings) are positive for all equipment classes.

The cumulative national net present value (NPV) of the proposed standards at TSL 4 from 2012 to 2042 ranges from $1.1 billion (at a seven percent discount rate) to $3.24 billion (at a three percent discount rate), in 2007$. This is the estimated total value of future operating cost savings minus the estimated increased equipment costs, discounted to 2007$. The benefits and costs of the standard can also be expressed in terms of annualized 2007$ values over the forecast period 2012 through 2062. Using a 7 percent discount rate for the annualized cost analysis, the cost of the standard is estimated to be $109 million per year in increased equipment and installation costs while the annualized benefits are expected to be $214 million per year in reduced equipment operating costs. Using a 3 percent discount rate, the annualized cost of the standard is expected to be $92 million per year while the annualized benefits of today's standard are expected to be $234 million per year. See Section V.B.3 for additional details. If DOE adopts the proposed standards, it expects manufacturers will lose 8 to 35 percent of the industry net present value (INPV), which is approximately $40 to $180 million.

DOE estimates that the proposed standards will have environmental benefits leading to reductions in greenhouse gas emissions (i.e., cumulative (undiscounted) emission reductions) of 44 million tons (Mt) of carbon dioxide ($CO_2$) from 2012 to 2042.[3] Most of the energy saved is electricity. In addition, DOE expects the energy savings from the proposed standards to eliminate the need for approximately 640 megawatts (MW) of generating capacity by 2042. These results reflect DOE's use of energy price projections from the U.S. Energy Information Administration (EIA)'s Annual Energy Outlook 2007 (AEO 2007).[4]

DOE proposes that TSL 4 represents the maximum improvement in energy efficiency that is technologically feasible and economically justified. DOE proposes that the benefits to the Nation of TSL 4 (energy savings, commercial consumer average LCC savings, national NPV increase, and emission reductions) outweigh the costs (loss of manufacturer INPV) and is therefore proposing TSL 4 as the energy conservation standards for commercial refrigeration equipment in this NOPR. TSL 4 is technologically feasible because the technologies required to achieve these levels already exist.

In this NOPR, DOE proposes that TSL 5 is not economically justified because, under the current circumstances, DOE believes that the benefits to the Nation of TSL 5 (energy savings, commercial consumer average LCC savings, and emission reductions) do not outweigh the costs (national NPV decrease and loss of manufacturer INPV). DOE's analyses indicate that TSL 5 would save a greater amount of energy than TSL 4—an estimated 1.21 quadrillion quads of cumulative energy over 30 years (2012–2042). At TSL 5, while the economic impacts on commercial consumers (i.e., LCC savings and NPV) are still positive for the majority of equipment classes, the impacts on commercial customers for five classes (VOP.RC.M, VOP.SC.M, SVO.RC.M, SVO.SC.M, and SOC.RC.M) are negative. The life-cycle cost savings are negative for three classes and NPV results for each of these five classes are negative.

The cumulative NPV at TSL 5, from 2012 to 2042, ranges from −$200 million (at a seven percent discount rate) to $1.16 billion (at a three percent discount rate), in 2007$. Using a 7 percent discount rate, the annualized cost of the standard is estimated to be $285 million per year in increased equipment and installation costs while the annualized benefits are expected to be $266 million per year in reduced equipment operating costs. Using a 3 percent discount rate, the annualized cost of the standard is expected to be $241 million per year while the annualized benefits are expected to be $292 million per year. See Section V.B.3 for additional details. At TSL 5, DOE expects manufacturers will lose 3 to 56 percent of the industry net present value INPV, which is approximately $18 to $285 million.

DOE based its estimates of the economic impacts referenced above on current costs for energy improving technologies used in commercial refrigeration equipment. A key technology for energy savings benefits in most commercial refrigeration equipment is the use of solid state lighting (i.e., light emitting diodes or LEDs). At current LED prices, the life-cycle cost savings at TSL 5 are substantially lower than TSL 3 and TSL 4 for several equipment classes. For example, the average per unit LCC savings for the VOP.RC.M equipment class is $1,551 at TSL 3, but this number falls by $1,785 to −$234 when moving to TSL 5. When accounting for the projected volume of sales for these equipment classes in 2012, the net effect of moving from TSL 3 to TSL 5 is a decrease in LCC savings of $130 million per year. To achieve the same or greater LCC savings at TSL 5 as other efficiency levels (e.g., TSL 3 or 4), for all equipment classes, average LED costs would need to decrease by almost 45 percent.

While considerable information is available that suggests LED costs are likely to decline more than assumed in DOE's analysis, DOE believes it must have a higher degree of confidence of further cost reductions than assumed in today's proposed rule. In this NOPR, DOE projected future LED costs based on DOE's Multi-Year Program Plan,[5] which are consistent with historical LED price reductions between 2000 and 2007. The Multi-Year Program Plan projects that LED chip costs will continue to decrease at a compound annual growth rate (CAGR) of approximately −27 percent between 2007 and 2012, which represents a price reduction of 80 percent over that time period. Since LED chips are only a portion of the total LED system (other components include power supply and the LED fixture), the 80 percent reduction in chip costs contributes to an estimated decrease in total LED system cost of approximately 50 percent by 2012, assuming the costs of the power supply and LED fixtures do not change significantly. Such a decrease in cost

[3] Additionally, the standards would result in 17 thousand tons (kt) of nitrogen oxides ($NO_X$) emissions reductions or generate a similar amount of $NO_X$ emissions allowance credits in areas where such emissions are subject to regulatory or voluntary emissions caps.

[4] DOE intends to use EIA's AEO 2008 to generate the results for the final rule. The AEO2008 Early Release contains reference case energy price forecasts which show higher commercial electricity prices at the national level compared with the AEO 2007 on a real (inflation adjusted) basis. If these early release energy prices remain unchanged in the final release, then incorporation of the AEO 2008 forecasts would likely result in reduced payback periods and greater life-cycle cost savings and greater national net present value for the proposed standards.

[5] U.S. Department of Energy, Solid-State Lighting Research and Development, Multi-Year Program Plan FY'09–FY'14. This document was prepared under the direction of a Technical Committee from the Next Generation Lighting Initiative Alliance (NGLIA). Information about the NGLIA and its members is available at *http://www.nglia.org*.

would be sufficient for TSL 5 to achieve LCC savings equal to or greater than other TSLs.

DOE examined whether the projected LED costs presented in the Multi-Year Program Plan and used in this NOPR are consistent with publicly available empirical historical cost data. DOE reviewed available price data for the LED market and found that between 2000 and 2007, white-light LEDs had a CAGR ranging from approximately −18 to −31 percent. DOE's LED cost projection (i.e., −27 percent CAGR) falls within the range of CAGRs observed. DOE expanded its examination by comparing this projected trend to the red-light LED market, which is a related technology, with cost information spanning approximately three decades (i.e., 1973 to 2005). DOE found that the CAGR of red-light LED costs was −22 percent over this longer time span. The trend in red-light LED costs derived from empirical data over this longer time period is of a similar magnitude to DOE's projected costs for white-light LEDs. Due to the technological similarities between red-light LEDs and white-light LEDs, DOE believes that the historical cost reductions for red-light LEDs are indicative of future cost reductions for white-light LEDs. Furthermore, the white-light LED market is undergoing a massive expansion and growth phase, with significant investment, new products and innovative applications for LED technology, including illumination of commercial refrigeration equipment. See Section V.C of this NOPR and Appendix B of the technical support document (TSD) for more detail on the cost projection and DOE's validation of those estimates. DOE seeks comment on the extent to which these price trends are indicative of what can be expected for commercial refrigeration equipment LED lighting from 2007 to 2012 and the extent to which the cost reduction observed for red-light LEDs is relevant to DOE's cost projections for white-light LEDs. DOE also seeks comment on the extent to which stakeholders expect projected LED cost reductions would occur, the timing of the projected LED cost reductions, and the certainty of the projected LED cost reductions. Finally, considering the rapid development of LED technology and the steady reductions in cost, DOE seeks comment on the extent to which manufacturers would adopt LED technology into the design of commercial refrigeration equipment in the absence of standards.

DOE also performed sensitivity analyses of the effect of projected cost reductions in LED lighting systems on LCC and NPV. Incorporation of DOE LED lighting system cost projections of a 50 percent decline by 2012 shift the calculated NPV, for 2012–2042, from −$200 million to a positive $1.62 billion at a seven percent discount rate, for TSL 5. See Section V.C of this NOPR or Chapter 8 of the TSD for additional details.

TSL 5 is estimated to have environmental benefits leading to reductions in greenhouse gas emissions of 63 Mt of $CO_2$ from 2012 to 2042. Additionally, TSL 5 would result in 23 kt of $NO_X$ emissions reductions or generate a similar amount of $NO_X$ emissions allowance credits in areas where such emissions are subject to emissions caps. Most of the energy saved is electricity. In addition, DOE expects the energy savings from the proposed standards to eliminate the need for approximately 930 MW of generating capacity by 2042.

Although DOE has tentatively rejected TSL 5 because, under the current circumstances, it tentatively found that the benefits to the Nation do not outweigh the costs, and therefore does not consider TSL 5 economically justified, DOE expects that LED costs will decline substantially over the next 4–5 years and could have a dramatic effect on the economic impacts described above. Therefore, DOE requests data or information that could provide a greater level of confidence that the projected LED cost reductions will occur and DOE will assess that data in determining whether to further consider TSL 5 in its final rule analysis.

## II. Introduction

### *A. Overview*

DOE proposes to set energy conservation standards for commercial refrigeration equipment at the levels shown in Table I–1. The proposed standards would apply to equipment manufactured on or after January 1, 2012, and offered for sale in the United States. DOE has tentatively found that the standards would save a significant amount of energy (see Section III.C.2) and result in a cleaner environment. In the 30-year period after the new standard becomes effective, the Nation would tentatively save 0.83 quads of primary energy. These energy savings also would tentatively result in significantly reduced emissions of air pollutants and greenhouse gases associated with electricity production, by avoiding the emission of 44 Mt of $CO_2$ and 17 kt of $NO_X$. In addition, DOE expects the standard to prevent the construction of the new power plants that would be necessary to produce approximately 640 MW by 2042. In total, DOE tentatively estimates the net present value to the Nation of this standard to be $1.1 billion from 2012 to 2042 in 2007$.

Commercial customers would see benefits from the proposed standards. Although DOE expects the price of the higher efficiency commercial refrigeration equipment to be approximately 11 percent higher than the average price of this equipment today, weighted by shipments across equipment classes, the energy efficiency gains would result in lower energy costs, saving customers about 26 percent per year on their energy bills. Based on DOE's LCC analysis, DOE tentatively estimates that the mean payback period for the higher efficiency commercial refrigeration equipment would be between a low of 1.4 to a high of 6.1 years. In addition, when the net results of these price increases and energy cost savings are summed over the lifetime of the higher efficiency equipment, customers could save approximately $690 to $3800, depending on equipment class, compared to their expenditures on today's baseline commercial refrigeration equipment.

### *B. 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. Part A–1 of Title III (42 U.S.C. 6311–6317) establishes a similar program for certain types of commercial and industrial equipment.[6] The Energy Policy Act of 2005 (EPACT 2005), Pub. L. 109–58, included an amendment to Part A–1 requiring that DOE prescribe energy conservation standards for the commercial refrigeration equipment that is the subject of this rulemaking. (EPACT 2005, Section 136(c); 42 U.S.C. 6313(c)(4)(A)) Hence, DOE publishes today's notice of proposed rulemaking (NOPR) pursuant to Part A–1, which provides definitions, test procedures, labeling provisions, energy conservation standards, and the authority to require information and reports from manufacturers. The test procedures for commercial refrigeration equipment appear at Title 10 Code of Federal Regulations (CFR) Sections 431.63 and 431.64.

EPCA provides criteria for prescribing new or amended standards for covered equipment. As indicated above, any

[6] This part was originally titled Part C, however, it was renamed Part A–1 after Part B of Title III was repealed by EPACT 2005.

new or amended standard for commercial refrigeration equipment must be designed to achieve the maximum improvement in energy efficiency that is technologically feasible and economically justified.[7] (42 U.S.C. 6295(o)(2)(A) and 6316(e)(1)) But EPCA precludes DOE from adopting any standard that would not result in significant conservation of energy. (42 U.S.C. 6295(o)(3) and 6316(e)(1)) Moreover, DOE may not prescribe a standard for certain equipment if no test procedure has been established for that equipment, or if DOE determines by rule that the standard is not technologically feasible or economically justified, and that such standard will not result in significant conservation of energy. (42 U.S.C. 6295(o)(3) and 6316(e)(1)) EPCA also provides that, in deciding whether a standard is economically justified, DOE must determine whether the benefits of the standard exceed its burdens after receiving comments on the proposed standard. (42 U.S.C. 6295(o)(2)(B)(i) and 6316(e)(1)) To the greatest extent practicable, DOE must consider the following seven factors:

(I) The economic impact of the standard on manufacturers and consumers of the equipment subject to the standard;

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

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

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

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

(VI) The need for national energy conservation; and

(VII) Other factors the Secretary considers relevant.

*Id.*

Furthermore, the Secretary may not prescribe an amended or 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 equipment type (or class) with performance characteristics (including reliability), 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) and 6316(e)(1)) In addition, there is a rebuttable presumption that a standard level is economically justified if the Secretary finds that ''the additional cost to the consumer of purchasing equipment 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 * * *.'' (42 U.S.C. 6295(o)(2)(B)(iii) and 6316(e)(1)) The rebuttable presumption test is an alternative path to establishing economic justification.

Section 325(q)(1) of EPCA addresses the situation where DOE sets a standard for a type or class of covered equipment that has two or more groups of covered equipment. DOE must specify a different standard level than that which applies generally to such equipment ''for any group of covered equipment which have the same function or intended use, if * * * equipment within such group—(A) consume a different kind of energy from that consumed by other covered equipment within such type (or class); or (B) have a capacity or other performance-related feature which other equipment 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 equipment. (42 U.S.C. 6295(q)(1) and 6316(e)(1)) In determining whether a performance-related feature justifies a different standard for a group of equipment, DOE must ''consider such factors as the utility to the consumer of such a feature'' and other factors DOE deems appropriate. Any rule prescribing such a standard must include an explanation of the basis on which a higher or lower level was established. (42 U.S.C. 6295(q)(2) and 6316(e)(1))

Finally, Federal energy conservation requirements for commercial equipment generally supersede State laws or regulations concerning energy conservation testing, labeling, and standards for such equipment. (42 U.S.C. 6316(a)–(b)) For the commercial refrigeration equipment covered by this rulemaking, Federal energy conservation requirements will supersede all such State laws or regulations beginning on the date of publication of the Federal standards, except that any state or local standard issued before that time will be superseded only when the Federal standards take effect. (42 U.S.C. 6316(e)(3)) Furthermore, DOE can grant waivers of preemption to any State laws or regulations that are superseded in accordance with the procedures and other provisions of Section 327(d) of the Act. (42 U.S.C. 6297(d) and 6316(e)(3))

### *C. Background*

#### 1. Current Standards

There are no national energy conservation standards for the commercial refrigeration equipment covered by this rulemaking. EPACT 2005 did amend EPCA to establish energy conservation standards that will apply to certain other types of commercial refrigerators, freezers, and refrigerator-freezers when manufactured on or after January 1, 2010. (42 U.S.C. 6313(c)(2)–(3)) Those standards are not at issue in this rulemaking.

#### 2. History of Standards Rulemaking for Commercial Refrigeration Equipment

On August 8, 2005, Section 136(c) of EPACT 2005 amended EPCA, in part to direct DOE to issue energy conservation standards for the equipment covered by this rulemaking, which standards would apply to equipment manufactured on or after January 1, 2012. (42 U.S.C. 6313(c)(4)(A)) Section 136(a)(3) of EPACT 2005 also amended EPCA, by adding definitions for terms relevant to this equipment. (42 U.S.C. 6311(9)) In defining the term ''commercial refrigerator, freezer, and refrigerator-freezer,'' EPCA states that this refrigeration equipment is connected to either a self-contained condensing unit or to a remote condensing unit. 42 U.S.C. 6311(9)(A)(vii). Subsequently, EPCA defines the terms ''remote condensing unit'' and ''self-contained condensing unit.'' 42 U.S.C. 6311(9)(E)–(F). These are the two condenser configurations of equipment covered by this rulemaking.

On December 19, 2006, the Energy Independence and Security Act of 2007 (EISA 2007) was signed into law by the President. This legislation affected some of the products for which DOE had rulemakings underway. However, it did not create any additional requirements for commercial refrigeration equipment.

As an initial step to comply with EPCA's mandate to issue standards for commercial refrigeration equipment, and to commence this rulemaking, on April 25, 2006, DOE published notice of a public meeting and of the availability

[7] This notice concerns types of ''covered equipment'' as that term is defined in EPCA, (42 U.S.C. 6311(1)(E)) in Part A–1, Certain Industrial Equipment. Therefore, when DOE quotes from, paraphrases or describes general provisions in Part A, for instance, 42 U.S.C. 6295(o), it substitutes the term ''equipment'' for ''product'' when the latter term appears in those provisions. (See 42 U.S.C. 6316 (a)(3))

of its Framework Document for this rulemaking. 71 FR 23876. The Framework Document described the procedural and analytical approaches that DOE anticipated using to evaluate energy conservation standards for commercial refrigeration equipment, and identified various issues to be resolved in conducting the rulemaking. DOE held a public meeting on May 16, 2006 to present the contents of the Framework Document, describe the analyses it planned to conduct during the rulemaking, obtain public comment on these subjects, and inform and facilitate interested persons' involvement in the rulemaking. DOE also gave interested persons an opportunity, after the public meeting, to submit written statements in response to the Framework Document. DOE received five statements.

On July 26, 2007, DOE published an advance notice of proposed rulemaking (ANOPR) concerning energy conservation standards for commercial refrigeration equipment. 72 FR 41161. In the ANOPR, DOE described and sought comment on its proposed equipment classes for this rulemaking, and on the analytical framework, models, and tools (e.g., LCC and national energy savings (NES) spreadsheets) that DOE used to analyze the impacts of energy conservation standards for commercial refrigeration equipment. In conjunction with the ANOPR, DOE also published on its Web site the complete ANOPR TSD. The TSD included the results of DOE's preliminary (1) engineering analysis, (2) markups analysis to determine equipment price, (3) energy use characterization, (4) LCC and payback period (PBP) analyses, (5) NES and national impact analyses (NIA), and (6) manufacturer impact analysis (MIA). In the ANOPR, DOE requested comment on these results, and on a range of other issues. These issues included equipment classes, definitions for air-curtain angle and door angle, case lighting operating hours, operation and maintenance practices, equipment lifetime, LCC baseline levels, NIA base case, base case and standards case forecasts, differential impact of new standards on future shipments, selection of standard levels for post-ANOPR analysis, the equation that expresses the energy conservation standards, and the nature of standards for commercial refrigerator-freezers.

DOE held a public meeting in Washington, DC on August 23, 2007, to present the methodology and results of the ANOPR analyses, and to solicit both oral and written comments from the interested persons who attended. Public comment focused on DOE's assumptions, approach, and equipment class breakdown, and are addressed in detail in this NOPR.

## III. General Discussion

### *A. Test Procedures*

On December 8, 2006, DOE published a final rule in which it adopted American National Standards Institute (ANSI)/Air-Conditioning and Refrigeration Institute (ARI) Standard 1200–2006, *Performance Rating of Commercial Refrigerated Display Merchandisers and Storage Cabinets,* as the DOE test procedure for this equipment. 71 FR 71340, 71369–70; 10 CFR 431.63–431.64. ANSI/ARI Standard 1200–2006 contains rating temperature specifications of 38 °F (±2 °F) for commercial refrigerators and refrigerator compartments, 0 °F (±2 °F) for commercial freezers and freezer compartments, and −5 °F (±2 °F) for commercial ice-cream freezers. The standard also requires performance tests to be conducted according to the American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) Standard 72–2005, *Method of Testing Commercial Refrigerators and Freezers*. In this final rule, DOE also adopted a −15 °F (±2 °F) rating temperature for commercial ice-cream freezers. 71 FR 71370. In addition, DOE adopted ANSI/Association of Home Appliance Manufacturers (AHAM) Standard HRF–1–2004, *Energy, Performance and Capacity of Household Refrigerators, Refrigerator-Freezers and Freezers,* for determining compartment volumes for this equipment. 71 FR 71369–70.

### *B. Technological Feasibility*

#### 1. General

DOE considers design options technologically feasible if industry already uses these options or if research has progressed to the development of a working prototype. ''Technologies incorporated in commercially available equipment or in working prototypes will be considered technologically feasible.'' 10 CFR Part 430, Subpart C, Appendix A, Section 4(a)(4)(i).

In each standards rulemaking, DOE conducts a screening analysis, which it bases on information it has gathered regarding all current technology options and prototype designs. In consultation with interested parties, DOE develops a list of design options for consideration in the rulemaking. All technologically feasible design options are candidates in this initial assessment. Early in the process, DOE eliminates from consideration any design option (a) that is not practicable to manufacture, install, or service; (b) that will have adverse impacts on equipment utility or availability; or (c) for which there are health or safety concerns that cannot be resolved. Chapter 4 of the TSD accompanying this notice contains a description of the screening analysis for this rulemaking.

In the ANOPR, DOE eliminated five of the technologies considered in the market and technology assessment: (1) Air-curtain design, (2) thermoacoustic refrigeration, (3) magnetic refrigeration, (4) electro-hydrodynamic heat exchangers, and (5) copper rotor motors. Because all five of these technologies are in the research stage, DOE believes that they would not be practicable to manufacture, install and service on the scale necessary to serve the relevant market at the time of the effective date of the standard. In addition, because these technologies are in the research stage, DOE cannot assess whether they would have any adverse impacts on utility to significant subgroups of consumers, result in the unavailability of any types of equipment, or present any significant adverse impacts on health or safety. Therefore, DOE did not consider these technologies as design options for improving the energy efficiency of commercial refrigeration equipment. DOE believes that all the efficiency levels discussed in today's notice are technologically feasible because there is equipment either in the market or in working prototypes at all of the efficiency levels analyzed. See Chapter 4 of the TSD for further discussion of the screening analysis.

#### 2. Maximum Technologically Feasible Levels

In deciding whether to adopt a new standard for a type or class of commercial refrigeration equipment, DOE must ''determine the maximum improvement in energy efficiency or maximum reduction in energy use that is technologically feasible'' for such equipment. (42 U.S.C. 6295(p)(1) and 6316(e)(1)) If such standard is not designed to achieve such efficiency or use, the Secretary shall state the reasons such is the case in the proposed rule. Id. For this rulemaking, DOE determined that the values in Table III–1 represent the energy use levels that would achieve the maximum reductions in energy use that are technologically feasible at this time for commercial refrigeration equipment. DOE identified these ''max-tech'' levels for the equipment classes analyzed as part of the engineering analysis (Chapter 5 of the TSD). For each equipment class, DOE applied the most efficient design options available for energy-consuming components. These levels are set forth in TSL 5.

TABLE III–1—“MAX-TECH” ENERGY USE LEVELS

| Equipment class | “Max-Tech” level kilowatt hours per day (kWh/day) | Equipment class | “Max-Tech” level kilowatt hours per day (kWh/day) |
|---|---|---|---|
| VOP.RC.M | 0.68 × TDA + 4.07 | VCT.RC.I | 0.71 × TDA + 3.05 |
| SVO.RC.M | 0.69 × TDA + 3.18 | HCT.RC.M | 0.16 × TDA + 0.13 |
| HZO.RC.M | 0.35 × TDA + 2.88 | HCT.RC.L | 0.34 × TDA + 0.26 |
| VOP.RC.L | 2.28 × TDA + 6.85 | HCT.RC.I | 0.4 × TDA + 0.31 |
| HZO.RC.L | 0.57 × TDA + 6.88 | VCS.RC.M | 0.11 × V + 0.26 |
| VCT.RC.M | 0.25 × TDA + 1.95 | VCS.RC.L | 0.23 × V + 0.54 |
| VCT.RC.L | 0.6 × TDA + 2.61 | VCS.RC.I | 0.27 × V + 0.63 |
| SOC.RC.M | 0.39 × TDA + 0.11 | HCS.RC.M | 0.11 × V + 0.26 |
| VOP.SC.M | 1.57 × TDA + 4.71 | HCS.RC.L | 0.23 × V + 0.54 |
| SVO.SC.M | 1.58 × TDA + 4.59 | HCS.RC.I | 0.27 × V + 0.63 |
| HZO.SC.M | 0.77 × TDA + 5.55 | SOC.RC.L | 0.83 × TDA + 0.22 |
| HZO.SC.L | 1.92 × TDA + 7.08 | SOC.RC.I | 0.97 × TDA + 0.26 |
| VCT.SC.I | 0.73 × TDA + 3.29 | VOP.SC.L | 3.95 × TDA + 11.82 |
| VCS.SC.I | 0.38 × V + 0.88 | VOP.SC.I | 5.02 × TDA + 15.02 |
| HCT.SC.I | 0.56 × TDA + 0.43 | SVO.SC.L | 3.98 × TDA + 11.51 |
| SVO.RC.L | 2.28 × TDA + 6.85 | SVO.SC.I | 5.06 × TDA + 14.63 |
| VOP.RC.I | 2.9 × TDA + 8.7 | HZO.SC.I | 2.44 × TDA + 9 |
| SVO.RC.I | 2.9 × TDA + 8.7 | SOC.SC.I | 1.35 × TDA + 0.36 |
| HZO.RC.I | 0.72 × TDA + 8.74 | HCS.SC.I | 0.38 × V + 0.88 |

*C. Energy Savings*

1. Determination of Savings

DOE used the NES spreadsheet to estimate energy savings. The spreadsheet forecasts energy savings over the period of analysis for TSLs relative to the base case. DOE quantified the energy savings attributable to an energy conservation standard as the difference in energy consumption between the trial standards case and the base case. The base case represents the forecast of energy consumption in the absence of new mandatory efficiency standards. The NES spreadsheet model is described in Section IV.G of this notice and in Chapter 11 of the TSD accompanying this notice.

The NES spreadsheet model calculates the energy savings in site energy or kilowatt hours (kWh). Site energy is the energy directly consumed at building sites by commercial refrigeration equipment. DOE expresses national energy savings in terms of the source energy savings, which are the energy savings used to generate and transmit the energy consumed at the site. Chapter 11 of the TSD contains a table of factors used to convert kWh to Btu. DOE derives these conversion factors, which change with time, from DOE's EIA's AEO2007.

2. Significance of Savings

For commercial refrigeration equipment, EPCA prohibits DOE from adopting a standard that would not result in significant additional energy savings. (42 U.S.C. 6295(o)(3)(B) and 6316(e)(1)) 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 estimated energy savings for all of the trial standard levels considered in this rulemaking are nontrivial, and therefore DOE considers them significant within the meaning of Section 325 of the Act.

*D. Economic Justification*

1. Specific Criteria

As noted earlier, EPCA provides seven factors to be evaluated in determining whether an energy conservation standard is economically justified. The following sections discuss how DOE has addressed each factor thus far in this rulemaking. (42 U.S.C. 6295(o)(2)(B)(i) and 6316(e)(1))

a. Economic Impact on Manufacturers and Commercial Customers

DOE uses an annual cash-flow approach in determining the quantitative impacts of a new or amended standard on manufacturers. This includes both a short-term assessment based on the cost and capital requirements between the announcement of a regulation and when the regulation comes into effect, and a long-term assessment. Impacts analyzed include INPV, cash flows by year, and changes in revenue and income. Next, DOE analyzes and reports the impacts on different types of manufacturers, with particular attention to impacts on small manufacturers. DOE then considers the impact of standards on domestic manufacturer employment, manufacturing capacity, plant closures, and loss of capital investment. Finally, DOE takes into account the cumulative impact of regulations on manufacturers.

For commercial consumers, measures of economic impact are generally the changes in installed cost and annual operating costs, i.e., the LCC. Chapter 6 of the TSD presents the LCC of the equipment at each TSL. The LCC is 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) and 6316(e)(1)) It is discussed in the paragraphs that follow.

b. Life-Cycle Costs

The LCC is the sum of the purchase price, including the installation and operating expense (i.e., operating energy, maintenance, and repair expenditures) discounted over the lifetime of the equipment. To determine the purchase price including installation, DOE estimated the markups that distributors and contractors add to the manufacturer selling price (MSP); DOE also estimated installation costs from an analysis of commercial refrigeration equipment installation costs for each equipment class. DOE determined that preventative maintenance costs do not depend on efficiency but that repair costs increase with efficiency and that the cost of replacement lighting fixtures (''lighting maintenance'') increased with higher efficiency. See Sections IV.E.8 and IV.E.9 for more detail. In estimating operating energy costs, DOE used average effective commercial electricity prices at the State level from the EIA publication, *State Energy Consumption, Price, and Expenditure Estimates*. DOE modified the 2006 average commercial electricity prices to reflect the average electricity prices for each of the four types of businesses examined in this analysis. The LCC analysis compares the LCCs of equipment designed to meet possible energy conservation standards with the LCCs of equipment likely to be installed in the absence of standards. The LCC analysis also identifies a range of energy price forecasts for the electricity prices used in the economic analyses and provides results showing the sensitivity of the LCC results to these price forecasts.

Recognizing that each commercial building that uses commercial refrigeration equipment is unique, DOE analyzed variability and uncertainty by performing the LCC and PBP calculations for two prototype commercial buildings (i.e., stores) and four types of businesses (two types of businesses for each prototype store). The first store prototype is a large grocery store, which encompasses supermarkets and wholesaler/retailer multi-line stores such as big-box stores, warehouse stores, and supercenters. The second prototype is a small store, which encompasses convenience stores and small specialty stores such as meat markets; wine, beer, and liquor stores; and convenience stores associated with gasoline stations. Various types of commercial refrigeration equipment can serve a given type of store's refrigeration needs. DOE gives the LCC savings as a distribution, with a mean value and a range. DOE developed average discount rates for each of four business types analyzed, ranging from 5.1 to 8.4 percent for the calculations, and assumed that the customer purchases the equipment in 2012. Chapter 8 of the TSD contains the details of the LCC calculations.

c. Energy Savings

While significant energy conservation is a separate statutory requirement for imposing an energy conservation standard, EPCA requires DOE, in determining the economic justification of such a standard, to 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) and 6316(e)(1)) DOE used the NES spreadsheet results in its consideration of total projected savings. Section IV.G.1 of this notice discusses the savings figures.

d. Lessening of Utility or Performance of Equipment

In establishing equipment classes, evaluating design options, and assessing the impact of potential standard levels, DOE tried to avoid having new standards for commercial refrigeration equipment lessen the utility or performance of the equipment under consideration in this rulemaking. (42 U.S.C. 6295(o)(2)(B)(i)(IV) and 6316(e)(1)) None of the proposed trial standard levels considered in this rulemaking involve changes in equipment design or unusual installation requirements that would reduce the utility or performance of the equipment. See Chapter 4 and Chapter 16 of the TSD for more detail.

e. Impact of Any Lessening of Competition

EPCA directs DOE to consider any lessening of competition likely to result from standards. It directs the Attorney General to determine in writing the impact, if any, of any lessening of competition likely to result from imposition of a proposed standard. (42 U.S.C. 6295(o)(2)(B)(i)(V) and (ii); and 6316(e)(1)) DOE has transmitted a written request to the Attorney General soliciting a written determination on this issue.

f. Need of the Nation to Conserve Energy

The non-monetary benefits of the proposed standard are likely to be reflected in improvements to the security and reliability of the Nation's energy system. Reductions in the overall demand for energy will reduce the Nation's reliance on foreign sources of energy and increase reliability of the Nation's electricity system. DOE conducts a utility impact analysis to show the reduction in installed generation capacity. Reduced power demand (including peak power demand) generally improves the security and reliability of the energy system.

The proposed standard also is likely to result in improvements to the environment. In quantifying these improvements, DOE has defined a range of primary energy conversion factors and associated emission reductions based on the generation that energy conservation standards displaced. DOE reports the environmental effects from each trial standard level for this equipment in the environmental assessment in the TSD. (42 U.S.C. 6295(o)(2)(B)(i)(VI) and 6316(e)(1))

g. Other Factors

EPCA allows the Secretary of Energy, in determining whether a standard is economically justified, to consider any other factors the Secretary deems to be relevant. (42 U.S.C. 6295(o)(2)(B)(i)(VII) and 6316(e)(1)) Under this provision, DOE considered LCC impacts on identifiable groups of customers, such as customers of different business types, who may be disproportionately affected by any national energy conservation standard level. In particular, DOE examined the LCC impact on independent small grocery/convenience store businesses where both higher discount rates and lack of access to national account equipment purchases might disproportionately affect those business types when compared to the overall commercial refrigeration equipment market.

2. Rebuttable Presumption

Another criterion for determining whether a standard level is economically justified is the following rebuttable presumption test:

> If the Secretary finds that the additional cost to the consumer of purchasing equipment complying with an energy conservation standard level will be less than three times the value of the energy * * * savings during the first year that the consumer will receive as a result of the standard, as calculated under the applicable test procedure, there shall be a rebuttable presumption that such standard level is economically justified. A determination by the Secretary that such criterion is not met shall not be taken into consideration in the Secretary's determination of whether a standard is economically justified. (42 U.S.C. 6295(o)(2)(B)(iii) and 6316(e)(1))

If the initial price of equipment increases due to a conservation standard, and the consumer would recover the increase in energy savings in less than three years through reduced energy costs resulting from the standard, then DOE presumes that such standard is economically justified. This presumption of economic justification can be rebutted upon a proper showing. The rebuttable presumption payback calculation is discussed in Sections III.D.2 and V.B.1.b of this NOPR.

## IV. Methodology and Discussion of Comments

DOE used two spreadsheet tools to determine the impact of energy conservation standards on the Nation. The first spreadsheet calculates LCCs and payback periods of potential new energy conservation standards. The second provides shipments forecasts and then calculates national energy savings and net present value impacts of potential new energy conservation standards. DOE also assessed manufacturer impacts, largely through use of the Government Regulatory Impact Model (GRIM).

Additionally, DOE estimated the impacts of energy conservation standards for commercial refrigeration equipment on utilities and the environment. DOE used a version of EIA's National Energy Modeling System (NEMS) for the utility and environmental analyses. The NEMS model simulates the energy economy of the United States and has been developed over several years by the EIA primarily for the purpose of preparing the Annual Energy Outlook (AEO). The NEMS produces a widely known baseline forecast for the Nation through 2025 that is available on the DOE Web site. The version of NEMS used for efficiency standards analysis is called NEMS–BT,[8] and is based on the AEO2007 version with minor modifications. The NEMS offers a sophisticated picture of the effect of standards, since its scope allows it to measure the interactions between the various energy supply and demand sectors and the economy as a whole.

*A. Market and Technology Assessment*

When beginning an energy conservation standards rulemaking, DOE develops information that provides an overall picture of the market for the equipment concerned, including the purpose of the equipment, 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 (Chapter 3 of the TSD) include equipment classes, manufacturers, quantities, and types of equipment sold and offered for sale, retail market trends, and regulatory and non-regulatory programs.

1. Definitions Related to Commercial Refrigeration Equipment

a. Air Curtain Angle Definition

For equipment without doors, an air curtain divides the refrigerated compartment from the ambient space. DOE stated in the ANOPR that the orientation of the air curtain affects the energy consumption of both remote condensing and self-contained equipment, and that equipment without doors can be broadly categorized by the angle of the air curtain. DOE considered defining the air-curtain angle as ''the angle between a vertical line and the line formed by the points at the center of the discharge air grille and the center of the return air grille, when viewed in cross-section.'' DOE presented this definition in the ANOPR, 72 FR 41173, and for discussion at the ANOPR public meeting, and requested feedback.

ARI and Edison Electric Institute (EEI) recommended that DOE slightly modify its definition of air-curtain angle to ''the angle formed between a vertical line and the line formed by the points at the *inside edge* of the discharge air opening and the *inside edge* of the return air opening, when viewed in cross-section.'' For equipment without doors and without a discharge air grille or discharge air honeycomb, the air curtain should be defined as ''the angle between a vertical line extended down from the highest point on the manufacturer's recommended load limit line and the same load limit line.'' (ARI, No. 18 at p. 2 and EEI, No. 15 at p. 2) DOE recognizes that these proposed definitions are consistent with industry-approved standards and is therefore including the suggested modifications to the definition for air-curtain angle in today's proposed rule.

b. Door Angle Definition

For equipment with doors, DOE stated in the ANOPR that the orientation of the doors affects the energy consumption, and that equipment with doors can be broadly categorized by the angle of the door. DOE considered defining door angle as ''the angle between a vertical line and the line formed by the plane of the door, when viewed in cross-section.'' 72 FR 41174. DOE also presented this definition for discussion at the ANOPR public meeting and requested feedback.

While stakeholders agreed with DOE's proposed definition of door angle flat doors, it was not clear how DOE would define the door angle for curved doors such as those found on service over-the-counter cases. True stated that curved door angle should be defined by forming a plane between ''the end plane and the end peak in-section.'' (Public Meeting Transcript, No. 13.5 at p. 59) Southern California Edison (SCE) suggested defining door angle for curved doors in the way air-curtain angle is defined, by the angle formed between the vertical and a line drawn between the top and bottom edges. (Public Meeting Transcript, No. 13.5 at p. 59) DOE is proposing its original definition of door angle for cases with flat doors. For cases with curved doors, DOE is not clear what True's intent was in defining door angle, and no clarification was made in True's written comments. DOE believes the approach suggested by SCE is appropriate because it accounts for the complex geometry of curved doors while still remaining consistent with the existing definition for air-curtain angle. Therefore, DOE is proposing to define door angle as ''the angle formed between a vertical line and the straight line drawn by connecting the top and bottom points where the display area glass joins the cabinet, when the equipment is viewed in cross-section.''

2. Equipment Classes

When establishing energy conservation standards, DOE generally divides covered equipment into equipment classes by the type of energy used, capacity, or other performance-related features that affect efficiency. Different energy conservation standards may apply to different equipment classes. (42 U.S.C. 6295(q) and 6316(e)(1))

Commercial refrigerators, commercial freezers, and commercial refrigerator-freezers can be divided into various equipment classes categorized largely by physical characteristics that affect energy efficiency. Some of these characteristics delineate the categories of equipment covered by this rulemaking.[9] Most affect the merchandise that the equipment can be used to display, and how the customer can access that merchandise. Key physical characteristics that affect energy efficiency are the operating temperature, the presence or absence of doors (i.e., closed cases or open cases), the type of doors used (i.e., transparent

[8] The EIA approves 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 used here. For more information on NEMS, refer to The National Energy Modeling System: An Overview 1998. DOE/EIA–0581 (98), February, 1998. BT is DOE's Building Technologies Program. NEMS–BT was formerly called NEMS–BRS.

[9] ''Commercial refrigerators, commercial freezers, and commercial refrigerator-freezers'' is a type of covered commercial equipment. For purposes of discussion only in this proceeding, DOE uses the term ''categories'' to designate groupings of ''commercial refrigeration equipment.'' The categories of equipment are: Self-contained commercial refrigerators, commercial freezers, and commercial refrigerator-freezers without doors; remote condensing commercial refrigerators, commercial freezers, and commercial refrigerator-freezers; and commercial ice-cream freezers. DOE will analyze specific equipment classes that fall within these general categories and set appropriate standards.

or solid), the angle of the door or air-curtain (i.e., horizontal, semivertical, or vertical) and the type of condensing unit (i.e., remote or self-contained). As discussed in the ANOPR, 72 FR 41173–77, and below, DOE has developed equipment classes in this rulemaking by (1) dividing commercial refrigerators, commercial freezers, and commercial refrigerator-freezers into equipment families, (2) subdividing these families based on condensing unit configurations and rating temperature designations, and (3) identifying the resulting classes that are within each of the three equipment categories covered by this rulemaking.

DOE divided covered equipment into eight equipment families, which are shown in Table IV–1. Following the ANOPR, DOE did not receive any comments that it believes warranted changes to the eight equipment families proposed in the ANOPR and therefore, the eight families are unchanged. The two issues related to equipment family designations are discussed below.

TABLE IV–1—EQUIPMENT FAMILY DESIGNATIONS

| Equipment family | Description |
|---|---|
| Vertical Open (VOP) | Equipment without doors and an air-curtain ≥ 0° and < 10° from the vertical. |
| Semivertical Open (SVO) | Equipment without doors and an air-curtain angle ≥ 10° and < 80° from the vertical. |
| Horizontal Open (HZO) | Equipment without doors and an air-curtain angle ≥ 80° from the vertical. |
| Vertical Closed Transparent (VCT) | Equipment with hinged or sliding transparent doors and a door angle < 45°. |
| Horizontal Closed Transparent (HCT) | Equipment with hinged or sliding transparent doors and a door angle ≥ 45°. |
| Vertical Closed Solid (VCS) | Equipment with hinged or sliding solid (opaque) doors and a door angle < 45°. |
| Horizontal Closed Solid (HCS) | Equipment with hinged or sliding solid (opaque) doors and a door angle ≥ 45°. |
| Service Over Counter (SOC) | Equipment with sliding or hinged doors intended for use by sales personnel and fixed or hinged glass for displaying merchandise. |

Within each of the eight equipment families is equipment that has one of the two condensing unit configurations, which are shown in Table IV–2. Because these are the only two condensing unit configurations used in commercial refrigeration equipment, and since DOE did not receive any comments on these configurations following the ANOPR, DOE did not make any changes.

TABLE IV–2—CONDENSING UNIT CONFIGURATION

| Condensing unit configuration | Description |
|---|---|
| Remote Condensing (RC) | Condensing unit is remotely located from the refrigerated equipment and consists of one or more refrigerant compressors, refrigerant condensers, condenser fans and motors, and factory-supplied accessories. |
| Self-Contained (SC) | Condensing unit is an integral part of the refrigerated equipment and consists of one or more refrigerant compressors, refrigerant condensers, condenser fans and motors, and factory-supplied accessories. |

DOE is also organizing equipment classes based on the three operating temperature ranges shown in Table IV–3. Based on the temperature at which the equipment is designed to operate, it will fall into one of these operating temperature ranges. This is identified as Issue 3 under ''Issues on Which DOE Seeks Comment'' in Section VII.E of this NOPR.

Each temperature range coincides with a rating temperature used in the test procedure final rule for the different equipment types. 10 CFR 431.64. Following the ANOPR, DOE did not receive any comments regarding the rating temperature designations proposed in the ANOPR, and therefore DOE did not make any changes to the rating temperature designations.

TABLE IV–3—RATING TEMPERATURE DESIGNATIONS

| Operating temperature (°F) | Rating temperature (°F) | Description |
|---|---|---|
| ≥ 32 (M) | 38 | Medium temperature (refrigerators). |
| < 32 and > −5 (L) | 0 | Low temperature (freezers). |
| ≤ −5 (I) | −15 | Ice-cream temperature (ice-cream freezers). |

In the ANOPR, DOE responded to several comments and presented a discussion (Section II.A.2) of the air-curtain angle ranges used to delineate vertical, semivertical, and horizontal equipment families without doors (VOP, SVO, and HZO). 72 FR 41173–74. In comments received following the Framework document publication, some stakeholders felt that the air-curtain angle ranges used in the data provided by ARI might encourage manufacturers to redesign equipment to take advantage of less stringent standards. Specifically, the stakeholders were concerned that manufacturers of VOP.RC.M equipment (a high-volume equipment class) would make slight alterations in their designs that would shift the equipment to the SVO.RC.M equipment class. If this shift occurred for a large number of models, and if standards for SVO.RC.M equipment were significantly less stringent than standards for VOP.RC.M equipment, a significant amount of energy savings would be avoided. In other words, energy savings will be less than if that equipment was not modified and remained under the vertical classification. DOE responded to these comments in the ANOPR, concurring with stakeholders' concerns, and requesting any relevant data or feedback regarding the ranges of air-curtain angle proposed in the ANOPR. No further comments were received on this issue following the ANOPR. DOE is proposing standards for the SVO.RC.M equipment class that are virtually equivalent to standards for the VOP.RC.M equipment class (see the proposed rule language of this NOPR). As a result, DOE believes that the proposed standards eliminate motivation for market shifts between these equipment classes. However, to assure that no changes to the air-curtain ranges for the VOP, SVO, and HZO equipment families are warranted, DOE seeks comment on the possibility of market shifts between equipment classes based on the proposed standards.

As discussed in the ANOPR, 72 FR 41174 and during the ANOPR public meeting, DOE stated that it was considering defining two equipment families each for equipment with solid and transparent doors, based on door angles of 0° to 45° (vertical) and 45° to 90° (horizontal). EEI stated that DOE should consider revising its definition of door angle, because it is unclear whether a door angle of 45° to be vertical or horizontal. (Public Meeting Transcript, No. 13.5 at p. 58) DOE agrees with EEI that its previous designation did not specify what equipment family a unit with a 45° door angle would fall under. Therefore, DOE has tentatively decided that it will designate vertical equipment with transparent or solid doors as ''equipment with hinged or sliding doors and a door angle less than 45°,'' and horizontal equipment with transparent or solid doors as ''equipment with hinged or sliding doors and a door angle greater than or equal to 45°.''

DOE is considering 38 of the 48 equipment classes shown in Table IV–4.[10] The equipment classes are organized by equipment family, compressor operating mode, and rating temperature. The right-hand column in Table IV–4 with the heading ''Equipment Class Designation'' identifies each of the 48 equipment classes with a particular set of letters. The first three letters for each class represent its equipment family. The next two letters represent the condensing unit configuration. The last letter represents the rating temperature. Table IV–1 through Table IV–3 set forth the meaning of the equipment class lettering designations.

TABLE IV–4—COMMERCIAL REFRIGERATION EQUIPMENT CLASSES

| Equipment family | Condensing unit configuration | Operating temperature (°F) | Equipment class designation |
|---|---|---|---|
| Vertical Open | Remote | ≥ 32 | VOP.RC.M |
| | | < 32 and > −5 | VOP.RC.L |
| | | ≤ −5 | VOP.RC.I |
| | Self-Contained | ≥ 32 | VOP.SC.M |
| | | < 32 and > −5 | VOP.SC.L |
| | | ≤ −5 | VOP.SC.I |
| Semivertical Open | Remote | ≥ 32 | SVO.RC.M |
| | | < 32 and > −5 | SVO.RC.L |
| | | ≤ −5 | SVO.RC.I |
| | Self-Contained | ≥ 32 | SVO.SC.M |
| | | < 32 and > −5 | SVO.SC.L |
| | | ≤ −5 | SVO.SC.I |
| Horizontal Open | Remote | ≥ 32 | HZO.RC.M |
| | | < 32 and > −5 | HZO.RC.L |
| | | ≤ −5 | HZO.RC.I |
| | Self-Contained | ≥ 32 | HZO.SC.M |
| | | < 32 and > −5 | HZO.SC.L |
| | | ≤ −5 | HZO.SC.I |
| Vertical Closed Transparent | Remote | ≥ 32 | VCT.RC.M |
| | | < 32 and > −5 | VCT.RC.L |
| | | ≤ −5 | VCT.RC.I |
| | Self-Contained | ≥ 32 | VCT.SC.M* |
| | | < 32 and > −5 | VCT.SC.L* |
| | | ≤ −5 | VCT.SC.I |
| Horizontal Closed Transparent | Remote | ≥ 32 | HCT.RC.M |
| | | < 32 and > −5 | HCT.RC.L |
| | | ≤ −5 | HCT.RC.I |
| | Self-Contained | ≥ 32 | HCT.SC.M* |
| | | < 32 and > −5 | HCT.SC.L* |
| | | ≤ −5 | HCT.SC.I |
| Vertical Closed Solid | Remote | ≥ 32 | VCS.RC.M |
| | | < 32 and > −5 | VCS.RC.L |
| | | ≤ −5 | VCS.RC.I |
| | Self-Contained | ≥ 32 | VCS.SC.M* |
| | | < 32 and > −5 | VCS.SC.L* |
| | | ≤ −5 | VCS.SC.I |
| Horizontal Closed Solid | Remote | ≥ 32 | HCS.RC.M |
| | | < 32 and > −5 | HCS.RC.L |
| | | ≤ −5 | HCS.RC.I |
| | Self-Contained | ≥ 32 | HCS.SC.M* |
| | | < 32 and > −5 | HCS.SC.L* |
| | | ≤ −5 | HCS.SC.I |

[10] Table IV–4 identifies 48 classes of commercial refrigerators, commercial freezers, and commercial refrigerator-freezers. Of the 48 classes, 10 classes are identified by asterisks. EPCA has already established energy conservation standards for these 10 classes, (42 U.S.C. 6313(c)(2)–(3)) which are not covered under this rulemaking.

TABLE IV–4—COMMERCIAL REFRIGERATION EQUIPMENT CLASSES—Continued

| Equipment family | Condensing unit configuration | Operating temperature (°F) | Equipment class designation |
|---|---|---|---|
| Service Over Counter | Remote | ≥ 32 | SOC.RC.M |
| | | < 32 and > −5 | SOC.RC.L |
| | | ≤ −5 | SOC.RC.I |
| | Self-Contained | ≥ 32 | SOC.SC.M* |
| | | < 32 and > −5 | SOC.SC.L* |
| | | ≤ −5 | SOC.SC.I |

* These equipment classes are covered by standards established in EPCA and are not covered under this rulemaking. (42 U.S.C. 6313(c)(2)–(3))

EPCA contains standards for self-contained commercial refrigerators, commercial freezers and commercial refrigerator-freezers with doors (42 U.S.C. 6313(c)(2)–(3)); this equipment is not included in this rulemaking. Equipment classes already covered by EPCA, and therefore not included in this rulemaking, are indicated with asterisks in Table IV–4. DOE has based the designations of these possible equipment classes on the classification methodology presented in Table IV–1 through Table IV–3.

Table IV–5 presents the equipment classes covered under this rulemaking, organized by the three equipment categories.

TABLE IV–5—COMMERCIAL REFRIGERATION EQUIPMENT CLASSES BY CATEGORY

| Equipment category | Condensing unit configuration | Equipment family | Operating temperature (°F) | Equipment class designation |
|---|---|---|---|---|
| Remote Condensing Commercial Refrigerators, Commercial Freezers, and Commercial Refrigerator-Freezers. | Remote | Vertical Open | ≥ 32 | VOP.RC.M |
| | | | < 32 and > −5 | VOP.RC.L |
| | | Semivertical Open | ≥ 32 | SVO.RC.M |
| | | | < 32 and > −5 | SVO.RC.L |
| | | Horizontal Open | ≥ 32 | HZO.RC.M |
| | | | < 32 and > −5 | HZO.RC.L |
| | | Vertical Closed Transparent | ≥ 32 | VCT.RC.M |
| | | | < 32 and > −5 | VCT.RC.L |
| | | Horizontal Closed Transparent | ≥ 32 | HCT.RC.M |
| | | | < 32 and > −5 | HCT.RC.L |
| | | Vertical Closed Solid | ≥ 32 | VCS.RC.M |
| | | | < 32 and > −5 | VCS.RC.L |
| | | Horizontal Closed Solid | ≥ 32 | HCS.RC.M |
| | | | < 32 and > −5 | HCS.RC.L |
| | | Service Over Counter | ≥ 32 | SOC.RC.M |
| | | | < 32 and > −5 | SOC.RC.L |
| Self-Contained Commercial Refrigerators, Commercial Freezers, and Commercial Refrigerator-Freezers without Doors. | Self-Contained | Vertical Open | ≥ 32 | VOP.SC.M |
| | | | < 32 and > −5 | VOP.SC.L |
| | | Semivertical Open | ≥ 32 | SVO.SC.M |
| | | | < 32 and > −5 | SVO.SC.L |
| | | Horizontal Open | ≥ 32 | HZO.SC.M |
| | | | < 32 and > −5 | HZO.SC.L |
| Commercial Ice-Cream Freezers | Remote | Vertical Open | ≤ −5 | VOP.RC.I |
| | | Semivertical Open | | SVO.RC.I |
| | | Horizontal Open | | HZO.RC.I |
| | | Vertical Closed Transparent | | VCT.RC.I |
| | | Horizontal Closed Transparent | | HCT.RC.I |
| | | Vertical Closed Solid | | VCS.RC.I |
| | | Horizontal Closed Solid | | HCS.RC.I |
| | | Service Over Counter | | SOC.RC.I |
| | Self-Contained | Vertical Open | | VOP.SC.I |
| | | Semivertical Open | | SVO.SC.I |
| | | Horizontal Open | | HZO.SC.I |
| | | Vertical Closed Transparent | | VCT.SC.I |
| | | Horizontal Closed Transparent | | HCT.SC.I |
| | | Vertical Closed Solid | | VCS.SC.I |
| | | Horizontal Closed Solid | | HCS.SC.I |
| | | Service Over Counter | | SOC.SC.I |

*B. Engineering Analysis*

The engineering analysis develops cost-efficiency relationships to show the manufacturing costs of 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 cost data for parts and material, labor, shipping/packaging, and investment for models that operate at particular efficiency levels.

1. Approach

In the ANOPR engineering analysis, the primary methodology was an efficiency-level approach, supplemented by a design option approach. DOE analyzed only the 15 equipment classes with shipment volumes greater than 100 per year. The basis of the approach was four industry-supplied cost-efficiency curves for the four equipment classes shipped most frequently (i.e., VCT.RC.L, VOP.RC.M, SVO.RC.M, and HZO.RC.L). See Section 0 for shipment data. DOE developed these classes using an efficiency-level approach. DOE supplemented these industry-supplied curves with 15 curves it developed using a design option approach. Four of DOE's curves were intended only for comparison with the industry-supplied curves, as verification of the industry data. The other 11 curves formed the basis of analysis for the other 11 analyzed equipment classes. The ANOPR provides more details on this approach. 72 FR 41180.

During the ANOPR public meeting and subsequent comment period, stakeholders raised concerns over using industry-supplied data as the basis of the engineering analysis. ARI stated that the intent was to use the industry curves only to validate DOE's design option analysis, not to use them directly in the analysis. (Public Meeting Transcript, No. 13.5 at p. 91) The American Council for an Energy Efficient Economy (ACEEE) stated that rulemakings have always used industry curves when they were available. (Public Meeting Transcript, No. 13.5 at p. 91) ARI stated that the industry data represents an average and covers the range of available equipment, but not all manufacturers' equipment would span the whole range. ARI also stated that as few as three manufacturers submitted data for some of the cost-efficiency curves, while in the best cases there were up to seven. ARI explained that three manufacturers might not represent the entire industry. (Public Meeting Transcript, No. 13.5 at pp. 94–95) Hussmann stated that it doesn't know, for example, how many shelf lights other manufacturers included in the data they submitted to ARI, and therein lies some of the danger of using an industry average. (Public Meeting Transcript, No. 13.5 at p. 95) Regarding the HZO.RC.L equipment class, EEI stated that DOE's data does not appear to have the same range as ARI's data. (Public Meeting Transcript, No. 13.5 at p. 93) Copeland also questioned whether the cost-efficiency curves from industry made sense [because they did not appear to be ordered in terms of increasing payback]. (Public Meeting Transcript, No. 13.5 at p. 149) ACEEE noted that the analytically derived price points for several equipment classes are significantly higher than the industry-supplied data at high efficiency, and suggested that DOE reexamine this data. (ACEEE, No. 16 at p. 2) ARI stated that DOE's design option approach appears to be technically sound, and that the ARI cost-efficiency curves are only available for a limited number of equipment classes. For consistency, ARI recommended that DOE base its analysis solely on DOE's analytically derived curves. (ARI, No. 18 at p. 6)

As mentioned above, DOE used the four cost-efficiency curves [11] provided by ARI as the basis for its ANOPR engineering analysis. DOE was not aware of ARI's intent that they be used only to validate DOE's own analysis, or of ARI's concerns that the data may have been insufficient for some classes. DOE agrees with stakeholders that using the analytically derived curves (a design option approach) for all equipment classes would be more consistent and provide more transparency. Although the efficiency-level and design option approaches have been used together in other rulemakings, DOE recognizes the challenges in using the industry-supplied data as the primary engineering analysis approach in this rulemaking. The ARI data cannot be disaggregated for public review, since doing so would disclose sensitive manufacturer information. This prevents a rigorous investigation of any discrepancies or irregularities in data submitted by the manufacturers. At the ANOPR public meeting, Hussmann mentioned lighting levels as one example of a design feature that could cause discrepancies among data from different manufacturers. In the design option approach, data on design features that affect performance (such as lighting) are available for interested persons to review and comment on, along with other assumptions and calculations. The aggregation of industry data seems to have resulted in cost-efficiency curves that lack the marked cost increases at higher levels of efficiency that are typical of the cost-efficiency relationship. The industry-supplied curves tended to be ''flatter'' than those developed by DOE, and in some cases appear to have efficiency levels that were not in order of increasing payback, as noted by Copeland. DOE believes the flatness of the industry curves may account for some of the discrepancies in pricing between the industry-supplied and analytically derived data, as noted by ACEEE.

The extent of the industry-supplied data was also cause for concern. ARI's statement that not all manufacturers' equipment would span the whole range of efficiency levels is consistent with EEI's concern that the data derived using DOE's design option approach did not span the same range as the industry data. Because of overlapping ranges of efficiency of manufacturers' data, the overall cost-efficiency data reported by ARI spans a range that in some cases is greater than the range covered by DOE's design option data. DOE realizes this could raise a concern that its analysis is incomplete, for example by neglecting design options that could account for additional increases in efficiency, and thus an increase in the span of efficiencies covered. However, based on the comments received, DOE believes the extra range in the ARI data is instead largely due to inconsistencies in the manufacturer data submitted to ARI, such as lighting levels. A smaller portion of the extra range may also be attributable to subtle aspects of design and manufacturing (e.g., airflow and air-curtain design) that have an insignificant impact on performance and that cannot be modeled accurately in the design option approach. DOE appreciates the feedback from ARI that the design option approach appears sound, and believes that the design option data is more accurate in depicting the cost-efficiency relationship for commercial refrigeration equipment.

For the NOPR engineering analysis, DOE analyzed the same 15 equipment classes as in the ANOPR analysis, but used only a design option approach. That approach is identical to the one used in the ANOPR, involving consultation with outside experts,

[11] These four curves applied to the following four equipment classes: VCT.RC.L, VOP.RC.M, SVO.RC.M, and HZO.RC.L. These represent the equipment classes with the highest shipment volumes.

review of publicly available cost and performance information, and modeling of equipment cost and energy consumption, but DOE applied it to all 15 equipment classes analyzed. The industry-supplied data developed using an efficiency-level approach is used only as a check on DOE's data. DOE believes this approach is more reliable, and affords the public full transparency of assumptions and results and the ability to perform independent analyses for verification. See Chapter 5 of the TSD for more detail.

2. Equipment Classes Analyzed

For the NOPR, DOE did not make any changes to the equipment classes directly analyzed in the ANOPR engineering analysis. Because of the large number of equipment classes in this rulemaking, DOE did not directly analyze all equipment classes using the design option approach. DOE maintained the same equipment class prioritization used in the ANOPR. Equipment classes with more than 100 units shipped per year (''primary'' classes), as well as the VOP.RC.L [12] equipment class, were directly analyzed. Table IV–6 lists these equipment classes, which represent approximately 98 percent of the shipments of commercial refrigeration equipment reported by ARI.

TABLE IV–6—EQUIPMENT CLASSES DIRECTLY ANALYZED IN THE ENGINEERING ANALYSIS

| Equipment class | Description |
|---|---|
| VOP.RC.M | Vertical Refrigerator without Doors with a Remote Condensing Unit, Medium Temperature. |
| VOP.RC.L | Vertical Freezer without Doors with a Remote Condensing Unit, Low Temperature. |
| SVO.RC.M | Semi-Vertical Refrigerator without Doors with a Remote Condensing Unit, Medium Temperature. |
| HZO.RC.M | Horizontal Refrigerator without Doors with a Remote Condensing Unit, Medium Temperature. |
| HZO.RC.L | Horizontal Freezer without Doors with a Remote Condensing Unit, Low Temperature. |
| VCT.RC.M | Vertical Refrigerator with Transparent Doors with a Remote Condensing Unit, Medium Temperature. |
| VCT.RC.L | Vertical Freezer with Transparent Doors with a Remote Condensing Unit, Low Temperature. |
| SOC.RC.M | Service Over Counter Refrigerator with a Remote Condensing Unit, Medium Temperature. |
| VOP.SC.M | Vertical Refrigerator without Doors with a Self-Contained Condensing Unit, Medium Temperature. |
| SVO.SC.M | Semi-Vertical Refrigerator without Doors with a Self-Contained Condensing Unit, Medium Temperature. |
| HZO.SC.M | Horizontal Refrigerator without Doors with a Self-Contained Condensing Unit, Medium Temperature. |
| HZO.SC.L | Horizontal Freezer without Doors with a Self-Contained Condensing Unit, Low Temperature. |
| VCT.SC.I | Vertical Ice-Cream Freezer with Transparent Doors with a Self-Contained Condensing Unit, Ice-Cream Temperature. |
| VCS.SC.I | Vertical Ice-Cream Freezer with Solid Doors with a Self-Contained Condensing Unit, Ice-Cream Temperature. |
| HCT.SC.I | Horizontal Ice-Cream Freezer with Transparent Doors with a Self-Contained Condensing Unit, Ice-Cream Temperature. |

3. Analytical Models

In the design option approach, DOE used models to develop estimates of cost and energy consumption for each equipment class at each efficiency level. DOE used a cost model to estimate the manufacturer production cost (MPC) in dollars, and an energy consumption model to estimate the daily energy consumption in kWh for each of the 15 primary equipment classes analyzed.

a. Cost Model

Development of the cost model involved the disassembly of a self-contained refrigerator with transparent doors, an analysis of the materials and manufacturing processes, and the development of a parametric spreadsheet model flexible enough to cover all equipment classes. The manufacturing cost model estimated MPC and reported it in aggregated form to maintain confidentiality of sensitive cost data. DOE obtained input from stakeholders on the MPC estimates and assumptions to confirm accuracy. The cost model was used for 7 of the 15 examined equipment classes and the results were extended to 6 of the remaining examined equipment classes. The cost of the remaining two equipment classes was estimated using available manufacturer list price (MLP) information discounted to MPC. Details of the cost model are provided in chapter 5 of the TSD.

Following the ANOPR, no comments were received regarding DOE's cost model, and therefore no significant changes were made to the methodology used in the NOPR analysis. One change was made to the manufacturer markup assumption, which is discussed below.

One key element of DOE's cost model concerned features and structural elements common in commercial refrigeration equipment, but that would not affect the energy use of the equipment. Development of this part of the cost model involved disassembling a self-contained refrigerator with transparent doors, analyzing the materials and manufacturing processes, and developing a parametric spreadsheet model flexible enough to cover all equipment classes. The other key part of the cost model estimated the costs of particular features or design options that would affect the energy use of the equipment. DOE obtained input from stakeholders on the MPC estimates and assumptions to confirm their accuracy. DOE used the cost model for 7 of the 15 examined equipment classes and extended the results to 6 of the remaining examined equipment classes. DOE estimated the cost of the remaining two equipment classes using available manufacturer list price (MLP) information reduced to MPC. Chapter 5 of the TSD provides details of the cost model.

A manufacturer markup is applied to the MPC estimates to arrive at the MSP. This is the price of equipment sold at which the manufacturer can recover both production and non-production costs and can earn a profit. DOE calculated the manufacturer markup as the market share weighted average value for the industry. For the ANOPR, DOE developed this manufacturer markup by examining several major commercial refrigeration equipment manufacturers' gross margin information from annual reports and the Securities and Exchange Commission (SEC) 10–K reports. The manufacturers DOE analyzed account for approximately 80 percent of the market, and each company is a subsidiary of a more diversified parent company that manufactures equipment other than commercial refrigeration equipment. Because the 10–K reports do

[12] The VOP.RC.L equipment class was reported as having zero shipments in the ARI shipment data, but was included in the analysis based on recommendations from manufacturers. During interviews conducted for the NOPR, manufacturers reported to DOE their individual shipment numbers for the VOP.RC.L class. Regardless of the actual shipment volume, DOE believes there are significantly more than 100 annual shipments of the VOP.RC.L equipment class.

not provide gross margin information at the subsidiary level, the estimated markups represent the average markups that the parent company applies over its entire range of equipment offerings and does not necessarily represent the manufacturer markup of the subsidiary.

The ANOPR analysis indicated that the average manufacturer markup is 1.39. However, DOE adjusted the markups to be more representative of the industry following discussions with manufacturers during the MIA interviews (Chapter 13). An aggregation of the MIA interview responses gives a market share weighted average manufacturer markup value of 1.32. For the NOPR, DOE used this revised manufacturer markup with the MPC values from the engineering analysis to arrive at the MSP values used in the GRIM.

As explained in the ANOPR, DOE received industry-supplied curves from ARI in the form of daily energy consumption versus MLP, both normalized by total display area (TDA). Since DOE developed its analytically derived curves in the form of calculated daily energy consumption (CDEC) versus MSP, it was necessary for DOE to estimate an industry list price markup so that it could make comparisons between the two sets of curves. The industry list price markup is a markup to the selling price that provides the list price. To make comparisons between the analytically derived and industry-supplied cost-efficiency curves, DOE discounted the industry data with the list price markup and normalized the analytically derived curves by TDA.

Manufacturers typically offer a discount from the MLP, which depends on factors such as the relationship with the customer and the volume and type of equipment being purchased. For the estimate of list price markup, DOE relied on information gathered on self-contained commercial refrigeration equipment, since list price information is readily available and typically published by manufacturers of this equipment. A review of the data shows that the list price markup is typically 2.0 (i.e., manufacturers will typically sell their equipment for 50 percent off the published list price). DOE further verified the estimate by obtaining list price quotes from several remote condensing equipment manufacturers. During manufacturer interviews, some commercial refrigeration equipment manufacturers agreed with the 2.0 markup estimate, while others stated the estimate was somewhat high. Although the list price markup can vary significantly by manufacturer and by customer, DOE believes the estimated list price markup of 2.0 is representative of the industry. DOE applied this markup to all equipment classes.

DOE did not receive any additional comments or information indicating that revision of the cost model used in the ANOPR analysis is warranted. Therefore DOE has adhered to that model in the NOPR analysis.

b. Energy Consumption Model

The energy consumption model estimates the daily energy consumption of commercial refrigeration equipment at various performance levels using a design options approach. The model is specific to the categories of equipment covered under this rulemaking, but is sufficiently generalized to model the energy consumption of all covered equipment classes. For a given equipment class, the model estimates the daily energy consumption for the baseline and the energy consumption of several levels of performance above the baseline. The model is used to calculate each performance level separately.

In developing the energy consumption model, DOE made general assumptions about the analysis methodology and specific numerical assumptions regarding load components and design options. DOE based its energy consumption estimates on new equipment tested in a controlled-environment chamber in accordance with ANSI/ARI Standard 1200–2006, the DOE test procedure for commercial refrigeration equipment, which references the ANSI/ASHRAE Standard 72–2005 test method.[13] Once Federal standards for this equipment become operative, manufacturers will be required to test units with this test method, which specifies a certain ambient temperature, humidity, light level, and other requirements. This test method, however, contains no specification as to the operating hours of the display case lighting, and DOE's energy consumption model considers the operating hours to be 24 hours per day (i.e., that lights are on continuously). This assumption is consistent with the lighting operating time assumption used in the energy use characterization (see Section IV.D). Chapter 5 of the TSD discusses further the assumptions used in the energy consumption model.

The energy consumption model calculates CDEC as having two major components: Compressor energy consumption and component energy consumption (expressed as kWh/day). Component energy consumption is the sum of the direct electrical energy consumption of fan motors, lighting, defrost and drain heaters, anti-sweat heaters, and pan heaters. Compressor energy consumption is calculated from the total refrigeration load (expressed in Btu/h) and one of two compressor models: One version for remote condensing equipment and one for self-contained equipment. The total refrigeration load is a sum of the component load and the non-electric load. The component load is the sum of the heat emitted by evaporator fan motors, lighting, defrost and drain heaters, and anti-sweat heaters inside and adjacent to the refrigerated space (condenser fan motors and pan heaters are outside of the refrigerated space and do not contribute to the component heat load). The non-electric load is the sum of the heat contributed by radiation through glass and openings, heat conducted through walls and doors, and sensible and latent loads from warm, moist air infiltration through openings. Chapter 5 of the TSD discusses component energy consumption, compressor energy consumption, and load models.

DOE made one change to the methodology of calculating the radiation load for cases without doors (VOP, SVO, and HZO equipment families). In the ANOPR analysis, the view factor[14] from the interior of the case to the walls of the test chamber was estimated as 0.025. This value was kept as a constant for all cases and sizes in the ANOPR analysis, but it is clear this value should change somewhat as the geometry and the overall size of the case changes. For the NOPR, DOE calculated the view factor separately for each equipment class depending on the geometry specific to the baseline design specifications of that class. The view factor from the case to the room is calculated as the ratio of TDA (i.e., the area of the plane separating the case from the room) to the test chamber wall surface area.

Stakeholders raised questions regarding DOE's method of calculating the infiltration load[15] for commercial refrigeration equipment. Carrier asserted that DOE's method of using defrost water to model infiltration has limitations. Carrier pointed out that as the case is run at higher suction temperatures, the coil has a tendency to run as a wet coil and does not retain much of the moisture on its exterior. Typically on manufacturer specification sheets, defrost meltwater is only the

[13] The test procedures are found at 10 CFR 431.64.

[14] A view factor is the proportion of all radiation that leaves one surface and strikes another.

[15] The mass of warm ambient store air that displaces the cold air inside of the case.

water that comes out during a defrost period, and Carrier noted that there may be additional water that would come off the coil between defrost periods. Carrier believes DOE may be underestimating the infiltration load using information from the specification sheets, and estimated that the infiltration load is typically around 75 percent of total cooling water. Carrier questioned whether or not DOE compared its estimates with the calculated infiltration loads. (Public Meeting Transcript, No. 13.5 at p. 83) Hussmann stated that when it publishes data for defrost meltwater, it does so for the sole purpose of sizing sewer lines and not for estimating the infiltration load. (Public Meeting Transcript, No. 13.5 at p. 85)

In the ANOPR analysis, DOE calculated infiltration load using empirical defrost meltwater data obtained from manufacturers' detailed specification sheets. DOE assumed that defrost meltwater could be correlated with infiltration load, given certain known parameters such as ambient relative humidity. This methodology was calibrated with detailed refrigeration load data obtained from Southern California Edison for several large-volume equipment classes. DOE agrees with the assessment made by stakeholders and has altered its methodology accordingly. In the NOPR engineering design specifications, defrost meltwater (in pounds per hour, lbs/hr) is replaced with infiltrated air (also in lbs/hr) for all equipment classes. DOE estimated infiltrated air by using manufacturers' detailed specification sheets, recognizing that infiltration load is the only load component that cannot be directly calculated. Using physical parameters about each case, the other load components (internal load, conduction load, radiation load) are calculated. DOE subtracted these load components from the listed total refrigeration load, and it is assumed that the remaining load is due to infiltration. Chapter 5 of the TSD provides more details of the change to this methodology.

At the public meeting, stakeholders expressed concern over the refrigerants DOE used in the analysis. EEI asked if hydrofluorocarbon (HFC) refrigerants were already assumed to be in use in the baseline. (Public Meeting Transcript, No. 13.5 at p. 97) ARI stated that most of the data it provided to DOE was based on such refrigerants and no changes are expected in that regard. (Public Meeting Transcript, No. 13.5 at p. 97) In its analysis, DOE assumed that HFC refrigerants are already fully in use for commercial refrigeration equipment. For all remote condensing equipment, in accordance with the DOE test procedure in ANSI/ARI Standard 1200–2006, DOE assumes the use of a compressor using an HFC refrigerant (i.e., R–404A). Likewise, all of the compressors DOE used in modeling self-contained equipment use either R–404A or R–134A, another HFC refrigerant.

c. Design Options

In the market and technology assessment for the ANOPR, DOE defined an initial list of technologies that have the potential to reduce the energy consumption of commercial refrigeration equipment. In the screening analysis for the ANOPR, DOE screened out some of these technologies based on four screening criteria: Technological feasibility; practicability to manufacture, install and service; impacts on equipment utility or availability; and impacts on health or safety. 72 FR 41179–80. The remaining technologies became inputs to the ANOPR engineering analysis as design options. However, for reasons described in the ANOPR, DOE did not incorporate all of these technologies as design options in the energy consumption model. 72 FR 41182–83. Stakeholders commented that some of these technologies should be included in the NOPR engineering analysis, and recommended additional design options DOE should consider. Comments pertaining to each suggested technology and DOE's response are provided below. As a general comment about design options, ACEEE stated that some design options that were screened out should be considered for further analysis and that prevalence in the marketplace is not necessarily a good reason to screen out a design option. (Public Meeting Transcript, No. 13.5 at p. 62) DOE screened out five technologies in the ANOPR screening analysis. These are air-curtain design, thermoacoustic refrigeration, magnetic refrigeration, electro-hydrodynamic heat exchangers, and copper rotor motors. All five of these design options were screened out because they are in the research stage and would not be practical to manufacture, install, and service. Since the publication of the ANOPR, DOE is not aware of any significant changes to the status of these technologies, and has not included them in the NOPR analysis.

ACEEE recommended that variable-speed compressors be included in the analysis. (ACEEE, No. 16 at p. 2) EEI also suggested that DOE consider the use of variable-speed drives for compressors. (EEI, No. 15 at p. 2) Variable-speed compressors could potentially improve the efficiency of commercial refrigeration equipment classes that are self-contained units without doors and self-contained ice-cream freezers. Variable-speed compressors can reduce energy consumption under real-world conditions by matching cooling capacity to the refrigeration load, which can change due to variations in ambient conditions and product loading. This load matching allows for a more constant temperature inside the case, eliminating the large fluctuations in temperature that are typical of single-speed compressors. The stability in temperature allows manufacturers to design equipment with higher evaporator temperatures, improving compressor efficiency. However, the energy-saving benefit of variable-speed compressors is not clear under ANSI/ASHRAE Standard 72–2005, because it is a steady-state test for commercial refrigeration equipment. Further, DOE is not aware of any test data showing the energy savings benefit of variable speed compressors in the types of equipment covered in this rule. Certain test data does exist for walk-ins and residential refrigerators, but DOE does not believe that this data can be used to predict the performance of variable-speed compressors in commercial refrigeration equipment. Therefore, DOE did not include variable-speed compressors as a design option in its engineering analysis.

ACEEE recommended that variable-speed evaporator fans be included in the analysis. (ACEEE, No. 16 at p. 2) San Diego Gas & Electric Company (SDGE) also recommended that DOE include in its analysis the energy savings, cost-effectiveness, and feasibility of such fans for enclosed refrigeration equipment served by remote refrigeration compressors. (SDGE, No. 22 at p. 2) SCE recommended that DOE consider the cost-effectiveness of variable-speed evaporator fans for this equipment. SCE asserted that variable-speed fan control was a very effective and cost-effective means of increasing refrigerated warehouse efficiency and should be applicable to commercial refrigeration equipment as well. SCE stated that this reduces the energy consumption of the fan and the amount of load that the refrigerant must reject. SCE also noted that its work in support of California building and appliance standards showed variable-speed controls on evaporator fans had approximately one-year simple paybacks in both refrigerated warehouses and small walk-in coolers. (Public Meeting Transcript, No. 13.5 at p. 69 and SCE, No. 19 at p. 3) EEI also suggested that DOE consider the use of variable-speed drives for evaporator fans and compressors. (EEI, No. 15 at p. 2)

Variable-speed evaporator fans can operate at speeds that match changing conditions in the case. DOE recognizes that the use of these fans provides some opportunity for energy savings, because the buildup and removal of frost creates differing pressure drops across the evaporator coil. Theoretically, less fan power is required when the coil is free of frost. Additionally, when an evaporator fan operates at variable speeds, the coil would operate at a more stable temperature during the period of frost build-up. However, the effectiveness of the air curtain in equipment without doors is very sensitive to changes in airflow, so fan motor controllers would likely disrupt air curtains. DOE believes the likely disturbance to the air curtain, which would lead to higher infiltration loads and higher overall energy consumption, would negate the use of evaporator fan motor controllers in equipment without doors, even if there were some reduction in fan energy use. In addition, the ANSI/ASHRAE Standard 72–2005 test method is a steady-state test for commercial refrigeration equipment, so similar to variable-speed compressors, the energy-saving benefit of variable-speed fans is not clear. Therefore, DOE did not include variable-speed fans as a design option in its engineering analysis.

ACEEE recommended that remote ballast location be included in the analysis. (ACEEE, No. 16 at p. 2) Fluorescent lamp ballasts generate heat, and their relocation outside the refrigerated space can reduce energy consumption by lessening the refrigeration load on the compressor. However, for the majority of commercial refrigeration equipment currently manufactured, ballasts are already located in electrical trays outside of the refrigerated space, in either the base or top of the equipment. The notable exceptions are the equipment classes in the VCT equipment family, where ballasts are most often located on the interior of each door mullion. Most commercial refrigeration equipment manufacturers purchase doors for VCT units that are preassembled with the entire lighting system in place rather than configured for separate ballasts. DOE believes that most commercial refrigeration equipment manufacturers choose these kinds of doors because it would be labor intensive and time consuming to relocate these ballasts at the factory, and because of the additional cost and labor of wiring separate ballasts. Manufacturers have indicated that the potential energy savings are also small, since modern electronic ballasts are very efficient and typically contribute only a few watts (W) each to the refrigeration load. Because (1) lamp ballasts are already located externally on most equipment; (2) most units that have internally located lamp ballasts use preassembled lighting systems; and (3) potential energy savings are small, DOE did not consider remote relocation of ballasts as a design option in its engineering analysis.

ACEEE recommended that improved insulation be included in the analysis. (ACEEE, No. 15 at p. 2) Potential improvements to insulation material used in commercial refrigeration equipment cabinets include better polyurethane foams and vacuum panels. In consultation with insulation material manufacturers, DOE determined that there are no significant differences in ''grades'' of insulation material, so equipment manufacturers are already using the best commercially available foam materials in their equipment. Vacuum panels are an alternative form of insulation; however, they may degrade in performance in time as small leaks develop. Based on knowledge of typical manufacturing practices, DOE also believes it would be impractical to use vacuum panels to construct commercial refrigeration equipment, because they cannot be penetrated by fasteners, and do not provide the rigidity of ''foamed-in-place'' polyurethane insulation panels. Thicker insulation is another possible option, but could be problematic because it would likely result in either a reduced volume for the refrigerated space or an increase in the overall size of the equipment cabinet. Reducing the volume of the refrigerated space could affect the utility of the equipment, and because the outer dimensions of commercial refrigeration equipment are often limited (e.g., by interior dimensions of shipping containers), it is often not practical to increase the overall size of the cabinet. For all these reasons, DOE did not consider insulation thickness increases or improvements as a design option in its ANOPR engineering analysis.

However, DOE did add increases in insulation thickness as a design option in the NOPR engineering analysis, because it now believes this is a cost-effective option in several equipment types, most notably self-contained ice-cream freezers with doors. DOE understands that in equipment classes where conduction makes up a significant portion of the total refrigeration load, a modest increase in insulation thickness can lead to small, but significant energy savings. In relatively large units, which make up the largest portion of the shipments of commercial refrigeration equipment, even if such added insulation results in reduction of the refrigerated volume, any such reduction would not be substantial. DOE does not foresee any impact on the availability of this type of equipment from the use of increased insulation that would trigger EPCA's prohibition at 42 U.S.C. 6295(o)(4) and 6316(e)(1). As to smaller units, DOE assumes that their outer dimensions are less constrained than the dimensions of larger units, and that therefore manufacturers could accommodate a small increase in insulation thickness, and maintain the amount of refrigerated volume, by making a small increase in the overall size of the cabinet. Therefore, in the NOPR, DOE modeled a ½-inch increase in insulation thickness for all equipment classes. When implemented as a design option, this increase in thickness was added to the baseline value of insulation thickness and DOE recalculated the conduction load. DOE based the cost of increasing the insulation thickness on a sunk cost per unit, considering foam fixture engineering and tooling costs, production line lifetime, and number of fixtures and units produced. Chapter 5 of the TSD provides details of the assumptions DOE used to calculate the additional cost of insulation thickness increases.

ACEEE recommended that DOE include defrost cycle control in the analysis. (ACEEE, No. 16 at p. 2) Defrost cycle control can reduce energy consumption by reducing the frequency and duration of defrost periods. The majority of equipment currently manufactured already uses partial defrost cycle control in the form of cycle termination control. However, defrost cycle initiation is still scheduled at regular intervals. Full defrost cycle control would involve detecting frost buildup and initiating defrost. As described in the market and technology assessment (Chapter 3 of the TSD), this could be accomplished through an optical sensor or by sensing the temperature differential across the evaporator coil. However, both methods are unreliable due to problems with fouling of the coil from dust and other surface contaminants. This becomes more of an issue as the display case ages. Because of these issues, DOE did not consider defrost cycle control as a design option in its engineering analysis.

SCE asserted that doors should be considered a design option for open units, and that open units without doors should be held to energy consumption standards at levels warranted for units with doors. (Public Meeting Transcript, No. 13.5 at p. 44) SCE advocates, in essence, that manufacture of new, open commercial refrigeration equipment be discontinued and replaced by manufacture of equipment with doors. It stated that this would be a cost-effective way of saving substantial amounts of energy. (SCE, No. 19 at p. 2) Although SCE did not state it explicitly, DOE understands that its main argument for advocating that doors be considered for open cases is that doors should be regarded as a design option and not a feature, such that there are not separate equipment classes for equipment with and without doors.

DOE acknowledges SCE's position. Substantial, cost-effective energy savings might well result from standards that would, in effect, require the manufacture of commercial refrigeration equipment with doors instead of without. DOE has not considered such standards in this proceeding, however, nor has it studied their potential energy savings or economic justification (including the extent of their impact on product utility), because it believes EPCA precludes their adoption. First, DOE believes that, for commercial refrigeration equipment, the existence or lack of doors (i.e., whether the case is open or closed) does affect the utility of the equipment to its owner and user, and therefore is a ''feature'' as that term is used in 42 U.S.C. 6295(o)(4) and 6316(e)(1). Because a standard based on combining open and closed equipment classes would result in the unavailability of open cases, as described above, such a standard would violate EPCA's prohibition against any standard that would ''result in the unavailability'' of equipment with ''features * * * that are substantially the same'' as those currently available in the United States. (42 U.S.C. 6295(o)(4) and 6316(e)(1)) Second, EPCA prescribes energy conservation standards for self-contained equipment with doors, and mandates that DOE issue standard levels for ''self-contained commercial refrigerators, freezers, and refrigerator-freezers without doors.'' (42 U.S.C. 6313(c)(2)–(4)) The latter equipment is one of the subjects of this rulemaking. Hence, the plain language of EPCA covers standards for commercial refrigeration equipment with and without doors. DOE must follow this legislative mandate. For these reasons, DOE did not consider doors as a design option for open equipment in its engineering analysis.

The design options DOE considered in the NOPR engineering analysis are:

- Higher efficiency lighting and ballasts for the VOP, SVO, HZO, and SOC equipment families (horizontal fixtures);
- Higher efficiency lighting and ballasts for the VCT equipment family (vertical fixtures);
- Higher efficiency evaporator fan motors;
- Increased evaporator surface area;
- Increased insulation thickness;
- Improved doors for the VCT equipment family, low temperature;
- Improved doors for the VCT equipment family, medium temperature;
- Improved doors for the HCT equipment family, ice-cream temperature;
- Improved doors for the SOC equipment family, medium temperature;
- Higher efficiency condenser fan motors (for self-contained equipment only);
- Increased condenser surface area (for self-contained equipment only); and
- Higher efficiency compressors (for self-contained equipment only).[16]

At the public meeting and during the comment period, stakeholders raised concerns about some of the design option data DOE used in its analysis and about DOE's depiction of some of the design options. Several stakeholders were concerned with the lighting design option data. Zero Zone stated that DOE's estimate of the incremental increase in cost for light emitting diode (LED) lighting was too low. (Public Meeting Transcript, No. 13.5 at p. 89) ARI seemed to agree with Zero Zone's assessment, stating that DOE appears to have significantly underestimated the incremental cost for LED lighting by about 50 percent.

DOE revised its cost assumption for LED lighting used in the VOP, SVO, HZO, and SOC equipment families (horizontal four-foot fixtures) and the VCT equipment family (vertical 5-foot fixtures). For the ANOPR, DOE based LED lighting costs on an LED retrofit case study, but DOE revised some of its assumptions for the NOPR based on conversations with manufacturers of LED chips and LED fixtures. Specifically, DOE revised its assumptions on the relative weight of the costs of LED chips, power supplies, and the balance of fixtures (which includes labor). These changes cause the original equipment manufacturer (OEM) cost (i.e., the cost to commercial refrigeration equipment manufacturers) of LED fixtures to increase for both horizontal and vertical fixtures. DOE believes the cost estimates for LED fixtures are now more accurate and are consistent with the costs commercial refrigeration equipment manufacturers would experience in today's market at mass-production volumes. Further discussion of the assumptions used to calculate LED fixture costs are provided in Chapter 5 of the TSD.

Although DOE found that current LED costs are higher than originally estimated in the ANOPR analysis, through a closer examination of cost data for currently available LEDs, DOE recognizes that LED technology has historically exceeded DOE's efficiency and cost targets. In this NOPR, DOE conducted a sensitivity study that analyzed future LED costs based on DOE's Multi-Year Program Plan,[17] which are consistent with historical LED price reductions between 2000 and 2007 (see Appendix B of the TSD). The Multi-Year Program Plan projects that LED chip costs will continue to decrease at a compound annual growth rate (CAGR) of approximately −27 percent between 2007 and 2012, which represents a price reduction of 80 percent over that time period. Also in agreement, EIA's NEMS uses a technology characterization for LED light sources, which show that LED chip costs are expected to decline by approximately 71 percent for the same time period. Since LED chips are only a portion of the total LED system (other components include power supply and the LED fixture), the 80 percent reduction in chip costs contributes to an estimated decrease in total LED system cost of approximately 50 percent by 2012, assuming the costs of the power supply and LED fixtures do not change significantly.

DOE examined whether the projected LED costs presented in the Multi-Year Program Plan and used in this NOPR are consistent with publicly available empirical historical cost data. DOE reviewed available price data for the LED market and found that between 2000 and 2007, white-light LEDs had a CAGR ranging from approximately −18 to −31 percent. DOE's LED cost projection (i.e., −27 percent CAGR) falls within the range of CAGRs observed.

[16] Improvements to the condensing unit are not considered for remote condensing equipment, since the test procedure and standard apply only to the cabinet and not the condensing unit.

[17] U.S. Department of Energy, Solid-State Lighting Research and Development, Multi-Year Program Plan FY'09–FY'14. This document was prepared under the direction of a Technical Committee from the Next Generation Lighting Initiative Alliance (NGLIA). Information about the NGLIA and its members is available at *http://www.nglia.org*.

DOE expanded its examination by comparing this projected trend to the red-light LED market, which is a related technology, with price information spanning approximately three decades (i.e., 1973 to 2005). DOE found that the CAGR of red-light LED costs was −22 percent over this longer time span. The trend in red-light LED costs derived from empirical data over this longer time period is of a similar magnitude to DOE's projected costs for white-light LEDs. Due to the technological similarities between red-light LEDs and white-light LEDs, DOE believes that the historical cost reductions for red-light LEDs are indicative of future cost reductions for white-light LEDs. Furthermore, the white-light LED market is undergoing a massive expansion and growth phase, with significant investment, new products and innovative applications for LED technology, including illumination of commercial refrigeration equipment. See Section V.C of this NOPR and Appendix B of the TSD for more detail on the cost projection and DOE's validation of those estimates. DOE seeks comment on the extent to which these price trends are indicative of what can be expected for commercial refrigeration equipment LED lighting from 2007 to 2012 and the extent to which the cost reduction observed for red-light LEDs is relevant to DOE's cost projections for white-light LEDs. Also, in order to consider that LED costs are to decline more than assumed in this analysis, DOE will need more information than currently available on the extent, timing, and certainty of such further price reductions. Finally, DOE seeks comment on the extent to which manufacturers would adopt LED technology into the design of commercial refrigeration equipment in the absence of standards considering the rapid development of LED technology and the steady reductions in cost. See Section VII.E.1 for details.

The design option data for doors on VCT equipment were another area of concern for stakeholders. Zero Zone stated that the incremental increase in cost for high-efficiency doors (particularly cooler doors) seemed too high. (Public Meeting Transcript, No. 13.5 at p. 89) ACEEE also indicated that DOE's costs for high-efficiency doors are too high. (ACEEE, No. 16 at p. 2) ARI stated that it does not believe that the door used in DOE's analysis (one that uses no energy) is available in the market today. According to ARI, high-efficiency door models currently in the market have no heat in the door, but the frame installed in the case uses at least 40 W per door. ARI also stated that this option is not available to manufacturers in all applications because it is not intended for stores that operate outside a condition of 75 °F dry bulb and 55 percent relative humidity, which requires higher wattage anti-condensate heaters in the doors/frames. (ARI, No. 18 at p. 6) Zero Zone made similar comments, stating that building humidity could be an issue in the use and functionality of higher efficiency doors without heaters. Zero Zone also recommended that DOE revise its analysis and use 40 W per door for the high-efficiency medium temperature frame, and that high-efficiency doors should be dropped from the analysis because they can result in condensate and water on the floor, such that they are not safe to use in a number of stores. (Public Meeting Transcript, No. 13.5 at p. 119 and Zero Zone, No. 17 at p. 2)

DOE did not revise its costs for doors on VCT equipment. After reviewing the information collected for the ANOPR analysis, DOE concluded that its preliminary cost estimates were reasonable. Notwithstanding the stakeholder observations just set forth, none of them provided any specific additional data that would warrant revision of DOE's cost assessments, and DOE is not aware of such data. However, DOE revised the values for the anti-sweat heater power for glass doors for VCT.RC.L and VCT.RC.I equipment in the NOPR engineering analysis. Based on discussion with manufacturers and data from manufacturer specification sheets, the anti-sweat heater power for both the baseline and high-efficiency doors was increased (from 160 W to 200 W for baseline doors and from 60 W to 110 W for high-efficiency doors). DOE also revised the anti-sweat heater power for glass doors for VCT.RC.M equipment in the NOPR engineering analysis based on comments and data received from manufacturer specification sheets. DOE increased the anti-sweat heater power for both the baseline doors (from 60 W to 100 W) and high-efficiency doors (from 0 W to 50 W). See Chapter 5 of the TSD for more detail.

Regarding the compressor design options, Emerson noted that possible efficiency improvements for compressors in self-contained units may be too optimistic. True believes that because the test procedure is not steady-state (due to door openings), variable-speed compressors may be an effective design option. (Public Meeting Transcript, No. 13.5 at p. 75) However, True also noted that few variable-speed compressors are available in the appropriate power range, but that their development is continuing. (Public Meeting Transcript, No. 13.5 at p. 76) Emerson also believes that high-efficiency compressors may not be readily available and that it may be particularly hard to find compressors capable of this level of increased efficiency for low temperature equipment. (Public Meeting Transcript, No. 13.5 at p. 65) For the NOPR, DOE revised the assumptions it used to estimate the changes in cost and efficiency for high-efficiency, single-speed compressors. Based on discussions with manufacturers and other experts, DOE concluded that the assumptions used in the ANOPR analysis (a 10 percent increase in cost results in a 20 percent reduction in energy use) overstated the actual efficiency gains that are possible for today's compressors. Therefore, DOE now assumes that a five percent increase in cost would result in a 10 percent reduction in compressor energy use. Per-dollar efficiency gains are equivalent with these new assumptions, but the overall magnitude of power reduction and the cost premium are reduced. This change affects only the self-contained equipment classes analyzed in the engineering analysis.

Additionally, in the NOPR analysis, DOE revised the capacity values used to select self-contained compressors in the energy consumption model. DOE's energy consumption model selects the most appropriate compressor by comparing each compressor's capacity to the total refrigeration load in the case multiplied by the compressor oversize factor. Because compressor capacity is dependent on the conditions the compressor is tested at (compressor manufacturers provide capacity data over a range of conditions), it is important to select the compressor capacity based on the same conditions used to calculate total refrigeration load. For the ANOPR analysis, DOE listed capacity at standard ASHRAE rating conditions. However, the standard rating conditions used in the ASHRAE 540–2004 standard differ from the operating conditions used in the model, and each set of conditions results in different capacity values.[18] Because the standard conditions and modeled

[18] ASHRAE Standard 540–2004 lists standard rating conditions for hermetic refrigeration compressors. For medium-temperature equipment, compressors are rated at 20 °F suction dewpoint, 120 °F discharge dewpoint, 40 °F return gas, and 0 °F subcooling. For low-temperature equipment, compressors are rated at −10 °F suction dewpoint, 120 °F discharge dewpoint, 40 °F return gas, and 0 °F subcooling. For ice-cream-temperature equipment, compressors are rated at −25 °F suction dewpoint, 105 °F discharge dewpoint, 40 °F return gas, and 0 °F subcooling.

conditions differed, the model typically overestimated the capacity of the selected compressors. To compensate, DOE adjusted the compressor oversize factor to an unrealistic level (typically 1) in order for the ANOPR model to select the correct compressor. For the NOPR, DOE used capacities based on the same conditions used to calculate total refrigeration load and revised the oversize factor (typically 1.4 in the NOPR model) for all self-contained equipment classes to maintain the selection of the correct compressor size. See Chapter 5 of the TSD for more detail.

In the analysis for the ANOPR, the calculation of LED energy use assumed that the LED lighting fixtures at the ends of VCT cases were identical to those between doors. With fluorescent fixtures, manufacturers install the same lamp regardless of whether it is at the end of the case (attached to an end mullion) or between doors (attached to an interior mullion). This causes excess light at the ends of the case. The light output of a single lamp between two doors is directed in both directions (i.e., behind two doors), whereas lamps at the ends direct light only on the contents behind the end door. LED fixtures are inherently scalable, so manufacturers can install an LED fixture in the end mullion that uses fewer LEDs than fixtures in interior mullions. In the NOPR analysis, the calculation assumes single-row LED fixtures are used in the end mullions and that these fixtures use roughly 75 percent of the energy of double-row fixtures in interior mullions. See Chapter 5 of the TSD for more detail.

4. Baseline Models

As mentioned above, the engineering analysis estimates the incremental costs for equipment with efficiency levels above the baseline in each equipment class. DOE was not able to identify a voluntary or industry standard that provided a minimum baseline efficiency requirement for commercial refrigeration equipment. Therefore, it was necessary for DOE to determine baseline specifications for each equipment class to define the energy consumption and cost of the typical, baseline equipment. These specifications include dimensions, number of components, temperatures, nominal power ratings, and other case features that affect energy consumption, as well as a basic case cost (the cost of a piece of equipment not including the major efficiency-related components such as lights, fan motors, and evaporator coils).

DOE established baseline specifications for each equipment class modeled in the engineering analysis by reviewing available manufacturer data, selecting several representative units from available manufacturer data, and then aggregating the physical characteristics of the selected units. This process created a unit representative of commercial refrigeration equipment currently being offered for sale in each equipment class, with average characteristics for physical parameters (e.g., volume, TDA), and minimum performance of energy-consuming components (e.g., fans, lighting). DOE used the cost model to develop the basic case cost for each equipment class. See Appendix B of the TSD for these specifications.

Zero Zone expressed concern over DOE's method for calculating the internal case volume. Zero Zone suggested that DOE update its analysis to use ARI Standard 1200 for calculating the internal volume of a case. This standard calculates internal volume using the internal height and depth of the case from the inside of the door to the rear wall or rear duct. This is typically how the industry calculates internal volume. (Zero Zone, No. 17 at p. 1)

In its engineering analysis, DOE followed the methodology in ANSI/ARI Standard 1200–2006 when calculating the refrigerated volume parameter used in the baseline design specifications. DOE used the internal height and depth of the case from inside of the door to the rear wall. No subtractions were made for shelving or other protrusions within the case interior envelope.

At the public meeting, Zero Zone expressed concern over the lighting technology for the baseline models in each equipment class. Zero Zone stated that T12 lighting is no longer used in closed cases, and that T8 lighting is now the baseline for those cases. (Public Meeting Transcript, No. 13.5 at p. 88) Further, Zero Zone reiterated in writing that the baseline lighting for cases with a vertical transparent door should be T8. (Zero Zone, No. 17 at p. 3) DOE has changed the baseline specifications and is now using T8 lighting in the analysis of baseline models.

Stakeholders raised concerns over the accuracy of some of the data used for the baseline models. Zero Zone stated that the TDA for VCT.RC.L and VCT.RC.M cases may be incorrect, and that the sum of the TDA for each door did not equal the TDA of the entire case for these two equipment classes. (Zero Zone, No. 17 at p. 3)

In the NOPR analysis, DOE made several revisions to the baseline specifications. Appendix B of the TSD shows changes to baseline design specifications relative to the ANOPR analysis. DOE revised the TDA for VCT.RC.L and VCT.RC.M equipment so that the sum of the display area of the doors matches the TDA of the case. The baseline models used in the NOPR analysis are more representative of actual equipment than those DOE used in the ANOPR analysis, but in some situations, the changes to baseline characteristics affected the baseline energy consumption significantly compared to the ANOPR. Four equipment classes (HZO.RC.M, HZO.SC.M, HZO.SC.L, and VCS.SC.I) had changes that resulted in a significant increase in the baseline energy consumption, and one equipment class (SOC.RC.M) had changes that resulted in a decrease in the baseline energy consumption. See Appendix B of the TSD for more detail.

For the ANOPR analysis, DOE calculated a baseline energy usage of 0.16 kWh/ft$^2$ for the HZO.RC.M equipment class. During manufacturer interviews, some manufacturers stated that this seemed unreasonably low. DOE reviewed the data it presented in the ANOPR TSD, as to the energy consumption of equipment on the market and realized that its figure for baseline energy usage for HZO.RC.M cases was well below the amounts indicated by the market data. DOE identified problems with the ANOPR design specifications for the HZO.RC.M equipment class, namely a lack of electric defrost and a mismatch between the size of the case (TDA) and the amount of infiltration load. For the NOPR analysis, DOE revised its baseline design specifications for this equipment to include electric defrost based on discussions with manufacturers during the MIA interviews and a review of market data. Although electric defrost is not always required on HZO.RC.M cases, about two-thirds of such equipment on the market use electric defrost. Based on manufacturer interviews, DOE understands there are lower infiltration loads (on a per-TDA basis) in horizontal open cases because of the natural ''well'' of cold air that tends to sit inside the case. In contrast, for a vertical or semivertical open case, the cold air tends to spill out of the opening under the influence of gravity. With a lower infiltration load for a given TDA, there is less heat available to melt frost from the evaporator coil using off-cycle defrost. Thus, most HZO.RC.M case designs necessitate the use of electric resistance heating for defrost. DOE also revised the specifications for the HZO.RC.M equipment class to include a higher infiltration load (in accordance with the updated infiltration methodology), and updated dimensions. In the ANOPR analysis, DOE used defrost meltwater to estimate the infiltration load. In accordance with the updated infiltration methodology, DOE used refrigeration load data to calculate the baseline infiltration load, which was higher than the load estimated using meltwater data in the ANOPR analysis (Chapter 5 for details). DOE also revised the dimensions of the HZO.RC.M class to reflect a somewhat smaller case size that was more representative of cases currently on the market. This change involved reducing the TDA, volume, wall area, and case interior surface area, all of which DOE matched to the infiltration load and other case components. See Appendix B of the TSD for more detail.

For the HZO.SC.M and HZO.SC.L equipment classes, DOE made changes similar to those described in the preceding paragraph. These two equipment classes are in the same equipment family as the HZO.RC.M equipment class, so they share similarities to that class (e.g., having the same cabinet). Because of a lack of detailed data for the HZO.SC.M and HZO.SC.L equipment classes, DOE based its baseline specifications on the HZO.RC.M equipment class, making reasonable adjustments for design features specific to self-contained equipment. In particular, self-contained equipment has a lower compressor energy efficiency ratio (EER), and an added drain pan heater to evaporate defrost meltwater. Similar to the HZO.RC.M class, the change in infiltration load calculation led to a higher infiltration load for the HZO.SC.M class. DOE also added electric defrost to the HZO.SC.M class and increased the anti-sweat heater load. For the HZO.SC.L class, electric defrost was already included, since it is necessary for low-temperature equipment. However, DOE revised the infiltration load in accordance with the change in methodology and increased the anti-sweat heater load. See Appendix B of the TSD for more detail.

Discussions during the manufacturer interviews revealed that in the ANOPR analysis, the baseline energy usage for the VCS.SC.I equipment class was unrealistically low. Therefore, in the NOPR analysis, DOE made revisions that increased energy usage in the baseline equipment for this class. DOE was unable to verify the accuracy of the baseline specifications in the ANOPR analysis, because of a lack of publicly available performance data for this class. For the NOPR, DOE revised its baseline assumptions to reflect a two-door case instead of the three-door model analyzed in the ANOPR. DOE believes this change more accurately reflects the current market for VCS.SC.I cases and is more in line with the electric defrost power level. DOE increased infiltration load somewhat relative to the ANOPR specifications and added anti-sweat power. See Appendix B of the TSD for more detail.

5. Engineering Analysis Results

The results of the engineering analysis are reported as cost-efficiency data (or ''curves'') in the form of CDEC (in kWh) versus MSP (in dollars), both normalized by TDA (or volume for the VCS.SC.I equipment class). DOE created 15 cost-efficiency curves in the engineering analysis.

Table IV–7 presents data for these curves. See Chapter 5 of the TSD for additional detail on the engineering analysis and comparisons of DOE's analytically derived curves to industry-supplied curves. See Appendix B of the TSD for complete cost-efficiency results.

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**Table IV-7 Engineering Analysis Cost-Efficiency Results**

| | | Efficiency Level | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **Baseline** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** |
| **VCT.RC.L** | MSP/TDA $[\$/\text{ft}^2]$ | $113.17 | $113.61 | $114.67 | $134.42 | $135.24 | $147.83 | $149.55 | - | - | - | - |
| | CDEC/TDA $[\text{kWh/day/ft}^2]$ | 1.07 | 1.04 | 1.01 | 0.72 | 0.71 | 0.65 | 0.64 | - | - | - | - |
| **VOP.RC.M** | MSP/TDA $[\$/\text{ft}^2]$ | $79.12 | $79.76 | $81.30 | $82.90 | $87.59 | $88.58 | $129.36 | - | - | - | - |
| | CDEC/TDA $[\text{kWh/day/ft}^2]$ | 1.09 | 1.04 | 0.98 | 0.95 | 0.89 | 0.89 | 0.76 | - | - | - | - |
| **SVO.RC.M** | MSP/TDA $[\$/\text{ft}^2]$ | $95.10 | $95.67 | $97.04 | $98.56 | $102.91 | $141.73 | $143.06 | - | - | - | - |
| | CDEC/TDA $[\text{kWh/day/ft}^2]$ | 1.09 | 1.04 | 0.99 | 0.96 | 0.91 | 0.78 | 0.77 | - | - | - | - |
| **HZO.RC.L** | MSP/TDA $[\$/\text{ft}^2]$ | $93.63 | $94.12 | $95.31 | $97.40 | $98.56 | - | - | - | - | - | - |
| | CDEC/TDA $[\text{kWh/day/ft}^2]$ | 0.83 | 0.80 | 0.77 | 0.73 | 0.72 | - | - | - | - | - | - |
| **HZO.RC.M** | MSP/TDA $[\$/\text{ft}^2]$ | $129.23 | $129.92 | $131.58 | $133.95 | $135.56 | - | - | - | - | - | - |
| | CDEC/TDA $[\text{kWh/day/ft}^2]$ | 0.59 | 0.54 | 0.48 | 0.45 | 0.44 | - | - | - | - | - | - |
| **VCT.RC.M** | MSP/TDA $[\$/\text{ft}^2]$ | $103.23 | $103.67 | $104.72 | $120.28 | $121.10 | $133.69 | $134.71 | - | - | - | - |
| | CDEC/TDA $[\text{kWh/day/ft}^2]$ | 0.51 | 0.49 | 0.46 | 0.35 | 0.34 | 0.29 | 0.28 | - | - | - | - |
| **VOP.RC.L** | MSP/TDA $[\$/\text{ft}^2]$ | $143.54 | $145.32 | $149.62 | $156.20 | $157.02 | $158.21 | $179.07 | - | - | - | - |
| | CDEC/TDA $[\text{kWh/day/ft}^2]$ | 2.99 | 2.84 | 2.65 | 2.54 | 2.52 | 2.51 | 2.44 | - | - | - | - |
| **SOC.RC.M** | MSP/TDA $[\$/\text{ft}^2]$ | $146.36 | $146.81 | $147.88 | $149.08 | $150.33 | $180.77 | $181.81 | $187.79 | - | - | - |
| | CDEC/TDA $[\text{kWh/day/ft}^2]$ | 0.62 | 0.59 | 0.55 | 0.53 | 0.51 | 0.41 | 0.41 | 0.40 | - | - | - |
| **VOP.SC.M** | MSP/TDA $[\$/\text{ft}^2]$ | $145.66 | $146.49 | $147.25 | $148.39 | $150.23 | $155.87 | $157.96 | $160.71 | $179.11 | $226.80 | $230.37 |
| | CDEC/TDA $[\text{kWh/day/ft}^2]$ | 2.65 | 2.54 | 2.50 | 2.46 | 2.41 | 2.30 | 2.27 | 2.24 | 2.06 | 1.89 | 1.89 |
| **SVO.SC.M** | MSP/TDA $[\$/\text{ft}^2]$ | $138.92 | $139.82 | $140.27 | $140.71 | $141.78 | $146.81 | $147.88 | $149.57 | $165.98 | $205.92 | $210.08 |
| | CDEC/TDA $[\text{kWh/day/ft}^2]$ | 2.59 | 2.47 | 2.44 | 2.43 | 2.40 | 2.30 | 2.28 | 2.26 | 2.09 | 1.95 | 1.94 |
| **HZO.SC.L** | MSP/TDA $[\$/\text{ft}^2]$ | $154.04 | $155.38 | $155.85 | $156.99 | $161.97 | $162.44 | $178.69 | $179.83 | $184.26 | - | - |
| | CDEC/TDA $[\text{kWh/day/ft}^2]$ | 3.22 | 3.03 | 3.00 | 2.96 | 2.80 | 2.79 | 2.54 | 2.53 | 2.51 | - | - |
| **HZO.SC.M** | MSP/TDA $[\$/\text{ft}^2]$ | $132.19 | $132.87 | $133.34 | $134.48 | $134.96 | $137.83 | $147.19 | $148.33 | $152.76 | - | - |
| | CDEC/TDA $[\text{kWh/day/ft}^2]$ | 1.60 | 1.52 | 1.49 | 1.45 | 1.44 | 1.38 | 1.26 | 1.24 | 1.23 | - | - |
| **HCT.SC.I** | MSP/TDA $[\$/\text{ft}^2]$ | $202.29 | $203.93 | $205.04 | $225.93 | $228.61 | $239.00 | - | - | - | - | - |
| | CDEC/TDA $[\text{kWh/day/ft}^2]$ | 1.42 | 1.29 | 1.24 | 0.72 | 0.69 | 0.65 | - | | - | - | - |
| **VCT.SC.I** | MSP/TDA $[\$/\text{ft}^2]$ | $134.76 | $135.45 | $135.88 | $136.94 | $138.95 | $145.51 | $165.26 | $165.70 | $181.45 | $182.50 | $184.55 |
| | CDEC/TDA $[\text{kWh/day/ft}^2]$ | 1.75 | 1.66 | 1.61 | 1.55 | 1.45 | 1.32 | 0.97 | 0.97 | 0.87 | 0.87 | 0.86 |
| **VCS.SC.I** | MSP/$V_r$ $[\$/\text{ft}^3]$ | $43.38 | $43.61 | $43.91 | $44.48 | $45.03 | $46.82 | $47.06 | $48.17 | $48.74 | - | - |
| | CDEC/$V_r$ $[\text{kWh/day/ft}^3]$ | 0.57 | 0.54 | 0.51 | 0.47 | 0.45 | 0.41 | 0.41 | 0.40 | 0.40 | - | - |

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*C. Markups to Determine Equipment Price*

This section explains how DOE developed the distribution channel markups it used (Chapter 6 of the TSD). DOE used these markups, along with sales taxes, installation costs, and the MSPs developed in the engineering analysis, to arrive at the final installed equipment prices for baseline and higher efficiency commercial refrigeration equipment. As explained in the ANOPR, 72 FR 41184, and as shown in Table IV–8, DOE defined three distribution channels for commercial refrigeration equipment to describe how the equipment passes from the manufacturer to the customer.

TABLE IV–8—DISTRIBUTION CHANNEL MARKET SHARES FOR COMMERCIAL REFRIGERATION EQUIPMENT

[In percent]

| | Channel 1 | Channel 2 | Channel 3 |
|---|---|---|---|
| | Manufacturer | Manufacturer, wholesaler | Manufacturer, wholesaler, contractor |
| | Customer | Customer | Customer |
| Remote Condensing Equipment | 70 | 15 | 15 |
| Self-Contained Equipment | 30 | 35 | 35 |

For the ANOPR analysis, DOE estimated shares of 86 percent, 7 percent, and 7 percent for the manufacturer, manufacturer/wholesaler, and manufacturer/wholesaler/contractor channels, respectively, for all commercial refrigeration equipment, based on market estimates from consultants. At the ANOPR public meeting, ARI and Carrier commented that the breakdown should be changed to 70 percent, 15 percent, and 15 percent among the three channels, respectively, for remote condensing equipment and 30 percent, 35 percent, and 35 percent, respectively, for self-contained equipment. (Public Meeting Transcript, No. 13.5 at p. 122; ARI, No. 18 at p. 7) No other alternative estimates were provided of shipments through these distribution channels. Therefore, in the NOPR, DOE decided to modify the breakdown and it recalculated the overall markups using the same procedure described in the ANOPR (72 FR 41184), but based upon the industry comments from ARI and Carrier. The new overall baseline and incremental markups for sales to supermarkets within each distribution channel are shown in Table IV–9, Table IV–10, Table IV–11, and Table IV–12, respectively. Chapter 6 of the TSD provides additional details on markups.

TABLE IV–9—BASELINE MARKUPS BY DISTRIBUTION CHANNEL INCLUDING SALES TAX FOR SELF-CONTAINED EQUIPMENT IN SUPERMARKETS

| | Wholesaler | Mechanical contractor (includes wholesaler) | National account (manufacturer-direct) | Overall |
|---|---|---|---|---|
| Distributor(s) Markup | 1.436 | 2.182 | 1.218 | 1.631 |
| Sales Tax | 1.068 | 1.068 | 1.068 | 1.068 |
| Overall Markup | 1.533 | 2.330 | 1.300 | 1.742 |

TABLE IV–10—BASELINE MARKUPS BY DISTRIBUTION CHANNEL INCLUDING SALES TAX FOR REMOTE CONDENSING EQUIPMENT IN SUPERMARKETS

| | Wholesaler | Mechanical contractor (includes wholesaler) | National account (manufacturer-direct) | Overall |
|---|---|---|---|---|
| Distributor(s) Markup | 1.436 | 2.182 | 1.218 | 1.395 |
| Sales Tax | 1.068 | 1.068 | 1.068 | 1.068 |
| Overall Markup | 1.533 | 2.330 | 1.300 | 1.490 |

TABLE IV–11—INCREMENTAL MARKUPS BY DISTRIBUTION CHANNEL INCLUDING SALES TAX FOR SELF-CONTAINED EQUIPMENT IN SUPERMARKETS

| | Wholesaler | Mechanical contractor (includes wholesaler) | National account (manufacturer-direct) | Overall |
|---|---|---|---|---|
| Distributor(s) Markup | 1.107 | 1.362 | 1.054 | 1.180 |
| Sales Tax | 1.068 | 1.068 | 1.068 | 1.068 |
| Overall Markup | 1.182 | 1.454 | 1.125 | 1.260 |

TABLE IV–12—INCREMENTAL MARKUPS BY DISTRIBUTION CHANNEL INCLUDING SALES TAX FOR REMOTE CONDENSING EQUIPMENT IN SUPERMARKETS

| | Wholesaler | Mechanical contractor (includes wholesaler) | National account (manufacturer-direct) | Overall |
|---|---|---|---|---|
| Distributor(s) Markup | 1.107 | 1.362 | 1.054 | 1.108 |
| Sales Tax | 1.068 | 1.068 | 1.068 | 1.068 |
| Overall Markup | 1.182 | 1.454 | 1.125 | 1.183 |

*D. Energy Use Characterization*

The energy use characterization estimates the annual energy consumption of commercial refrigeration equipment systems (including the remote condensing units). This estimate is used in the subsequent LCC and PBP analyses (Chapter 8 of the TSD) and NIA (Chapter 11 of the TSD). DOE estimated the energy consumption of the 15 equipment classes analyzed in the engineering analysis (Chapter 5 of the TSD) using the relevant test procedure. DOE then validated these energy consumption estimates with annual whole-building simulation modeling of selected equipment classes and efficiency levels. One of the key assumptions in both the engineering analysis and the whole-building simulation in the ANOPR analysis was that the display case lighting operated 24 hours per day. DOE conducted a limited sensitivity analysis to explore how variation in display case lighting operating hours affected the energy savings. The sensitivity analysis showed that energy savings fell as lighting operating hours were reduced for all equipment classes that used display case lighting. The magnitude of this effect depended on the equipment class.

At the ANOPR public meeting, SCE stated that it was studying display case lighting and will gladly share results of the study with DOE as soon as the study is done. (Public Meeting Transcript, No. 13.5 at p. 117) Hussman stated that with today's low-temperature cabinets, store owners won't turn those lights off because they may not come back on when they are so cold. (Public Meeting Transcript, No. 13.5 at p. 118) Hill Phoenix stated that turning off fluorescent lights at night can lead to maintenance issues because of moisture infiltration, so it is typical to leave the lights on all night. LEDs don't have that problem. They agreed that 24-hour lighting is not a bad assumption. (Public Meeting Transcript, No. 13.5 at p. 118) Another manufacturer, Zero Zone, also agreed that 24 hours is a valid assumption for case lighting operating hours. (Zero Zone, No. 17 at p. 4) ARI recommended that the DOE analysis be based on 24 hours-per-day operation as this represents the worst-case scenario and many stores are open for 24 hours. (ARI, No. 18 at p. 4) Based on these comments, DOE decided to leave the assumption of display case lighting operating hours of 24 hours per day unchanged for the NOPR analysis. Additional detail on the energy use characterization can be found in Chapter 7 of the TSD.

DOE also requested comments on other operational factors that might be encountered in the field that would differ from that found in the relevant test procedure, the relative frequency of these factors, and how it could account for them in its energy analysis. DOE received a comment from the Chinese delegation to the World Trade Organization stating that it should consider all kinds of on-site factors in operation and maintenance practices of the commercial refrigerating equipment when evaluating the optional standard class of the equipment. (China, No. 20 at pp. 3–4) No specifics on what these factors might be or how to take them into account were provided, however. Chapter 7 of the TSD provides additional detail on the energy use characterization.

*E. Life-Cycle Cost and Payback Period Analyses*

In response to the requirements of Section 325(o)(2)(B)(i) of EPCA, DOE conducted LCC and PBP analyses to evaluate the economic impacts of possible new commercial refrigeration equipment standards on individual customers. This section describes the LCC and PBP analyses and the spreadsheet model DOE used for analyzing the economic impacts of possible standards on individual commercial customers. Details of the spreadsheet model, and of all the inputs to the LCC and PBP analyses, are in TSD Chapter 8. DOE conducted the LCC and PBP analyses using a spreadsheet model developed in Microsoft Excel for Windows 2003.

The LCC is the total cost for a unit of commercial refrigeration equipment, over the life of the equipment, including purchase and installation expense and operating costs (energy expenditures and maintenance). To compute the LCC, DOE summed the installed price of the equipment and its lifetime operating costs discounted to the time of purchase. The PBP is the change in purchase expense due to a given energy conservation standard divided by the change in first-year operating cost that results from the standard. DOE expresses PBP in years. Otherwise stated, the payback period is the number of years it would take for the customer to recover the increased costs of a higher-efficiency product through energy savings. DOE measures the changes in LCC and in PBP associated with a given energy use standard level relative to a base case forecast of equipment energy use. The base case forecast reflects the market in the absence of mandatory energy conservation standards.

The data inputs to the PBP calculation are the purchase expense (otherwise known as the total installed customer cost or first cost) and the annual operating costs for each selected design. The inputs to the equipment purchase expense were the equipment price and the installation cost, with appropriate markups. The inputs to the operating costs were the annual energy consumption, the electricity price, and the repair and maintenance costs. The PBP calculation uses the same inputs as the LCC analysis but, since it is a simple payback, the operating cost is for the year the standard takes effect, assumed to be 2012. For each efficiency level analyzed, the LCC analysis required input data for the total installed cost of the equipment, the operating cost, and the discount rate.

Table IV–13 summarizes the inputs and key assumptions used to calculate the customer economic impacts of various energy consumption levels. Equipment price, installation cost, and baseline and standard design selection affect the installed cost of the equipment. Annual energy use, electricity costs, electricity price trends, and repair and maintenance costs affect the operating cost. The effective date of the standard, the discount rate, and the lifetime of equipment affect the calculation of the present value of annual operating cost savings from a proposed standard. Table IV–13 also shows how DOE modified these inputs and key assumptions for the NOPR, relative to the ANOPR.

TABLE IV–13—SUMMARY OF INPUTS AND KEY ASSUMPTIONS USED IN THE LCC AND PBP ANALYSES

| Input | Description | Changes for NOPR |
| --- | --- | --- |
| Baseline Manufacturer Selling Price. | Price charged by manufacturer to either a wholesaler or large customer for baseline equipment. | Data reflects updated engineering analysis. |
| Standard-Level Manufacturer Selling Price Increases. | Incremental change in manufacturer selling price for equipment at each of the higher efficiency standard levels. | Data reflects updated engineering analysis. |
| Markups and Sales Tax | Associated with converting the manufacturer selling price to a customer price (Chapter 6 of TSD). | Markups updated based on revised distribution channel shipment estimates. |
| Installation Price | Cost to the customer of installing the equipment. This includes labor, overhead, and any miscellaneous materials and parts. The total installed cost equals the customer equipment price plus the installation price. | Installation prices for remote condensing and self-contained equipment revised based on ANOPR comments. |
| Equipment Energy Consumption. | Site energy use associated with the use of commercial refrigeration equipment, which includes only the use of electricity by the equipment itself. | Data reflects updated engineering analysis for each efficiency level. |
| Electricity Prices | Average commercial electricity price ($/kWh) in each State and for four classes of commercial customers, as determined from EIA data for 2003$ converted to 2006$. | Electricity prices updated to 2007$ using Electricity EIA Monthly Electricity Database for base commercial electricity prices; and AEO2007 to convert 2006 prices to 2007 prices. |
| Electricity Price Trends | Used the AEO2006 reference case to forecast future electricity prices. | Used the AEO2007 reference case to forecast future electricity prices. |
| Maintenance Costs | Labor and material costs associated with maintaining the commercial refrigeration equipment (e.g., cleaning heat exchanger coils, checking refrigerant charge levels, lamp replacement). | No change in methodology. Lamp replacement costs reflect updated engineering analysis costs and are in 2007$. |
| Repair Costs | Labor and material costs associated with repairing or replacing components that have failed. Based on a fixed percentage of baseline equipment costs. | Repair costs in NOPR reflect estimates of individual component life and cost to replace. Repair costs increase with increasing component costs. |
| Equipment Lifetime | Age at which the commercial refrigeration equipment is retired from service (estimated to be 10 years). | Average equipment life for small grocery and convenience stores adjusted to 15 years. |
| Discount Rate | Rate at which future costs are discounted to establish their present value to commercial refrigeration equipment users. | Updated to 2007 version of the Damodaran website with very little change to discount rates. |
| Rebound Effect | A rebound effect was not taken into account in the LCC analysis. | No change. |

The following sections contain brief discussions of the methods underlying each input and key assumption in the LCC analysis. Where appropriate, DOE also summarizes comments on these inputs and assumptions and explains how it took these comments into consideration.

1. Manufacturer Selling Price

The baseline MSP is the price charged by manufacturers to either a wholesaler/distributor or very large customer for equipment meeting existing energy use (or baseline) levels. The MSP includes a markup that converts the MPC to MSP. DOE obtained the baseline MSPs through industry-supplied efficiency-level data supplemented with a design option analysis. Refer to Chapter 5 of the TSD for details.

DOE developed MSPs for equipment classes consisting of eight possible equipment families, two possible condensing unit configurations (remote condensing and self-contained), and three possible operating temperature ranges. Not all covered equipment classes have significant actual shipments (Chapter 3 of the TSD). DOE carried out the LCC and PBP analyses on the 15 primary equipment classes identified earlier. DOE estimated the MSP for each primary equipment class between the baseline efficiency level and for four to seven additional more-efficient levels. Refer to Chapter 5 of the TSD for details.

DOE was not able to identify data on relative shipments for equipment classes by efficiency level, and DOE did not find equivalent data in the literature or studies. DOE designated the equipment with the highest energy use as Level 1, and selected this as the baseline equipment.

In the ANOPR analysis, DOE requested feedback on whether the Level 1 baseline is valid for the LCC analysis, and if not, what changes should be made to provide a more realistic baseline level. DOE also asked whether a distribution of efficiencies should be used to establish the baseline for the LCC analysis. 72 FR 41193, 41208. DOE received comments on the engineering analysis and the use of the analytically derived curves versus the industry-supplied curves. DOE modified the engineering analysis, which resulted in a modified Level 1 baseline. See Section IV.B for details.

ARI stated that it would try to provide energy efficiency distribution data to DOE, but was unable to provide that data in time for the NOPR. (Public Meeting Transcript, No. 13.5 at p. 143) EEI stated that Electric Power Research Institute (EPRI) end use studies might provide some data that could be used to establish distributions. (Public Meeting Transcript, No. 13.5 at p. 141) ACEEE suggested that DOE check with the Northwest Energy Efficiency Alliance for possible energy efficiency distribution data. (Public Meeting Transcript, No. 13.5 at p. 142) However, ARI agreed with DOE's approach to use the Level 1 data established in the engineering analysis as the appropriate baseline for DOE's LCC analysis. DOE was able to explore some of the data available with the Northwest Energy Efficiency Alliance; however, the available data generally provides only frequency of use of specific design features and not energy use. Based on this, DOE chose to continue to use the Level 1 energy efficiency level as the baseline efficiency level for the LCC analysis. See Chapter 8 of the TSD.

2. Increase in Selling Price

The standard level MSP increase is the change in MSP associated with producing equipment at lower energy consumption levels associated with higher standards. DOE developed MSP increases associated with decreasing equipment energy consumption (or higher efficiency) levels through a combination of energy consumption level and design-option analyses. See Chapter 5 of the TSD for details. DOE developed MSP increases as a function of equipment energy consumption for each of the 15 equipment classes. Although the engineering analysis produced up to 11 energy consumption levels, depending on equipment class, the LCC and PBP analyses used only up to eight selected energy consumption levels.

3. Markups

As discussed earlier, overall markups are based on one of three distribution channels and the calculation of baseline and incremental markups. The distribution channels defined in the ANOPR were also used for the NOPR analysis, but DOE modified the relative fractions of shipments through each distribution channel based on stakeholder input. See Section IV.C, Markups to Determine Equipment Price, for details.

4. Installation Costs

In the ANOPR, DOE derived installation costs for commercial refrigeration equipment from data provided in RS Means Mechanical Cost Data.[19] RS Means provides estimates on the person-hours required to install commercial refrigeration equipment and the labor rates associated with the type of crew required to install the equipment. DOE developed separate installation costs for self-contained and remote condensing equipment. DOE considered the installation costs to be fixed, independent of the cost or efficiency of the equipment. Although the LCC spreadsheet allows for alternative scenarios, DOE did not find a basis for changing its basic premise for the ANOPR analysis.

DOE received comments on the RS Means installation costs. Zero Zone commented that the installation costs seem low, and that it tracks installation costs and would provide installation cost data to DOE. (Public Meeting Transcript, No. 13.5 at p. 133) Separately, Zero Zone provided installation costs of $2,000 and $750, respectively, for remote condensing and self-contained equipment. DOE has decided to use these cost data in the NOPR analysis. Zero Zone also stated that a high-efficiency case installation isn't going to cost significantly more than a standard case unless there are more controls to tune and adjust. SCE stated that if the installation cost doesn't change with the equipment efficiency, then it doesn't affect the relative life-cycle cost. (Public Meeting Transcript, No. 13.5 at p. 117)

The total installed cost is the sum of the equipment price and the installation cost. DOE derived the customer equipment price for any given standard level by multiplying the baseline MSP by the baseline markup and adding to it the product of the incremental MSP and the incremental markup. Because MSPs, markups, and the sales tax can take on a variety of values depending on location, the resulting total installed cost for a particular standard level will not be a single-point value, but a distribution of values. See Chapter 8 of the TSD.

5. Energy Consumption

The electricity consumed by the commercial refrigeration equipment was based on the engineering analysis estimates as described previously in Section IV.B. No change was made to the ANOPR methodology.

6. Electricity Prices

Electricity prices are necessary to convert the electric energy savings into energy cost savings. Because of the wide variation in electricity consumption patterns, wholesale costs, and retail rates across the country, it is important to consider regional differences in electricity prices. DOE used average commercial electricity prices at the State level from the EIA Monthly Electricity Database.[20] The 2006 prices were then converted to 2007$ using AEO2007.

Different kinds of businesses typically use electricity in different amounts at different times of the day, week, and year, and therefore face different effective prices. To make this adjustment, DOE used the 2003 *Commercial Building Energy Consumption Survey* (CBECS) data to identify the average prices the four kinds of businesses in this analysis paid compared with the average prices all commercial customers paid. The ratios of prices paid by the four types of businesses to the national average commercial prices seen in the 2003 CBECS were used as multiplying factors to increase or decrease the average commercial 2006 price data previously developed. Once the electricity prices for the four types of businesses were adjusted, the resulting prices were used in the analysis.

To obtain a weighted-average national electricity price, the prices paid by each business in each State was weighted by the estimated sales of frozen and refrigerated food products, which also serves as the distribution of commercial refrigeration equipment units in each State, to each prototype building. The State/business type weights are the probabilities that a given commercial refrigeration equipment unit shipped will be operated with a given electricity price. For evaluation purposes, the prices and weights can be depicted as a cumulative probability distribution. The effective electricity prices range from approximately 5 cents per kWh to approximately 22 cents per kWh.

During the ANOPR public meeting, EEI concurred with the DOE analysis that shows grocery stores and food markets having lower electric prices than typical commercial facilities. (EEI, No. 15 at p. 3) DOE continued to use the same approach to develop electric prices for the NOPR analysis; however, DOE updated electric costs to 2007$. The section below describes the development and use of State-average electricity prices by building type; Chapter 8 of the TSD provides more detail.

7. Electricity Price Trends

The electricity price trend provides the relative change in electricity prices for future years to 2030. Estimating future electricity prices is difficult, especially considering that many States are attempting to restructure the electricity supply industry. DOE applied the AEO2007 reference case as the default scenario and extrapolated the trend in values from 2020 to 2030 of the forecast to establish prices in 2030 to 2042. This method of extrapolation is in line with methods the EIA uses to forecast fuel prices for the Federal Energy Management Program (FEMP). DOE provided a sensitivity analysis of the life-cycle cost savings and PBP results to future electricity price scenarios using both the AEO2007 high-growth and low-growth forecasts in

[19] RS Means Company, Inc. 2005. Mechanical Cost Data 28th Annual Edition. Kingston, Massachusetts.

[20] EIA form 826. Annual 1991 through 2006, Jan-Feb 2007. *http://www.eia.doe.gov/cneaf/electricity/page/data.html*. Accessed May 29, 2007.

Chapter 8 of the TSD. ACEEE suggested that the NOPR economic analysis be recalculated using AEO2008 price forecasts. (ACEEE, No. 16 at p. 2) However, the AEO2008 was not available when DOE was completing the NOPR analysis. DOE used the most recent AEO forecast available (AEO2007) when it performed the LCC analysis for the NOPR.

8. Repair Costs

The equipment repair cost is the cost to the customer of replacing or repairing components in commercial refrigeration equipment that have failed. For the ANOPR analysis, DOE calculated the annualized repair cost for baseline efficiency equipment using the following expression:

$$RC = k \times EQP/LIFE$$

Where

$RC$ = repair cost in dollars
$k$ = fraction of equipment price (estimated to be 0.5)
$EQP$ = baseline equipment price in dollars, and
$LIFE$ = average lifetime of the equipment in years (estimated to be 10 years for large grocery and multi-line retail chains and 15 years for small grocery and convenience stores)

DOE placed replacement of lighting components (lamps and ballasts) under maintenance expenses since the typical lamp life is known and commonly considered a maintenance item by customers of commercial refrigeration equipment.

Because data were not available for how repair costs vary with equipment efficiency, DOE held repair costs constant as the default scenario for the ANOPR LCC and PBP analyses. DOE received several comments on the use of constant repair costs for higher efficiency equipment. Carrier stated that while it had no data to support this, higher efficiency design options—like adding controls—could cost more to repair, and it encouraged DOE to find more accurate repair costs that would correlate with more sophisticated controls. (Public Meeting Transcript, No. 13.5 at p. 135) Carrier felt that making repair costs proportional was better than making them flat. ARI stated that the assumption that repair costs are constant and do not vary with equipment efficiency is incorrect. (ARI, No. 18 at p. 7) Industry experience indicates that higher efficiency equipment is more expensive to repair because it uses more sophisticated and more expensive components. If actual cost data are not available, ARI recommended that DOE assume the repair cost to increase as a function of equipment cost. True stated that many routine maintenance items are affected by higher efficiency fan motors and lighting systems. (Public Meeting Transcript, No. 13.5 at p. 136) Hill Phoenix stated that higher maintenance costs would be incurred with almost any new technology. (Public Meeting Transcript, No. 13.5 at p. 136) However, True Manufacturing also stated that no data exists as to whether components such as energy efficient motors would have the same lifetime or costs as existing components. (Public Meeting Transcript, No. 13.5 at p. 138) ACEEE stated that it would caution against a straight ratio of repair cost to initial purchase cost; for controls this might be appropriate, but it shouldn't affect repair costs for heat exchangers. (Public Meeting Transcript, No. 13.5 at p. 137) ACEEE suggested that any measures requiring increased repair costs be treated on a measure-by-measure basis. (ACEEE, No. 16 at p. 3)

To address comments on repair costs, DOE contacted users and manufacturers of commercial refrigeration equipment to determine typical repair frequency for components used in commercial refrigeration equipment. Based on this review, DOE estimated replacement frequencies for five key components that appear to represent the most common repairs, and for which higher efficiency and more costly components were used in the engineering analysis for higher efficiency commercial refrigeration equipment. DOE then annualized the expected costs for these components at each efficiency level and added these component costs to the baseline repair cost estimates. This resulted in repair costs that increase with higher efficiency equipment. Refer to Chapter 8 of the TSD for details.

9. Maintenance Costs

DOE estimated the annualized maintenance costs for commercial refrigeration equipment from data in RS Means Facilities Maintenance & Repair Cost Data.[21] RS Means provides estimates on the person-hours, labor rates, and materials required to maintain commercial refrigeration equipment on a semi-annual basis. DOE used a single figure of $160/year (2007$) for preventive maintenance for all classes of commercial refrigeration equipment based on data from RS Means. Because data were not available to indicate whether, and if so, how, maintenance costs vary with equipment efficiency, DOE held preventive maintenance costs constant even as equipment efficiency increased. Lamp replacement and other lighting maintenance activities are required maintenance for commercial refrigeration equipment, which DOE considered to be separate from preventive maintenance, and were not itemized in the preventive maintenance activities described by RS Means. Different commercial refrigeration equipment classes have different numbers of lamps (and ballasts), and many of the efficiency options DOE considered in the engineering analysis involved changes to the lighting configuration (lamp, ballast, or use of LED lighting systems). Because the lighting configurations can vary by energy consumption level, DOE estimated the relative maintenance costs for lighting for each case type for which a design-option analysis was performed. DOE estimated the frequency of failure and replacement of individual lighting components, estimated the cost of replacement in the field, and developed an annualized maintenance cost based on the sum of the total lighting maintenance costs (in 2007$) over the estimated life of the equipment divided by the estimated life of the equipment.

DOE based costs for fluorescent lamp and ballast replacements on a review of the OEM costs used in the engineering analysis, RS Means estimates, cost data from Grainger, Inc., and previous studies. DOE estimated the costs of field replacement using labor cost hours from RS Means Electrical Cost Data[22] for typical lamp or ballast replacement for other lighting fixtures using a 150-percent multiplier on OEM costs for lamps and ballasts (provided in the engineering analysis spreadsheets) to reflect retail pricing. See Chapter 8 of the TSD for details.

Fluorescent lamp and ballast technology is mature, so DOE made no change in inflation-adjusted costs for these components. However, because of rapid technological improvement, costs for LED lamps are declining. DOE estimated the cost for field replacement of LED lighting fixtures (believed to occur approximately 6 years after the effective date of the standard, or 2018) at 140 percent of the OEM cost of LED lighting fixtures (2007 MPC cost in 2007$), plus installation. This estimate includes installation labor and all retail markups for replacement fixtures. This estimate of replacement LED costs was based on 2007 OEM prices for LED fixtures, but with additional contractor markups for replacement fixtures similar to that used for fluorescent light ballasts and lamps (150 percent of OEM

[21] RS Means Company, Inc. 2006. Means Costworks 2006: Facility Maintenance & Repair Cost Data. Kingston, Massachusetts.

[22] RS Means Company, Inc. 2005. 2005 RS Means Electrical Cost Data. Kingston, Massachusetts.

costs). In addition, because of the rapid development of LED technology and the projected OEM cost reductions for LED systems, DOE performed an LCC sensitivity analysis that examined the impact of reducing the cost of the LED replacement fixtures in 2018 by 50 percent of the cost used in the base analysis.[23] DOE recognizes that both life and cost estimates for LED replacement are projections and seeks comment on how it can best estimate the price for replacement LED fixture costs in the LCC analysis. This is identified as Issue 1 under ''Issues on Which DOE Seeks Comment'' in Section VII.E of this NOPR. Chapter 8 of the TSD provides details on the development of maintenance costs.

10. Lifetime

DOE defines lifetime as the age when a commercial refrigeration equipment unit is retired from service. In its ANOPR analysis, DOE based equipment lifetime on discussions with industry experts and other stakeholders, as well as a review of estimates in the subject literature. DOE concluded that a typical lifetime of 10 years is appropriate for commercial refrigeration equipment. In commenting on the ANOPR analysis, ARI stated that, on average, equipment lifetime is approximately 10 years. ARI noted, however, that properly installed and maintained equipment typically has a useful life longer than end-use customers retain it due to retail store customer business models and competitive demands to upgrade and remodel stores. (ARI, No. 18 at p. 5) Zero Zone stated that door cases may be changed in store remodels every 10 years at larger chains, but small independent chains will use cases for 20 years. (Zero Zone, No. 17 at p. 4) True stated that most self-contained equipment has a life expectancy of 7 to 12 years, although it regularly services equipment that is 25 years old. (Public Meeting Transcript, No. 13.5 at p. 98) For the NOPR analysis, DOE used an average life of 10 years for large grocery and multi-line retailers, but modified the lifetime in the LCC analysis to use a longer average 15-year life for the small grocery and convenience store business types, consistent with stakeholder comments and equipment life estimates from industry experts regarding smaller stores and independent grocers and chains. See Chapter 3 of the TSD for more detail.

[23] DOE anticipates a reduction in installed cost of LED systems over time. The projected reduction in price for LED systems is provided and discussed in Sections V.C and IV.B.3.c of this NOPR and Appendix B of the TSD.

Commercial refrigeration equipment units are typically replaced when stores are renovated, which is before the units would have physically worn out. Therefore, there is a used equipment market for commercial refrigeration equipment. Due to the difficulty of incorporating used equipment into grocery store display case line-ups, the salvage value to the original purchaser is very low. Therefore, the ANOPR LCC analysis did not take the used equipment market into account. This methodology was also maintained in the NOPR LCC analysis.

11. Discount Rate

The discount rate is the rate at which future expenditures are discounted to establish their present value. DOE derived the discount rates for the LCC analysis by estimating the cost of capital for companies that purchase commercial refrigeration equipment. The cost of capital is commonly used to estimate the present value of cash flows to be derived from a typical company project or investment. Most companies use both debt and equity capital to fund investments, so their cost of capital is the weighted average of the cost to the company of equity and debt financing.

DOE estimated the cost of equity financing by using the Capital Asset Pricing Model (CAPM). The CAPM, among the most widely used models to estimate the cost of equity financing, considers the cost of equity to be proportional to the amount of systematic risk associated with a company. The cost of equity financing tends to be high when a company faces a large degree of systematic risk, and it tends to be low when the company faces a small degree of systematic risk.

To estimate the weighted average cost of capital (WACC) (including the weighted average cost of debt and equity financing) of commercial refrigeration equipment purchasers, DOE used a sample of companies involved in grocery and multi-line retailing drawn from a database of 7,319 U.S. companies on the Damodaran Online website. The WACC approach taken to determine discount rates takes into account the current tax status of the individual firms on an overall corporate basis. DOE did not evaluate the marginal effects of increased costs (and thus depreciation due to higher cost equipment on the overall tax status).

DOE used a sample of 17 companies to represent the purchasers of commercial refrigeration equipment. For each company in the sample, DOE derived the cost of debt, percent debt financing, and systematic company risk from information provided by Damodaran Online. DOE estimated the cost of debt financing from the long-term Government bond rate (4.39 percent) and the standard deviation of the stock price. The cost of capital for small, independent grocers; convenience store franchisees; gasoline station owner-operators; and others with more limited access to capital is more difficult to determine. Individual credit-worthiness varies considerably, and some franchisees have access to the financial resources of the franchising corporation. However, personal contacts with a sample of commercial bankers yielded an estimate for the small operator weighted cost of capital of about 200 to 300 basis points (2 percent to 3 percent) above the rates for large grocery chains. A central value equal to the weighted average of large grocery chains, plus 250 basis points (2.5 percent), was used for small operators. Deducting expected inflation from the cost of capital provides the estimates of the real discount rate by ownership category. The average after-tax discount rate, weighted by the percentage shares of total purchases of commercial refrigeration equipment, is 5.87 percent for large grocery stores, 5.11 percent for multi-line retailers, and 8.37 percent for convenience stores and convenience stores associated with gasoline stations. DOE received no comments on the discount rates developed in the ANOPR but took advantage of the availability of 2007 financial data to update the discount rate assumptions in the NOPR. See Chapter 8 of the TSD.

12. Payback Period

The PBP is the amount of time it takes the customer to recover the incrementally higher purchase cost of more energy efficient equipment as a result of lower operating costs. Numerically, the PBP is the ratio of the increase in purchase cost (i.e., from a less efficient design to a more efficient design) to the decrease in annual operating expenditures. This type of calculation is known as a ''simple'' PBP, because it does not take into account changes in operating cost over time or the time value of money, that is, the calculation is done at an effective discount rate of zero percent.

The equation for PBP is:

$$PBP = \Delta IC / \Delta OC$$

Where

$PBP$ = payback period in years,
$\Delta IC$ = difference in the total installed cost between the more efficient standard level equipment (energy consumption levels 2, 3, etc.) and the baseline (energy consumption level 1) equipment, and
$\Delta OC$ = difference in annual operating costs.

The data inputs to the PBP analysis are the total installed cost of the equipment to the customer for each energy consumption level and the annual (first-year) operating costs for each energy consumption level. The inputs to the total installed cost are the equipment price and the installation cost. The inputs to the operating costs are the annual energy cost, the annual repair cost, and the annual maintenance cost. The PBP uses the same inputs as the LCC analysis, except that electricity price trends and discount rates are not required. Since the PBP is a ''simple'' (undiscounted) payback, the required electricity cost is only for the year in which a new energy conservation standard is to take effect—in this case, 2012. The electricity price used in the PBP calculation of electricity cost was the price projected for 2012, expressed in 2007$, but not discounted to 2007. Discount rates are not used in the PBP calculation.

PBP is one of the economic indicators that DOE uses when assessing economic impact to a customer. PBP does not take into account the time value of money explicitly (*e.g.*, through a discount factor), the life of the efficiency measure, or changing fuel costs over time. In addition, because PBP takes into account the cumulative energy and first-cost impact of a set of efficiency measures, it can be sensitive to the baseline level assumed. In addition, what is deemed an acceptable payback period can vary. By contrast, when examining LCC savings by efficiency levels, there is generally a maximum LCC savings point (minimum LCC efficiency level) indicative of maximum economic benefit to the customer. The selection of the baseline efficiency level does not affect the identification of the minimum LCC efficiency level, although a baseline efficiency is used when calculating net LCC savings or costs. DOE considers both LCC and PBP as related to the seven factors discussed in Section II.B to determine whether a standard is economically justified and whether the benefits of an energy conservation standard will exceed its burdens to the greatest extent practicable. However, because LCC uses an explicit discount rate, takes into account changing energy prices, and does not require selection of a baseline efficiency level, it is considered by DOE to be a better indicator of the likely economic impacts on consumers.

*F. Shipments Analysis*

One of the more important components of any estimate of the future impact of a standard is equipment shipments. DOE developed forecasts of shipments for the base case and standards cases and includes those forecasts in the NES spreadsheet. The shipments portion of the spreadsheet forecasts shipments of commercial refrigeration equipment from 2012 to 2042. DOE developed shipments forecasts for the 15 primary equipment classes by accounting for the shipments to replace the existing stock of commercial refrigeration equipment, commercial refrigeration shipments into new commercial floor spaces, and old equipment removed through demolitions. Chapter 10 of the TSD provides additional details on the shipments forecasts.

The results of the shipments analysis are driven primarily by historical shipments data for the 15 equipment classes of commercial refrigeration equipment, DOE estimates of average equipment life, relative shipment estimates to each of the four business types, the existing total floor space in food sales buildings, and the anticipated growth in food sales floor space estimated in EIA's NEMS. The model estimates that, in each year, the existing stock of commercial refrigeration equipment either ages by one year or is worn out and replaced. In addition, new equipment can be shipped into new commercial floor space, and old equipment can be removed through demolitions. DOE chose to preserve the capability to analyze all efficiency levels analyzed in the LCC in the NIA.

The shipments analysis is a description of commercial refrigeration equipment stock flows as a function of year and age. While there are 15 equipment classes, the shipment analysis treats each category of equipment independently such that future shipments in any one class are unaffected by shipments in any other equipment classes and the relative fraction of shipments in each product class compared to all commercial refrigeration equipment shipments is assumed to be constant over time. DOE recognizes that a retailer of refrigerated or frozen food can choose to use different classes of commercial refrigeration equipment to sell the same food product as long as the equipment is in the required temperature range (i.e. refrigerator, freezer, or ice-cream temperature range). The decision to adopt one equipment class over another within the same temperature range will depend on first costs, operating costs, and the perceived ability to merchandise product. In addition, relative sales refrigerated versus frozen foods could change in the future. However, DOE had no information with which to develop and calibrate a shipments model incorporating these factors.

DOE formulated the equations used in the analysis as updates of the distribution of stock in any given year, as a function of age, to the following year using the following steps:

1. DOE first converted the equipment units to linear feet of display space cooled by those units by taking the national statistics on sales of equipment and calculating equipment capacity per linear foot of retail grocery building display space.
2. DOE used this calculation of existing stock, and the average age of the equipment, as a basis for calculating replacement sales.
3. DOE subtracted replacement sales from historical total sales statistics to calculate new sales of commercial refrigeration equipment.
4. DOE forecasted new sales as a function of new construction of retail food sales space.
5. DOE recorded sales of new and replacement equipment by the year sold, and depreciated each annual vintage over the estimated life of the equipment.
6. DOE allocated sales in each year to the 15 equipment classes in proportion to their relative historical sales.

In response to DOE's presentation of the ANOPR shipment analysis, the public made two primary comments. True stated that while food sales buildings are probably representative of remote condensing equipment, as much as 25 percent of the self-contained market goes into unusual conditions, but that the majority does end up in some sort of food-sales type application. (Public Meeting Transcript, No. 13.5 at p. 165) However, in a follow-up conversation, True agreed that for self-contained equipment without doors, which is the majority of the self-contained equipment covered in this rulemaking, the amount of equipment not shipped to food sales buildings represents a very small fraction of the total market. DOE concluded that it was therefore unnecessary to include other business types or building categories for the analysis of self-contained equipment to be valid and representative.

Other stakeholders commented on the assumption of zero shipments in the ANOPR for the VOP.RC.L equipment class based on the submitted ARI shipment data. (Public Meeting Transcript, No. 13.5 at p. 164) ARI, in turn, stated that zero values in its data submittal to DOE may represent an equipment class where only one or two manufacturers have shipments. These data were excluded to maintain confidentiality. (Public Meeting

Transcript, No. 13.5 at p. 52) To address these issues, DOE estimated the shipments for the VOP.RC.L equipment class at five percent of the similarly designed VOP.RC.M equipment class based on information provided in manufacturer interviews.

Finally, DOE received comments on the impact of the used equipment market on shipments in the presence of new equipment standards. True stated that DOE should consider how long existing low-efficiency equipment will be in service. (Public Meeting Transcript, No. 13.5 at p. 98) As you drive the cost higher, the life expectancy of existing equipment increases. ACEEE countered, however, that the issue of used equipment has come up in other rulemakings. Customers may use existing equipment longer, but the average was only one or two years more, which has a small impact on the energy savings projected through 2042. It may be more of a factor in the manufacturer impact analysis, because that could affect sales in at least the first year. (Public Meeting Transcript, No. 13.5 at p. 102)

True stated that the used equipment market is often ignored. As you drive costs of capital up, you drive the need for low-end users to buy used equipment and that the higher the cost per unit, the more the used equipment market thrives. True stated that this is very significant in the restaurant industry, where studies suggest that 90 percent of all new non-chain restaurants fail within the first year. Most of these businesses are buying used equipment. (Public Meeting Transcript, No. 13.5 at p. 202–207) EEI suggested that, if possible, DOE should investigate the use of used versus new equipment in restaurants, and make sure that new standards do not increase the purchase of older, less efficient equipment. (EEI, No. 15 at p. 2)

Follow-up conversations with True lead DOE to believe that it is unnecessary to take the restaurant business type into account since it is not a large market for the equipment covered under this rulemaking. DOE determined that it would not try to account for life extension in the NIA. While DOE recognizes that there may be some initial life extension for existing markets for some customers, no data are available to forecast the frequency and amount of life extension that might occur within the industry. DOE agrees with ACEEE that this would result in a relatively small impact on energy savings and, given that it would also reduce expenditures for new equipment, would have an even smaller impact on calculated NPV. For the NOPR analysis, DOE did not assume an initial decrease in sales and life extension for commercial refrigeration equipment covered in this rulemaking.

Table IV–14 shows the results of the shipments analysis for the 15 commercial refrigeration equipment classes for the base case (baseline efficiency level or Level 1). As equipment purchase price increases with higher efficiency levels, a drop in shipments can be expected relative to the base case. However, as annual energy consumption is reduced, there is potentially a countering effect of increased equipment sales due to more frequent installations and use of commercial refrigeration equipment by retailers (a potential rebound effect). Although there is a provision in the spreadsheet for a change in projected shipments in response to efficiency level increases (or energy consumption level decreases), DOE has no information with which to calibrate such a relationship. No such data was provided in comments on the ANOPR analysis. Therefore, for the NOPR analysis, DOE assumed that the overall shipments do not change in response to the changing TSLs. Additional details on the shipments analysis can be found in Chapter 10 of the TSD.

TABLE IV–14—FORECASTED SHIPMENTS FOR COMMERCIAL REFRIGERATION EQUIPMENT, 2012–2042, (BASE CASE)

| Equipment class | Thousands of linear feet shipped by year and equipment class | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 2012 | 2015 | 2020 | 2025 | 2030 | 2035 | 2040 | 2042 | Cumulative |
| VOP.RC.M | 451 | 436 | 451 | 464 | 497 | 531 | 582 | 604 | 15,270 |
| VOP.RC.L | 23 | 22 | 23 | 23 | 25 | 27 | 29 | 30 | 763 |
| VOP.SC.M | 30 | 29 | 30 | 31 | 33 | 36 | 39 | 41 | 1,027 |
| VCT.RC.M | 32 | 31 | 32 | 33 | 35 | 38 | 42 | 43 | 1,091 |
| VCT.RC.L | 448 | 433 | 448 | 461 | 494 | 527 | 578 | 600 | 15,167 |
| VCT.SC.I | 11 | 11 | 11 | 11 | 12 | 13 | 14 | 15 | 374 |
| VCS.SC.I | 3 | 3 | 3 | 3 | 3 | 3 | 4 | 4 | 93 |
| SVO.RC.M | 344 | 332 | 344 | 354 | 379 | 405 | 444 | 460 | 11,647 |
| SVO.SC.M | 45 | 44 | 45 | 47 | 50 | 53 | 59 | 61 | 1,537 |
| SOC.RC.M | 87 | 84 | 87 | 89 | 96 | 102 | 112 | 116 | 2,936 |
| HZO.RC.M | 53 | 51 | 53 | 54 | 58 | 62 | 68 | 71 | 1,790 |
| HZO.RC.L | 166 | 161 | 166 | 171 | 183 | 196 | 214 | 222 | 5,627 |
| HZO.SC.M | 4 | 4 | 4 | 4 | 4 | 5 | 5 | 5 | 132 |
| HZO.SC.L | 8 | 8 | 8 | 8 | 9 | 10 | 10 | 11 | 274 |
| HCT.SC.I | 36 | 35 | 36 | 37 | 39 | 42 | 46 | 48 | 1,214 |

*G. National Impact Analysis*

The NIA assesses future NES and the national economic impacts of different efficiency levels. The analysis measures economic impacts using the NPV metric (i.e., future amounts discounted to the present) of total commercial customer costs and savings expected to result from new standards at specific efficiency levels.

To make the analysis more accessible and transparent to the public, DOE used an Excel spreadsheet model to calculate the energy savings and the national economic costs and savings from new standards. 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 Excel as the basis for the spreadsheet models provides interested persons with access to the models within a familiar context. In addition, the TSD and other documentation that DOE provides during the rulemaking help explain the models and how to use them, and interested persons can review DOE's analyses by changing various input quantities within the spreadsheet.

Unlike the LCC analysis, the NES spreadsheet does not use distributions for inputs or outputs. DOE examined sensitivities by applying different scenarios. DOE used the NES spreadsheet to perform calculations of national energy savings and NPV using the annual energy consumption and total installed cost data from the LCC analysis and estimates of national shipments for each of the 15 primary commercial refrigeration equipment classes. DOE forecasted the energy savings, energy cost savings, equipment costs, and NPV of benefits for all primary commercial refrigeration equipment classes from 2012 through 2062. The forecasts provided annual and cumulative values for all four output parameters.

DOE calculated the NES by subtracting energy use under a standards scenario from energy use in a base case (no new standards) scenario. Energy use is reduced when a unit of commercial refrigeration equipment in the base case efficiency distribution is replaced by a more efficient piece of equipment. Energy savings for each equipment class are the same national average values as calculated in the LCC and payback period spreadsheet. However, these results are normalized on a per-unit-length basis by equipment class and applied to the total annual estimated shipments in terms of line-up length of all equipment with the class. Table IV–15 shows key inputs to the NIA. Chapter 11 of the TSD provides additional information about the NES spreadsheet.

TABLE IV–15—SUMMARY OF NATIONAL ENERGY SAVINGS AND NET PRESENT VALUE INPUTS

| Input data | Description | Changes for NOPR |
|---|---|---|
| Shipments | Annual shipments from shipments model (Chapter 10, Shipments Analysis). | Shipments model modified to use a distribution of equipment lifetimes based on a 10-year average life in large grocery and multi-line retail, and a 15-year average life in small grocery and convenience stores. Estimates for shipments for the VOP.RC.L equipment class were added and are provided. |
| Effective Date of Standard | 2012 | No change. |
| Base Case Efficiencies | Distribution of base case shipments by efficiency level | No change in methodology to derive base case shipments by efficiency level. |
| Standards Case Efficiencies | Distribution of shipments by efficiency level for each standards case. Standards case annual market shares by efficiency level remain constant over time for the base case and each standards case. | No change in methodology to derive shipments by efficiency level in each standards case. |
| Annual Energy Consumption per Linear Foot. | Annual weighted-average values are a function of energy consumption level, which are established in the engineering analysis (Chapter 5 of the TSD). Converted to a per linear foot basis. | No change in methodology. Energy consumption estimates reflect updates to NOPR engineering analysis. |
| Total Installed Cost per Linear Foot. | Annual weighted-average values are a function of energy consumption level (Chapter 8 of the TSD). Converted to a per linear foot basis. | No change in methodology. Installed costs reflect updates to NOPR LCC. |
| Repair Cost per Linear Foot | Annual weighted-average values are constant with energy consumption level (Chapter 8 of the TSD). Converted to a per linear foot basis. | No change in methodology. Repair costs reflected updates to NOPR LCC. |
| Maintenance Cost per Linear Foot. | Annual weighted-average value equals $156 (Chapter 8 of the TSD), plus lighting maintenance cost. Converted to a per linear foot basis. | No change in methodology, but annual weighted-average value updated to $160 in 2007$. |
| Escalation of Electricity Prices. | EIA AEO2006 forecasts (to 2030) and extrapolation for beyond 2030 (Chapter 8 of the TSD). | EIA AEO2007 forecasts (to 2030) and extrapolation for beyond 2030 (Chapter 8 of the TSD). |
| Electricity Site-to-Source Conversion. | Conversion varies yearly and is generated by DOE/EIA's NEMS* program (a time series conversion factor; includes electric generation, transmission, and distribution losses). | Conversion factor varies yearly and is generated by EIA's NEMS model. Includes the impact of electric generation, transmission, and distribution losses. |
| Discount Rate | 3 and 7 percent real | No change. |
| Present Year | Future costs are discounted to year 2007 | Future costs are discounted to year 2008. |
| Rebound Effect | A rebound effect (due to changes in shipments resulting from standards) was not considered in the NIA. | No change. |

1. Base Case and Standards Case Forecasted Efficiencies

A key component of DOE's estimates of NES and NPV are the energy efficiencies for shipped equipment that it forecasts over time for the base case (without new standards) and for each standards case. The forecasted efficiencies represent the distribution of energy efficiency of the equipment under consideration that is shipped over the forecast period (i.e., from the assumed effective date of a new standard to 30 years after the standard becomes effective).

The annual per-unit energy consumption is the site energy consumed by a commercial refrigeration equipment unit per year. The annual energy consumption is directly tied to the efficiency of the unit. Thus, knowing the efficiency of a commercial refrigeration equipment unit determines the corresponding annual energy consumption. DOE determined annual forecasted market shares by efficiency level that, in turn, enabled determination of shipment-weighted annual energy consumption values.

Because no data were available on market shares broken down by efficiency level, DOE determined market shares by efficiency level for commercial refrigeration based on its own analysis. DOE first converted 2005 shipment information by equipment class into market shares by equipment class, and then adapted a cost-based method similar to that used in the NEMS to estimate market shares for each equipment class by efficiency level. This cost-based method relied on cost data developed in the engineering and life-cycle cost analyses, as well as economic purchase criteria data taken directly from NEMS. From those market shares and projections of shipments by equipment class, DOE developed the future efficiency scenarios for a base case (i.e., without new standards) and for various standards cases (i.e., with new standards). DOE did not have data to calibrate this approach to actual market shipments by efficiency level. DOE requested comment on this approach to generating market shares by efficiency level in the ANOPR.

Commenting on the distribution of market efficiency, ARI stated that experience with other equipment tells us that the majority of the shipments are usually at the lower end of the curve of the highest efficiency. ARI was surprised that DOE had only 25 percent or 30 percent of the shipments at that efficiency level. They also cautioned DOE that the industry-supplied curves are cost curves and do not mean that such equipment is on the market today. As Section IV.E, Life-Cycle Cost, discusses, ARI offered to try to provide data on the distribution of efficiencies in current equipment but was not able to do so. (Public Meeting Transcript, No. 13.5 at p. 143) Other stakeholders, such as EEI and ACEEE, suggested possible avenues that DOE could examine but did not have data DOE could use to establish a distribution of efficiencies. (Public Meeting Transcript, No. 13.5 at p. 141–142; p. 173) Because of the lack of data on market shipments by efficiency level, DOE chose to continue to use the ANOPR approach to estimate shipments by efficiency level.

DOE developed base case efficiency forecasts based on the estimated market shares by equipment class and efficiency level. Because there are no historical data to indicate how equipment efficiencies or relative equipment class preferences have changed over time, DOE predicted that forecasted market shares would remain frozen at the 2012 efficiency level until the end of the forecast period (30 years after the effective date, 2042). DOE requested comments on this assumption.

Copeland commented that since DOE plans to update the forecast in five years, no one can really figure out what that distribution of efficiency in the future looks like. (Public Meeting Transcript, No. 13.5 at p. 175) EEI suggested DOE make further contacts with national accounts that use commercial refrigeration equipment. No suggestions for improving this assumption were received. For the NOPR, DOE continued to use the assumption of flat market shares by efficiency level for the forecast period.

For its determination of standards case forecasted efficiencies, DOE used a ''roll-up'' scenario to establish the market shares by efficiency level for 2012, the year that standards become effective. Information available to DOE suggests that equipment shipments with efficiencies in the base case that did not meet the standard level under consideration would roll up to meet the new standard level, and that all equipment efficiencies in the base case that were above the standard level under consideration would not be affected. Emerson commented that a standard brings some compression in the distribution of efficiencies. (Public Meeting Transcript, No. 13.5 at p. 175) However, ARI stated the roll-up scenario best represents what is likely to happen when energy conservation standards take effect. (ARI, No. 18 at p. 5) DOE continued to use the roll-up scenario for the NOPR analysis.

Finally, DOE recognizes that baseline efficiency trends can change if equipment costs are different than those projected. For example, if LED prices drop more than assumed in the engineering analysis, consumer demand for equipment with LEDs could change. DOE seeks comment on whether shipments of equipment with LEDs would change if LED costs drop and if so, the extent and timing of such shipment changes. See Section VII.E.1.

2. Annual Energy Consumption, Total Installed Cost, Maintenance Cost, and Repair Costs

The difference in shipments by equipment efficiency level between the base and standards cases was the basis for determining the reduction in per-unit annual energy consumption that could result from new standards. The commercial refrigeration equipment stock in a given year is the total linear footage of commercial refrigeration equipment shipped from earlier years that survive in the given year. The NES spreadsheet model keeps track of the total linear footage of commercial refrigeration equipment units shipped each year and estimates the total commercial refrigeration equipment stock for each year. The annual energy consumption by efficiency level for each equipment category comes from the LCC analysis and is converted to a per-linear-foot basis by dividing by the length of the specific equipment analyzed in the engineering analysis. Similarly, the total installed cost, maintenance cost, and repair costs for each efficiency level for each equipment class analyzed in the LCC are converted to a per linear foot basis. Using the total estimated shipments and total estimated stock by equipment category and efficiency level, DOE calculates the annual energy consumption for the commercial refrigeration equipment stock in each year, the maintenance and repair costs associated with the equipment stock, and the total installed costs associated with new shipments in each year based on the standards scenario and associated distribution of shipments by efficiency level.

3. Escalation of Electricity Prices

DOE uses the most recent AEO reference case to forecast energy prices for standard rulemakings. For the ANOPR, DOE used the AEO2006 reference case forecasts to estimate future electricity prices. ACEEE commented that it would like DOE to use the AEO2008 forecasts for the NOPR analysis. (ACEEE, No. 16 at p. 2) However, this forecast was not available when DOE completed the NOPR analysis. DOE used the AEO2007 reference case forecasts for future electricity prices, extended out to the end of the analysis period. DOE extrapolated the trend in values from 2020 to 2030 of the forecast to establish prices for the remainder of the analysis period. DOE intends to update its analysis for the final rule to reflect the AEO 2008 electricity price forecasts when final versions of these price forecasts are available. An AEO Revised Early Release for the AEO 2008 reference case only has indicated that the reference case electricity prices are higher in real (inflation adjusted) terms and if this holds true in the final release it would generally result in more favorable economics for higher efficiency standard levels (i.e. shorter payback periods, greater life-cycle cost savings, and greater national net present value).

4. Electricity Site-to-Source Conversion

The site-to-source conversion factor is a multiplier used for converting site energy consumption, expressed in kWh, into primary or source energy consumption, expressed in quadrillion Btu (quads). The site-to-source conversion factor accounts for losses in electricity generation, transmission, and distribution. For the ANOPR, DOE used site-to-source conversion factors based on U.S. average values for the commercial sector, calculated from AEO2006, Table A5. The average conversion factors vary over time, due to projected changes in electricity generation sources (i.e., the power plant types projected to provide electricity to the country). For the NOPR, DOE developed marginal site-source conversion factors that relate the national electrical energy savings at the point of use to the fuel savings at the power plant. These factors use the NEMS model and the examination of the corresponding energy savings from standards scenarios considered in DOE's utility analysis (Chapter 14 of the TSD). The conversion factors vary over time, due to projected changes in electricity generation sources (i.e., the power plant types projected to provide electricity to the country) and power plant dispatch scenarios. Average U.S. conversion factors were used in the ANOPR because the utility analysis which is used to determine marginal conversion factors appropriate to efficiency standards for commercial refrigeration equipment occurs in the NOPR stage of DOE's analysis.

To estimate NPV, DOE calculated the net impact each year as the difference between total operating cost savings (including electricity, repair, and maintenance cost savings) and increases in total installed costs (including MSP, sales taxes, distribution channel markups, and installation cost). DOE calculated the NPV of each TSL over the life of the equipment using three steps. First, DOE determined the difference between the equipment costs under the TSL and the base case to calculate the net equipment cost increase resulting from the TSL. Second, DOE determined the difference between the base case operating costs and the TSL operating costs to calculate the net operating cost savings from the TSL. Third, DOE determined the difference between the net operating cost savings and the net equipment cost increase to calculate the net savings (or expense) for each year. DOE then discounted the annual net savings (or expenses) for commercial refrigeration equipment purchased on or after 2012 to 2008, and summed the discounted values to determine the NPV of a TSL. An NPV greater than zero shows net savings (i.e., the TSL would reduce overall customer expenditures relative to the base case in present value terms). An NPV less than zero indicates that the TSL would result in a net increase in customer expenditures in present value terms.

*H. Life-Cycle Cost Sub-Group Analysis*

In analyzing the potential impact of new or amended standards on commercial customers, DOE evaluates the impact on identifiable groups (i.e., sub-groups) of customers, such as different types of businesses that may be disproportionately affected by a National standard level. For this rulemaking, DOE identified independent small grocery and convenience stores as a commercial refrigeration equipment customer sub-group that could be disproportionately affected, and examined the impact of proposed standards on this group.

DOE determined the impact on this commercial refrigeration equipment customer sub-group using the LCC spreadsheet model. DOE conducted the LCC and PBP analyses for commercial refrigeration equipment customers. The standard LCC and PBP analyses (described in Section IV.E) includes various types of businesses that use commercial refrigeration equipment. The LCC spreadsheet model allows for the identification of one or more sub-groups of businesses, which can then be analyzed by sampling only each such sub-group. The results of DOE's LCC sub-group analysis are summarized in Section V.B.1.c and described in detail in Chapter 12 of the TSD.

*I. Manufacturer Impact Analysis*

1. Overview

DOE performed an MIA to estimate the financial impact of energy conservation standards on manufacturers of commercial refrigeration equipment, and to assess the impact of such standards on employment and manufacturing capacity. The MIA has both quantitative and qualitative aspects. The quantitative part of the MIA relies on the GRIM, an industry-cash-flow model customized for this rulemaking. The GRIM inputs are information regarding the industry cost structure, shipments, and revenues. This includes information from many of the analyses described above, such as manufacturing costs and prices from the engineering analysis and shipments forecasts. The key GRIM output is the industry net present value (INPV). The model estimates the financial impact of energy conservation standards by comparing changes in INPV between the base case and the various trial standard levels. Different sets of assumptions (scenarios) will produce different results. The qualitative part of the MIA addresses factors such as equipment characteristics, characteristics of particular firms, and market and equipment trends, and includes assessment of the impacts of standards on sub-groups of manufacturers. Chapter 13 of the TSD outlines the complete MIA.

DOE conducted the MIA for commercial refrigeration equipment in three phases. Phase 1, Industry Profile, consisted of preparing an industry characterization, including data on market share, sales volumes and trends, pricing, employment, and financial structure. Phase 2, Industry Cash Flow Analysis, focused on the industry as a whole. In this phase, DOE used the GRIM to prepare an industry cash-flow analysis. Using publicly available information developed in Phase 1, DOE adapted the GRIM's generic structure to perform an analysis of commercial refrigeration equipment energy conservation standards. In Phase 3, Sub-Group Impact Analysis, DOE conducted interviews with manufacturers representing the majority of domestic commercial refrigeration equipment sales. This group included large and small manufacturers, providing a representative cross-section of the industry. During these interviews, DOE discussed engineering, manufacturing, procurement, and financial topics specific to each company and obtained each manufacturer's view of the industry. The interviews provided valuable information DOE used to evaluate the impacts of an energy conservation standard on manufacturer cash flows, manufacturing capacities, and employment levels. For more detail on the manufacturer impact analysis, refer to Chapter 13 of the TSD.

a. Phase 1, Industry Profile

In Phase 1 of the MIA, DOE prepared a profile of the commercial refrigeration equipment industry based on the market and technology assessment prepared for this rulemaking. Before initiating the detailed impact studies, DOE collected information on the present and past structure and market characteristics of the commercial refrigeration equipment industry. The information DOE collected at that time included market share, equipment shipments, markups, and cost structure for various manufacturers. The industry profile includes further detail on equipment characteristics, estimated manufacturer market shares, the financial situation of manufacturers, trends in the number of firms, the market, and equipment characteristics of the commercial refrigeration equipment industry.

The industry profile included a top-down cost analysis of commercial refrigeration equipment manufacturers that DOE used to derive cost and preliminary financial inputs for the GRIM (e.g., revenues; material, labor, overhead, and depreciation expenses; selling, general, and administrative expenses (SG&A); and research and development (R&D) expenses). DOE also used public sources of information to further calibrate its initial characterization of the industry, including U.S. Securities and Exchange Commission (SEC) 10–K reports, Standard & Poor's (S&P) stock reports, and corporate annual reports.

b. Phase 2, Industry Cash-Flow Analysis

Phase 2 of the MIA focused on the financial impacts of energy conservation standards on the industry. Higher energy conservation standards can affect a manufacturer's cash flow in three distinct ways, resulting in: (1) A need for increased investment; (2) higher production costs per unit; and (3) altered revenue by virtue of higher per-unit prices and changes in sales values. To quantify these impacts in Phase 2 of the MIA, DOE used the GRIM to perform a cash-flow analysis of commercial refrigeration equipment manufacturers. In performing these analyses, DOE used the financial values derived during Phase 1 and the shipment scenarios used in the NES analyses.

c. Phase 3, Sub-Group Impact Analysis

Using average cost assumptions to develop an industry-cash-flow estimate is not adequate for assessing differential impacts among sub-groups of manufacturers. For example, small manufacturers, niche equipment manufacturers, or manufacturers exhibiting a cost structure that largely differs from the industry average could be more negatively affected. DOE used the results of the industry characterization analysis (in Phase 1) to group manufacturers that exhibit similar characteristics.

During the interview process, DOE discussed the potential sub-groups and sub-group members it identified for the analysis. DOE encouraged the manufacturers to recommend sub-groups or characteristics that are appropriate for the sub-group analysis. DOE identified small commercial refrigeration equipment manufacturers as a potential manufacturing sub-group. DOE found that small business manufacturers generally have the same concerns as large manufacturers regarding energy conservation standards. In addition, DOE found no significant differences in the R&D emphasis or marketing strategies between small business manufacturers and large manufacturers. Therefore, for the equipment classes comprised primarily of small business manufacturers, DOE believes the GRIM analysis, which models each equipment class separately, is representative of the small business manufacturers affected by standards.

2. Government Regulatory Impact Model Analysis

As mentioned above, DOE uses the GRIM to quantify changes in cash flow that result in a higher or lower industry value. The GRIM analysis uses a standard annual cash-flow analysis that incorporates manufacturer prices, manufacturing costs, shipments, and industry financial information. The GRIM models changes in costs, distribution of shipments, investments, and associated margins that would result from new regulatory conditions (in this case, standard levels). The GRIM spreadsheet uses a number of inputs to arrive at a series of annual cash flows, beginning with the base year of the analysis, 2007, and continuing to 2042. DOE calculated INPVs by summing the stream of annual discounted cash flows during this period.

DOE used the GRIM to calculate cash flows using standard accounting principles and compare changes in INPV between a base case and different TSLs (the standards cases). Essentially, the difference in INPV between the base case and a standards case represents the financial impact of the energy conservation standards on manufacturers. DOE collected this information from a number of sources, including publicly available data and interviews with manufacturers (Chapter 13 of the TSD).

3. Manufacturer Interviews

As part of the MIA, DOE discussed potential impacts of energy conservation standards with manufacturers responsible for a majority of commercial refrigeration equipment sales. The manufacturers interviewed manufacture close to 90 percent of the commercial refrigeration equipment on the market. These interviews were in addition to those DOE conducted as part of the engineering analysis. The interviews provided valuable information that DOE used to evaluate the impacts of energy conservation standards on manufacturers' cash flows, manufacturing capacities, and employment levels.

a. Key Issues

Manufacturers identified the following key issues for DOE to consider in developing energy conservation standards:

- *Meeting Standards.* Manufacturers expressed concern that they would have difficulty meeting certain efficiency levels for certain equipment classes. First, some manufacturers stated that they could not meet or would have extreme difficulty meeting any of the possible efficiency levels presented during interviews for self-contained equipment (e.g., horizontal open units). One manufacturer stated that due to the small number of parts in the self-contained equipment, efficiency improvements are constrained to these parts and are therefore limited. The same manufacturer stated that it already implements the most efficient options on the market that are available within its price range. For some manufacturers, self-contained equipment represents only a small portion of their business. These manufacturers make more remote condensing equipment and simply convert the design into self-contained units. Second, some manufacturers stated that they could not meet efficiency levels 3 and 4 for medium-temperature equipment (e.g., SOC.RC.M, VCT.RC.M, VOP.RC.M), and that they would need advances in technology to achieve these levels by 2012. One manufacturer stated that it does not manufacture any equipment in the VOP.RC.M equipment class that meets DOE's baseline level.
- *Customer Needs.* Manufacturers are concerned that increased equipment efficiency will come at the expense of equipment functionality, utility, and customizability. The commercial refrigeration equipment industry is focused on customers' need to sell products, and customers place a higher priority on marketing and displaying their goods than they do on energy efficiency. Customers demand high levels of customization to differentiate themselves from other retail stores. They do not want to lose any functionality or utility in their equipment, such as display area, that affects their ability to sell products. Often, the desire of customers for easy product access requires equipment that is less energy efficient. They also do not want to lose any flexibility in design choices, such as lighting options. For example, some customers specify certain lighting configurations (e.g., color rendering, color temperature, light distribution) to maximize the sale of products such as fresh meat, produce, or dairy. Manufacturers believe that setting standards at the maximum level will affect their customers' ability to merchandise products by limiting the flexibility to choose from among different designs, which they expect would commoditize the industry and lead to reduced profit margins. Having some allowance in the efficiency thresholds would allow tradeoffs in design selection that would ease the reconciliation of energy savings with the ability to sell products.
- *Customer Awareness.* Manufacturers expressed concern that their retail customers are not sufficiently aware of pending energy conservation standards and the impacts these standards may have on their purchasing decisions. The supermarket industry is a low-margin industry, which places much emphasis on low-first-cost equipment. Manufacturers believe that many customers may not be able to handle an increase in equipment

price effectively since they operate with a fixed budget, or a fixed amount of capital available for purchasing commercial refrigeration equipment. Manufacturers stated that customers with a fixed capital budget would tend to extend refurbishment periods and cut back on equipment growth to deal with the increase in price of higher efficiency equipment, which manufacturers say will reduce annual sales of commercial refrigeration equipment. Manufacturers expect that smaller stores and even small regional chains will feel significant financial pressure when faced with the increase in prices. Single family-owned stores and local stores in large cities may have no capital budget with which to replace existing cases with cases that are 30 percent to 50 percent higher in price. Manufacturers stated that a reduction in sales would lead to employee layoffs since labor is proportional to units sold, not equipment price. Manufacturers also stated that customers have usually been unwilling to adopt energy efficiency improvements unless there is a 12-month payback period or less.

• *Equipment Classes.* Manufacturers expressed concern regarding how equipment they manufacture would be categorized in DOE's equipment classes. Manufacturers stated that certain pieces of low-volume equipment they manufacture do not easily fit into DOE's equipment classes, and other pieces of equipment are excluded from coverage. For example, custom pieces of equipment, especially hybrid or combination units, do not easily fall within the DOE equipment classes since they could be classified in more than one category. A self-contained case with a service over counter upper portion and an open lower portion could be classified as a self-contained service over counter unit as well as a self-contained open unit. Another example is wedges—transition pieces placed at the corners of a case lineup. These do not have a reasonable TDA and therefore do not have meaningful energy consumption levels when normalized to TDA. Some manufacturers stated that low-volume equipment that cannot meet energy conservation standards may be discontinued because the cost to increase the efficiency will not be worth the benefit gained. Manufacturers also expressed concern regarding secondary coolant systems, which may provide a loophole. Manufacturers estimate that secondary coolant systems represent about 10 percent of the market currently and consume about five percent more energy than their direct expansion equivalent. Some manufacturers stated that customers might purchase these lower efficiency secondary coolant systems instead of the direct expansion equipment that are subject to standards. This concerns manufacturers since it would defeat the purpose of regulatory action.

• *Component Manufacturers.* Manufacturers expressed concern that they have little control over the options available and the price they pay for components used to manufacture commercial refrigeration equipment. Commercial refrigeration equipment manufacturers purchase many of the components needed to build the equipment and therefore rely heavily on component manufacturers to deliver parts, such as doors, motors, fans, and lights. However, commercial refrigeration equipment manufacturers state that higher efficiency components may not be readily available to meet standards. For example, the high-efficiency compressors needed for self-contained equipment to meet energy conservation standards may not be readily available. Manufacturers said that the compressors they purchase for commercial refrigeration are left over from the white goods (home appliances) industry since that industry has a much higher sales volume compared to commercial refrigeration equipment. Also, manufacturers stated that component suppliers set their own pricing, and manufacturers have no control over this. Manufacturers are concerned about what prices they would have to pay for higher efficiency components in the future.

4. Government Regulatory Impact Model Key Inputs and Scenarios

a. Base Case Shipments Forecast

The GRIM estimates manufacturer revenues based on total unit shipment forecasts and the distribution of these values by efficiency level. Changes in the efficiency mix at each standard level are a key driver of manufacturer finances. For this analysis, the GRIM used the NES shipments forecasts from 2007 to 2042. Total shipments forecasted by the NES for the base case in 2012 are shown in Table IV–16 and further discussed in this section of today's Notice.

TABLE IV–16—TOTAL NES-FORECASTED SHIPMENTS IN 2012 (NUMBER OF UNITS)

| Equipment class | Total industry shipments |
|---|---|
| VOP.RC.M | 37,607 |
| VOP.RC.L | 1,880 |
| VOP.SC.M | 7,585 |
| VCT.RC.M | 2,533 |
| VCT.RC.L | 35,184 |
| VCT.SC.I | 2,571 |
| VCS.SC.I | 637 |
| SVO.RC.M | 28,685 |
| SVO.SC.M | 11,357 |
| SOC.RC.M | 7,231 |
| HZO.RC.M | 4,408 |
| HZO.RC.L | 13,859 |
| HZO.SC.M | 976 |
| HZO.SC.L | 2,024 |
| HCT.SC.I | 10,487 |

In the shipments analysis, DOE also estimated the distribution of efficiencies in the base case for commercial refrigeration equipment (Chapter 10 of the TSD). Table IV–17 shows one example of the distribution of efficiencies in the base case for the VOP.RC.M equipment class. The distribution of efficiencies in the base case for other equipment classes are shown in Chapter 10 of the TSD.

TABLE IV–17—GRIM DISTRIBUTION OF SHIPMENTS IN THE BASE CASE FOR VOP.RC.M

| TSL (CDEC/TDA—kWh/day/ft²) | Baseline 1.09 | TSL 1 0.98 | TSL 2 0.95 | TSL 3 0.89 | TSL 4 * 0.89 | TSL 5 0.76 |
|---|---|---|---|---|---|---|
| Distribution of Shipments (%) | 17.6 | 36.3 | 16.6 | 14.0 | 14.0 | 15.6 |

* For VOP.RC.M, TSL 4 is set at the same efficiency level as TSL 3. Therefore, the shipment distribution is the same for both of these TSLs.

b. Standards Case Shipments Forecast

For each standards case, DOE assumed that shipments at efficiencies below the projected standard levels were most likely to roll up to those efficiency levels in response to an energy conservation standard. This scenario assumes that demand for high-efficiency equipment is a function of its price without regard to the standard level. See Chapter 12 of the TSD for additional details.

c. Markup Scenarios

To understand how baseline and more efficient equipment are differentiated, DOE reviewed manufacturer catalogs and information gathered by manufacturers. To estimate the manufacturer price of the equipment sold, DOE applied markups to the production costs. For the analysis, DOE considered different markup scenarios, based on manufacturer input, for commercial refrigeration equipment. Scenarios were used to bound the range of expected equipment prices following new energy conservation standards. For each equipment class, DOE used the markup scenarios that best characterized the prevailing markup conditions and described the range of market responses manufacturers expect as a result of new energy conservation standards. DOE learned from interviews with manufacturers that the majority of manufacturers only offer one equipment line. A single equipment line means that there is no markup used to differentiate baseline equipment from premium equipment.

After discussions with manufacturers, DOE believes its adoption of standards for commercial refrigeration equipment would likely result in one of two distinct markup scenarios: Preservation-of-gross-margin-percentage or preservation-of-operating-profit. Under the preservation-of-gross-margin-percentage scenario, DOE applied a single uniform gross margin percentage markup across all efficiency levels. As production cost increases with efficiency, this scenario implies that the absolute dollar markup will increase. DOE assumed the non-production cost markup—which includes SG&A expenses, R&D expenses, interest, and profit—to be 1.32. Manufacturers believe it is optimistic to assume that as their production costs increase in response to an efficiency standard, they would be able to maintain the same gross margin percentage markup. Therefore, DOE assumes that this scenario represents a high bound to industry profitability under an energy conservation standard.

Gross margin is defined as revenues less cost of goods sold. The implicit assumption behind this markup scenario is that the industry can maintain its gross margin from the baseline (in absolute dollars) after the standard. The industry would do so by passing through its increased production costs to customers without passing through its increased R&D and selling, general, and administrative expenses so the gross profit per unit is the same in absolute dollars. DOE implemented this scenario in the GRIM by setting the production cost markups for each TSL to yield approximately the same gross margin in the standards cases in the year standard are effective (2012) as is yielded in the base case.

d. Equipment and Capital Conversion Costs

New efficiency standards typically cause manufacturers to incur one-time conversion costs to bring their production facilities and equipment designs into compliance with the new regulation. For the purpose of the MIA, DOE classified these one-time conversion costs into three major groups. Capital conversion expenditures are one-time investments in property, plant, and equipment to adapt or change existing production facilities so that new equipment designs can be fabricated and assembled under the new regulation. Equipment conversion expenditures are one-time investments in research, development, testing, and marketing focused on creating equipment designs that comply with the new efficiency standard. Stranded assets are equipment or tooling that become obsolete as a result of new regulation.

During the MIA interviews, DOE asked manufacturers for their estimates of the conversion costs they would incur due to new energy conservation standards. DOE then used the costs provided by each manufacturer and their respective market shares to develop estimates for the conversion costs of the entire industry at varying TSLs. Chapter 13 of the TSD summarizes these estimates.

*J. Utility Impact Analysis*

The utility impact analysis estimates the effects of reduced energy consumption due to improved equipment efficiency on the utility industry. This utility analysis consists of a comparison between forecast results for a case comparable to the AEO2007 reference case and forecasts for policy cases incorporating each of the commercial refrigeration equipment TSLs.

DOE analyzed the effects of proposed standards on electric utility industry generation capacity and fuel consumption using a variant of the EIA's NEMS. NEMS, which is available on the DOE website, is a large, multi-sector, partial-equilibrium model of the U.S. energy sector. EIA uses NEMS to produce its AEO, a widely recognized baseline energy forecast for the United States. DOE used a variant known as NEMS–BT. The NEMS–BT is run similarly to the AEO2007 NEMS, except that commercial refrigeration equipment energy usage is reduced by the amount of energy (by fuel type) saved due to the TSLs. DOE obtained the inputs of national energy savings from the NES spreadsheet model. For the final rule, DOE intends to report utility analysis results using a version of NEMS–BT based on the AEO2008 NEMS.

DOE conducted the utility analysis as policy deviations from the AEO2007, applying the same basic set of assumptions. In the utility analysis, DOE reported the changes in installed capacity and generation by fuel type that result for each TSL, as well as changes in end-use electricity sales. Chapter 14 of the TSD provides details of the utility analysis methods and results.

*K. Employment Impact Analysis*

Employment impact is one of the factors that DOE considers in selecting a standard. Employment impacts include direct and indirect impacts. Direct employment impacts are any changes in the number of employees for commercial refrigeration equipment manufacturers, their suppliers, and related service firms. Indirect impacts are those changes of employment in the larger economy that occur due to the shift in expenditures and capital investment caused by the purchase and operation of more efficient commercial refrigeration equipment. The MIA in this rulemaking addresses only the direct employment impacts on manufacturers of commercial refrigeration equipment. Chapter 15 of the TSD describes other, primarily indirect, employment impacts.

Indirect employment impacts from commercial refrigeration equipment standards consist of the net jobs created or eliminated in the national economy, other than in the manufacturing sector being regulated, as a consequence of (1) reduced spending by end users on electricity (offset to some degree by the increased spending on maintenance and repair); (2) reduced spending on new energy supply by the utility industry; (3) increased spending on the purchase price of new commercial refrigeration equipment; 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 developing this proposed rule, DOE estimated indirect national employment impacts using an input/output model of the U.S. economy, called ImSET (Impact of Sector Energy Technologies), developed by DOE's Building Technologies Program. ImSET is a personal-computer-based, economic-analysis model that characterizes the interconnections among 188 sectors of the economy as national input/output structural matrices, using data from the U.S. Department of Commerce's 1997 Benchmark U.S. input-output table. The ImSET model estimates changes in employment, industry output, and wage income in the overall U.S. economy resulting from changes in expenditures in various sectors of the economy. DOE estimated changes in expenditures using the NES spreadsheet. ImSET then estimated the net national indirect employment impacts of potential commercial refrigeration equipment efficiency standards on employment by sector. In comments on the ANOPR, Zero Zone asked if DOE was going to contact second tier suppliers (e.g., door suppliers, fluorescent lighting suppliers, shaded pole motor suppliers) regarding employment impacts. (Public Meeting Transcript, No. 13.5 at pp. 230–231) ARI noted that this had been done in the central air conditioning rulemaking. (Public Meeting Transcript, No. 13.5 at p. 231)

DOE stated that the ImSET tool would not be able to address this in detail, but that it has been done within the MIA for other equipment. In the public meeting, DOE commented that there would be impacts from standards, but the effective date is different from the issuance date partly to allow time for adjustments in manufacturing.

The ImSET input/output model suggests that the proposed commercial refrigeration equipment efficiency standards could increase the net demand for labor in the economy and the gains would most likely be very small relative to total national employment. DOE therefore concludes that the proposed commercial refrigeration equipment standards are only likely to produce employment benefits that are sufficient to fully offset any adverse impacts on employment in the commercial refrigeration equipment industry. For more details on the employment impact analysis, see Chapter 15 of the TSD.

*L. Environmental Assessment*

DOE has prepared a draft Environmental Assessment (EA) pursuant to the National Environmental Policy Act and the requirements of 42 U.S.C. 6295(o)(2)(B)(i)(VI) and 6316(e)(1)(A), to determine the environmental impacts of the proposed standards. Specifically, DOE estimated the reduction in power plant emissions of $CO_2$, $NO_X$, and mercury (Hg) using the NEMS–BT computer model. However, the Environmental Assessment (Chapter 16 of the TSD) does not include the estimated reduction in power plant emissions of $SO_2$ because, DOE has determined that due to the presence of national caps on $SO_2$ emissions as addressed below, any such reduction resulting from an energy conservation standard would not affect the overall level of $SO_2$ emissions in the United States.

The NEMS–BT is run similarly to the AEO2007 NEMS, except that commercial refrigeration equipment energy use is reduced by the amount of energy saved (by fuel type) due to the TSLs. DOE obtained the inputs of national energy savings from the NES spreadsheet model. For the environmental analysis, the output is the forecasted physical emissions. The net benefit of the standard is the difference between emissions estimated by NEMS–BT and the AEO2007 Reference Case. The NEMS–BT tracks $CO_2$ emissions using a detailed module that provides results with broad coverage of all sectors and inclusion of interactive effects. For the final rule, DOE intends to revise the emissions analysis using the AEO2008 NEMS model using the process outlined above.

The Clean Air Act Amendments of 1990 set an emissions cap on $SO_2$ for all power generation. The attainment of this target, however, is flexible among generators and is enforced through the use of emissions allowances and tradable permits. As a result, accurate simulation of $SO_2$ trading tends to imply that the effect of energy conservation standards on physical emissions will be near zero because emissions will always be at, or near, the ceiling. Thus, it is unlikely that there will be an $SO_2$ environmental benefit from electricity savings as long as there is enforcement of the emissions ceilings.

Although there may not be an actual reduction in $SO_2$ emissions from electricity savings, there still may be an economic benefit from reduced demand for $SO_2$ emission allowances. Electricity savings decrease the generation of $SO_2$ emissions from power production, which can decrease the need to purchase or generate $SO_2$ emissions allowance credits, and decrease the costs of complying with regulatory caps on emissions.

Like $SO_2$, future emissions of $NO_X$ and Hg would have been subject to emissions caps under the Clean Air Interstate Act and Clean Air Mercury Rule. As discussed later, these rules have been vacated by a Federal court. DOE calculated a forecast of reductions for these emissions under an uncapped scenario. DOE assumes that the uncapped emissions reduction estimate would have corresponded generally to the generation of emissions allowance credits under an emissions cap scenario.

## V. Analytical Results

*A. Trial Standard Levels*

DOE selected between four and eight energy consumption levels for each commercial refrigeration equipment class in the LCC analysis. Based on the results of the LCC analysis, DOE selected five trial standard levels above the baseline level for each equipment class for the NOPR stage of the rulemaking. The range of TSLs selected includes the most energy efficient combination of design options with a positive NPV at the seven percent discount rate, and the combination of design options with the minimum LCC. Additionally, TSLs were selected that filled large gaps between the baseline and the level with the minimum LCC.

Because of the size variation within each equipment class and the use of daily energy consumption as the efficiency metric, DOE presented a methodology to express efficiency standards in terms of a normalizing metric. This allows for a single energy conservation standard to be used for a broad range of equipment sizes within a given equipment class. DOE proposed the use of TDA as the normalizing metric for equipment with display capability. For equipment classes without display capability (*e.g.*, equipment with solid doors), DOE proposed the use of internal volume as the normalizing metric. See Chapter 9 of the TSD for more detail.

True commented that all self-contained units (including any open units) should be tested using volume as a normalizing factor to provide a straight comparison between open and closed-door self-contained units. (Public Meeting Transcript, No. 13.5 at pp. 202–207) DOE understands the usefulness of comparing self-contained equipment with and without doors on the basis of volume. However, the self-contained equipment covered in this rulemaking is frequently installed in supermarkets and convenience stores, where its primary purpose is to display and merchandise food. The most common application of remote condensing equipment is also in supermarkets and convenience stores. Therefore, DOE believes that, with respect to the purpose of equipment, the self-contained equipment covered in this rulemaking is more similar to remote condensing equipment than other self-contained equipment (i.e., equipment with doors). DOE discussed this issue with manufacturers, and determined that TDA is the most appropriate normalization metric for the self-contained equipment covered in this rulemaking, since that is the metric used for remote condensing equipment.

DOE expressed the ANOPR efficiency levels in terms of a normalized energy consumption using these normalization factors. DOE proposed equations for final standards that would have maximum energy consumption for equipment whose display area is directly proportional to TDA. DOE also suggested that for equipment normalized to volume, it might be necessary to develop equations that use offset factors to account for a potential non-linear variation of energy consumption with volume. At the ANOPR public meeting and during the comment period, stakeholders expressed concerns about the size of equipment DOE analyzed as the representative model for each equipment class. Zero Zone stated that its analysis indicates that using a two-door case as the baseline (for the VCT.RC.L class) is more reasonable because of the end effects in those cases. Zero Zone reported a 10 percent increase in energy consumption per door for a two-door case with the same design features as a five-door case. A two-door case consumes more energy per door than a five-door case because of the lighting and end effects. Zero Zone noted that if the standard is based on a five-door case, it will penalize any smaller cabinet, and could eliminate smaller cases from production due to their size. (Public Meeting Transcript, No. 13.5 at p. 87) At the public meeting, Zero Zone stated that it would give some thought to what should be used for a representative model—a two-door case, or some combination of two-door and five-door cases. Zero Zone also noted that not all manufacturers make all case sizes. (Public Meeting Transcript, No. 13.5 at p. 88) Later, in a written comment, Zero Zone recommended that DOE base its analysis on the smaller case models instead of the larger case models to avoid accidentally outlawing smaller cases. (Zero Zone, No. 17 at p. 3) ARI commented that it generally agrees with the approach proposed by DOE for characterizing energy conservation standards for commercial refrigeration equipment, and offered to work with DOE in developing appropriate offset factors. (ARI, No. 18 at p. 6)

For the NOPR, DOE developed offset factors as a way to adjust the energy efficiency requirements for smaller-sized equipment in each equipment class analyzed. These offset factors account for certain components of the refrigeration load (such as the conduction end effects) that remain constant even when equipment sizes vary. These constant loads affect smaller cases disproportionately. The offset factors are intended to approximate these constant loads and provide a fixed end point, corresponding to a zero TDA or zero volume case, in an equation that describes the relationship between energy consumption and the corresponding TDA or volume metric. See Chapter 5 of the TSD for further details on the development of these offset factors for each equipment class. This is identified as Issue 4 under ''Issues on Which DOE Seeks Comment'' in Section VII.E of this NOPR.

DOE preserved the general methodology and themes it used for the selection of efficiency levels in the ANOPR in establishing specific efficiency levels for equipment classes. These levels are based on the results of the updated LCC analysis and make up the TSLs used in the NOPR. Table V–1 shows the TSL levels DOE selected for energy use for the equipment classes analyzed. TSL 5 is the max-tech level for each equipment class. TSL 4 is the maximum efficiency level with a positive NPV at the seven percent discount rate, except for VOP.RC.M, where the minimal difference in energy efficiency between the minimum life-cycle cost level as determined by the LCC analysis and the maximum efficiency level with positive NPV prompted DOE to select the minimum life-cycle cost level in preference to the maximum level with positive NPV. TSL 4 is a combination of the efficiency levels selected for TSL 3 and TSL 5. For a given equipment class, the efficiency levels selected for TSL 4 are either equivalent to that of TSL 3 or that of TSL 5. TSL 3 is the efficiency level that provides the minimum life-cycle cost as determined by the LCC analysis. TSL 2 and TSL 1 represent lower efficiency levels that fill in the gap between the current baseline and the levels determined to have the minimum LCC.

Table V–2 shows the same TSL levels in terms of proposed equations that establish a maximum daily energy consumption (MEC) limit through a linear equation of the form:

$MEC = A \times TDA + B$ (*for equipment using TDA as a normalizing metric*) or

$MEC = A \times V + B$ (*for equipment using volume as a normalizing metric*)

Coefficients *A* and *B* are uniquely derived for each equipment class based on the calculated offset factor *B* (see Chapter 5 of the TSD for offset factors) and the equation slope A, which would be used to describe the efficiency requirements for equipment of different sizes within the same equipment class. Chapter 9 of the TSD explains the methodology DOE used for selecting trial standard levels and developing the coefficients shown in Table V–2.

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## Table V-1 Trial Standard Levels for Analyzed Equipment Expressed in Terms of Daily Energy Consumption

| Equipment Class | Test Metric | Trial Standard Level in Order of Efficiency | | | | | | Trial Standard Levels for Equipment Analyzed Expressed in Terms of Energy Consumption (kWh/day) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Baseline | TSL 1 | TSL 2 | TSL 3 | TSL 4 | TSL 5 | Baseline | TSL 1 | TSL 2 | TSL 3 | TSL 4 | TSL 5 |
| VOP.RC.M | CDEC kWh/day | Level 1 | Level 3 | Level 4 | Level 5 | Level 5 | Level 7 | 57.90 | 51.99 | 50.68 | 47.69 | 47.69 | 40.26 |
| VOP.RC.L | CDEC kWh/day | Level 1 | Level 3 | Level 4 | Level 6 | Level 7 | Level 7 | 133.60 | 118.44 | 113.28 | 112.00 | 108.77 | 108.77 |
| VOP.SC.M | TDEC* kWh/day | Level 1 | Level 3 | Level 5 | Level 6 | Level 6 | Level 8 | 39.60 | 35.95 | 33.38 | 30.70 | 30.70 | 28.17 |
| VCT.RC.M | CDEC kWh/day | Level 1 | Level 2 | Level 3 | Level 5 | Level 7 | Level 7 | 33.18 | 31.77 | 30.00 | 22.27 | 18.51 | 18.51 |
| VCT.RC.L | CDEC kWh/day | Level 1 | Level 3 | Level 4 | Level 5 | Level 7 | Level 7 | 69.31 | 65.73 | 46.90 | 46.36 | 41.85 | 41.85 |
| VCT.SC.I | TDEC kWh/day | Level 1 | Level 4 | Level 5 | Level 7 | Level 8 | Level 8 | 45.63 | 34.40 | 25.31 | 22.74 | 22.37 | 22.37 |
| VCS.SC.I | TDEC kWh/day | Level 1 | Level 3 | Level 5 | Level 8 | Level 8 | Level 8 | 16.95 | 14.53 | 12.24 | 10.19 | 10.19 | 10.19 |
| SVO.RC.M | CDEC kWh/day | Level 1 | Level 3 | Level 4 | Level 5 | Level 5 | Level 7 | 43.56 | 39.58 | 38.59 | 36.34 | 36.34 | 30.97 |
| SVO.SC.M | TDEC kWh/day | Level 1 | Level 3 | Level 5 | Level 6 | Level 6 | Level 8 | 33.11 | 30.66 | 28.87 | 26.74 | 26.74 | 24.87 |
| SOC.RC.M | CDEC kWh/day | Level 1 | Level 2 | Level 3 | Level 5 | Level 5 | Level 8 | 31.70 | 30.01 | 27.93 | 26.24 | 26.24 | 20.17 |
| HZO.RC.M | CDEC kWh/day | Level 1 | Level 2 | Level 3 | Level 4 | Level 5 | Level 5 | 19.63 | 17.89 | 15.73 | 14.69 | 14.54 | 14.54 |
| HZO.RC.L | CDEC kWh/day | Level 1 | Level 3 | Level 4 | Level 5 | Level 5 | Level 5 | 38.38 | 35.30 | 33.41 | 32.97 | 32.97 | 32.97 |
| HZO.SC.M | TDEC kWh/day | Level 1 | Level 3 | Level 5 | Level 7 | Level 8 | Level 8 | 19.23 | 17.85 | 16.51 | 14.93 | 14.81 | 14.81 |
| HZO.SC.L | TDEC kWh/day | Level 1 | Level 3 | Level 5 | Level 7 | Level 8 | Level 8 | 38.69 | 36.02 | 33.52 | 30.31 | 30.14 | 30.14 |
| HCT.SC.I | TDEC kWh/day | Level 1 | Level 3 | Level 4 | Level 5 | Level 6 | Level 6 | 7.25 | 6.37 | 3.70 | 3.53 | 3.32 | 3.32 |

* "TDEC" is total daily energy consumption of the case.

## Table V-2 Trial Standard Levels Expressed in Terms of Equations and Coefficients for Each Primary Equipment Class

| Equipment Class | Test Metric | Trial Standard Levels for Primary Equipment Classes Analyzed | | | | | |
|---|---|---|---|---|---|---|---|
| | | Baseline | TSL 1 | TSL 2 | TSL 3 | TSL 4 | TSL 5 |
| VOP.RC.M | CDEC kWh/day | 1.01 x TDA + 4.07 | 0.9 x TDA + 4.07 | 0.87 x TDA + 4.07 | 0.82 x TDA + 4.07 | 0.68 x TDA + 4.07 | 0.82 x TDA + 4.07 |
| VOP.RC.L | CDEC kWh/day | 2.84 x TDA + 6.85 | 2.5 x TDA + 6.85 | 2.38 x TDA + 6.85 | 2.35 x TDA + 6.85 | 2.28 x TDA + 6.85 | 2.28 x TDA + 6.85 |
| VOP.SC.M | TDEC kWh/day | 2.34 x TDA + 4.71 | 2.09 x TDA + 4.71 | 1.92 x TDA + 4.71 | 1.74 x TDA + 4.71 | 1.57 x TDA + 4.71 | 1.74 x TDA + 4.71 |
| VCT.RC.M | CDEC kWh/day | 0.48 x TDA + 1.95 | 0.46 x TDA + 1.95 | 0.43 x TDA + 1.95 | 0.31 x TDA + 1.95 | 0.25 x TDA + 1.95 | 0.25 x TDA + 1.95 |
| VCT.RC.L | CDEC kWh/day | 1.03 x TDA + 2.61 | 0.97 x TDA + 2.61 | 0.68 x TDA + 2.61 | 0.67 x TDA + 2.61 | 0.6 x TDA + 2.61 | 0.6 x TDA + 2.61 |
| VCT.SC.I | TDEC kWh/day | 1.63 x TDA + 3.29 | 1.2 x TDA + 3.29 | 0.85 x TDA + 3.29 | 0.75 x TDA + 3.29 | 0.73 x TDA + 3.29 | 0.73 x TDA + 3.29 |
| VCS.SC.I | TDEC kWh/day | 0.55 x V + 0.88 | 0.49 x V + 0.88 | 0.43 x V + 0.88 | 0.38 x V + 0.88 | 0.38 x V + 0.88 | 0.38 x V + 0.88 |
| SVO.RC.M | CDEC kWh/day | 1.01 x TDA + 3.18 | 0.91 x TDA + 3.18 | 0.89 x TDA + 3.18 | 0.83 x TDA + 3.18 | 0.69 x TDA + 3.18 | 0.83 x TDA + 3.18 |
| SVO.SC.M | TDEC kWh/day | 2.23 x TDA + 4.59 | 2.04 x TDA + 4.59 | 1.9 x TDA + 4.59 | 1.73 x TDA + 4.59 | 1.58 x TDA + 4.59 | 1.73 x TDA + 4.59 |
| SOC.RC.M | CDEC kWh/day | 0.62 x TDA + 0.11 | 0.59 x TDA + 0.11 | 0.55 x TDA + 0.11 | 0.51 x TDA + 0.11 | 0.39 x TDA + 0.11 | 0.51 x TDA + 0.11 |
| HZO.RC.M | CDEC kWh/day | 0.51 x TDA + 2.88 | 0.45 x TDA + 2.88 | 0.39 x TDA + 2.88 | 0.36 x TDA + 2.88 | 0.35 x TDA + 2.88 | 0.35 x TDA + 2.88 |
| HZO.RC.L | CDEC kWh/day | 0.68 x TDA + 6.88 | 0.62 x TDA + 6.88 | 0.58 x TDA + 6.88 | 0.57 x TDA + 6.88 | 0.57 x TDA + 6.88 | 0.57 x TDA + 6.88 |
| HZO.SC.M | TDEC kWh/day | 1.14 x TDA + 5.55 | 1.02 x TDA + 5.55 | 0.91 x TDA + 5.55 | 0.78 x TDA + 5.55 | 0.77 x TDA + 5.55 | 0.77 x TDA + 5.55 |
| HZO.SC.L | TDEC kWh/day | 2.63 x TDA + 7.08 | 2.41 x TDA + 7.08 | 2.2 x TDA + 7.08 | 1.94 x TDA + 7.08 | 1.92 x TDA + 7.08 | 1.92 x TDA + 7.08 |
| HCT.SC.I | TDEC kWh/day | 1.33 x TDA + 0.43 | 1.16 x TDA + 0.43 | 0.64 x TDA + 0.43 | 0.61 x TDA + 0.43 | 0.56 x TDA + 0.43 | 0.56 x TDA + 0.43 |

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In addition to the 15 primary equipment classes analyzed, DOE intends to establish standards for the remaining 23 secondary equipment classes of commercial refrigeration equipment covered in this rulemaking that were not directly analyzed in the engineering analysis due to low annual shipments (less than 100 units per year). DOE's approach involves extension multipliers developed using both the 15 primary equipment classes analyzed and a set of focused matched-pair analyses. In addition, DOE believes that standards for certain primary equipment classes can be directly applied to other similar secondary equipment classes.

Chapter 5 of the TSD discusses the development of the extension multipliers and the set of focused matched-pair analyses.

Using this approach, DOE developed an additional set of TSLs for these secondary equipment classes that corresponds to each of the equations shown in Table V–2 at each TSL. Table V–3 shows this additional set of corresponding TSL levels. The levels shown in Table V–3 do not necessarily reflect the minimum life-cycle cost or max-tech efficiency levels for these equipment classes, and do not reflect TSLs that DOE has analyzed in its impact analyses. The primary purpose of presenting these levels in this section is to provide interested persons with the range of efficiency standards that DOE is considering for these secondary equipment classes. This is identified as Issue 5 under ''Issues on Which DOE Seeks Comment'' in Section VII.E of this NOPR.

**Table V-3 Trial Standard Levels Expressed in Terms of Equations and Coefficients for Each Secondary Equipment Class**

| Equipment Class | Test Metric | Trial Standard Levels for Secondary Equipment Classes Analyzed | | | | | |
|---|---|---|---|---|---|---|---|
| | | Baseline | TSL 1 | TSL 2 | TSL 3 | TSL 4 | TSL 5 |
| SVO.RC.L | CDEC kWh/day | 2.84 x TDA + 6.85 | 2.5 x TDA + 6.85 | 2.38 x TDA + 6.85 | 2.35 x TDA + 6.85 | 2.28 x TDA + 6.85 | 2.28 x TDA + 6.85 |
| VOP.RC.I | CDEC kWh/day | 3.6 x TDA + 8.7 | 3.17 x TDA + 8.7 | 3.03 x TDA + 8.7 | 2.99 x TDA + 8.7 | 2.9 x TDA + 8.7 | 2.9 x TDA + 8.7 |
| SVO.RC.I | CDEC kWh/day | 3.6 x TDA + 8.7 | 3.17 x TDA + 8.7 | 3.03 x TDA + 8.7 | 2.99 x TDA + 8.7 | 2.9 x TDA + 8.7 | 2.9 x TDA + 8.7 |
| HZO.RC.I | CDEC kWh/day | 0.87 x TDA + 8.74 | 0.78 x TDA + 8.74 | 0.73 x TDA + 8.74 | 0.72 x TDA + 8.74 | 0.72 x TDA + 8.74 | 0.72 x TDA + 8.74 |
| VCT.RC.I | CDEC kWh/day | 1.2 x TDA + 3.05 | 1.14 x TDA + 3.05 | 0.8 x TDA + 3.05 | 0.79 x TDA + 3.05 | 0.71 x TDA + 3.05 | 0.71 x TDA + 3.05 |
| HCT.RC.M | CDEC kWh/day | 0.39 x TDA + 0.13 | 0.34 x TDA + 0.13 | 0.19 x TDA + 0.13 | 0.18 x TDA + 0.13 | 0.16 x TDA + 0.13 | 0.16 x TDA + 0.13 |
| HCT.RC.L | CDEC kWh/day | 0.81 x TDA + 0.26 | 0.71 x TDA + 0.26 | 0.39 x TDA + 0.26 | 0.37 x TDA + 0.26 | 0.34 x TDA + 0.26 | 0.34 x TDA + 0.26 |
| HCT.RC.I | CDEC kWh/day | 0.95 x TDA + 0.31 | 0.83 x TDA + 0.31 | 0.46 x TDA + 0.31 | 0.43 x TDA + 0.31 | 0.4 x TDA + 0.31 | 0.4 x TDA + 0.31 |
| VCS.RC.M | CDEC kWh/day | 0.16 x V + 0.26 | 0.14 x V + 0.26 | 0.13 x V + 0.26 | 0.11 x V + 0.26 | 0.11 x V + 0.26 | 0.11 x V + 0.26 |
| VCS.RC.L | CDEC kWh/day | 0.33 x V + 0.54 | 0.3 x V + 0.54 | 0.26 x V + 0.54 | 0.23 x V + 0.54 | 0.23 x V + 0.54 | 0.23 x V + 0.54 |
| VCS.RC.I | CDEC kWh/day | 0.39 x V + 0.63 | 0.35 x V + 0.63 | 0.31 x V + 0.63 | 0.27 x V + 0.63 | 0.27 x V + 0.63 | 0.27 x V + 0.63 |
| HCS.RC.M | CDEC kWh/day | 0.16 x V + 0.26 | 0.14 x V + 0.26 | 0.13 x V + 0.26 | 0.11 x V + 0.26 | 0.11 x V + 0.26 | 0.11 x V + 0.26 |
| HCS.RC.L | CDEC kWh/day | 0.33 x V + 0.54 | 0.3 x V + 0.54 | 0.26 x V + 0.54 | 0.23 x V + 0.54 | 0.23 x V + 0.54 | 0.23 x V + 0.54 |
| HCS.RC.I | CDEC kWh/day | 0.39 x V + 0.63 | 0.35 x V + 0.63 | 0.31 x V + 0.63 | 0.27 x V + 0.63 | 0.27 x V + 0.63 | 0.27 x V + 0.63 |
| SOC.RC.L | CDEC kWh/day | 1.3 x TDA + 0.22 | 1.23 x TDA + 0.22 | 1.15 x TDA + 0.22 | 1.08 x TDA + 0.22 | 0.83 x TDA + 0.22 | 1.08 x TDA + 0.22 |
| SOC.RC.I | CDEC kWh/day | 1.52 x TDA + 0.26 | 1.44 x TDA + 0.26 | 1.34 x TDA + 0.26 | 1.26 x TDA + 0.26 | 0.97 x TDA + 0.26 | 1.26 x TDA + 0.26 |
| VOP.SC.L | TDEC kWh/day | 5.87 x TDA + 11.82 | 5.25 x TDA + 11.82 | 4.82 x TDA + 11.82 | 4.37 x TDA + 11.82 | 3.95 x TDA + 11.82 | 4.37 x TDA + 11.82 |
| VOP.SC.I | TDEC kWh/day | 7.45 x TDA + 15.02 | 6.68 x TDA + 15.02 | 6.13 x TDA + 15.02 | 5.55 x TDA + 15.02 | 5.02 x TDA + 15.02 | 5.55 x TDA + 15.02 |
| SVO.SC.L | TDEC kWh/day | 5.59 x TDA + 11.51 | 5.11 x TDA + 11.51 | 4.76 x TDA + 11.51 | 4.34 x TDA + 11.51 | 3.98 x TDA + 11.51 | 4.34 x TDA + 11.51 |
| SVO.SC.I | TDEC kWh/day | 7.11 x TDA + 14.63 | 6.5 x TDA + 14.63 | 6.05 x TDA + 14.63 | 5.52 x TDA + 14.63 | 5.06 x TDA + 14.63 | 5.52 x TDA + 14.63 |
| HZO.SC.I | TDEC kWh/day | 3.34 x TDA + 9. | 3.06 x TDA + 9. | 2.8 x TDA + 9. | 2.46 x TDA + 9. | 2.44 x TDA + 9. | 2.44 x TDA + 9. |
| SOC.SC.I | TDEC kWh/day | 2.13 x TDA + 0.36 | 2.02 x TDA + 0.36 | 1.88 x TDA + 0.36 | 1.76 x TDA + 0.36 | 1.35 x TDA + 0.36 | 1.76 x TDA + 0.36 |
| HCS.SC.I | TDEC kWh/day | 0.55 x V + 0.88 | 0.49 x V + 0.88 | 0.43 x V + 0.88 | 0.38 x V + 0.88 | 0.38 x V + 0.88 | 0.38 x V + 0.88 |

1. Miscellaneous Equipment

In the ANOPR, DOE proposed as part of its commercial refrigeration equipment test procedure that all equipment be tested at one of three rating temperatures: 38 °F for refrigerators, 0 °F for freezers, and −15 °F for ice-cream freezers. Zero Zone, Hill Phoenix, Carrier/Tyler Refrigeration, and True expressed concern because they produce equipment that is not designed to operate at these designated rating temperatures. (Public Meeting Transcript, No. 13.5 at pp. 28–33) ARI stated that DOE should not require all equipment to be tested at these three rating temperatures alone. Doing so may require manufacturers to produce equipment that is less efficient solely for the purpose of meeting a specific rating condition, thus defeating the intent of the regulation. (ARI, No. 18 at p. 4) Hill Phoenix and True stated that the equipment they manufacture that is unable to meet these rating temperatures is only one percent to two percent of their shipments. Hill Phoenix added that, if possible, it would prefer to avoid the excessive paperwork of applying for waivers for equipment that cannot meet the three rating temperatures in the test procedure. (Public Meeting Transcript, No. 13.5 at p. 33)

Zero Zone recommended developing regulations that apply to the special circumstances of the rating temperature (Zero Zone, No. 17 at p. 2) and that DOE should consider developing additional rating temperatures. (Public Meeting Transcript, No. 13.5 at p. 28) ACEEE suggested that DOE develop a method to interpolate the standard based on the standards at the three official rating temperatures. (ACEEE, No. 16 at p. 2) ARI recommended that any equipment specifically designed to hold temperatures higher than the rating temperature should be tested at its application temperature, but must still meet the energy standard for its respective equipment class. (ARI, No. 18 at p. 4)

The DOE test procedure for commercial refrigeration equipment specifies three rating temperatures, 38 °F, 0 °F, and −15 °F, that are required to be used in the testing of this equipment, each applied to designated equipment classes. 71 FR 71357. Since all of this equipment must be tested at one of these three rating temperatures, any manufacturer that is unable to test such equipment at its designated rating temperature, must request a test procedure waiver from DOE pursuant to the provisions described in 10 CFR 431.401. If the equipment is unable to meet the maximum daily energy consumption (MDEC) limit for its designated equipment class, a manufacturer can petition DOE's Office of Hearing and Appeals (OHA) for exception relief from the energy conservation standard pursuant to OHA's authority under section 504 of the DOE Organization Act (42 U.S.C. 7194), as implemented at subpart B of 10 CFR part 1003. OHA grants such relief on a case-by-case basis if it determines that a manufacturer has demonstrated that meeting the standard would cause hardship, inequity, or unfair distributions of burdens. DOE believes that the majority of equipment covered by this rulemaking can be tested using the three specified rating temperatures (38 °F, 0 °F and −15 °F) provided in the test procedure.

Certain types of equipment meet the definition of "commercial refrigeration equipment" (Section 136(a)(3) of EPACT 2005), but do not fall directly into any of the 38 equipment classes defined in the market and technology assessment. One of these types is hybrid cases, where two or more compartments are in different equipment families and are contained in one cabinet. Another is refrigerator-freezers, which have two compartments in the same equipment family but with different operating temperatures. Hybrid refrigerator-freezers, where two or more compartments are in different equipment families and have different operating temperatures, may also exist. Another is wedge cases, which form miter transitions (a corner section between two refrigerated display merchandisers) between standard display case lineups. DOE is proposing language that will allow manufacturers to determine appropriate standard levels for these types of equipment.

An example of a pure hybrid case (one with two or more compartments in different equipment families and at the same temperature) is a unit with one open and one closed medium-temperature compartment, such as those seen in coffee shops that merchandise baked goods and beverages. These hybrid cases may be either self-contained or remote condensing, and may be cooled by one or more condensing units. They may also have one evaporator cooling both compartments or one evaporator feeding each compartment separately.

An example of a refrigerator-freezer is a unit with doors where one compartment operates at medium temperature and one compartment operates at low temperature. Remote condensing commercial refrigerator-freezers (with and without doors) and self-contained commercial refrigerator-freezers without doors may operate in one of two ways. First, they may operate as separate chilled and frozen compartments with evaporators fed by two sets of refrigerant lines or two compressors. Second, they may operate as separate chilled and frozen compartments fed by one set of low-temperature refrigerant lines (with evaporator pressure regulator (EPR) valves or similar devices used to raise the evaporator pressure) or one compressor.

An example of a hybrid refrigerator-freezer is a unit with one open compartment at medium temperature and one closed compartment at low temperature. As with pure hybrid cases, these cases may be either self-contained or remote condensing, and may be cooled by one or more condensing units. In the case of remote condensing equipment, they may operate as separate chilled and frozen compartments with evaporators fed by two sets of refrigerant lines or two compressors. Or they may operate as separate chilled and frozen compartments fed by one set of low-temperature refrigerant lines (with EPR valves or similar devices used to raise the evaporator pressure of one compartment) or one compressor.

During the ANOPR public meeting, stakeholders commented on how to handle these types of cases. True suggested that for self-contained refrigerator-freezer equipment, DOE should use a weighted average of the minimum standard requirements for the freezer and refrigerator. This is the present standard used in California and Canada, and [EPACT] 2005 for self-contained equipment with doors: 1.63 times freezer volume plus the refrigerated volume gives you a number [adjusted volume]. (Public Meeting Transcript, No. 13.5 at p. 215) Copeland followed up on the True comment on refrigerator-freezers, suggesting that a refrigerator-freezer standard for remote cases should be simple, and that they should be treated as if they have two separate compressors. (Public Meeting Transcript, No. 13.5 at p. 215) Zero Zone stated that a manufacturer could build equipment with one or two separate suction lines. If it is built with one, measure the suction pressure for that one and base the EER on that suction pressure, without concern for what is happening upstream of the case. (Public Meeting Transcript, No. 13.5 at p. 215)

DOE has reviewed the comments and is proposing the following language for requiring manufacturers to meet standards for hybrid cases, refrigerator-freezers, and hybrid refrigerator/freezers:

- For commercial refrigeration equipment with two or more compartments (hybrid refrigerators, hybrid freezers, hybrid refrigerator-freezers, and non-hybrid refrigerator/freezers), the MDEC for each model shall be the sum of the MDEC values for all of its compartments. For each compartment, measure the TDA or volume of that compartment, and determine the appropriate equipment class based on that compartment's equipment family, condensing unit configuration, and designed operating temperature. The MDEC limit for each compartment shall be the calculated value obtained by entering that compartment's TDA or volume into the standard equation in subsection (d)(1) for that compartment's equipment class. Measure the calculated daily energy consumption (CDEC) or total daily energy consumption (TDEC) for the entire case as follows:
  - For remote condensing commercial hybrid refrigerators, hybrid freezers, hybrid refrigerator-freezers, and non-hybrid refrigerator-freezers, where two or more independent condensing units each separately cool only one compartment, measure the total refrigeration load of each compartment separately according to the ANSI/ASHRAE Standard 72–2005 test procedure. Calculate compressor energy consumption (CEC) for each compartment using Table 1 in ANSI/ARI Standard 1200–2006 using the saturated evaporator temperature for that compartment. The calculated daily energy consumption (CDEC) for the entire case shall be the sum of the CEC for each compartment, fan energy

consumption (FEC), lighting energy consumption (LEC), anti-condensate energy consumption (AEC), defrost energy consumption (DEC), and condensate evaporator pan energy consumption (PEC) (as measured in ANSI/ARI Standard 1200–2006).

○ For remote condensing commercial hybrid refrigerators, hybrid freezers, hybrid refrigerator-freezers, and non-hybrid refrigerator-freezers, where two or more compartments are cooled collectively by one condensing unit, measure the total refrigeration load of the entire case according to the ANSI/ASHRAE Standard 72–2005 test procedure. Calculate a weighted saturated evaporator temperature for the entire case by (i) multiplying the saturated evaporator temperature of each compartment by the volume of that compartment (as measured in ANSI/ARI Standard 1200–2006), (ii) summing the resulting values for all compartments, and (iii) dividing the resulting total by the total volume of all compartments. Calculate the CEC for the entire case using Table 1 in ANSI/ARI Standard 1200–2006, using the total refrigeration load and the weighted average saturated evaporator temperature. The CDEC for the entire case shall be the sum of the CEC, FEC, LEC, AEC, DEC, and PEC.

○ For self-contained commercial hybrid refrigerators, hybrid freezers, hybrid refrigerator-freezers, and non-hybrid refrigerator-freezers, measure the total daily energy consumption (TDEC) for the entire case according to the ANSI/ASHRAE Standard 72–2005 test procedure.

• For remote-condensing and self-contained wedge cases, measure the CDEC or TDEC according to the ANSI/ASHRAE Standard 72–2005 test procedure. The MDEC for each model shall be the amount derived by incorporating into the standards equation in subsection (d)(1) for the appropriate equipment class a value for the TDA that is the product of (1) the vertical height of the air-curtain (or glass in a transparent door) and (2) the largest overall width of the case, when viewed from the front. This is identified as Issue 6 under ''Issues on Which DOE Seeks Comment'' in Section VII.E of this NOPR.

### *B. Economic Justification and Energy Savings*

#### 1. Economic Impacts on Commercial Customers

##### a. Life-Cycle Cost and Payback Period

To evaluate the economic impact of the TSLs on customers, DOE conducted an LCC analysis for each level. More efficient commercial refrigeration equipment would affect customers in two ways: Annual operating expense would decrease and purchase price would increase. DOE analyzed the net effect by calculating the LCC. Inputs used for calculating the LCC include total installed costs (i.e., equipment price plus installation costs), annual energy savings, average electricity costs by customer, energy price trends, repair costs, maintenance costs, equipment lifetime, and discount rates.

DOE's LCC and PBP analyses provided five outputs for each TSL that are reported in Table V–4 through Table V–18. The first three outputs are the proportion of commercial refrigeration equipment purchases where the purchase of a standard-compliant piece of equipment would create a net LCC increase, no impact, or a net LCC savings for the customer. DOE used the estimated distribution of shipments by efficiency level for each equipment class to determine the affected customers. The fourth output is the average net LCC savings from standard-compliant equipment. The fifth output is the average PBP for the customer investment in standard-compliant equipment. The payback period is the number of years it would take for the customer to recover through energy savings the increased costs of higher efficiency equipment compared with the purchase of baseline efficiency equipment.

TABLE V–4—SUMMARY LCC AND PBP RESULTS FOR VOP.RC.M EQUIPMENT CLASS

| | Trial standard level | | | | |
|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 |
| Equipment with Net LCC Increase (%) | 0 | 0 | 0 | 0 | 63 |
| Equipment with No Change in LCC (%) | 65 | 47 | 30 | 30 | 2 |
| Equipment with Net LCC Savings (%) | 35 | 53 | 70 | 70 | 34 |
| Mean LCC Savings ($) | 1,201 | 1,143 | 1,551 | 1,551 | −234 |
| Mean Payback Period (years) | 0.9 | 1.5 | 2.2 | 2.2 | 9.7 |

TABLE V–5—SUMMARY LCC AND PBP RESULTS FOR VOP.RC.L EQUIPMENT CLASS

| | Trial standard level | | | | |
|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 |
| Equipment with Net LCC Increase (%) | 0 | 0 | 0 | 0 | 0 |
| Equipment with No Change in LCC (%) | 68 | 52 | 22 | 8 | 8 |
| Equipment with Net LCC Savings (%) | 32 | 48 | 78 | 92 | 92 |
| Mean LCC Savings ($) | 3,132 | 4,005 | 4,089 | 3,364 | 3,364 |
| Mean Payback Period (years) | 0.8 | 1.2 | 1.3 | 3.0 | 3.0 |

TABLE V–6—SUMMARY LCC AND PBP RESULTS FOR VOP.SC.M EQUIPMENT CLASS

| | Trial standard level | | | | |
|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 |
| Equipment with Net LCC Increase (%) | 0 | 0 | 0 | 0 | 19 |
| Equipment with No Change in LCC (%) | 65 | 32 | 17 | 17 | 3 |
| Equipment with Net LCC Savings (%) | 35 | 68 | 83 | 83 | 78 |
| Mean LCC Savings ($) | 758 | 1,065 | 1,342 | 1,342 | 703 |

TABLE V–6—SUMMARY LCC AND PBP RESULTS FOR VOP.SC.M EQUIPMENT CLASS—Continued

| | Trial standard level | | | | |
|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 |
| Mean Payback Period (years) | 0.8 | 1.8 | 2.7 | 2.7 | 5.9 |

TABLE V–7—SUMMARY LCC AND PBP RESULTS FOR VCT.RC.M EQUIPMENT CLASS

| | Trial standard level | | | | |
|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 |
| Equipment with Net LCC Increase (%) | 0 | 0 | 0 | 19 | 19 |
| Equipment with No Change in LCC (%) | 79 | 57 | 25 | 7 | 7 |
| Equipment with Net LCC Savings (%) | 21 | 43 | 75 | 74 | 74 |
| Mean LCC Savings ($) | 286 | 581 | 1,107 | 867 | 867 |
| Mean Payback Period (years) | 0.9 | 1.4 | 4.6 | 6.1 | 6.1 |

TABLE V–8—SUMMARY LCC AND PBP RESULTS FOR VCT.RC.L EQUIPMENT CLASS

| | Trial standard level | | | | |
|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 |
| Equipment with Net LCC Increase (%) | 0 | 0 | 0 | 0 | 0 |
| Equipment with No Change in LCC (%) | 60 | 40 | 28 | 8 | 8 |
| Equipment with Net LCC Savings (%) | 40 | 60 | 72 | 92 | 92 |
| Mean LCC Savings ($) | 676 | 3,594 | 3,662 | 3,546 | 3,546 |
| Mean Payback Period (years) | 1.2 | 2.6 | 2.6 | 3.7 | 3.7 |

TABLE V–9—SUMMARY LCC AND PBP RESULTS FOR VCT.SC.I EQUIPMENT CLASS

| | Trial standard level | | | | |
|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 |
| Equipment with Net LCC Increase (%) | 0 | 0 | 0 | 0 | 0 |
| Equipment with No Change in LCC (%) | 52 | 37 | 15 | 7 | 7 |
| Equipment with Net LCC Savings (%) | 48 | 63 | 85 | 93 | 93 |
| Mean LCC Savings ($) | 2,305 | 3,806 | 3,841 | 3,818 | 3,818 |
| Mean Payback Period (years) | 1.1 | 1.7 | 2.4 | 2.5 | 2.5 |

TABLE V–10—SUMMARY LCC AND PBP RESULTS FOR VCS.SC.I EQUIPMENT CLASS

| | Trial standard level | | | | |
|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 |
| Equipment with Net LCC Increase (%) | 0 | 0 | 0 | 0 | 0 |
| Equipment with No Change in LCC (%) | 76 | 49 | 11 | 11 | 11 |
| Equipment with Net LCC Savings (%) | 24 | 51 | 89 | 89 | 89 |
| Mean LCC Savings ($) | 640 | 1,191 | 1,565 | 1,565 | 1,565 |
| Mean Payback Period (years) | 0.4 | 0.6 | 1.4 | 1.4 | 1.4 |

TABLE V–11—SUMMARY LCC AND PBP RESULTS FOR SVO.RC.M EQUIPMENT CLASS

| | Trial standard level | | | | |
|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 |
| Equipment with Net LCC Increase (%) | 0 | 0 | 0 | 0 | 62 |
| Equipment with No Change in LCC (%) | 62 | 42 | 24 | 24 | 4 |
| Equipment with Net LCC Savings (%) | 38 | 58 | 76 | 76 | 34 |
| Mean LCC Savings ($) | 810 | 782 | 1,106 | 1,106 | −170 |
| Mean Payback Period (years) | 0.8 | 1.5 | 2.1 | 2.1 | 9.7 |

TABLE V–12—SUMMARY LCC AND PBP RESULTS FOR SVO.SC.M EQUIPMENT CLASS

| | Trial standard level | | | | |
|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 |
| Equipment with Net LCC Increase (%) | 0 | 0 | 0 | 0 | 17 |
| Equipment with No Change in LCC (%) | 67 | 34 | 19 | 19 | 4 |
| Equipment with Net LCC Savings (%) | 33 | 66 | 81 | 81 | 79 |
| Mean LCC Savings ($) | 527 | 756 | 988 | 988 | 516 |
| Mean Payback Period (years) | 0.7 | 1.6 | 2.6 | 2.6 | 5.9 |

TABLE V–13—SUMMARY LCC AND PBP RESULTS FOR SOC.RC.M EQUIPMENT CLASS

| | Trial standard level | | | | |
|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 |
| Equipment with Net LCC Increase (%) | 0 | 0 | 0 | 0 | 71 |
| Equipment with No Change in LCC (%) | 83 | 66 | 32 | 32 | 5 |
| Equipment with Net LCC Savings (%) | 17 | 34 | 68 | 68 | 24 |
| Mean LCC Savings ($) | 363 | 759 | 819 | 819 | −673 |
| Mean Payback Period (years) | 0.6 | 0.9 | 1.9 | 1.9 | 12.6 |

TABLE V–14—SUMMARY LCC AND PBP RESULTS FOR HZO.RC.M EQUIPMENT CLASS

| | Trial standard level | | | | |
|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 |
| Equipment with Net LCC Increase (%) | 0 | 0 | 0 | 0 | 0 |
| Equipment with No Change in LCC (%) | 80 | 60 | 39 | 19 | 19 |
| Equipment with Net LCC Savings (%) | 20 | 40 | 61 | 81 | 81 |
| Mean LCC Savings ($) | 376 | 792 | 942 | 917 | 917 |
| Mean Payback Period (years) | 0.6 | 0.9 | 1.4 | 1.8 | 1.8 |

TABLE V–15—SUMMARY LCC AND PBP RESULTS FOR HZO.RC.L EQUIPMENT CLASS

| | Trial standard level | | | | |
|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 |
| Equipment with Net LCC Increase (%) | 0 | 0 | 0 | 0 | 0 |
| Equipment with No Change in LCC (%) | 59 | 39 | 19 | 19 | 19 |
| Equipment with Net LCC Savings (%) | 41 | 61 | 81 | 81 | 81 |
| Mean LCC Savings ($) | 593 | 927 | 971 | 971 | 971 |
| Mean Payback Period (years) | 1.1 | 1.5 | 1.8 | 1.8 | 1.8 |

TABLE V–16—SUMMARY LCC AND PBP RESULTS FOR HZO.SC.M EQUIPMENT CLASS

| | Trial standard level | | | | |
|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 |
| Equipment with Net LCC Increase (%) | 0 | 0 | 0 | 0 | 0 |
| Equipment with No Change in LCC (%) | 73 | 45 | 21 | 10 | 10 |
| Equipment with Net LCC Savings (%) | 27 | 55 | 79 | 90 | 90 |
| Mean LCC Savings ($) | 312 | 551 | 759 | 721 | 721 |
| Mean Payback Period (years) | 0.4 | 1.1 | 2.0 | 2.5 | 2.5 |

TABLE V–17—SUMMARY LCC AND PBP RESULTS FOR HZO.SC.L EQUIPMENT CLASS

| | Trial standard level | | | | |
|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 |
| Equipment with Net LCC Increase (%) | 0 | 0 | 0 | 0 | 0 |
| Equipment with No Change in LCC (%) | 73 | 45 | 21 | 10 | 10 |
| Equipment with Net LCC Savings (%) | 27 | 55 | 79 | 90 | 90 |
| Mean LCC Savings ($) | 610 | 1,094 | 1,585 | 1,559 | 1,559 |
| Mean Payback Period (years) | 0.4 | 0.9 | 1.6 | 1.9 | 1.9 |

TABLE V–18—SUMMARY LCC AND PBP RESULTS FOR HCT.SC.I EQUIPMENT CLASS

| | Trial standard level | | | | |
|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 |
| Equipment with Net LCC Increase (%) | 0 | 0 | 0 | 0 | 0 |
| Equipment with No Change in LCC (%) | 64 | 46 | 30 | 14 | 14 |
| Equipment with Net LCC Savings (%) | 36 | 54 | 70 | 86 | 86 |
| Mean LCC Savings ($) | 192 | 692 | 710 | 693 | 693 |
| Mean Payback Period (years) | 0.7 | 1.5 | 1.6 | 2.1 | 2.1 |

For three equipment classes (VOP.RC.M, SVO.RC.M, and SOC.RC.M) TSL 5 resulted in a negative LCC savings compared with the purchase of baseline equipment. For all other equipment classes, TSL 5 showed positive LCC savings. DOE noted that for equipment classes with lighting, the inclusion of LED lighting at TSL 5 had a significant impact on the calculated LCC savings. For equipment classes without lighting (i.e., VCS.SC.I, HZO.RC.L, HZO.SC.M, HZO.SC.L, HCT.SC.I), the LCC savings at TSL 5 was either identical to that of TSL 3, or less (between $17 and $38 over the life of the equipment). However, for equipment classes with lighting the difference in the LCC calculated between TSL 3 and TSL 5 varied from $23 for VCT.SC.I to $1785 for VOP.RC.M. When compared to TSL 3, the estimated reduction in LCC savings for TSL 5 was most pronounced for the three medium temperature equipment classes identified above as having negative LCC compared to the baseline (VOP.RC.M, SOC.RC.M, and SVO.RC.M), varying between $1276 and $1785 dollars. For three additional equipment classes (VOP.RC.L, SVO.SC.M, and VOP.SC.M), when compared to TSL 3, the difference in LCC was greater than $500. DOE noted that these are all medium temperature cases with the exception of VOP.RC.L, which is a small sales volume unit, similar in design to a medium temperature VOP.RC.M case.

The inclusion of LED lighting systems result in an incremental increase in installed price. It also increases annualized lighting maintenance cost, since LED lights were assumed to be replaced after 50,000 hours or 5.7 years of steady operation. DOE performed two sensitivity analyses of the effect of projected cost reductions in LED lighting systems on LCC. These analyses involved five equipment classes: VOP.RC.M, VOP.SC.M, SVO.RC.M, SVO.SC.M, and SOC.RC.M. In the first sensitivity analysis, DOE determined the reduction in LED fixture cost, applied to the installed price in 2012, that would be necessary to reduce the average LCC for TSL 5 to a level equivalent to the LCC savings at TSL 3, the maximum LCC level. DOE determined that for these five equipment classes, a LED cost reduction ranging from 37 percent to 44 percent, depending on equipment class, would provide an LCC at TSL 5 equivalent to that at TSL 3.

In the second sensitivity analysis, DOE presumed that the cost for replacement LED fixtures in 2018 would be reduced by 50 percent of the cost assumed in the base LCC analysis, and then calculated the reduction in LED fixture cost necessary by 2012 to reduce the average LCC for TSL 5 to a level that provided equivalent LCC savings as TSL 3. DOE determined that for these five equipment classes an LED cost reduction ranging from 29 percent to 40 percent, depending on equipment class, would provide a LCC at TSL 5 equivalent to that at TSL 3.

Based on these analyses, DOE concluded that a reduction in LED fixture costs of approximately 45 percent would be sufficient to result in the maximum LCC savings for all five equipment classes at TSL 5. DOE estimated that this reduction in LED fixture costs would also increase LCC savings for all other equipment classes with installed lighting at TSL 5. DOE estimates that for all equipment classes to achieve their maximum LCC savings at TSL 5, LED fixture costs must decrease by at least 45 percent. DOE concluded that a reduction in LED costs of less than 45 percent could result in only certain commercial refrigeration equipment classes achieving their maximum LCC savings at TSL 5.

b. Rebuttable Presumption Payback

As discussed above, EPCA provides a rebuttable presumption that an energy conservation standard is economically justified if the increased purchase cost for the equipment that meets the standard is less than three times the value of the first year energy savings resulting from the standard. DOE calculated a rebuttable presumption payback period for each TSL to determine if DOE could presume that a standard at that level is economically justified. Rather than using distributions for input values, DOE used discrete values and, as required by EPCA, based the calculation on the DOE commercial refrigeration equipment test procedure assumptions. As a result, DOE calculated a single rebuttable presumption payback value for each standard level, and not a distribution of payback periods.

To evaluate the rebuttable presumption, DOE estimated the additional customer price of a more efficient, standard-compliant unit using the average customer markup, and compared this cost to the value of the energy saved during the first year of operation of the equipment as determined by ANSI/ARI Standard 1200–2006. DOE interprets that the increased cost of purchasing a standard-compliant unit includes the cost of installing the equipment for use by the purchaser. DOE calculated the rebuttable presumption PBP, or the ratio of the value of the increased installed price above the baseline efficiency level to the first year's energy cost savings. When this PBP is less than three years, the rebuttable presumption is satisfied; when this PBP is equal to or more than three years, the rebuttable presumption is not satisfied.

Rebuttable presumption PBPs were calculated based on single-point national average values for installed costs and energy prices appropriate to commercial refrigeration equipment. Equipment prices are based on a shipment-weighted average distribution markup for remote condensing equipment or self-contained equipment, as applied to the MSP for each equipment class. The installed cost is based on the national average equipment price and the national average installation cost for remote condensing or self-contained equipment as appropriate. Average first-year energy costs were calculated as the product of the annual energy consumption used in the LCC and the shipment-weighted national-average electricity price, which was calculated using the shipment weights for the four business types using commercial refrigeration equipment.

The equation for the rebuttable PBP is:

$PBP = \Delta IC/\Delta EC$

Where

$PBP$ = payback period in years,
$\Delta IC$ = difference in the total installed cost between the more efficient standard level equipment (energy consumption levels 2, 3, etc.) and the baseline (energy consumption level 1) equipment, and
$\Delta EC$ = difference in annual energy costs.

PBPs are expressed in years. PBPs greater than the life of the equipment means that the increased total installed cost of the more efficient equipment is not recovered in reduced operating costs for the more efficient equipment. The rebuttable presumption PBPs differ from the other PBPs calculated in the LCC analysis (see Section IV.E.12 of this NOPR) because they do not include maintenance or repair costs and they are based on single point values instead of distributions for installation costs or energy costs. The baseline efficiency level for the rebuttable presumption calculation is the baseline established in the engineering analysis.

Table V–19 shows the nationally averaged rebuttable presumption paybacks calculated for all equipment classes and efficiency levels. The highest efficiency level with a rebuttable presumption payback of less than three years is also shown in Table V–19 for each equipment class. For eight equipment classes, the rebuttable presumption criteria were satisfied at all TSLs. At TSL 4, the rebuttable presumption criteria are satisfied for 13 equipment classes. At TSL 3, the rebuttable presumption criteria are satisfied for 14 equipment classes. At TSL 2, the rebuttable presumption criteria were satisfied for all equipment classes. However, while DOE has examined the rebuttable presumption PBPs, DOE has not determined economic justification for any of the standard levels analyzed based on the ANOPR rebuttable presumption analysis. The economic justification for each TSL for each equipment class will take into account the more detailed analysis of the economic impacts of increased efficiency pursuant to Section 325(o)(2)(B)(i) of EPCA. (42 U.S.C. 6295(o)(2)(B)(i) and 6316(e)(1)).

TABLE V–19—REBUTTABLE PRESUMPTION PAYBACK PERIODS BY EFFICIENCY LEVEL AND EQUIPMENT CLASS

| Equipment type | Rebuttable presumption payback period (years) | | | | | Highest TSL with PBP < 3 Years |
|---|---|---|---|---|---|---|
| | Level 1 | Level 2 | Level 3 | Level 4 | Level 5 | |
| VOP.RC.M | 0.8 | 1.1 | 1.7 | 1.7 | 5.9 | 4 |
| VOP.RC.L | 0.7 | 1.1 | 1.2 | 2.5 | 2.5 | 5 |
| VOP.SC.M | 0.8 | 1.5 | 2.3 | 2.3 | 4.5 | 4 |
| VCT.RC.M | 0.8 | 1.2 | 4.1 | 5.4 | 5.4 | 2 |
| VCT.RC.L | 1.0 | 2.4 | 2.4 | 3.3 | 3.3 | 3 |
| VCT.SC.I | 1.0 | 1.6 | 2.2 | 2.3 | 2.3 | 5 |
| VCS.SC.I | 0.4 | 0.6 | 1.3 | 1.3 | 1.3 | 5 |
| SVO.RC.M | 0.8 | 1.1 | 1.7 | 1.7 | 5.9 | 4 |
| SVO.SC.M | 0.6 | 1.3 | 2.2 | 2.2 | 4.5 | 4 |
| SOC.RC.M | 0.5 | 0.8 | 1.4 | 1.4 | 7.1 | 4 |
| HZO.RC.M | 0.5 | 0.8 | 1.2 | 1.6 | 1.6 | 5 |
| HZO.RC.L | 1.0 | 1.3 | 1.6 | 1.6 | 1.6 | 5 |
| HZO.SC.M | 0.4 | 1.0 | 1.9 | 2.3 | 2.3 | 5 |
| HZO.SC.L | 0.3 | 0.8 | 1.5 | 1.7 | 1.7 | 5 |
| HCT.SC.I | 0.7 | 1.4 | 1.5 | 2.0 | 2.0 | 5 |

c. Life-Cycle Cost Sub-Group Analysis

Using the LCC spreadsheet model, DOE estimated the impact of the TSLs on the following customer sub-group: small businesses. For the retail food sales business, the Small Business Association (SBA) defines as small businesses supermarkets and other grocery stores and convenience stores with less than $25 million in total annual sales. For specialty stores (e.g., meat markets, bakeries, fish and seafood markets), this limit is set at less than $6.5 million in annual sales. According to the Food Marketing Institute, the average supermarket had sales of approximately $15 million in 2006, so a small business could be represented by one to two average-size supermarkets or a chain of smaller grocery or convenience stores. The Food Marketing Institute defines independent stores as a retailer with one to ten stores, so most small supermarkets or grocery businesses as defined by SBA would be classified as independent grocery stores by the industry. A somewhat larger chain of convenience stores could still be classified as a small business.

DOE estimated the LCC and PBP for small food sales businesses defined by SBA by presuming that most small business customers could be represented by the analysis performed for small grocery and convenience store owners. DOE assumed, however, that the smaller, independent grocery and convenience store chains may not have access to national accounts, but would instead purchase equipment primarily through distributors and grocery wholesalers. DOE modified the distribution channels for remote condensing and self-contained equipment to these small businesses as follows:

- For remote condensing equipment, 15 percent of the sales were assumed to pass through a manufacturer-to-distributor-to-contractor-to-customer channel, and 85 percent were assumed to be purchased through a manufacturer-to-distributor-to-customer channel.
- For self-contained equipment, 35 percent of sales were assumed to pass through a manufacturer-to-distributor-to-contractor-to-customer channel, and 65 percent were assumed to be purchased through a manufacturer-to-distributor-to-customer channel.

In both cases, the distribution chain markups were calculated accordingly. Table V–20 shows the mean LCC savings from proposed energy conservation standards for the small business sub-group, and Table V–21 shows the mean payback period (in years) for this sub-group. More detailed discussion on the LCC sub-group analysis and results can be found in Chapter 12 of the TSD.

TABLE V–20—MEAN LIFE-CYCLE COST SAVINGS FOR COMMERCIAL REFRIGERATION EQUIPMENT PURCHASED BY LCC SUB-GROUP (SMALL BUSINESS) (2007$) *

| Equipment class | TSL 1 | TSL 2 | TSL 3 | TSL 4 | TSL 5 |
|---|---|---|---|---|---|
| VOP.RC.M | 1,536 | 1,524 | 2,096 | 2,096 | 564 |
| VOP.RC.L | 3,995 | 5,158 | 5,301 | 4,688 | 4,688 |
| VOP.SC.M | 968 | 1,413 | 1,840 | 1,840 | 1,308 |
| VCT.RC.M | 366 | 757 | 1,689 | 1,625 | 1,625 |
| VCT.RC.L | 876 | 4,842 | 4,941 | 5,042 | 5,042 |
| VCT.SC.I | 2,957 | 4,981 | 5,155 | 5,151 | 5,151 |
| VCS.SC.I | 805 | 1,511 | 2,031 | 2,031 | 2,031 |
| SVO.RC.M | 1,036 | 1,044 | 1,492 | 1,492 | 400 |
| SVO.SC.M | 669 | 994 | 1,346 | 1,346 | 953 |
| SOC.RC.M | 461 | 973 | 1,107 | 1,107 | (175) |
| HZO.RC.M | 476 | 1,013 | 1,221 | 1,202 | 1,202 |
| HZO.RC.L | 766 | 1,206 | 1,274 | 1,274 | 1,274 |
| HZO.SC.M | 393 | 708 | 1,005 | 974 | 974 |
| HZO.SC.L | 766 | 1,394 | 2,069 | 2,052 | 2,052 |
| HCT.SC.I | 244 | 898 | 925 | 919 | 919 |

* Numbers in parentheses indicate negative savings.

TABLE V–21—MEAN PAYBACK PERIOD FOR COMMERCIAL REFRIGERATION EQUIPMENT PURCHASED BY LCC SUB-GROUP (SMALL BUSINESS) (YEARS)

| Equipment class | TSL 1 | TSL 2 | TSL 3 | TSL 4 | TSL 5 |
|---|---|---|---|---|---|
| VOP.RC.M | 0.8 | 1.3 | 2.0 | 2.0 | 8.5 |
| VOP.RC.L | 0.7 | 1.1 | 1.2 | 2.7 | 2.7 |
| VOP.SC.M | 0.8 | 1.6 | 2.4 | 2.4 | 5.2 |
| VCT.RC.M | 0.8 | 1.3 | 4.2 | 5.6 | 5.6 |
| VCT.RC.L | 1.1 | 2.4 | 2.4 | 3.4 | 3.4 |
| VCT.SC.I | 1.0 | 1.6 | 2.1 | 2.2 | 2.2 |
| VCS.SC.I | 0.4 | 0.6 | 1.3 | 1.3 | 1.3 |
| SVO.RC.M | 0.8 | 1.3 | 1.9 | 1.9 | 8.5 |
| SVO.SC.M | 0.6 | 1.4 | 2.3 | 2.3 | 5.2 |
| SOC.RC.M | 0.5 | 0.8 | 1.7 | 1.7 | 10.8 |
| HZO.RC.M | 0.5 | 0.8 | 1.2 | 1.6 | 1.6 |
| HZO.RC.L | 1.0 | 1.4 | 1.7 | 1.7 | 1.7 |
| HZO.SC.M | 0.4 | 1.0 | 1.8 | 2.3 | 2.3 |
| HZO.SC.L | 0.3 | 0.8 | 1.5 | 1.7 | 1.7 |
| HCT.SC.I | 0.6 | 1.3 | 1.4 | 1.9 | 1.9 |

For commercial refrigeration equipment, the LCC and PBP impacts for small businesses are similar to those of all customers as a whole. While the discount rate for small grocery stores is higher than that for commercial refrigeration equipment customers as a whole and equipment prices are higher due to the higher markups, these small business customers appear to retain commercial refrigeration equipment over longer periods, and generally, smaller stores tend to pay higher electrical prices. The average LCC savings for the small business sub-group is slightly higher than that calculated for the average commercial refrigeration equipment customer, and the average PBP is slightly shorter than the national average. DOE tentatively concluded that the small food sales businesses as defined by SBA will not experience economic impacts significantly different or more negative than those impacts on food sales businesses as a whole.

2. Economic Impacts on Manufacturers

DOE performed an MIA to estimate the impact of amended energy conservation standards on commercial refrigeration equipment manufacturers (Chapter 13 of the TSD).

a. Industry Cash-Flow Analysis Results

Table V–22 and Table V–23 show the MIA results for each TSL using both markup scenarios described above for commercial refrigeration equipment.[24]

TABLE V–22—MANUFACTURER IMPACT ANALYSIS FOR THE COMMERCIAL REFRIGERATION EQUIPMENT INDUSTRY UNDER THE PRESERVATION OF GROSS MARGIN PERCENTAGE MARKUP SCENARIO

| Preservation of gross margin percentage markup scenario with a rollup shipment scenario | | | | | | | |
|---|---|---|---|---|---|---|---|
| | Units | Base case | Efficiency level | | | | |
| | | | 1 | 2 | 3 | 4 | 5 |
| INPV | 2007$ Millions | 510 | 510 | 517 | 493 | 471 | 493 |

[24] The MIA estimates the impacts on commercial refrigeration equipment manufacturers of equipment in the entire range of equipment classes (i.e., the MIA results in Table V–22 and Table V–23 take into consideration the impacts on manufacturers of equipment from all equipment classes).

TABLE V–22—MANUFACTURER IMPACT ANALYSIS FOR THE COMMERCIAL REFRIGERATION EQUIPMENT INDUSTRY UNDER THE PRESERVATION OF GROSS MARGIN PERCENTAGE MARKUP SCENARIO—Continued

| Preservation of gross margin percentage markup scenario with a rollup shipment scenario | | | | | | | |
|---|---|---|---|---|---|---|---|
| | Units | Base case | Efficiency level | | | | |
| | | | 1 | 2 | 3 | 4 | 5 |
| Change in INPV | 2007$ Millions | ........................ | (0) | 6 | (17) | (40) | (18) |
| | (%) .................. | ........................ | 0.00% | 1.22% | −3.30% | −7.76% | −3.49% |
| Energy Conservation Standards Equipment Conversion Expenses. | 2007$ Millions | ........................ | 0.5 | 2.8 | 20.6 | 40.4 | 51.6 |
| Energy Conservation Standards Capital Investments. | 2007$ Millions | ........................ | 0.8 | 5.0 | 36.3 | 71.2 | 90.8 |
| Total Investment Required. | 2007$ Millions | ........................ | 1.3 | 7.8 | 57.0 | 111.6 | 142.4 |

TABLE V–23—MANUFACTURER IMPACT ANALYSIS FOR THE COMMERCIAL REFRIGERATION EQUIPMENT INDUSTRY UNDER THE PRESERVATION OF OPERATING PROFIT MARKUP SCENARIO

| Preservation of operating profit markup scenario with a rollup shipment scenario | | | | | | | |
|---|---|---|---|---|---|---|---|
| | Units | Base case | Efficiency level | | | | |
| | | | 1 | 2 | 3 | 4 | 5 |
| INPV ................ | 2007$ Millions | 510 | 447 | 423 | 382 | 330 | 226 |
| Change in INPV | 2007$ Millions | ........................ | (63) | (88) | (129) | (180) | (285) |
| | (%) .................. | ........................ | −12.34% | −17.16% | −25.20% | −35.32% | −55.77% |
| Energy Conservation Standards Equipment Conversion Expenses. | 2007$ Millions | ........................ | 0.5 | 2.8 | 20.6 | 40.4 | 51.6 |
| Energy Conservation Standards Capital Investments. | 2007$ Millions | ........................ | 0.8 | 5.0 | 36.3 | 71.2 | 90.8 |
| Total Investment Required. | 2007$ Millions | ........................ | 1.3 | 7.8 | 57.0 | 111.6 | 142.4 |

At TSL 1, the impact on INPV and cash flow varies greatly depending on the manufacturers and their ability to pass on MPC increases to the customer. DOE estimated the impacts in INPV at TSL 1 to range from approximately no impact to −$63 million, which is a change in INPV of zero percent to −12.34 percent. At this level, the industry cash flow is $50.9 million, which is nearly the same as the base case value of $51.4 million in the year leading up to the standards. Since DOE estimates that more than 80 percent of the equipment being sold is already at or above this level, manufacturers that currently meet TSL 1 will not have to make additional modifications to their equipment lines to conform to the energy conservation standards. DOE expects the lower end of the impacts to be reached, because manufacturers will be able to fully recover the increase in manufacturer production cost from customers. Therefore, DOE expects that industry revenues and costs will not be significantly negatively affected at TSL 1.

At TSL 2, the impact on INPV and cash flow continues to vary depending on the manufacturers and their ability to pass on MPC increases to the customer. DOE estimated the impacts in INPV at TSL 2 to range from approximately $6 million to −$88 million, which is a change in INPV of 1.22 percent to −17.16 percent. At this level, the industry cash flow decreases by approximately 6 percent, to $48.2 million, compared to the base case value of $51.4 million in the year leading up to the standards. DOE estimates that roughly 45 percent of the equipment being sold is already at or above this level. The required higher level of efficiency will cause some manufactures to modify their equipment lines to conform to the energy conservation standards. DOE does not expect industry revenues and costs to be affected significantly as long as manufacturers fully recover the increase in manufacturer production cost from customers. The positive INPV value is explained by the assumption that MSP increases due to higher costs of the equipment, so that manufacturers fully recover and even surpass the investments needed to achieve this level.

At TSL 3, DOE estimated the impacts in INPV to range from approximately −$17 million to −$129 million, which is a change in INPV of −3.3 percent to −25.2 percent. At this level, the industry cash flow decreases by approximately 45.5 percent, to $28 million, compared to the base case value of $51.4 million in the year leading up to the standards. Based on information submitted by industry, the majority of manufacturers would require a complete redesign of their equipment, and therefore DOE expects that commercial refrigeration equipment manufacturers will have some difficulty fully passing on larger MPC increases to customers. Manufacturers expect that the actual impacts will be closer to the higher end of the range of impacts (i.e., a drop of 25.2 percent in INPV).

At TSL 4, DOE estimated the impacts on INPV to range from −$40 million to −$180 million, which is a change in INPV of approximately −7.76 percent to −35.32 percent. At this level, the industry cash flow decreases by approximately 88.4 percent to $5.5 million, compared to the base case value of $51.4 million in the year leading up to the standards. TSL 4 was created as a combination of TSL 3 (minimum LCC) and TSL 5 (max-tech). Manufacturers were not directly asked about this combination TSL during interviews. However, DOE estimated the range of impacts at TSL 4 based on the expected impacts manufacturers reported for TSL 3 and TSL 5. Since manufacturers expect that the actual impacts will be closer to the higher range of impacts at TSL 3 and TSL 5, DOE expects that the actual impacts for TSL 4 will also be at the higher range (i.e., a drop of 35.32 percent in INPV).

At TSL 5 (max-tech), DOE estimated the impacts in INPV to range from −$18 million to −$285 million, which is a change in INPV of approximately −3.49 percent to −55.77 percent. At this level, the industry cash flow decreases by approximately 114 percent to −$7.2 million, compared to the base case value of $51.4 million in the year leading up to the standards. At higher TSLs, manufacturers have more difficulty fully passing on larger MPC increases to customers, and therefore manufacturers expect that the actual impacts will be closer to the higher end of the range of impacts (i.e., a drop of 55.77 percent in INPV). Currently, there is only one model being manufactured at these efficiency levels for most equipment classes, and some equipment classes have no equipment at these levels. At TSL 5, DOE recognizes that there is a risk of very large negative impacts if manufacturers' expectations are accurate about reduced profit margins. During the interviews, manufacturers expressed great concern at the possibility of requiring an entire equipment line to be manufactured at the max-tech levels.

b. 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 the energy conservation regulations on commercial refrigeration equipment, several other Federal regulations and pending regulations apply to commercial refrigeration equipment and other equipment produced by the same manufacturers or parent companies. DOE recognizes that each regulation can significantly affect manufacturers' financial operations. Multiple regulations affecting the same manufacturer can quickly strain manufacturers' profits and possibly cause an exit from the market. An example of these additional regulations is the U.S. Environmental Protection Agency (EPA)-mandated phaseout of hydrochlorofluorocarbons (HCFCs) and the potential residential central air conditioners and heat pumps Federal energy conservation standard. Table V–24 provides the timetables for these mandatory or potential regulations. DOE believes that the cumulative burden of the HCFC phaseout is minimal because much of the commercial refrigeration equipment industry has already initiated the transition to HFC refrigerants. As shown in Section IV.B.3 above, ARI stated that the data it provided to DOE was based on HFC refrigerants, and DOE therefore used HFC refrigerants in its analysis. DOE is aware of the industry's transition to HFC refrigerants, but requests comment on any cumulative regulatory burdens from the combined effects of impending regulations that may affect manufacturers.

TABLE V–24—FEDERAL REGULATION TIMETABLES

| Regulation | Key affected appliance | Effective date |
|---|---|---|
| Potential DOE energy conservation standards | Central air conditioners and heat pumps (residential) | 06/2011. |
| Potential DOE energy conservation standards | Room air conditioners | 06/2011 |
| EPA phaseout of HCFC refrigerant on new equipment | Room and residential central air conditioners, and commercial air conditioners. | 01/2010 |
| EPA phaseout of HCFC blowing agents on new equipment | Commercial refrigeration equipment | 01/2010. |

Production of foam insulation uses a blowing agent. The EPA strategy for meeting U.S. obligations under the Montreal Protocol requires the United States to phase out the production and use of HCFC blowing agents. HCFC–22 and HCFC–142b will be phased out on January 1, 2010. This affects equipment manufacturing in the United States after this date and causes manufacturers to switch to other blowing agents with no ozone depletion potential.

DOE recognizes that some parent companies of commercial refrigeration equipment manufacturers could also be affected by the potential energy conservation standards for central air conditioners and heat pumps and for room air conditioners. Additional investments necessary to meet these potential standards could have significant impacts on manufacturers of commercial refrigeration equipment. DOE seeks comment on the magnitude of impacts for cumulative regulatory burden on manufacturers for potential energy conservation standards for central air conditioners and heat pumps and for room air conditioners.

c. Impacts on Employment

DOE used the GRIM to assess the impacts of energy conservation standards on commercial refrigeration equipment employment. DOE used statistical data from the U.S. Census Bureau's 2006 Annual Survey of Manufacturers, the results of the engineering analysis, and interviews with manufacturers to estimate the inputs necessary to calculate industry-wide labor expenditures and employment levels.

Currently the vast majority of commercial refrigeration equipment is manufactured in the U.S. Based on the GRIM results and interviews with manufacturers, DOE expects that there would be positive direct employment impacts among domestic commercial refrigeration equipment manufacturers for TSL 1 through TSL 5. This conclusion ignores the possible relocation of domestic jobs to lower-labor-cost countries which may occur independently of new standards or may be influenced by the level of investments required by new standards. Because the labor impacts in the GRIM do not take relocation into account, the labor impacts would be different if manufacturers chose to relocate to lower cost countries. Manufactures stated that, although there are no current plans to relocate production facilities, at higher TSLs there would be increased pressure to cut costs, which could result in relocation. Chapter 13 of the TSD further discusses the employment impacts and exhibits the actual changes in employment levels by TSL.

The conclusions in this section are independent of any conclusions regarding employment impacts from the broader U.S. economy estimated in the Employment Impact Analysis. These impacts are documented in Chapter 15 of this TSD.

d. Impacts on Manufacturing Capacity

According to the majority of commercial refrigeration equipment manufacturers, new energy conservation standards will not significantly affect manufacturers' production capacity. Any necessary redesign of commercial refrigeration equipment will not change the fundamental assembly of the equipment. However, manufacturers anticipate some minor changes to tooling. Thus, DOE believes manufacturers will be able to maintain manufacturing capacity levels and continue to meet market demand under new energy conservation standards.

e. Impacts on Sub-Groups of Manufacturers

As discussed above, using average cost assumptions to develop an industry cash-flow estimate is not adequate for assessing differential impacts among sub-groups of manufacturers. Small manufacturers, niche equipment manufacturers, or manufacturers exhibiting a cost structure that differs largely from the industry average could be affected differently. DOE used the results of the industry characterization to group manufacturers exhibiting similar characteristics.

DOE evaluated the impact of new energy conservation standards on small businesses, as defined by the SBA for the commercial refrigeration equipment industry, as manufacturing enterprises with 750 or fewer employees. DOE shared the interview guides with small commercial refrigeration equipment manufacturers and tailored specific questions for them. During DOE's interviews, small manufacturers suggested that the impacts of standards on them would not differ from impacts on larger companies within the industry (Chapter 13 of the TSD).

3. National Impact Analysis

a. Amount and Significance of Energy Savings

To estimate the energy savings through 2042 due to new energy conservation standards, DOE compared the energy consumption of commercial refrigeration equipment under the base case to energy consumption of commercial refrigeration equipment under a new standard. The energy consumption calculated in the NIA is source energy, taking into account energy losses in the generation and transmission of electricity as discussed in Section IV.J.

DOE tentatively determined the amount of energy savings at each of the 5 TSLs being considered for the 15 primary equipment class analyzed and aggregated the results. Table V–25 shows the forecasted aggregate national energy savings for all 15 equipment classes at each TSL. The table also shows the magnitude of the estimated energy savings if the savings are discounted at seven percent and three percent. Each TSL considered in this rulemaking would result in significant energy savings, and the amount of savings increases with higher energy conservation standards (Chapter 11 of the TSD).

TABLE V–25—SUMMARY OF CUMULATIVE NATIONAL ENERGY SAVINGS FOR COMMERCIAL REFRIGERATION EQUIPMENT (ENERGY SAVINGS FOR UNITS SOLD FROM 2012 TO 2042)

| Trial standard level | Primary national energy savings (quads) (sum of all equipment classes) | | |
|---|---|---|---|
| | Undiscounted | 3% Discounted | 7% Discounted |
| 1 | 0.141 | 0.073 | 0.034 |
| 2 | 0.545 | 0.284 | 0.132 |
| 3 | 0.715 | 0.372 | 0.173 |
| 4 | 0.832 | 0.433 | 0.201 |
| 5 | 1.208 | 0.630 | 0.292 |

DOE reports both undiscounted and discounted values of energy savings. Each TSL analyzed results in additional energy savings, ranging from an estimated 0.141 quads to 1.208 quads for TSLs 1 through 5 (undiscounted).

b. Net Present Value

The net present value analysis is a measure of the cumulative benefit or cost of standards to the Nation. In accordance with the Office of Management and Budget (OMB)'s guidelines on regulatory analysis (OMB Circular A–4, Section E, September 17, 2003), DOE calculated an estimated NPV using both a seven percent and a three percent real discount rate. The seven percent rate is an estimate of the average before-tax rate of return to private capital in the U.S. economy, and reflects the returns to 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 recent OMB analysis has found the average rate of return to capital to be near this rate. In addition, DOE used the three percent rate to capture the potential effects of standards on private consumption (e.g., through higher prices for equipment and purchase of reduced amounts of energy).

This rate represents the rate at which society discounts future consumption flows to their present value. This rate can be approximated by the real rate of return on long-term Government debt (e.g., the yield on Treasury notes minus the annual rate of change in the Consumer Price Index), which has averaged about three percent on a pre-tax basis for the last 30 years.

Table V–27 shows the estimated cumulative NPV for commercial refrigeration equipment resulting from the sum of the NPV calculated for each of the 15 primary equipment classes analyzed. Table V–27 assumes the AEO2007 reference case forecast for electricity prices. At a seven percent discount rate, TSL 1–4 show positive cumulative NPVs. The highest NPV is provided by TSL 3 at $1.20 billion. TSL 4 provided $1.10 billion, close to that of TSL 3. TSL 5 showed a negative NPV at −$200 million, the result of negative NPV observed in five equipment classes (VOP.RC.M, VOP.SC.M, SVO.RC.M, SVO.SC.M, and SOC.RC.M). DOE determined through a sensitivity analysis that a 50 percent reduction in LED fixture costs, applied to equipment sold during the analysis period starting in 2012, would yield a NPV of $1.62 billion for TSL 5.[25]

At a three percent discount rate, all TSLs showed a positive NPV, with the highest NPV provided at TSL 3 (i.e., $3.25 billion). TSL 4 provided a near equivalent NPV at $3.24 billion. TSL 5 provided a NPV of $1.16 billion dollars. Three equipment classes (VOP.RC.M, SVO.RC.M, and SOC.RC.M) were estimated to have negative NPVs at a three percent discount rate at TSL 5. DOE determined through a sensitivity analysis that a 50 percent reduction in LED fixture costs, applied to all equipment sold during the analysis period starting in 2012, would result in the greatest NPV at TSL 5 with $4.76 billion.

DOE also determined that a six percent reduction in LED system costs by 2012 would be sufficient to provide a positive NPV at TSL 5 in aggregate across all equipment classes at a seven percent discount rate. DOE recognizes that the aggregate six percent reduction in LED system costs could be attained by 2012 because of the rapid development of LED technology. In addition, DOE expects that a 50 percent reduction in LED system costs is possible in 2012, given the projections discussed previously, and considers a 50 percent reduction likely to occur by 2018 as examined in the LCC LED replacement cost sensitivity analysis.

Table V–26 shows the estimated NPV results at TSL 5, for projected LED system cost reductions of six percent and 50 percent.

TABLE V–26—SUMMARY OF NET PRESENT VALUE RESULTS WITH LED SYSTEM COST SENSITIVITY*

| | TSL 5 | TSL 5 Including 6% LED system cost reduction | TSL 5 Including 50% LED system cost reduction |
|---|---|---|---|
| NPV (2007$ billion): | | | |
| 7% Discount Rate | (0.20) | 0.03 | 1.62 |
| 3% Discount Rate | 1.16 | 1.62 | 4.76 |

* Parentheses indicate negative (−) values.

In addition to the reference case, DOE examined the NPV under the AEO2007 high-growth and low-growth electricity price forecasts. The results of this examination can be found in Chapter 11 of the TSD.

TABLE V–27—SUMMARY OF CUMULATIVE NET PRESENT VALUE FOR COMMERCIAL REFRIGERATION EQUIPMENT—AEO2007 REFERENCE CASE

| Trial standard level | NPV* (billion 2007$) 7% discount rate | NPV* (billion 2007$) 3% discount rate |
|---|---|---|
| 1 | 0.33 | 0.82 |
| 2 | 0.98 | 2.59 |
| 3 | 1.20 | 3.25 |
| 4 | 1.10 | 3.24 |
| 5 | (0.20) | 1.16 |

* Numbers in parentheses indicate negative NPV, i.e., a net cost.

c. Impacts on Employment

DOE develops general estimates of the indirect employment impacts of proposed standards on the economy. As discussed above, DOE expects energy conservation standards for commercial refrigeration equipment to reduce energy bills for commercial customers, and the resulting net savings to be redirected to other forms of economic activity. DOE also realizes that these shifts in spending and economic activity could affect the demand for labor. To estimate these effects, DOE used an input/output model of the U.S. economy using Bureau of Labor Statistics (BLS) data (as described in Section IV.K; see Chapter 15 of the TSD for details).

This input/output model suggests the proposed commercial refrigeration equipment energy conservation standards are likely to slightly increase the net demand for labor in the economy. Neither the BLS data nor the input/output model used by DOE includes the quality or wage level of the jobs. As shown in Table V–28, DOE estimates that net indirect employment impacts from a proposed commercial refrigeration equipment standard are likely to be very small. The net increase in jobs is so small that it would be

[25] DOE anticipates a reduction in installed cost of LED systems over time. The projected reduction in price for LED systems is provided and discussed in Sections V.C and IV.B.3.c of this NOPR and Appendix B of the TSD.

imperceptible in national labor statistics and might be offset by other, unanticipated effects on employment.

TABLE V–28—NET NATIONAL CHANGE IN INDIRECT EMPLOYMENT, JOBS IN 2042

| Trial standard level | Net national change in jobs | | | |
|---|---|---|---|---|
| | 2012 | 2022 | 2032 | 2042 |
| 1 | 0 | 324 | 448 | 505 |
| 2 | −6 | 1,270 | 1,744 | 1,970 |
| 3 | −15 | 1,680 | 2,312 | 2,606 |
| 4 | −94 | 2,204 | 3,047 | 3,434 |
| 5 | −315 | 3,317 | 4,607 | 5,187 |
| Maximum Job Impact | −315 | 3,317 | 4,607 | 5,187 |

4. Impact on Utility or Performance of Equipment

In performing the engineering analysis, DOE considered design options that would not lessen the utility or performance of the individual classes of equipment. (42 U.S.C. 6295(o)(2)(B)(i)(IV) and 6316(e)(1)) As presented in the screening analysis (Chapter 4 of the TSD), DOE did not consider design options that reduce the utility of the equipment. Because no design options were considered that reduce utility, DOE tentatively concluded that none of the efficiency levels proposed for commercial refrigeration equipment reduce the utility or performance of the equipment.

5. Impact of Any Lessening of Competition

EPCA directs DOE to consider any lessening of competition that is likely to result from standards. It directs the Attorney General to determine in writing the impact, if any, of any lessening of competition likely to result from a proposed standard. (42 U.S.C. 6295(o)(2)(B)(i)(V) and 6316(e)(1)) To assist the Attorney General in making such a determination, DOE has provided the Department of Justice (DOJ) with copies of this Notice and the TSD for review. During MIA interviews, domestic manufacturers indicated that foreign manufacturers have entered the commercial refrigeration equipment market over the past several years. Manufacturers also stated that while there has been significant consolidation with supermarket chains, little or no consolidation has occurred among commercial refrigeration manufacturers in recent years. DOE believes that these trends will continue to happen in this market regardless of the proposed standard level chosen.

6. Need of the Nation to Conserve Energy

An improvement in the energy efficiency of commercial refrigeration equipment is likely to improve the security of the Nation's energy system by reducing overall demand for energy, and thus reduce the Nation's reliance on foreign sources of energy. Reduced demand may also improve the reliability of the electricity system, particularly during peak-load periods. As a measure of this reduced demand, DOE expects the proposed standards (TSL 4) to prevent the need for the construction of new power plants totaling approximately 643 MW of electricity generation capacity in 2042.

Enhanced energy efficiency also produces environmental benefits. The expected energy savings from higher commercial refrigeration equipment standards will reduce the emissions of air pollutants and greenhouse gases associated with energy production and fossil fuel usage. Table V–29 shows estimated cumulative $CO_2$, $NO_X$, and Hg emissions reductions for all the commercial refrigeration equipment classes over the forecast period. The expected energy savings from commercial refrigeration equipment standards will reduce the emissions of greenhouse gases associated with energy production, and it may reduce the cost of maintaining nationwide emissions standards and constraints.

TABLE V–29—SUMMARY OF EMISSIONS REDUCTIONS FOR COMMERCIAL REFRIGERATION EQUIPMENT
(cumulative reductions for equipment, 2012 to 2042)

| | Trial Standard Levels | | | | |
|---|---|---|---|---|---|
| | TSL 1 | TSL 2 | TSL 3 | TSL 4 | TSL 5 |
| Emissions Reductions. | | | | | |
| $CO_2$ (Mt) | 7.37 | 28.47 | 37.37 | 43.50 | 63.17 |
| $NO_X$ (kt) | 2.74 | 10.58 | 13.88 | 16.16 | 23.47 |
| Hg (t) | 0.09 | 0.36 | 0.47 | 0.54 | 0.80 |

Mt = million metric tons.
kt = thousand tons.
t = tons.

The estimated cumulative $CO_2$, $NO_X$, and Hg emission reductions for the proposed standard are 43.5 Mt, 16.16 kt, and 0.54 t, respectively, for all 15 equipment classes over the period from 2012 to 2042. However, TSL 5 provides the greatest reduction of emissions of all the TSLs considered. In the environmental assessment (Chapter 16 of the TSD), DOE reports estimated annual changes in $CO_2$, $NO_X$, and Hg emissions attributable to each TSL. As discussed in Section IV.L, DOE does not report $SO_2$ emissions reduction from power plants because reductions from an energy conservation standard would not affect the overall level of $SO_2$ emissions in the United States due to the emissions caps for $SO_2$.

The NEMS–BT modeling assumed that $NO_X$ would be subject to the Clean Air Interstate Rule (CAIR) issued by the U.S. Environmental Protection Agency on March 10, 2005.[26] 70 FR 25162 (May 12, 2005). On July 11, 2008, the U.S. Court of Appeals for the District of Columbia Circuit (D.C. Circuit) issued its decision in *North Carolina* v. *Environmental Protection Agency*,[27] in which the court vacated the CAIR. If left in place, the CAIR would have permanently capped emissions of $NO_X$ in 28 eastern States and the District of Columbia. As with the $SO_2$ emissions cap, a cap on $NO_X$ emissions would have meant that equipment energy conservation standards are not likely to have a physical effect on $NO_X$ emissions in States covered by the CAIR caps. While the caps would have meant that physical emissions reductions in those States would not have resulted from the energy conservation standards we are proposing today, the standards might have produced an environmental-related economic impact in the form of lower prices for emissions allowance credits, if large enough. DOE notes that the estimated total reduction in $NO_X$ emissions, including projected emissions or corresponding allowance credits in States covered by the CAIR cap was between 0.004 and 0.034 percent of the nationwide $NO_X$ emissions as a whole, percentages that DOE estimated were too small to affect allowance prices for $NO_X$ under the CAIR.

Even though the D.C. Circuit vacated the CAIR, DOE notes that the D.C. Circuit left intact EPA's 1998 $NO_X$ SIP Call rule, which capped seasonal (summer) $NO_X$ emissions from electric generating units and other sources in 23 jurisdictions and gave those jurisdictions the option to participate in a cap and trade program for those emissions. See 63 Fed. Reg. 57356, 57359 (Oct. 27, 1998).[28] Accordingly, DOE is considering whether changes are needed to its plan for addressing the issue of $NO_X$ reduction. DOE invites public comment on how the agency should address this issue, including how it might value $NO_X$ emissions for States now that the CAIR has been vacated.[29]

With regard to mercury emissions, DOE is able to report an estimate of the physical quantity changes in mercury emissions associated with an energy conservation standard. Based on the NEMS–BT modeling, Hg emissions show a slight decrease in the period from 2012 to 2042. These changes in Hg emissions, as shown in Table V–29, are extremely small with a range of between 0.02 and 0.14 percent of national base case emissions depending on TSL.

The NEMS–BT model assumed that mercury emissions would be subject to EPA's Clean Air Mercury Rule[30] (CAMR), which would have permanently capped emissions of mercury for new and existing coal-fired plants in all States by 2010. Similar to $SO_2$ and $NO_X$, DOE assumed that under such a system, energy conservation standards would result in no physical effect on these emissions, but might result in an environmental-related economic benefit in the form of a lower price for emissions allowance credits, if large enough. DOE estimated that the change in Hg emissions from standards would not be large enough to influence allowance prices under CAMR.

On February 8, 2008, the D.C. Circuit issued its decision in *New Jersey* v. *Environmental Protection Agency*,[31] in which the Court, among other actions, vacated the CAMR referenced above. Accordingly, DOE is considering whether changes are needed to its plan for addressing the issue of mercury emissions in light of the D.C. Circuit's decision. DOE invites public comment on addressing mercury emissions in this rulemaking.

DOE is considering taking into account a monetary benefit of $CO_2$ emission reductions associated with this rulemaking. During the preparation of its most recent review of the state of climate science, the Intergovernmental Panel on Climate Change (IPCC) identified various estimates of the present value of reducing carbon-dioxide emissions by one ton over the life that these emissions would remain in the atmosphere. The estimates reviewed by the IPCC spanned a range of values. In the absence of a consensus on any single estimate of the monetary value of $CO_2$ emissions, DOE used an estimate identified by the study cited in Summary for Policymakers prepared by Working Group II of the IPCC's Fourth Assessment Report to estimate the potential monetary value of the $CO_2$ reductions likely to result from the standards under consideration in this rulemaking.

The estimated year-by-year reductions in $CO_2$ emissions were converted into monetary values ranging from the $0 and $14 per ton. These monetary estimates were based on an assumption of no benefit to an average benefit value reported by the IPCC and the values include a range of discount factors used in their development.[32] Based on DOE's consideration of the IPCC report, DOE escalated the average benefit value per ton in real 2007$ at 2.4 percent per year. The resulting estimates of the potential range of benefits associated with the reduction of $CO_2$ emissions are reflected in Table V–30.

[26] See *http://www.epa.gov/cleanairinterstaterule/*.

[27] Case No. 05–1244, 2008 WL 2698180 at *1 (D.C. Cir. July 11, 2008).

[28] In the $NO_X$ SIP Call rule, EPA found that sources in the District of Columbia and 22 ''upwind'' states (States) were emitting $NO_X$ (an ozone precursor) at levels that significantly contributed to ''downwind'' states not attaining the ozone NAAQS or at levels that interfered with states in attainment maintaining the ozone NAAQS. In an effort to ensure that ''downwind'' states attain or continue to attain the ozone NAAQS, EPA established a region-wide cap for $NO_X$ emissions from certain large combustion sources and set a $NO_X$ emissions budget for each State. Unlike the cap that CAIR would have established, the $NO_X$ SIP Call Rule's cap only constrains seasonal (summer time) emissions. In order to comply with the $NO_X$ SIP Call Rule, States could elect to participate in the $NO_X$ Budget Trading Program. Under the $NO_X$ Budget Trading Program, each emission source is required to have one allowance for each ton of $NO_X$ emitted during the ozone season. States have flexibility in how they allocate allowances through their State Implementation Plans but States must remain within the EPA-established budget. Emission sources are allowed to buy, sell and bank $NO_X$ allowances as appropriate. It should be noted that, on April 16, 2008, EPA determined that Georgia is no longer subject to the $NO_X$ SIP Call rule.

[29] In anticipation of CAIR replacing the $NO_X$ SIP Call Rule, many States adopted sunset provisions for their plans implementing the $NO_X$ SIP Call Rule. The impact of the $NO_X$ SIP Call Rule on $NO_X$ emissions will depend, in part, on whether these implementation plans are reinstated.

[30] 70 FR 28606 (May 18, 2005).

[31] No. 05–1097, 2008 WL 341338, at *1 (D.C. Cir. Feb. 8, 2008).

[32] According to the IPCC, the mean social cost of carbon (SCC) reported in studies published in peer-reviewed journals was US$43 per ton of carbon. This translates into about $12 per ton of carbon dioxide. The social costs estimated represented the discounted present value of increasing (or decreasing) current emissions of carbon dioxide (or an equivalent greenhouse gas) by one ton. The literature review (Tol 2005) from which this mean was derived did not report the year in which these dollars are denominated. However, since the underlying studies spanned several years on either side of 2000, the estimate is often treated as year 2000 dollars. Updating that estimate to 2007 dollars yields a SCC of $14 per ton of carbon dioxide. Tol concluded that when only peer-reviewed studies published in recognized journals are considered, ''* * * climate change impacts may be very uncertain *but is unlikely that the marginal damage costs of carbon dioxide emissions exceed $50 per tonne carbon* [about $14 per metric ton of $CO_2$ or about $12.66 per short ton][emphasis added].'' He also concluded that the costs may be *substantially lower* than $50 per tonne of C. Tol's survey showed that 10 percent of the SCC estimates were actually negative, so that a lower bound of zero is not unreasonable.

TABLE V–30—PRELIMINARY ESTIMATES OF SAVINGS FROM $CO_2$ EMISSIONS REDUCTIONS UNDER CONSIDERED COMMERCIAL REFRIGERATION EQUIPMENT TRIAL STANDARD LEVELS

| TSL | Estimated total $CO_2$ (Mt) emission reductions | Value of estimated $CO_2$ emission reductions based on IPCC range (million $) at 7% discount rate | Value of estimated $CO_2$ emission reductions based on IPCC range (million $) at 3% Discount Rate |
|---|---|---|---|
| 1 | 7.37 | 0 to 43 | 0 to 93 |
| 2 | 28.47 | 0 to 166 | 0 to 361 |
| 3 | 37.37 | 0 to 218 | 0 to 473 |
| 4 | 43.50 | 0 to 253 | 0 to 551 |
| 5 | 63.17 | 0 to 368 | 0 to 800 |

DOE relied on the average of the IPCC reported estimate as an upper bound on the benefits resulting from reducing each metric ton of U.S. $CO_2$ emissions. It is important to note that estimate of the $14 per ton of $CO_2$ represents an average value of worldwide impacts from potential climate impacts caused by $CO_2$ emissions, and is not confined to impacts likely to occur within the U.S. In contrast, most of the other estimates of costs and benefits of increasing the efficiency of commercial refrigeration equipment discussed in this proposal include only the economic values of impacts that would be experienced in the U.S. Consequently, as DOE considers a monetary value for $CO_2$ emission reductions, the value might be restricted to a representation of those cost/benefits likely to be experienced in the United States. Currently, there are no estimated values for the U.S. benefits likely to result from $CO_2$ emission reductions. However, DOE expects that, if such values were developed, DOE would use those U.S. benefit values, and not world benefit values, in its analysis. DOE further expects that, if such values were developed, they would be lower than comparable global values. DOE invites public comment on the above discussion of $CO_2$.

DOE also investigated the potential monetary impact resulting from the impact of today's efficiency standards on $SO_2$, $NO_X$, and mercury (Hg) emissions. As previously stated, DOE's analysis assumed the presence of nationwide emission caps on $SO_2$ and caps on $NO_X$ emissions in the 28 states covered by the CAIR caps. In the presence of emission caps, DOE concluded that no physical reductions in total sector emissions would occur, however DOE's estimates for reduction of these emissions could correspond to incremental changes in the prices of emissions allowances in cap-and-trade emissions markets rather than to physical emissions reductions. For $SO_2$, the changes in annual emissions from today's rule would be less than 0.03 percent of the annual $SO_2$ allowances, a change that DOE estimated is too small to influence allowance prices. Similarly, for $NO_X$, in the 28 CAIR states, the emissions savings from today's rule would be less than 0.018 percent of $NO_X$ allowances, also a change that DOE also estimated is too small to influence allowance prices.

In DOE's analysis, for 22 non-CAIR states, emissions of $NO_X$ from electricity generation were not controlled by a regulatory cap. By 2012, DOE projected that the $NO_X$ emissions in the non-CAIR states would be about 25 percent of the national total.[33] Mercury emissions are also not controlled by a regulatory cap. For these two emissions, DOE estimated the national monetized benefits of emissions reductions from today's rule based on environmental damage estimates from the literature. Non-CAIR emissions would not be controlled by an emissions cap so those emissions would actually be reduced by the PTAC-PTHP energy savings. Available estimates suggest a very wide range of monetary values for $NO_X$ emissions, ranging from $370 per ton to $3,800 per ton of $NO_X$ from stationary sources, measured in 2001 dollars[34] or a range of $432 per ton to $4,441 per ton in 2007 dollars. The basic science linking mercury emissions from power plants to impacts on humans is considered highly uncertain. However, DOE located two estimates of the environmental damages of mercury based on two estimates of the adverse impact of childhood exposure to methyl mercury on IQ for American children, and subsequent loss of lifetime economic productivity resulting from these IQ losses. The high end estimate is based on an estimate of the current aggregate cost of the loss of IQ that results from exposure of American children of U.S. power plant origin of $1.3 billion per year in year 2000$, which works out to $32.6 million per ton emitted per year (2007$).[35] The low-end estimate was $664,000 per ton emitted in 2004$ or $729,000 per ton in 2007$), which DOE derived from a published evaluation of mercury control using different methods and assumptions from the first study, but also based on the present value of the lifetime earnings of children exposed.[36] The resulting estimates of the potential range of the present value benefits associated with the reduction of $NO_X$ in the 22 non-CAIR states and national reductions in Hg emissions are reflected in Table V.31 and Table V.32

[33] U.S. $NO_X$ emissions have been trending downward steadily since 1995, falling from 31.5 million tons in 1995 to 15.2 million in 2006 (EIA 2007). Although non-CAIR states' emissions have also fallen, the emissions in the CAIR states have fallen more rapidly; thus, the CAIR states' percentage of the total has also fallen from 87.4% in 1997 to 80.9% in 2006. For purposes of this analysis, DOE assumed that the CAIR states, percentage of emissions continues to decline until it reaches 75 percent in 2012. Seventy-five percent of emissions reductions are allocated to the CAIR states thereafter. Consequently non-CAIR state emissions would be about 25% of the total. [Reference: EIA (Energy Information Administration). 2007. Estimated Emissions for U.S. Electric Power Industry by State, 1990–2006. State Historical Tables for 2006. Released: October 26, 2007. Next Update: October 2008 *http://www.eia.doe.gov/cneaf/electricity/epa/emission_state.xls].*

[34] 2006 Report to Congress on the Costs and Benefits of Federal Regulations and Unfunded Mandates on State, Local, and Tribal Entities. Office of Management and Budget Office of Information and Regulatory Affairs, Washington, DC.

[35] Trasande, L., *et al.*, ''Applying Cost Analyses to Drive Policy that Protects Children'' 1076 ANN. N.Y. ACAD. SCI. 911 (2006).

[36] Ted Gayer and Robert Hahn, Designing Environmental Policy: Lessons from the Regulation of Mercury Emissions, Regulatory Analysis 05–01. AEI-Brookings Joint Center For Regulatory Studies, Washington, DC, 31 pp., 2004. A version of this paper was published in the *Journal of Regulatory Economics* in 2006. The estimate was derived by back-calculating the annual benefits per ton from the net present value of benefits reported in the study.

TABLE V.31—PRELIMINARY ESTIMATES OF MONETARY SAVINGS FROM REDUCTIONS OF HG (NATION) AND $NO_X$ (NON-CAIR STATES) BY TRIAL STANDARD LEVEL AT A 7% DISCOUNT RATE

| Standard size TSL | Estimated cumulative $NO_X$ (kt) emission reductions * | Value of estimated $NO_X$ emission reductions (million 2007$) | Estimated cumulative Hg (tons) emission reductions* | Value of estimated Hg emission reductions (million 2007$) |
|---|---|---|---|---|
| 1 | 2.74 | $0.1–$0.6 | 0.09 | $0.0–$0.1 |
| 2 | 10.58 | 0.2–2.3 | 0.36 | 0.0–0.5 |
| 3 | 13.88 | 0.3–3.0 | 0.47 | 0.0–0.6 |
| 4 | 16.16 | 0.3–3.5 | 0.54 | 0.0–0.7 |
| 5 | 23.47 | 0.5–5.1 | 0.80 | 0.0–1.0 |

* Values in Table V.31 may not appear to sum to the cumulative values in Table V–29 due to rounding.

TABLE V.32—PRELIMINARY ESTIMATES OF MONETARY SAVINGS FROM REDUCTIONS OF HG (NATION) AND $NO_X$ (NON-CAIR STATES) BY TRIAL STANDARD LEVEL AT A 3% DISCOUNT RATE

| Standard size TSL | Estimated cumulative $NO_X$ (kt) emission reductions * | Value of estimated $NO_X$ emission reductions (million 2007$) | Estimated cumulative Hg (tons) emission reductions | Value of estimated Hg emission reductions (million 2007$) |
|---|---|---|---|---|
| 1 | 2.74 | $0.1–$1.5 | 0.09 | $0.0–$1.0 |
| 2 | 10.58 | 0.5–5.6 | 0.36 | 0.1–3.9 |
| 3 | 13.88 | 0.7–7.4 | 0.47 | 0.1–5.1 |
| 4 | 16.16 | 0.8–8.6 | 0.54 | 0.1–5.9 |
| 5 | 23.47 | 1.2–12.5 | 0.80 | 0.2–8.6 |

* Values in Table V.32 may not appear to sum to the cumulative values in Table V–29 due to rounding.

As discussed above, with the D.C. Circuit vacating the CAIR, DOE is considering how it should address the issue of $NO_X$ reduction and corresponding monetary valuation. DOE invites public comment on how the agency should address this issue, including how to value $NO_X$ emissions for States in the absence of the CAIR.

7. 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) and 6316(e)(1)) Under this provision, DOE considered LCC impacts on identifiable groups of customers, such as customers of different business types, who may be disproportionately affected by any national energy conservation standard level. DOE also considered the reduction in generated capacity that could result from the imposition of any national energy conservation standard level.

*C. Proposed Standard*

EPCA specifies that any new or amended energy conservation standard for any type (or class) of covered equipment 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) and 6316(e)(1)) In determining whether a standard is economically justified, the Secretary must determine whether the benefits of the standard exceed its burdens. (42 U.S.C. 6295(o)(2)(B)(i) and 6316(e)(1)) The new or amended standard must ''result in significant conservation of energy.'' (42 U.S.C. 6295(o)(3)(B) and 6316(e)(1))

DOE considered the impacts of standards at each of five trial standard levels, beginning with the most efficient level (TSL 5) and worked down to a level where DOE determined the benefits of potential standards outweighed the burdens of potential standards. To aid the reader as DOE discusses the benefits and/or burdens of each TSL, Table V–33 presents a summary of quantitative analysis results for each TSL based on the assumptions and methodology discussed above. This table presents the results or, in some cases, a range of results, for each TSL. The range of values reported in this table for industry impacts represents the results for the different markup scenarios that DOE used to estimate manufacturer impacts.

TABLE V–33—SUMMARY OF RESULTS BASED UPON THE AEO2007 REFERENCE CASE ENERGY PRICE FORECAST*

| | TSL 1 | TSL 2 | TSL 3 | TSL 4 | TSL 5 |
|---|---|---|---|---|---|
| Primary Energy Saved (quads) | 0.141 | 0.545 | 0.715 | 0.832 | 1.208 |
| 7% Discount Rate | 0.034 | 0.132 | 0.173 | 0.201 | 0.292 |
| 3% Discount Rate | 0.073 | 0.284 | 0.372 | 0.433 | 0.603 |
| Generation Capacity Reduction (GW) ** | 0.109 | 0.421 | 0.552 | 0.643 | 0.934 |
| NPV (2007$ billion): | | | | | |
| 7% Discount Rate | 0.33 | 0.98 | 1.20 | 1.10 | (0.20) |
| 3% Discount Rate | 0.82 | 2.59 | 3.25 | 3.24 | 1.16 |
| Industry Impacts: | | | | | |
| Industry NPV (2007$ million) | 0–(63) | 6–(88) | (17)–(129) | (40)–(180) | (18)–(285) |
| Industry NPV (% Change) | 0–(12) | 1–(17) | (3)–(25) | (8)–(35) | (3)–(56) |
| Cumulative Emissions Impacts: † | | | | | |

TABLE V–33—SUMMARY OF RESULTS BASED UPON THE AEO2007 REFERENCE CASE ENERGY PRICE FORECAST*—Continued

| | TSL 1 | TSL 2 | TSL 3 | TSL 4 | TSL 5 |
|---|---|---|---|---|---|
| $CO_2$ (Mt) | 7.37 | 28.47 | 37.37 | 43.50 | 63.17 |
| $NO_X$ (kt) | 2.74 | 10.58 | 13.88 | 16.16 | 23.47 |
| Hg (t) | 0.09 | 0.36 | 0.47 | 0.54 | 0.80 |
| Life-Cycle Cost: | | | | | |
| Net Savings (%) | 17–48 | 34–68 | 61–89 | 68–93 | 24–93 |
| Net Increase (%) | 0 | 0 | 0 | 0–19 | 0–71 |
| No Change (%) | 52–83 | 32–66 | 11–39 | 7–32 | 2–19 |
| Mean LCC Savings (2007$) | 192–3132 | 551–4005 | 710–4089 | 693–3818 | (673)–3818 |
| Mean PBP (yrs) | 0.4–1.2 | 0.6–2.6 | 1.3–4.6 | 1.4–6.1 | 1.4–12.6 |

* Parentheses indicate negative (−) values. For LCCs, a negative value means an increase in LCC by the amount indicated.
** Change in installed generation capacity by the year 2042 based on AEO2007 Reference Case.
† $CO_2$ emissions impacts include physical reductions at power plants. $NO_X$ emissions impacts include physical reductions at power plants as well as production of emissions allowance credits where $NO_X$ emissions are subject to emissions caps.

First, DOE considered TSL 5, the most efficient level for all equipment classes. TSL 5 would likely save an estimated 1.208 quads of energy through 2042, an amount DOE considers significant. Discounted at seven percent, the projected energy savings through 2042 would be 0.292 quads. For the Nation as a whole, DOE projects that TSL 5 would result in a net decrease of $200 million in NPV, using a discount rate of seven percent. Five equipment classes (VOP.RC.M, VOP.SC.M, SVO.RC.M, SVO.SC.M, and SOC.RC.M) show negative NPV at TSL 5. The emissions reductions at TSL 5 are 63.17 Mt of $CO_2$ and up to 23.47 kt of $NO_X$. DOE also estimates that under TSL 5, total generating capacity in 2042 will decrease compared to the base case by 0.934 gigawatts (GW).

At TSL 5, DOE projects that the average commercial refrigeration equipment customer will experience a reduction in LCC compared to the baseline for 12 of the 15 equipment classes analyzed, while three equipment classes (VOP.RC.M, SVO.RC.M, SOC.RC.M) experienced an increase in LCC. These three equipment classes are among the five identified above that DOE showed had negative NPV. The two additional classes, SVO.SC.M and VOP.SC.M, had positive LCC savings at TSL 5, but at substantially reduced values compared to those shown at TSL 4 or TSL 3. LCC savings for all 15 equipment classes vary from negative (−$673) to positive $3,818. At TSL 5, DOE estimates the fraction of customers experiencing LCC increases will vary between 0 and 71 percent depending on equipment class. The mean payback period for the average commercial refrigeration equipment customer at TSL 5 compared to the baseline level is projected to be between 1.4 and 12.6 years, depending on equipment class.

At higher TSLs, manufacturers have a more difficult time fully passing on larger increases in MPC to customers, and therefore manufacturers expect the higher end of the range of impacts to be reached at TSL 5 (i.e., a drop of 55.77 percent in INPV). At TSL 5, there is the risk of very large negative impacts on the industry if manufacturers' profit margins are reduced. Manufacturers expressed great concern at the possibility of having to manufacture an entire equipment line at the max-tech levels, because customers put a much higher priority on marketing and displaying their goods than they do on energy efficiency. For this reason, manufacturers fear that they will be unable to recover the additional cost incurred from producing the most efficient equipment possible. See Section IV.I for additional manufacturer concerns.

After carefully considering the analysis and weighing the benefits and burdens of TSL 5, DOE tentatively concludes that the estimated benefits of energy savings and related benefits would not outweigh the potential $200 million net economic cost to the Nation (at the seven percent discount rate), as well as the economic burden on consumers and the potential negative impact on manufacturers through reduction in INPV.

As discussed above, DOE proposes to reject TSL 5 because DOE finds that the benefits to the Nation of TSL 5 (energy savings, commercial consumer average LCC savings, and emission reductions) do not outweigh the costs (national NPV decrease and loss of manufacturer INPV), and, therefore, DOE proposes that TSL 5 is not economically justified. This proposal reflects DOE's tentative conclusion that there remains too much uncertainty regarding the timing and extent of anticipated reductions in LED costs to justify standards at the TSL 5 level. While considerable information is available that suggests LED costs are likely to decline more than assumed in DOE's analysis (see discussion in sections IV.B.3.c, V.B.1.a, and V.B.3.b), DOE believes that it must have a higher degree of confidence that the timing and extent of such further cost reductions will warrant higher standards before it imposes such requirements. DOE is soliciting public comments on these and other issues, and will reconsider this tentative conclusion during the development of its final rule. (See Section VII.E.1.)

As mentioned above, if LED system costs achieve the 50 percent reduction projection by 2012, the estimated NPV at TSL 5 would be a positive $1.62 billion at a seven percent discount rate and $4.76 billion at the three percent discount rate, and is likely to result in a net benefit. DOE requests comment on whether the benefits of TSL 5 would outweigh the burdens of TSL 5, considering the potential impacts of future LED cost projections. This is identified as Issue 7 under ''Issues on Which DOE Seeks Comment'' in Section VII.E of this NOPR. DOE also seeks comment on the extent to which stakeholders expect projected LED cost reductions would occur, the timing of the projected LED cost reductions, and the certainty of the projected LED cost reductions. Also, considering the rapid development of LED technology and the steady reductions in cost, DOE seeks comment on the extent to which manufacturers would adopt LED technology into the design of commercial refrigeration equipment in the absence of standards.

DOE then considered TSL 4, which provides for all equipment classes the maximum efficiency levels that the analysis showed to have positive NPV to the Nation. TSL 4 would likely save an estimated 0.832 quads of energy through 2042, an amount DOE considers significant. Discounted at seven percent, the projected energy savings through 2042 would be 0.201 quads. For the

Nation as a whole, DOE projects that TSL 4 would result in a net increase of $1.10 billion in NPV, using a discount rate of seven percent. The estimated emissions reductions at TSL 4 are 43.50 Mt of $CO_2$ and up to 16.16 kt of $NO_X$. Total generating capacity in 2042 is estimated to decrease compared to the base case by 0.643 GW under TSL 4.

At TSL 4, DOE projects that the average commercial refrigeration equipment customer will experience a reduction in LCC compared to the baseline for all 15 equipment classes analyzed, ranging from $693 to $3,818 depending on equipment class. The mean payback period for the average commercial refrigeration equipment customer at TSL 4 is projected to be between 1.4 and 6.1 years compared to the purchase of baseline equipment.

As is the case with TSL 5, DOE believes the majority of manufacturers would need to completely redesign most equipment offered for sale, and therefore DOE expects that commercial refrigeration manufacturers will have some difficulty fully passing on larger MPC increases to customers. Similar to TSL 5, manufacturers expect the higher end of the range of impacts to be reached at TSL 4 (i.e., a drop of 35.3 percent in INPV). However, compared to the baseline, all 15 equipment classes showed significant positive life-cycle cost savings on a national average basis and few customers experienced an increase in LCC with a standard at TSL 4 compared with purchasing baseline equipment. The payback periods calculated for all equipment classes were lower than the life of the equipment.

After carefully considering the analysis and weighing the benefits and burdens of TSL 4, DOE proposes that TSL 4 represents the maximum improvement in energy efficiency that is technologically feasible and economically justified and that the estimated benefits to the Nation outweigh the costs. DOE proposes that TSL 4 is technologically feasible because the technologies required to achieve these levels are already in existence. Therefore, DOE is proposing TSL 4 as the energy conservation standards for commercial refrigeration equipment in this NOPR.

However, for the reasons discussed above, DOE also requests comments on whether it should adopt TSL 5 for all or some of the equipment classes.

## VI. Procedural Issues and Regulatory Review

### *A. Review Under Executive Order 12866*

DOE has determined that today's regulatory action is an ''economically significant'' action under Section 3(f)(1) of Executive Order 12866, ''Regulatory Planning and Review.'' 58 FR 51735 (October 4, 1993). The Executive Order requires that each agency identify in writing the specific market failure or other specific problem that it intends to address that warrants new agency action, as well as assess the significance of that problem to determine whether any new regulation is warranted. Executive Order 12866, § 1(b)(1).

In the ANOPR for this rulemaking, DOE requested feedback and data on a number of issues related to Executive Order 12866 and the existence of a market failure in the commercial refrigeration equipment industry. This request included (1) Data on, and suggestions for testing the existence and extent of, potential market failures to complete an assessment in the proposed rule of the significance of any failures; (2) data on the efficiency levels of existing commercial refrigeration equipment in use by store type; (3) comment on the Federal ENERGYSTAR program and its penetration into the commercial refrigeration equipment market as a resource on the availability and benefits of energy efficient refrigeration units; (4) data on owner-occupied buildings versus leased/non-owner occupied buildings for given store types and their associated use of high-efficiency equipment; and (5) comment on the weight that should be given to these factors in DOE's determination of the maximum efficiency level at which the total benefits are likely to exceed the total burdens resulting from a DOE standard. Following publication of the ANOPR and subsequent public comment period, DOE did not receive any feedback related to these requests.

Much of the industry segment that uses commercial refrigeration equipment tends to be large grocery stores, multi-line retailers, small grocery stores, or convenience stores. DOE believes that these owners may lack corporate direction on energy policy. The transaction costs for these owners to research, purchase, and install optimum efficiency equipment options are too high to make such action commonplace. DOE believes that there is a lack of information about energy efficiency opportunities in the commercial refrigeration equipment market available to these owners. Unlike residential heating and air conditioning equipment, commercial refrigeration equipment is not included in energy labeling programs such as the Federal Trade Commission's energy labeling program. Furthermore, the energy use of this equipment depends on usage. Information is not readily available for the owners to make a decision on whether improving the energy efficiency of commercial refrigeration equipment is cost-effective. DOE seeks data on the efficiency levels of existing commercial refrigeration equipment in use by owners, electricity price, and equipment class. Being part of the food merchandising industry, energy efficiency and energy cost savings are not the primary drivers of the business, as is selling food products to shoppers. This may incur transaction costs, thus preventing access to capital to finance energy efficiency investment.

Today's action also required a regulatory impact analysis (RIA) and, under the Executive Order, was subject to review by the Office of Information and Regulatory Affairs (OIRA) in the OMB. DOE presented to OIRA for review the draft proposed rule and other documents prepared for this rulemaking, including the RIA, and has included these documents in the rulemaking record. They are available for public review in the Resource Room of the Building Technologies Program, 950 L'Enfant Plaza, SW., 6th Floor, Washington, DC 20024, (202) 586–9127, between 9 a.m. and 4 p.m., Monday through Friday, except Federal holidays.

The RIA is contained in the TSD prepared for the rulemaking. The RIA consists of (1) a statement of the problem addressed by this regulation and the mandate for Government action; (2) a description and analysis of the feasible policy alternatives to this regulation; (3) a quantitative comparison of the impacts of the alternatives; and (4) the national economic impacts of the proposed standard.

The RIA calculates the effects of feasible policy alternatives to commercial refrigeration equipment standards and provides a quantitative comparison of the impacts of the alternatives. DOE evaluated the alternatives in terms of their ability to achieve significant energy savings at reasonable cost, and compared it to the effectiveness of the proposed rule. DOE analyzed these alternatives using a series of regulatory scenarios as input to the NES/shipments model for commercial refrigeration equipment, which DOE modified to provide inputs for these voluntary measures.

DOE identified the following major policy alternatives for achieving increased commercial refrigeration equipment energy efficiency:

- No new regulatory action.
- Commercial customer rebates.
- Commercial customer tax credits.

DOE evaluated each alternative's ability to achieve significant energy savings at reasonable cost (Table VI–1), and compared it to the effectiveness of the proposed rule.

TABLE VI–1—NON-REGULATORY ALTERNATIVES TO STANDARDS

| Policy alternatives | Energy savings* (quads) | Net present value** (billion 2007$) | |
|---|---|---|---|
| | | 7% discount rate | 3% discount rate |
| No New Regulatory Action | 0 | 0 | 0 |
| Commercial Customer Rebates | 0.099 | 0.139 | 0.315 |
| Commercial Customer Tax Credits† | 0.084 | 0.178 | 0.381 |
| Today's Standards at TSL 4 | 0.832 | 1.10 | 3.24 |

* Energy savings are in source quads.
** Net present value is the value in the present of a time series of costs and savings. DOE determined the net present value from 2012 to 2062 in billions of 2007$.
† These are example values for TSL 3.

The net present value amounts shown in Table VI–1 refer to the NPV for commercial customers. The following paragraphs discuss each policy alternative listed in Table VI–1. (See Chapter 17 of the TSD, Regulatory Impact Analysis, for further details.)

*No new regulatory action.* The case in which no regulatory action is taken for commercial refrigeration equipment constitutes the base case (or No Action) scenario. By definition, no new regulatory action yields zero energy savings and a net present value of zero dollars.

*Commercial Customer Rebates.* DOE modeled the impact of the customer rebate policy by determining the increased customer participation rate due to the rebates (i.e., the percent increase in customers purchasing high-efficiency equipment). DOE modeled a national rebate program after existing utility rebate programs that provide incentives for incorporating high-efficiency technologies into commercial refrigeration equipment. The reduction in retail cost of the higher efficiency cases was calculated and the methodology developed for the NIA used to assess relative shipments by efficiency level was used to assess relative shipments by efficiency level under the rebate scenario. DOE applied the resulting increase in market share of efficient units to the NES spreadsheet model to estimate the resulting NES and NPV for the rebate scenario with respect to the base case.

*Commercial Customer Tax Credits.* DOE assumed a commercial or industrial customer Federal tax credit patterned after the tax credits created in EPACT 2005. EPACT 2005 provided tax credits to customers who purchase and install specific products such as energy efficient windows, insulation, doors, roofs, and heating and cooling equipment. DOE presumed the presence of a certification or other program that could be used to identify high-efficiency commercial refrigeration equipment by energy consumption, and assumed TSL 3 as a likely candidate level for a tax credit incentive, given that it was the minimum LCC level. DOE then reviewed the incremental customer price increase to reach TSL 3 from the baseline for all 15 equipment classes. For 12 of the equipment classes, the incremental cost was between 6.1 and 21.3 percent. For three equipment classes (SOC.RC.M, HZO.RC.M, HZO.RC.L), the incremental cost was less than five percent. In its tax credit analysis, DOE assumed a flat tax credit equal to five percent of the customer price for equipment sold at TSL 3 or higher for each primary equipment class, with the exception of SOC.RC.M, HZO.RC.M, and HZO.RC.L. DOE assumed a 100 percent application rate for the tax credit from commercial refrigeration equipment customers and reduced the retail equipment price by five percent for TSL 3, TSL 4, and TSL 5 for the 12 equipment classes. The reductions in retail cost of commercial refrigeration equipment at these levels was calculated and the methodology developed for the NIA used to assess relative shipments by efficiency level under the tax credit scenario. DOE applied the resulting increase in market share of efficient units to the NES spreadsheet model to estimate the resulting NES and NPV for the tax credit scenario with respect to the base case. To see results for tax credits for equipment meeting or exceeding TSL 5, see the Regulatory Impact Analysis of the TSD.

*Performance Standards.* Each of the non-regulatory alternatives must be gauged against the performance standards DOE is proposing in this proposed rule. DOE also considered, but did not analyze, the potential of bulk Government purchases and early replacement incentive programs as alternatives to the proposed standards. In the case of bulk Government purchases, commercial refrigeration equipment is a very small part of the total market and the volume of high-efficiency equipment purchases that the Federal Government might make would have very limited impact on improving the overall market efficiency of commercial refrigeration equipment. In the case of replacement incentives, several policy options exist to promote early replacement, including a direct national program of customer incentives, incentives paid to utilities to promote an early replacement program, market promotions through equipment manufacturers, and replacement of Federally owned equipment. Previous analysis by DOE of methods to promote early replacement for other covered equipment have suggested that the energy savings realized through a one-time early replacement of existing stock equipment has not resulted in energy savings commensurate to the cost to run and administer the program. As a consequence, DOE did not analyze this option in detail.

As Table VI–1 indicates, none of the alternatives DOE examined would save as much energy as today's proposed rule. Also, several of the alternatives would require new enabling legislation, since authority to carry out those alternatives does not exist. The tax credit scenario would also require the development of a database of commercial refrigeration equipment that would meet or exceed the TSL 3 efficiency level in order to determine compliance with the tax credit.

*B. Review Under the Regulatory Flexibility Act/Initial Regulatory Flexibility Analysis*

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, 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 General Counsel's Web site, *http://www.gc.doe.gov*.

Small businesses, as defined by the Small Business Administration (SBA) for the commercial refrigeration equipment manufacturing industry, are manufacturing enterprises with 750 employees or fewer. DOE used the small business size standards published on January 31, 1996, as amended by the SBA to determine whether any small entities would be required to comply with the rule. 61 FR 3286 and codified at 13 CFR Part 121. The size standards are listed by North American Industry Classification System (NAICS) code and industry description. Commercial refrigeration equipment manufacturing is classified under NAICS 333415.

Prior to issuing this notice of proposed rulemaking, DOE interviewed two small businesses affected by the rulemaking. DOE also obtained information about small business impacts while interviewing manufacturers that exceed the small business size threshold of 750 employees.

DOE reviewed ARI's listing of its commercial refrigeration equipment manufacturer members and surveyed the industry to develop a list of all domestic manufacturers. DOE also asked stakeholders and ARI representatives within the industry if they were aware of any other small business manufacturers. DOE then examined publicly available data and contacted manufacturers, when needed, to determine if they meet the SBA's definition of a small manufacturing facility and if their manufacturing facilities are located within the United States. Based on this analysis, DOE identified nine small manufacturers of commercial refrigeration equipment. DOE conducted on-site interviews with two small manufacturers who agreed to be interviewed to determine if there are differential impacts on these companies that may result from new energy conservation standards.

DOE found that, in general, small manufacturers have the same concerns as large manufacturers regarding new energy conservation standards. DOE summarized the key issues for commercial refrigeration equipment manufacturers in Section IV.I.3.a of today's notice. Both manufacturers echoed the same concerns regarding new energy conservation standards as the larger manufacturers, including investments needed to meet standards, meeting customer needs, equipment sales, and coverage of niche equipment. Specifically, DOE found no significant differences in the R&D emphasis or marketing strategies between small business manufacturers and large manufacturers. Therefore, for the equipment classes manufactured primarily by the small businesses, DOE believes the GRIM analysis, which models each equipment class separately, is representative of the small businesses affected by standards. The qualitative and quantitative GRIM results are summarized in Section V.B.2 of today's notice.

DOE reviewed the standard levels considered in today's notice of proposed rulemaking under the provisions of the Regulatory Flexibility Act and the procedures and policies published on February 19, 2003. Based on this review, DOE has prepared an IRFA for this rulemaking. The IRFA describes potential impacts on small businesses associated with commercial refrigeration equipment design and manufacturing.

The potential impacts on commercial refrigeration equipment manufacturers are discussed in the following sections. DOE has transmitted a copy of this IRFA to the Chief Counsel for Advocacy of the Small Business Administration for review.

1. Reasons for the Proposed Rule

Part A–1 of Title III of EPCA addresses the energy efficiency of certain types of commercial and industrial equipment. (42 U.S.C. 6311–6317) EPACT 2005, Pub. L. 109–58, included an amendment to Part A–1 requiring that DOE prescribe energy conservation standards for the commercial refrigeration equipment that is the subject of this rulemaking. (EPACT 2005, Section 136(c); 42 U.S.C. 6313(c)(4)(A)) Hence, DOE is proposing in today's notice, energy conservation standards for commercial ice-cream freezers; self-contained commercial refrigerators, commercial freezers, and commercial refrigerator-freezers without doors; and remote condensing commercial refrigerators, commercial freezers, and commercial refrigerator-freezers.

2. Objectives of, and Legal Basis for, the Proposed Rule

EPCA provides that any new or amended standard for commercial refrigeration equipment 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) and 6316(e)(1)) But EPCA precludes DOE from adopting any standard that would not result in significant conservation of energy. (42 U.S.C. 6295(o)(3) and 6316(e)(1)) Moreover, DOE may not prescribe a standard for certain equipment if no test procedure has been established for that equipment, or if DOE determines by rule that the standard is not technologically feasible or economically justified, and that such standard will not result in significant conservation of energy. (42 U.S.C. 6295(o)(3) and 6316(e)(1)) EPCA also provides that, in deciding whether a standard is economically justified, DOE must determine whether the benefits of the standard exceed its burdens after receiving comments on the proposed standard. (42 U.S.C. 6295(o)(2)(B)(i) and 6316(e)(1)) To determine whether economic justification exists, DOE reviews comments received and conducts analysis to determine whether the economic benefits of the proposed standard exceed the burdens to the greatest extent practicable, taking into consideration seven factors set forth in 42 U.S.C. 6295(o)(2)(B) and 6316(e)(1) (see Section II.B of this preamble).

EPCA also states that the Secretary may not prescribe an amended or 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 equipment type (or class) with performance characteristics (including reliability), 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) and 6316(e)(1)) Further information concerning the background of this rulemaking is provided in Chapter 1 of the TSD.

3. Description and Estimated Number of Small Entities Regulated

DOE reviewed ARI's listing of commercial refrigeration equipment manufacturer members and surveyed the industry to develop a list of every manufacturer. DOE also asked stakeholders and ARI representatives within the industry if they were aware of any other small business manufacturers. DOE then looked at publicly available data and contacted manufacturers, where needed, to determine if they meet the SBA's definition of a small business manufacturing facility and have their manufacturing facilities located within the U.S. Based on this analysis, DOE estimates that there are nine small commercial refrigeration equipment manufacturers. See Chapter 13 of the TSD for further discussion about the methodology used in DOE's manufacturer impact analysis and its analysis of small-business impacts.

4. Description and Estimate of Compliance Requirements

Potential impacts on manufacturers, including small businesses, come from impacts associated with commercial refrigeration equipment design and manufacturing. The margins and/or market share of manufacturers, including small businesses, in the commercial refrigeration equipment industry could be negatively impacted in the long term by the standard levels under consideration in this notice of proposed rulemaking, specifically TSL 4. The level of research and development needed to meet energy conservation standards increases with more stringent energy conservation standards. DOE expects that small manufacturers will have more difficulty funding the required research and development necessary to meet energy conservation standards than larger manufacturers. Therefore, at proposed TSL 4, as opposed to lower TSLs, small manufacturers would have less flexibility in choosing a design path. However, as discussed under subsection 6 (Significant alternatives to the rule) below, DOE expects that the differential impact on small commercial refrigeration equipment manufacturers (versus large businesses) would be smaller in moving from proposed TSL 1 to proposed TSL 2 than it would be in moving from proposed TSL 4 to proposed TSL 5. The rationale for DOE's expectation is best discussed in a comparative context and is therefore elaborated upon in subsection 6 (Significant alternatives to the rule). As discussed in the introduction to this IRFA, DOE expects that the differential impact associated with commercial refrigeration equipment design and manufacturing on small businesses would be negligible.

5. Duplication, Overlap, and Conflict With Other Rules and Regulations

DOE is not aware of any rules or regulations that duplicate, overlap, or conflict with the rule being considered today.

6. Significant Alternatives to the Rule

The primary alternatives to the proposed rule considered by DOE are the other TSLs besides the one being considered today, proposed TSL 4. In addition to the other TSLs considered, the TSD associated with this proposed rule includes a report referred to in Section VI.A in the preamble as the regulatory impact analysis (RIA-discussed earlier in this report and in detail in the TSD). This report discusses the following policy alternatives: (1) No new regulatory action, (2) commercial customer rebates, and (3) commercial customer tax credits. The energy savings of these regulatory alternatives are one to two orders of magnitude smaller than those expected from the standard levels under consideration. The range of economic impacts of these regulatory alternatives is an order of magnitude smaller than the range of impacts expected from the standard levels under consideration.

The commercial refrigeration equipment industry is highly customized. Customers demand high levels of customization from commercial refrigeration equipment manufacturers to differentiate themselves from other retail stores. They do not want to lose any functionality or utility in their equipment, such as display area, because this affects their ability to merchandise products. Often, the customer's desire for easy consumer access requires equipment that is less energy efficient. They also do not want to lose any flexibility in design choices, such as lighting options. All manufacturers, including small businesses, would have to develop designs to enable compliance to higher TSLs. Product redesign costs tend to be fixed and do not scale with sales volume. Thus, small manufacturers would be at a relative disadvantage at higher TSLs because research and development efforts would be on the same scale as those for larger companies, but these expenses would be recouped over smaller sales volumes.

At proposed TSL 5, the max-tech level, manufacturers stated their concerns over the ability to be able to produce equipment by the future effective date of the standard. At proposed TSL 5, DOE estimates that the majority of manufacturers would be negatively impacted. Based on manufacturer interviews, some manufacturers stated that they could not meet proposed TSL 5 for medium-temperature equipment, and that they would need technological innovation to achieve these levels by 2012. Manufacturers believe that setting standards at the maximum level will affect their customers' ability to merchandise products by limiting the flexibility in choosing design options. For example, at TSL 5 specifically, the use of LED lighting technology may be necessary to meet the proposed levels for many equipment classes. Manufacturers expect that having limited choices in design options would commoditize the industry and reduce profit margins. This concern was echoed by all manufacturers, not just small business manufacturers.

For the proposed standard, TSL 4, and for alternative TSLs, TSL 1 through 3, DOE expects that impacts to small manufacturers would be less than the impacts described above for TSL 5. At lower TSLs, the differential impacts to small manufacturers are diminished because research and development efforts are less at lower TSLs. Chapter 12 of the TSD contains additional information about the impact of this rulemaking on manufacturers. As mentioned above, the other policy alternatives (no new regulatory action, commercial customer rebates, and commercial customer tax credits) are described in Section VI.A of the preamble and in the Regulatory Impact Analysis, Chapter 17 of the TSD. Since the impacts of these policy alternatives are lower than the impacts described above for TSL 5, DOE expects that the impacts to small manufacturers would also be less than the impacts described above for the proposed standard levels. DOE requests comment on the impacts to small business manufacturers for these and any other possible alternatives to the proposed rule. DOE will consider any comments received regarding impacts to small business manufacturers for all the alternatives identified, including those in the RIA, for the Final Rule.

### *C. Review Under the Paperwork Reduction Act*

This rulemaking will impose no new information or record keeping requirements. Accordingly, OMB clearance is not required under the

Paperwork Reduction Act. (44 U.S.C. 3501 *et seq.*)

*D. Review Under the National Environmental Policy Act*

DOE is preparing an environmental assessment of the impacts of the proposed rule. DOE is preparing an environmental assessment of the impacts of the proposed rule. The assessment will include 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. DOE anticipates completing a Finding of No Significant Impact (FONSI) before publishing the final rule on commercial refrigeration equipment, 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 (10 CFR Part 1021).

*E. Review Under Executive Order 13132*

Executive Order 13132, Federalism, 64 FR 43255 (August 4, 1999) imposes certain requirements on agencies formulating and implementing policies or regulations that preempt State law or that have federalism implications. 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 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. DOE has examined today's proposed rule and has determined that it would not have a substantial direct effect on the States, on the relationship between the National Government and the States, or on the distribution of power and responsibilities among the various levels of government. EPCA governs and prescribes Federal preemption of State regulations as to energy conservation for the equipment that is the subject of today's proposed 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(d) and 6316(b)(2(D)) 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 (61 FR 4729, February 7, 1996) 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. 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 proposed rule meets the relevant standards of Executive Order 12988.

*G. Review Under the Unfunded Mandates Reform Act of 1995*

DOE reviewed this regulatory action under Title II of the Unfunded Mandates Reform Act of 1995 (Pub. L. 104–4) (UMRA), which requires each Federal agency to assess the effects of Federal regulatory actions on State, local and Tribal governments and the private sector. Today's final rule may impose expenditures of $100 million or more on the private sector. It does not contain a Federal intergovernmental mandate.

Section 202 of UMRA authorizes an agency to respond to the content requirements of UMRA in any other statement or analysis that accompanies the proposed rule. 2 U.S.C. 1532(c). The content requirements of section 202(b) of UMRA relevant to a private sector mandate substantially overlap the economic analysis requirements that apply under section 325(o) of EPCA and Executive Order 12866. The **SUPPLEMENTARY INFORMATION** section of the notice of final rulemaking and 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. 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 sections 325(o), 345(a) and 342(c)(4)(A) of EPCA (42 U.S.C. 6295(o), 6316(a) and 6313(c)(4)(A)), today's proposed rule would establish energy conservation standards for commercial refrigeration equipment 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*

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. The 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 Notice 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 the OIRA, OMB, a Statement of Energy Effects for any proposed significant energy action. A significant energy action is defined as any action by an agency that promulgated 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 proposed 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.

Today's regulatory action would not have a significant adverse effect on the supply, distribution, or use of energy and, therefore, is not a significant energy action. Accordingly, DOE has not prepared a Statement of Energy Effects.

*L. Review Under the Information Quality Bulletin for Peer Review*

On December 16, 2004, the OMB, in consultation with the Office of Science and Technology (OSTP), issued its Final Information Quality Bulletin for Peer Review (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." The Bulletin defines "influential scientific information" 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 (January 14, 2005).

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. The Energy Conservation Standards Rulemaking Peer Review Report dated February 2007 has been disseminated and is available at *http://www.eere.energy.gov/buildings/appliance_standards/ peer_review.html.*

**VII. Public Participation**

*A. Attendance at Public Meeting*

The time, date and location of the public meeting are provided in the **DATES** and **ADDRESSES** sections at the beginning of this document. Anyone who wants to attend the public meeting must notify Ms. Brenda Edwards at (202) 586–2945. As explained in the **ADDRESSES** section, foreign nationals visiting DOE headquarters are subject to advance security screening procedures.

*B. Procedure for Submitting Requests To Speak*

Any person who has an interest in today's Notice, or who is a representative of a group or class of persons that has an interest in these issues, may request an opportunity to make an oral presentation. Please hand-deliver requests to speak to the address shown under the heading *"Hand Delivery/Courier"* in the **ADDRESSES** section of this NOPR, between 9 a.m. and 4 p.m., Monday through Friday, except Federal holidays. Also, requests may be sent by mail to the address shown under the heading *"Postal Mail"* in the **ADDRESSES** section of this NOPR, or by e-mail to *Brenda.Edwards@ee.doe.gov.*

Persons requesting to speak should briefly describe the nature of their interest in this rulemaking and provide a telephone number for contact. DOE asks persons selected to be heard to submit a copy of their statements at least two weeks before the public meeting, either in person, by postal mail, or by e-mail as described in the preceding paragraph. Please include an electronic copy of your statement on a computer diskette or compact disk when delivery is by postal mail or in person. Electronic copies must be in WordPerfect, Microsoft Word, Portable Document Format (PDF), or text (American Standard Code for Information Interchange (ASCII)) file format. At its discretion, DOE may permit any person who cannot supply an advance copy of his or her statement to participate, if that person has made alternative arrangements with the Building Technologies Program. In such situations, the request to give an oral presentation should ask for alternative arrangements.

*C. Conduct of Public Meeting*

DOE will designate a DOE official to preside at the public meeting and may also use a professional facilitator to aid discussion. The meeting will not be a judicial or evidentiary-type public hearing, but DOE will conduct it in accordance with 5 U.S.C. 553 and Section 336 of EPCA. (42 U.S.C. 6306) A court reporter will be present to record and transcribe the proceedings. DOE reserves the right to schedule the order of presentations and to establish the procedures governing the conduct of the public meeting. After the public meeting, interested parties may submit further comments about the proceedings, and any other aspect of the rulemaking, until the end of the comment period.

The public meeting will be conducted in an informal, conference style. DOE will present summaries of comments received before the public meeting, allow time for presentations by participants, and encourage all interested parties to share their views on issues affecting this rulemaking. Each participant will be allowed to make a prepared general statement (within time limits determined by DOE) before discussion of a particular topic. DOE will permit other participants to comment briefly on any general statements.

At the end of all prepared statements on a topic, DOE will permit participants to clarify their statements briefly and comment on statements made by others. Participants should be prepared to answer questions by DOE and by other participants concerning these issues. DOE representatives may also ask questions of participants concerning other matters relevant to the public meeting. The official conducting the public meeting will accept additional comments or questions from those attending, as time permits. The presiding official will announce any further procedural rules or modification of the above procedures that may be needed for proper conduct of the public meeting.

DOE will make the entire record of this proposed rulemaking, including the transcript from the public meeting, available for inspection at 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. Any person may purchase a copy of the transcript from the transcribing reporter.

*D. Submission of Comments*

DOE will accept comments, data, and information regarding all aspects of this NOPR before or after the public meeting, but no later than the date provided at the beginning of this notice of proposed rulemaking. Please submit comments, data, and information electronically to the following e-mail address: *commercialrefrigeration.rulemaking@ee.doe.gov*. Submit electronic comments in WordPerfect, Microsoft Word, PDF, or ASCII file format and avoid the use of special characters or any form of encryption. Comments in electronic format should be identified by the docket number EE–2006–STD–0126 and/or RIN 1904–AB59, and whenever possible carry the electronic signature of the author. Absent an electronic signature, comments submitted electronically must be followed and authenticated by submitting a signed original paper document. No telefacsimiles (faxes) will be accepted.

Under 10 CFR 1004.11, any person submitting information that he or she believes to be confidential and exempt by law from public disclosure should submit two copies: One copy of the document including all the information believed to be confidential, and one copy of the document with the information believed to be confidential deleted. DOE will make its own determination about the confidential status of the information and treat it according to its determination.

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

*E. Issues on Which DOE Seeks Comment*

DOE is particularly interested in receiving comments and views of interested parties concerning:

1. LED Price Projections

TSL 5 has an estimated −$200 million burden on the Nation. DOE recognizes that anticipated reductions in LED lighting costs by the effective date of the rule could shift the NPV, at the seven percent discount rate, for TSL 5 from a negative NPV (−$200 million) to a positive NPV. DOE calculated that a reduction in LED system cost of six percent would be sufficient to ensure a slightly positive aggregate NPV at TSL 5, at the seven percent discount rate, when compared with the base case. DOE fully expects that the aggregate six percent reduction in LED system costs could be attained and even exceeded by 2012 because of the rapid development of LED technology. Furthermore, if LED system costs achieve the 50 percent reduction projection, the NPV at a seven percent discount rate for TSL 5 would be substantially positive. DOE requests data or information on projected LED cost reductions and basis for such projections. DOE also seeks comment on its consideration of projected LED prices. DOE also seeks comment on the extent to which stakeholders expect projected LED cost reductions would occur, the timing of the projected LED cost reductions, and the certainty of the projected LED cost reductions. Also, considering the rapid development of LED technology and the steady reductions in cost, DOE seeks comment on the extent to which manufacturers would adopt LED technology into the design of commercial refrigeration equipment in the absence of standards. DOE recognizes that LED system replacement costs assumed in its LCC analysis would also be affected by projected LED cost reductions and seeks comment on how it can best predict the cost for LED fixture replacements in the LCC analysis. (See Section V.C of this NOPR for further details.)

2. Base Case Efficiency

DOE recognizes that baseline efficiency trends can change if equipment costs are different than those projected. For example, if LED prices drop more than assumed in the engineering analysis, consumer demand for LED-equipped equipment could change. DOE seeks comment on whether shipments of LED-equipped equipment would change if LED costs drop and if so, the extent and timing of such shipment changes. See Section IV.G.1.

3. Operating Temperature Ranges

One factor in determining which equipment class a commercial refrigeration equipment unit belongs to is its designed operating temperature. DOE is organizing equipment classes based on three operating temperature ranges. Medium temperature equipment operates at or above 32 °F, low temperature equipment operates at temperatures below 32 °F and greater than 5 °F, and ice-cream temperature equipment operates at or below −15 °F. DOE seeks comment on the temperatures selected to categorize equipment classes. (See Section IV.A.2 of this NOPR for further details.)

4. Offset Factors

For the NOPR, DOE developed offset factors as a way to adjust the energy efficiency requirements for smaller-sized equipment in each equipment class analyzed. These offset factors account for certain components of the refrigeration load (such as the conduction end effects) that remain constant even when equipment sizes vary. These constant loads affect smaller cases disproportionately. The offset factors are intended to approximate these constant loads and provide a fixed end point, corresponding to a zero TDA or zero volume case, in an equation that describes the relationship between energy consumption and the corresponding TDA or volume metric. DOE seeks comment on the use of offset factors and the methodology used to calculate them. (See Section V.A of this NOPR and Chapter 5 of the TSD for further details.)

5. Extension of Standards

DOE developed an extension approach to applying the standards developed for these 15 primary equipment classes to the remaining 23 secondary classes. This approach involves extension multipliers developed using both the 15 primary equipment classes analyzed and a set of focused matched-pair analyses. DOE believes that standards for certain primary equipment classes can be directly applied to other similar secondary equipment classes. DOE seeks comment on its approach to extending the results of the engineering analysis to the 23 secondary equipment classes. (See Section V.A of this NOPR and Chapter 5 of the TSD for further details.)

6. Standards for Hybrid Cases and Wedges

There are certain types of equipment that meet the definition of commercial refrigeration equipment (Section 136(a)(3) of EPACT 2005), but do not fall easily into any of the 38 equipment classes defined in the market and technology assessment. One of these types is hybrid cases, where two or more compartments are in different equipment families and contained in one cabinet. Another is refrigerator-freezers, which have two compartments in the same equipment family but with different operating temperatures. There may also exist hybrid refrigerator-freezers, where two or more compartments are in different equipment families and have different operating temperatures. Another is wedge cases, which form miter transitions between standard display case lineups. DOE seeks comment on proposed language that will allow manufacturers to determine appropriate standard levels for these types of equipment. (See Section 0 of this NOPR for further details.)

7. Standard Levels

If, based on comment, DOE were to revise the LED system costs as described above (section V.C) the economic impacts of TSL 5 would change. DOE seeks comments on its consideration of TSL 5 and whether the benefits would outweigh the burdens.

## VIII. Approval of the Office of the Secretary

The Secretary of Energy has approved publication of this proposed rule.

Issued in Washington, DC, on August 12, 2008.

**Alexander A. Karsner,**

*Assistant Secretary, Energy Efficiency and Renewable Energy.*

## List of Subjects in 10 CFR Part 431

Administrative practice and procedure, Energy conservation, Household appliances.

For the reasons set forth in the preamble, Chapter II of Title 10, Code of Federal Regulations, Part 431 is proposed to be amended to read as set forth below.

## PART 431—ENERGY EFFICIENCY PROGRAM FOR CERTAIN COMMERCIAL AND INDUSTRIAL EQUIPMENT

1. The authority citation for part 431 continues to read as follows:

**Authority:** 42 U.S.C. 6291–6317.

2. Section 431.62 of subpart C is amended by adding in alphabetical order new definitions for ''air-curtain angle,'' ''commercial hybrid refrigerator, freezer, and refrigerator-freezer,'' ''door angle,'' ''horizontal closed,'' horizontal open'', ''semivertical open,'' ''vertical closed,'' ''vertical open,'' and ''wedge case'' to read as follows:

### § 431.62 Definitions concerning commercial refrigerators, freezers and refrigerator-freezers.

*Air-curtain angle* means:

(1) For equipment without doors and without a discharge air grille or discharge air honeycomb, the angle between a vertical line extended down from the highest point on the manufacturer's recommended load limit line and the load limit line itself, when the equipment is viewed in cross-section; and

(2) For all other equipment without doors, the angle formed between a vertical line and the straight line drawn by connecting the point at the inside edge of the discharge air opening with the point at inside edge of the return air opening, when the equipment is viewed in cross-section.

* * * * *

*Commercial hybrid refrigerator, freezer, and refrigerator-freezer* means a commercial refrigerator, freezer, or refrigerator-freezer that has two or more chilled and/or frozen compartments that are (1) in two or more different equipment families, (2) contained in one cabinet and (3) sold as a single unit.

* * * * *

*Door angle* means:

(1) For equipment with flat doors, the angle between a vertical line and the line formed by the plane of the door, when the equipment is viewed in cross-section; and

(2) For equipment with curved doors, the angle formed between a vertical line and the straight line drawn by connecting the top and bottom points where the display area glass joins the cabinet, when the equipment is viewed in cross-section.

* * * * *

*Horizontal Closed* means equipment with hinged or sliding doors and a door angle greater than or equal to 45°.

*Horizontal Open* means equipment without doors and an air-curtain angle greater than or equal to 80° from the vertical.

* * * * *

*Semivertical Open* means equipment without doors and an air-curtain angle greater than or equal to 10° and less than 80° from the vertical.

* * * * *

*Vertical Closed* means equipment with hinged or sliding doors and a door angle less than 45°.

*Vertical Open* means equipment without doors and an air-curtain angle greater than or equal to 0° and less than 10° from the vertical.

*Wedge case* means a commercial refrigerator, freezer, or refrigerator-freezer that forms the transition between two regularly-shaped display cases.

3. Section 431.66 of subpart C is amended by adding new paragraphs (a)(3) and (d) to read as follows:

### § 431.66 Energy conservation standards and their effective dates.

(a) * * *

(3) The term ''TDA'' means the total display area ($ft^2$) as defined in the Air-Conditioning and Refrigeration Institute Standard 1200–2006.

* * * * *

(d) Each commercial refrigerator, freezer, and refrigerator-freezer with a self-contained condensing unit and without doors; commercial refrigerator, freezer, and refrigerator-freezer with a remote condensing unit; and commercial ice-cream freezer, manufactured on or after January 1, 2012, shall have a daily energy consumption (in kilowatt hours per day) that does not exceed the levels specified:

(1) For equipment other than hybrid equipment, refrigerator-freezers or wedge cases:

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| Equipment Category | Condensing Unit Configuration | Equipment Family | Rating Temp. (°F) | Operating Temp. (°F) | Equipment Class Designation* | Maximum Daily Energy Consumption (kWh/day) |
|---|---|---|---|---|---|---|
| Remote Condensing Commercial Refrigerators and Commercial Freezers | Remote (RC) | Vertical Open (VOP) | 38 (M) | ≥ 32 | VOP.RC.M | 0.82 x TDA + 4.07 |
| | | | 0 (L) | > -5 and < 32 | VOP.RC.L | 2.28 x TDA + 6.85 |
| | | Semivertical Open (SVO) | 38 (M) | ≥ 32 | SVO.RC.M | 0.83 x TDA + 3.18 |
| | | | 0 (L) | > -5 and < 32 | SVO.RC.L | 2.28 x TDA + 6.85 |
| | | Horizontal Open (HZO) | 38 (M) | ≥ 32 | HZO.RC.M | 0.35 x TDA + 2.88 |
| | | | 0 (L) | > -5 and < 32 | HZO.RC.L | 0.57 x TDA + 6.88 |
| | | Vertical Closed Transparent (VCT) | 38 (M) | ≥ 32 | VCT.RC.M | 0.25 x TDA + 1.95 |
| | | | 0 (L) | > -5 and < 32 | VCT.RC.L | 0.6 x TDA + 2.61 |
| | | Horizontal Closed Transparent (HCT) | 38 (M) | ≥ 32 | HCT.RC.M | 0.16 x TDA + 0.13 |
| | | | 0 (L) | > -5 and < 32 | HCT.RC.L | 0.34 x TDA + 0.26 |
| | | Vertical Closed Solid (VCS) | 38 (M) | ≥ 32 | VCS.RC.M | 0.11 x V + 0.26 |
| | | | 0 (L) | > -5 and < 32 | VCS.RC.L | 0.23 x V + 0.54 |
| | | Horizontal Closed Solid (HCS) | 38 (M) | ≥ 32 | HCS.RC.M | 0.11 x V + 0.26 |
| | | | 0 (L) | > -5 and < 32 | HCS.RC.L | 0.23 x V + 0.54 |
| | | Service Over Counter (SOC) | 38 (M) | ≥ 32 | SOC.RC.M | 0.51 x TDA + 0.11 |
| | | | 0 (L) | > -5 and < 32 | SOC.RC.L | 1.08 x TDA + 0.22 |
| Self-Contained Commercial Refrigerators and Commercial Freezers without Doors | Self-Contained (SC) | Vertical Open (VOP) | 38 (M) | ≥ 32 | VOP.SC.M | 1.74 x TDA + 4.71 |
| | | | 0 (L) | > -5 and < 32 | VOP.SC.L | 4.37 x TDA + 11.82 |
| | | Semivertical Open (SVO) | 38 (M) | ≥ 32 | SVO.SC.M | 1.73 x TDA + 4.59 |
| | | | 0 (L) | > -5 and < 32 | SVO.SC.L | 4.34 x TDA + 11.51 |
| | | Horizontal Open | 38 (M) | ≥ 32 | HZO.SC.M | 0.77 x TDA + 5.55 |
| | | | 0 (L) | > -5 and < 32 | HZO.SC.L | 1.92 x TDA + 7.08 |
| Commercial Ice-Cream Freezers | Remote (RC) | Vertical Open (VOP) | -15 (I) | ≤ -5 | VOP.RC.I | 2.9 x TDA + 8.7 |
| | | Semivertical Open (SVO) | | | SVO.RC.I | 2.9 x TDA + 8.7 |
| | | Horizontal Open (HZO) | | | HZO.RC.I | 0.72 x TDA + 8.74 |
| | | Vertical Closed Transparent (VCT) | | | VCT.RC.I | 0.71 x TDA + 3.05 |
| | | Horizontal Closed Transparent (HCT) | | | HCT.RC.I | 0.4 x TDA + 0.31 |
| | | Vertical Closed Solid (VCS) | | | VCS.RC.I | 0.27 x V + 0.63 |
| | | Horizontal Closed Solid (HCS) | | | HCS.RC.I | 0.27 x V + 0.63 |
| | | Service Over Counter (SVO) | | | SOC.RC.I | 1.26 x TDA + 0.26 |
| | Self-Contained (SC) | Vertical Open (VOP) | | | VOP.SC.I | 5.55 x TDA + 15.02 |
| | | Semivertical Open (SVO) | | | SVO.SC.I | 5.52 x TDA + 14.63 |
| | | Horizontal Open (HZO) | | | HZO.SC.I | 2.44 x TDA + 9. |
| | | Vertical Closed Transparent (VCT) | | | VCT.SC.I | 0.73 x TDA + 3.29 |
| | | Horizontal Closed Transparent (HCT) | | | HCT.SC.I | 0.56 x TDA + 0.43 |
| | | Vertical Closed Solid (VCS) | | | VCS.SC.I | 0.38 x V + 0.88 |
| | | Horizontal Closed Solid (HCS) | | | HCS.SC.I | 0.38 x V + 0.88 |
| | | Service Over Counter (SVO) | | | SOC.SC.I | 1.76 x TDA + 0.36 |

*The meaning of the letters in this column is indicated in the three columns to the left.

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(2) For commercial refrigeration equipment with two or more compartments (hybrid refrigerators, hybrid freezers, hybrid refrigerator-freezers, and non-hybrid refrigerator freezers), the maximum daily energy consumption (MDEC) for each model shall be the sum of the MDEC values for all of its compartments. For each compartment, measure the TDA or volume of that compartment, and determine the appropriate equipment class based on that compartment's equipment family, condensing unit configuration, and designed operating temperature. The MDEC value for each compartment shall be the amount derived by entering that compartment's TDA or volume into the standard equation in paragraph (d)(1) of this section for that compartment's equipment class. Measure the calculated daily energy consumption (CDEC) or total daily energy consumption (TDEC) for the entire case:

(i) For remote condensing commercial hybrid refrigerators, hybrid freezers, hybrid refrigerator-freezers, and non-hybrid refrigerator-freezers, where two or more independent condensing units each separately cool only one compartment, measure the total refrigeration load of each compartment separately according to the ANSI/ASHRAE Standard 72–2005 test procedure. Calculate compressor energy consumption (CEC) for each compartment using Table 1 in ANSI/ARI Standard 1200–2006 using the evaporator temperature for that compartment. The calculated daily energy consumption (CDEC) for the entire case shall be the sum of the CEC for each compartment, fan energy consumption (FEC), lighting energy consumption (LEC), anti-condensate energy consumption (AEC), defrost energy consumption (DEC), and condensate evaporator pan energy consumption (PEC) (as measured in ANSI/ARI Standard 1200–2006).

(ii) For remote condensing commercial hybrid refrigerators, hybrid freezers, hybrid refrigerator-freezers, and non-hybrid refrigerator-freezers, where two or more compartments are cooled collectively by one condensing unit, measure the total refrigeration load of the entire case according to the ANSI/ASHRAE Standard 72–2005 test procedure. Calculated a weighted saturated evaporator temperature for the entire case by (A) multiplying the saturated evaporator temperature of each compartment by the volume of that compartment (as measured in ANSI/ARI Standard 1200–2006), (B) summing the resulting values for all compartments, and (C) dividing the resulting total by the total volume of all compartments. Calculate the CEC for the entire case using Table 1 in ANSI/ARI Standard 1200–2006, using the total refrigeration load and the weighted average saturated evaporator temperature. The CDEC for the entire case shall be the sum of the CEC, FEC, LEC, AEC, DEC, and PEC.

(iii) For self-contained commercial hybrid refrigerators, hybrid freezers, hybrid refrigerator-freezers, and non-hybrid refrigerator-freezers, measure the total daily energy consumption (TDEC) for the entire case according to the ANSI/ASHRAE Standard 72–2005 test procedure.

(3) For remote-condensing and self-contained wedge cases, measure the CDEC or TDEC according to the ANSI/ASHRAE Standard 72–2005 test procedure. The MDEC for each model shall be the amount derived by incorporating into the standards equation in paragraph (d)(1) of this section for the appropriate equipment class a value for the TDA that is the product of (i) the vertical height of the air-curtain (or glass in a transparent door) and (ii) the largest overall width of the case, when viewed from the front.

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