DEPARTMENT OF ENERGY

Office of Energy Efficiency and Renewable 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; for Self-Contained Commercial Refrigerators, Commercial Freezers, and Commercial Refrigerator-Freezers without Doors; and for Remote Condensing Commercial Refrigerators, Commercial Freezers, and Commercial Refrigerator-Freezers

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

ACTION: Advance notice of proposed rulemaking and notice of public meeting.

SUMMARY: The Energy Policy and Conservation Act (EPCA) authorizes the Department of Energy (DOE) to establish energy conservation standards for various consumer products and commercial and industrial equipment, including 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, if DOE determines that energy conservation standards would be technologically feasible and economically justified, and would result in significant energy savings. DOE publishes this Advance Notice of Proposed Rulemaking (ANOPR) to consider establishing energy conservation standards for the categories of commercial refrigeration equipment mentioned above, and to announce a public meeting to receive comments on a variety of issues.

DATES: DOE will hold a public meeting on August 23, 2007, 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., August 3, 2007. 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., August 9, 2007. DOE will accept comments, data, and information regarding this ANOPR no later than October 9, 2007. See section IV, ''Public Participation,'' of this ANOPR for details.

ADDRESSES: The public meeting will be held at the U.S. Department of Energy, Forrestal Building, Room 1E–245, 1000 Independence Avenue, SW., Washington, DC. 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 of this fact as soon as possible by contacting Ms. Brenda Edwards-Jones at (202) 586–2945 so that the necessary procedures can be completed.

You may submit comments identified by docket number EE–2006–STD–0126 and/or Regulatory Information Number (RIN) 1904–AB59 using any of the following methods:

- *Federal eRulemaking Portal: http://www.regulations.gov*. Follow the instructions for submitting comments.
- *E-mail: commercial refrigeration.rulemaking@ee.doe.gov*. Include EE–2006–STD–0126 and/or RIN 1904–AB59 in the subject line of your message.
- *Postal Mail:* Ms. Brenda Edwards-Jones, 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 paper original.
- *Hand Delivery/Courier:* Ms. Brenda Edwards-Jones, U.S. Department of Energy, Building Technologies Program, Room 1J–018, 1000 Independence Avenue, SW., Washington, DC 20585–0121. Please submit one signed original paper copy.

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

Docket: For access to the docket to read background documents or comments received, go to the U.S. Department of Energy, Forrestal Building, Room 1J–018 (Resource Room of the Building Technologies Program), 1000 Independence Avenue, SW., Washington, DC, (202) 586–2945, between 9 a.m. and 4 p.m., Monday through Friday, except Federal holidays. Please call Ms. Brenda Edwards-Jones 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. E-mail: *Charles.Llenza@ee.doe.gov*, or Ms. Francine Pinto, Esq., U.S. Department of Energy, Office of General Counsel, GC–72, 1000 Independence Avenue, SW., Washington DC 20585, (202) 586–9507. E-mail: *Francine.Pinto@hq.doe.gov*.

SUPPLEMENTARY INFORMATION:

I. Introduction

A. Purpose of the Advance Notice of Proposed Rulemaking

The purpose of this Advance Notice of Proposed Rulemaking (ANOPR) is to provide interested persons with an opportunity to comment on:

1. The equipment classes that the Department of Energy (DOE) is planning to analyze in this rulemaking;

2. The analytical framework, models, and tools (e.g., life-cycle cost (LCC) and national energy savings (NES) spreadsheets) that DOE has been using to perform analyses of the impacts of 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]

3. The results of the preliminary engineering analyses, the markups analysis to determine equipment price, the energy use characterization, the LCC and payback period (PBP) analyses, and the NES and national impact analyses as presented in the *ANOPR Technical Support Document (TSD): Energy Efficiency Standards for Commercial and Industrial Equipment: Commercial Ice-Cream Freezers; Self-Contained Commercial Refrigerators, Freezers, and Refrigerator-Freezers without Doors; and Remote Condensing Commercial Refrigerators, Freezers, and Refrigerator-Freezers,* and summarized in this ANOPR; and

4. The candidate energy conservation standard levels that DOE has developed from these analyses.

B. Summary of the Analysis

The Energy Policy and Conservation Act, as amended, (EPCA) authorizes DOE to establish minimum energy conservation standards for various consumer products and commercial and industrial equipment, including commercial refrigeration equipment, which are the subject of this ANOPR. (42 U.S.C. 6291 *et seq.*) DOE conducted in-depth technical analyses for this ANOPR in the following areas: engineering, markups to determine equipment price, energy use characterization, LCC and PBP, and NES and net present value (NPV). The ANOPR discusses the methodologies and assumptions for each of these analyses. Table I.1 identifies the sections in this document that contain the results of each of the analyses, and summarizes the methodologies, key inputs and assumptions for the analyses. DOE consulted with interested parties and stakeholders in developing these analyses, and invites further input from interested parties and stakeholders on these topics. Obtaining that input is a primary purpose of this ANOPR. Thus, the results of the preliminary analyses presented in this ANOPR are subject to revision following review and input from stakeholders and other interested parties. The final rule will contain the results of the final analyses.

TABLE I.1.—IN-DEPTH TECHNICAL ANALYSES CONDUCTED FOR THE ADVANCE NOTICE OF PROPOSED RULEMAKING

Analysis area	Methodology	Key inputs	Key assumptions	ANOPR section for results	TSD section for results
Engineering (TSD Chapter 5).	Efficiency level approach supplemented with design option analysis.	Component cost data and performance values.	Component performance improvements are estimated using ANSI/ARI Standard 1200–2006.	Section II.C.5	Chapter 5, section 5.10, and appendix B.
Markups to Determine Equipment Price (TSD Chapter 6).	Assessment of company financial reports to develop markups to transform manufacturer prices into customer prices.	Distribution channels; market shares across the different channels; State sales taxes; and shipments to different States.	Markups for baseline and more efficient equipment are different.	Section II.D	Chapter 6, section 6.7.

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

TABLE I.1.—IN-DEPTH TECHNICAL ANALYSES CONDUCTED FOR THE ADVANCE NOTICE OF PROPOSED RULEMAKING—Continued

Analysis area	Methodology	Key inputs	Key assumptions	ANOPR section for results	TSD section for results
Energy Use Characterization (TSD Chapter 7).	Energy use estimates from the engineering analysis, validated using whole-building annual simulation for selected climates.	Component energy use and refrigerant load (from engineering analysis); and condenser rack performance data.	Case lighting operates for 24 hours a day; and supermarket is used as building prototype.	Section II.E	Chapter 7, section 7.4.4, and appendix D.
LCC and Payback Period (TSD Chapter 8).	Analysis of a representative sample of commercial customers by building-type and location.	Manufacturer selling prices; markups (including sales taxes); installation price; energy consumption; electricity prices and future trends; maintenance costs; repair costs; equipment lifetime; and discount rate.	Baseline efficiency level is Level 1; average electricity prices are by customer-type and State; *Annual Energy Outlook (AEO) 2006* is used as reference case for future trends; equipment lifetime is 10 years; and discount rate is estimated by weighted average cost of capital by customer type.	Section II.G.15	Chapter 8, section 8.4, and appendix G.
Shipments (TSD Chapter 9).	Projection of linear footage of total sales by equipment class for new and replacement markets.	Wholesaler markups from company balance-sheet data and mechanical markups from U.S. Census Bureau data; current shipments data by equipment class; average equipment lifetime; construction forecasts for food sales buildings; and shipments by equipment size.	Market shares by equipment class are constant; saturation by building type is constant; and shipments do not change in response to standards.	Section II.H	Chapter 9, section 9.4.
National Impact (TSD Chapter 10).	Forecasts of commercial refrigeration equipment costs, annual energy consumption and operating costs to the year 2042.	Shipments; effective date of standard; base case efficiencies; shipment-weighted market shares; annual energy consumption, total installed cost and repair & maintenance costs, all on a per linear foot basis; escalation of electricity prices; electricity site-to-source conversion; discount rate; and present year.	Annual shipments are from shipments model; annual weighted-average energy efficiency and installed cost are a function of energy efficiency level; annual weighted-average repair and maintenance costs are constant with energy consumption level; *AEO2006* is used for electricity price escalation; National Energy Modeling System (NEMS) is used for site-to-source conversion; discount rates are 3 percent and 7 percent real; and future costs are discounted to present year: 2007.	Section II.I.4	Chapter 10, section 10.4, and appendix I.

1. Engineering Analysis

The engineering analysis establishes the relationship between the cost and efficiency of commercial refrigeration equipment. This relationship serves as the basis for cost and benefit calculations for individual commercial consumers, manufacturers, and the Nation. The engineering analysis identifies representative baseline equipment, which is the starting point for analyzing technologies that provide energy efficiency improvements. Baseline equipment here refers to a model or models having features and technologies typically found in equipment currently offered for sale. The baseline model in each equipment class represents the characteristics of equipment in that class. After identifying baseline models, DOE estimated manufacturer selling prices (MSPs) through an analysis of manufacturer costs and manufacturer markups. Manufacturer markups are the multipliers used to determine the MSPs based on manufacturing cost.

The engineering analysis uses 4 industry-supplied cost-efficiency curves, which are based on an efficiency-level approach, and 15 cost-efficiency curves derived from DOE analysis, which are based on a design-options approach.[2] [3] DOE also discusses in the engineering analysis the equipment classes analyzed, the methodology used to extend the analysis to equipment classes that have low volumes of shipments, an analysis of sensitivity to material prices, and the use of alternative refrigerants.

2. Markups To Determine Equipment Price

DOE determines customer prices for commercial refrigeration equipment from MSP and equipment price markups using industry balance sheet data and U.S. Census Bureau data. To determine price markups, DOE identifies distribution channels for equipment sales and determines the existence and amounts of markups within each distribution channel. For each distribution channel, DOE distinguishes between ''baseline markups'' applied to the MSP for baseline equipment and ''incremental markups'' applied to the incremental increase in MSP for higher efficiency equipment. Overall baseline and overall incremental markups are calculated separately based on the product of all baseline markups at each step within a distribution channel or the product of all incremental markups at each step within a distribution channel, respectively. The combination of the overall baseline markup applied to the baseline MSP and the incremental markups applied to the incremental increase in MSP for higher efficiency equipment, including sales tax, determines the final customer price.

3. Energy Use Characterization

The energy use characterization provides estimates of annual energy consumption for commercial refrigeration equipment, which are used in the subsequent LCC and PBP analyses and the national impact analysis (NIA). DOE developed energy consumption estimates for the 15 classes of equipment analyzed in the engineering analysis. DOE validated these estimates with simulation modeling of energy consumption on an annual basis for selected equipment classes and efficiency levels.

4. Life-Cycle Cost and Payback Period Analyses

The LCC and PBP analyses determine the economic impact of potential standards on individual commercial consumers. The LCC is the total consumer expense for a piece of equipment over the life of the equipment. The LCC analysis compares the LCCs of equipment designed to meet more stringent energy conservation standards with the LCC of the equipment likely to be installed in the absence of standards. DOE determines LCCs by considering: (1) Total installed cost to the purchaser (which consists of MSP, sales taxes, distribution channel markups, and installation cost), (2) the operating expenses of the equipment (energy cost and maintenance and repair cost), (3) equipment lifetime, and (4) a discount rate that reflects the real consumer cost of capital and puts the LCC in present value terms. The PBP represents the number of years needed to recover the increase in purchase price (including installation cost) of more efficient equipment through savings in the operating cost of the equipment. The PBP is the increase in total installed cost due to increased efficiency divided by the (undiscounted) decrease in annual operating cost from increased efficiency.

5. National Impact Analysis

The NIA estimates the NES, and the NPV of total national customer costs and savings, expected to result from new standards at specific efficiency levels. DOE calculated the NES and NPV for each standard level for commercial refrigeration equipment as the difference between a base case forecast (without new standards) and the standards case forecast (with new standards). For the NES, DOE determined national annual energy consumption by multiplying the number of commercial refrigeration equipment units in use (by vintage) by the average unit energy consumption (also by vintage). DOE then computed cumulative energy savings, which is the sum of each annual NES determined from the year 2012 to 2042. The national NPV is the sum over time of the discounted net savings each year, which consists of the difference between total operating cost savings and the increase in total installed costs. Critical inputs to the NIA include shipments projections, rates at which users retire equipment (based on estimated equipment lifetimes), and estimates of changes in shipments and retirement rates in response to changes in equipment costs due to new standards.

C. Authority

Title III of EPCA, 42 U.S.C. 6311–6317, as amended by the Energy Policy Act of 2005 (EPACT 2005), Pub. L. 109–58, provides an energy conservation program for certain commercial and industrial equipment. Further, EPACT 2005 prescribes new or amended energy conservation standards and test procedures, and directs DOE to undertake rulemakings to promulgate such requirements. In particular, section 136(c) of EPACT 2005 directs DOE to prescribe energy conservation standards for commercial refrigeration equipment. (42 U.S.C. 6313(c)(4)(A))

Before DOE prescribes any such standards, however, it must first solicit comments on proposed standards. Moreover, DOE must design each new standard for commercial refrigeration equipment to achieve the maximum improvement in energy efficiency that is technologically feasible and economically justified, and will result in significant conservation of energy. (42 U.S.C. 6295(o)(2)(A), (o)(3)) To determine whether a standard is economically justified, DOE must, after receiving comments on the proposed standard, determine whether the benefits of the standard exceed its burdens to the greatest extent practicable, considering the following seven factors:

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

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

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

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

(5) The impact of any lessening of competition, as determined in writing by the Attorney General, that is likely to

[2] An efficiency-level approach establishes the relationship between manufacturer cost and increased efficiency at predetermined efficiency levels above the baseline. Under this approach, manufacturers typically provide incremental manufacturer cost data for incremental increases in efficiency.

[3] A design-options approach uses individual or combinations of design options to identify increases in efficiency. Under this approach, estimates are based on manufacturer or component supplier data, or through the use of engineering computer simulation models. Individual design options, or combinations of design options, are added to the baseline model in ascending order of cost-effectiveness.

result from the imposition of the standard;

(6) The need for national energy conservation; and

(7) Other factors the Secretary of Energy (Secretary) considers relevant. (42 U.S.C. 6295(o)(2)(B)(i)).

Other statutory requirements are set forth in 42 U.S.C. 6295 (o)(1)–(2)(A), (2)(B)(ii)–(iii), and (3)–(4), and 42 U.S.C. 6316(e).

D. Background

1. History of Standards Rulemaking for Commercial Refrigeration Equipment

Section 136(c) of EPACT 2005 amended section 342 of EPCA, in part, by adding new subsection 342(c)(4)(A), (42 U.S.C. 6313(c)(4)(A)) which directs the Secretary to issue, by rule, no later than January 1, 2009, energy conservation standards for the following equipment, manufactured on or after January 1, 2012: 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. This equipment, which has never before been regulated at the Federal level, is the subject of this rulemaking.

Section 136(a)(3) of EPACT 2005 amended section 340 of EPCA, in part by adding the definitions for ''commercial refrigerator, freezer, and refrigerator-freezer,'' ''holding temperature application,'' ''pull-down temperature application,'' ''remote condensing unit,'' and ''self-contained condensing unit.'' [4]

EPCA does not explicitly define the terms ''self-contained commercial refrigerator, freezer, or refrigerator-freezer'' and ''remote condensing commercial refrigerator, freezer, or refrigerator-freezer,'' which delineate two of the categories of equipment covered by this rulemaking. DOE construes these two terms to mean ''commercial refrigerator, freezer, or refrigerator-freezer that is connected to a self-contained condensing unit'' and ''commercial refrigerator, freezer, or refrigerator-freezer that is connected to a remote condensing unit,'' respectively.

On April 25, 2006, DOE published in the **Federal Register** a notice of public meeting and availability of the *Rulemaking Framework for Commercial Refrigeration Equipment Including Ice-Cream Freezers; Self-Contained Commercial Refrigerators, Freezers, and Refrigerator-Freezers without doors; and Remote Condensing Commercial Refrigerators, Freezers, and Refrigerator-Freezers* (Framework Document) that describes the procedural and analytical approaches that DOE anticipates using to evaluate energy conservation standards for commercial refrigeration equipment. 71 FR 23876. This document is available at *http://www.eere.energy.gov/buildings/appliance_standards/commercial/refrigeration_equipment.html.* DOE held a Framework public meeting on May 16, 2006, to discuss the procedural and analytical approaches for use in the rulemaking, and to inform and facilitate stakeholders' involvement in the rulemaking process. The analytical framework presented at the public meeting described different analyses, such as LCC and PBP, the proposed methods for conducting them, and the relationships among the various analyses. The ANOPR TSD describes the analytical framework in detail.

Statements received after publication of the Framework Document and at the May 16, 2006, Framework public meeting helped identify issues involved in this rulemaking and provided information that has contributed to DOE's proposed resolution of these issues. Many of the statements are quoted or summarized in this ANOPR. A parenthetical reference at the end of a quotation or passage provides the location index in the public record.

2. Rulemaking Process

Table I.2 sets forth a list of the analyses DOE has conducted and intends to conduct in its evaluation of standards for commercial refrigeration equipment. Until recently, DOE performed the manufacturer impact analysis (MIA) in its entirety between the ANOPR and notice of proposed rulemaking (NOPR) during energy conservation standards rulemakings. As noted in the table, DOE has performed a preliminary MIA for this ANOPR. DOE believes this change will improve the rulemaking process.

TABLE I.2.—COMMERCIAL REFRIGERATION EQUIPMENT ANALYSIS

ANOPR	NOPR	Final Rule *
• Market and technology assessment	• Revised ANOPR analyses	• Revised NOPR analyses.
• Screening analysis	• Life-cycle cost sub-group analysis.	
• Engineering analysis	• Manufacturer impact analysis.	
• Energy use characterization	• Utility impact analysis.	
• Markups to determine equipment price	• Employment impact analysis.	
• Life-cycle cost and payback period analyses	• Environmental assessment.	
• Shipments analysis	• Regulatory impact analysis.	
• National impact analysis.		

[4] ''(9)(A) The term 'commercial refrigerator, freezer, and refrigerator-freezer' means refrigeration equipment that—

(i) Is not a consumer product (as defined in section 321 of EPCA [42 U.S.C. 6291(1)]);

(ii) Is not designed and marketed exclusively for medical, scientific, or research purposes;

(iii) Operates at a chilled, frozen, combination chilled and frozen, or variable temperature;

(iv) Displays or stores merchandise and other perishable materials horizontally, semivertically, or vertically;

(v) Has transparent or solid doors, sliding or hinged doors, a combination of hinged, sliding, transparent, or solid doors, or no doors;

(vi) Is designed for pull-down temperature applications or holding temperature applications; and

(vii) Is connected to a self-contained condensing unit or to a remote condensing unit.'' (42 U.S.C. 6311(9)(A)).

''(B) The term 'holding temperature application' means a use of commercial refrigeration equipment other than a pull-down temperature application, except a blast chiller or freezer.'' (42 U.S.C. 6311(9)(B)).

''(D) The term 'pull-down temperature application' means a commercial refrigerator with doors that, when fully loaded with 12 ounce beverage cans at 90 degrees Fahrenheit (F), can cool those beverages to an average stable temperature of 38 degrees F in 12 hours or less.'' (42 U.S.C. 6311(9)(D)).

''(E) The term 'remote condensing unit' means a factory-made assembly of refrigerating components designed to compress and liquefy a specific refrigerant that is remotely located from the refrigerated equipment and consists of 1 or more refrigerant compressors, refrigerant condensers, condenser fans and motors, and factory supplied accessories.'' (42 U.S.C. 6311(9)(E)).

''(F) The term 'self-contained condensing unit' means a factory-made assembly of refrigerating components designed to compress and liquefy a specific refrigerant that is an integral part of the refrigerated equipment and consists of 1 or more refrigerant compressors, refrigerant condensers, condenser fans and motors, and factory supplied accessories.'' (42 U.S.C. 6311(9)(F)).

TABLE I.2.—COMMERCIAL REFRIGERATION EQUIPMENT ANALYSIS—Continued

ANOPR	NOPR	Final Rule *
• Preliminary manufacturer impact analysis.		

* During the Final Rule phase, DOE considers the comments submitted by the U.S. Department of Justice in the NOPR phase concerning the impact of any lessening of competition that is likely to result from the imposition of the standard. (42 U.S.C. 6295(o)(2)(B)(v)).

The analyses in Table I.2 include the development of economic models and analytical tools. If timely new data, models, or tools that enhance the development of standards become available, DOE will incorporate them into this rulemaking.

3. Miscellaneous Rulemaking Issues

a. Federal Preemption

During the Framework public meeting, the Air-Conditioning and Refrigeration Institute (ARI) stated that it interpreted EPACT 2005 as authorizing DOE to conduct a rulemaking for commercial refrigeration equipment, and to exempt certain categories from the standards DOE adopts. (Public Meeting Transcript, No. 3.4 at p. 80) [5] The Appliance Standards Awareness Project (ASAP) responded that setting a ''no-standard'' standard that preempts the States is problematic. (Public Meeting Transcript, No. 3.4 at pp. 81–82) However, ASAP agrees with ARI's basic view that DOE should address opportunities for energy savings, and should not necessarily have standards for every unit in the marketplace, because the objective is to save energy in a cost-effective way. *Id.* The American Council for an Energy-Efficient Economy (ACEEE), in apparent agreement with ARI and ASAP, expressed doubt that States would seek to set energy conservation standards for equipment that are truly niche equipment. (Public Meeting Transcript, No. 3.4 at p. 82) The Alliance to Save Energy, ACEEE, ASAP, Natural Resources Defense Council (NRDC), Northeast Energy Efficiency Partnerships (NEEP), and Northwest Power and Conservation Council (hereafter ''Joint Comment'') strongly opposed any suggestion that States be preempted from setting standards for equipment for which DOE does not itself set standards. (Joint Comment, No. 9 at p. 3) [6]

DOE is evaluating all commercial refrigeration equipment—*i.e.*, all 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—for the development of standards. DOE will evaluate all relevant equipment classes during this evaluation. This equipment has a large number of classes, however, and DOE intends to prioritize the technical analyses based on shipment data and only to conduct a full technical analysis on classes with the highest numbers of shipments for this ANOPR. In accordance with 42 U.S.C. 6316(e)(1), DOE intends to adopt standards for all equipment for which standards would satisfy the criteria in 42 U.S.C. 6295(o). DOE is not aware of any basis for it to exclude from this rule any commercial refrigeration equipment for which a standard would meet the statutory criteria above. Furthermore, the extent to which States will be barred from regulating the efficiency of any commercial refrigeration equipment for which the final rule in this rulemaking omits standards, will be governed by the relevant provisions of EPCA as to preemption, 42 U.S.C. 6297 and 6316(e)(3)–(4).

b. State Exemptions From Federal Preemption

Southern Company Services (Southern Company) and Edison Electric Institute (EEI) believe that the standards for commercial refrigeration equipment should be a ''50-state'' rule without exemptions from Federal preemption. They claim that exemptions would complicate the regulation of this equipment and increase costs to both manufacturers and consumers. (Southern Company, No. 6 at p. 1 and EEI, No. 8 at p. 1)

DOE fully intends that any standards it adopts in this rulemaking will apply uniformly in all of the States. In addition, any such Federal standards would, on the date of publication of the final rule, preempt any State standards that apply to the equipment covered by the Federal standards. In the event any State or local standard is issued before the date of publication of the final rule by the Secretary, that State or local standard shall not be preempted until the Federal standards take effect. (42 U.S.C. 6297 and 6316(e)(3)(A)) However, EPCA allows the States to petition DOE for waivers of preemption with regard to specific State standards, and DOE to grant such waiver applications if the statutory criteria are met. (42 U.S.C. 6297(d)) DOE does not have the authority to preclude States from seeking waivers or to decree in advance that it will not grant them, either generally or for any particular type of equipment.

c. Equipment Class Prioritization

ARI stated that it strongly recommends that DOE focus its rulemaking efforts on the commercial refrigeration equipment classes with the highest energy savings potential, and not spend its scarce resources establishing standards for equipment with limited shipment volume and/or energy consumption. (ARI, No. 7 at p. 1)

Because of the large number of equipment classes included in this rulemaking, for the ANOPR phase of the rulemaking DOE has focused on conducting a thorough examination of the equipment classes with the greatest energy savings potential. To determine which equipment classes have the greatest energy savings potential, DOE relied on industry-supplied shipment data and addressed equipment classes with the highest shipment values first. To address low-shipment equipment classes, DOE could, for the NOPR phase of the rulemaking, either conduct a full technical analysis of these equipment classes, or develop correlations to extend analyses or standard levels. DOE explored the approach of developing correlations by conducting a ''focused

[5] A notation in the form ''Public Meeting Transcript, No. 3.4 at p. 80'' identifies an oral comment that DOE received during the May 16, 2006, Framework public meeting and which was recorded in the public meeting transcript in the docket for this rulemaking (Docket No. EE–2006–STD–0126), maintained in the Resource Room of the Building Technologies Program This particular notation refers to a comment (1) made during the public meeting, (2) recorded in document number 3.4, which is the public meeting transcript that is filed in the docket of this rulemaking, and (3) which appears on page 80 of document number 3.4.

[6] A notation in the form ''Joint Comment'', No. 9 at p. 3'' identifies a written comment that DOE has received and has included in the docket of this rulemaking. This particular notation refers to (1) A joint comment, (2) in document number 9 in the docket of this rulemaking, and (3) appearing on page 3 of document number 9.

matched-pair analysis.'' [7] This methodology is described in further detail in chapter 5 of the TSD. DOE specifically seeks feedback on its approach to equipment-class prioritization and the approach to extend the technical analysis from high-shipment equipment classes to low-shipment equipment classes. This is identified as Issue 1 under ''Issues on Which DOE Seeks Comment'' in section IV.E of this ANOPR.

4. Test Procedure

A test procedure outlines the method by which manufacturers will determine the efficiency of their commercial refrigeration equipment, and thereby assess compliance with an energy conservation standard.

Section 136(f)(1)(B) of EPACT 2005 amended section 343 of EPCA (42 U.S.C. 6314) by adding new subsections 343(a)(6)(A)–(D) (42 U.S.C. 6314(a)(6)(A)–(D)), which direct the Secretary to develop test procedures for commercial refrigeration equipment. On December 8, 2006, DOE published a final rule (the December 2006 final rule) in which it adopted American National Standards Institute (ANSI)/ARI Standard 1200–2006, *Performance Rating of Commercial Refrigerated Display Merchandisers and Storage Cabinets,* with one modification, as the DOE test procedure for this equipment. 71 FR 71340, 71369–70.[8] 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, and 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,* test method. The one modification DOE made in adopting ANSI/ARI Standard 1200–2006 was to adopt in the final rule −15 °F (±2 °F) as the rating temperature for commercial ice-cream freezers, instead of −5 °F (±2 °F). 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.

As mentioned above, on April 25, 2006, DOE published a Framework Document that describes the procedural and analytical approaches to evaluate energy conservation standards for commercial refrigeration equipment and presented this analytical framework to stakeholders during the Framework public meeting held on May 16, 2006. During the Framework public meeting, the Food Products Association (FPA) suggested, in lieu of climate-adjusted standards, climate conditions be part of the test method. FPA stated that DOE should specify the range of conditions that are expected for efficiency testing, and pointed out that most grocery stores across the country operate in a 65 °F to 70 °F range. (Public Meeting Transcript, No. 3.4 at pp. 158–159) ANSI/ARI Standard 1200–2006 requires that testing be in accordance with ASHRAE Standard 72–2005, which requires ambient conditions during testing of 75.2 °F (±1.8 °F) for dry bulb temperature and 64.4 °F (±1.8 °F) for wet bulb temperature. Although this is not the range recommended by FPA, it is close to FPA's recommended range, these temperatures have been widely used for testing commercial refrigeration equipment, and they provide ambient test temperatures that are typical of the conditions in which this equipment generally operates. Therefore, DOE's test procedure for commercial refrigeration equipment does include ambient rating conditions that represent normal operation conditions for commercial refrigeration equipment.

During the Framework public meeting and Framework comment period, DOE received comments on the inclusion of ''application temperatures'' for commercial refrigeration equipment, which are rating temperatures other than the standard rating temperatures prescribed by DOE's test procedures (38 °F for commercial refrigerators, 0 °F for commercial freezers, and −15 °F for commercial ice-cream freezers). Hill Phoenix stated that manufacturers of commercial refrigeration equipment occasionally produce a piece of equipment (usually at the customer's request) that is designed to operate at a temperature significantly different from one of the three standard temperatures. (Public Meeting Transcript, No. 3.4 at pp. 74–76) ARI commented that DOE should analyze the shipment data and determine whether it would be worth regulating equipment that operates at application temperatures if shipments for these units are very low. (Public Meeting Transcript, No. 3.4 at p. 79) ARI also asserted that allowing for an application temperature category is essential because operating temperature plays a key role in equipment energy consumption. (ARI, No. 7 at p. 4) The Joint Comment pointed out that the application temperature category should be reserved for equipment that cannot operate at 0 °F or at 38 °F, that DOE should not regulate equipment that has a small shipments volume, and that appropriate Federal standards and rating temperatures should be developed if shipments are large. (Joint Comment, No. 9 at p. 3)

DOE analyzed the shipments data provided by ARI during the Framework comment period. Excluding equipment for which EPACT 2005 amended EPCA to set standards (self-contained commercial refrigerators and commercial freezers with doors), there were 170,949 units of remote condensing commercial refrigerators and commercial freezers, self-contained commercial refrigerators and commercial freezers without doors, and commercial ice-cream freezers shipped in 2005. Shipments of commercial refrigerator-freezers were not reported, but are considered to be very small. Of the total shipments (both self-contained and remote condensing), only 1.7 percent were equipment that operate at 45 °F, 20 °F, 10 °F, or −30 °F (application temperatures), and 98.3 percent were equipment that operate at 38 °F, 0 °F, or −15 °F. By far, the application temperature with the largest number of units shipped is the 45 °F category (typically ''wine chillers''), and these were predominately remote condensing equipment. There were 1,834 units of remote condensing wine chillers shipped in 2005. Comparatively, in 2005 there were 85,001 units of remote condensing refrigerators that operate at 38 °F.

As stated above, DOE's test procedure for commercial refrigeration equipment requires that all equipment, including equipment designed to operate at application temperatures, be tested at one of the three rating temperatures: 38 °F for refrigerators, 0 °F for freezers, and −15 °F for ice-cream freezers. Given the relatively low shipment volumes of equipment that operates at application temperatures, as well as DOE's understanding that some of this equipment already can operate and be tested at one of the standard rating temperatures and that manufacturers might be able to redesign other equipment in relatively minor ways to have these capabilities, DOE believes this requirement will not place an

[7] The ''focused matched-pair analysis'' establishes a correlation between rating temperature levels and energy consumption by quantifying the differences in energy consumption for matched pairs of equipment classes that are very similar in features and dimensions, but have different operating temperatures.

[8] DOE incorporated by reference the ANSI/ARI Standard 1200–2006 test procedure in section 431.64 of 10 CFR Part 431. 71 FR 71340 (December 8, 2006).

unreasonable burden on manufacturers. In addition, if necessary, manufacturers could seek waivers from the DOE test procedure, pursuant to 10 CFR 431.401. For these reasons, DOE does not intend to develop separate standards for equipment that operates at application temperatures.

II. Commercial Refrigeration Equipment Analyses

This section addresses the analyses DOE has performed and intends to perform for this rulemaking. A separate subsection addresses each analysis, and contains a general introduction that describes the analysis and a discussion of comments received from interested parties.

A. Market and Technology Assessment

When DOE begins a standards rulemaking, it develops information that provides an overall picture of the market for the equipment concerned, including the nature of the equipment, the industry structure, and the market characteristics for the equipment. This activity consists of both quantitative and qualitative efforts based primarily on publicly available information. The subjects addressed in the market and technology assessment for this rulemaking include definitions, equipment classes, manufacturers and market shares, shipments of covered equipment, regulatory and non-regulatory programs, and technologies that could be used to improve the efficiency of covered commercial refrigeration equipment. This information serves as resource material for use throughout the rulemaking.

1. Definitions of Commercial Refrigeration Equipment Categories

Section 136(c) of EPACT 2005 amended section 342 of EPCA to include new subsection (c)(4)(A), which mandates that DOE issue standards for three categories of commercial refrigerators, commercial freezers, and commercial refrigerator-freezers.[9] Accordingly, pursuant to this provision, the three categories of equipment addressed by this rulemaking are: remote condensing commercial refrigerators, commercial freezers and commercial refrigerator-freezers; self-contained commercial refrigerators, commercial freezers, and commercial refrigerator-freezers without doors; and commercial ice-cream freezers. These categories of equipment are referred to collectively as ''commercial refrigeration equipment.''

a. Coverage of Equipment Excluded From American National Standards Institute/Air-Conditioning and Refrigeration Institute Standard 1200–2006

During the Framework comment period, ARI stated that the ANSI/ARI Standard 1200–2006 test procedure specifically excludes ice-cream ''dipping cabinets,'' but recommended that DOE include this equipment under this rulemaking as commercial freezers. (ARI, No. 7 at p. 3) ARI also appeared to suggest, however, that this and certain other equipment excluded from ANSI/ARI Standard 1200–2006, such as floral merchandisers, are excluded from coverage under EPCA because they are not considered commercial display merchandisers or storage cabinets. (ARI, No. 7 at p. 7)

EPCA directs DOE to set standards for commercial refrigeration equipment (*i.e.*, the three categories of equipment identified above). Any equipment that meets the EPCA definition of a ''commercial refrigerator, freezer, or refrigerator-freezer'' (see section I.D and the preceding section) and falls under one of these three categories will be covered by this rulemaking. In the December 2006 final rule, DOE incorporated by reference certain sections of ANSI/ARI Standard 1200–2006 as the test procedure for commercial refrigeration equipment, but did not reference section 2.2, which provides exclusions for certain equipment such as ice-cream dipping cabinets and floral display merchandisers. The equipment excluded in this section of ANSI/ARI Standard 1200–2006 will only be excluded from this rulemaking if they do not meet the EPACT 2005 definition of a ''commercial refrigerator, freezer, or refrigerator-freezer.''

b. Coverage of Equipment Not Designed for Retail Use

During the Framework comment period, several stakeholders commented on whether this rulemaking applies to equipment not designated for retail use. FPA commented that DOE needs to distinguish between ''industrial'' and ''commercial.'' FPA believes that the EPCA requirements for commercial refrigeration equipment were intended for ''point-of-sale'' equipment that is found in convenience stores and supermarkets. FPA continued that, in the food industry, ''refrigeration'' includes the industrial equipment found in manufacturing and processing facilities, not just the equipment in retail stores. (Public Meeting Transcript, No. 3.4 at pp. 23–24) Southern Company stated that the language ''storing or displaying or dispensing'' in DOE's definition of ''ice-cream freezer'' is ambiguous because it could include some industrial equipment the size of a tractor-trailer compartment. Southern Company believes there needs to be language to clarify that this rulemaking covers equipment used at the retail level. (Public Meeting Transcript, No. 3.4 at pp. 35–36) Southern Company and EEI both stated that a literal reading of DOE's proposed equipment classes appears to include industrial refrigeration equipment, which is not used for the display of merchandise for sale to the consumer. Southern Company and EEI believe that the inclusion of this equipment would unnecessarily complicate the analysis and the development of test procedures. They also stated that this equipment is not covered by EPCA and only commercial equipment is covered. They suggest that DOE define which equipment is for commercial purposes and which is for industrial purposes. Southern Company and EEI suggest that DOE define commercial refrigeration equipment as ''refrigeration equipment which would normally be used in a commercial business which sells products to ultimate consumers.'' Further, the definition ''should not include equipment which is normally used only in refrigerated warehouses or manufacturing facilities.'' (Southern Company, No. 6 at pp. 1–2; EEI, No. 8 at p. 1)

DOE understands that industrial refrigeration equipment consists of equipment used to process, manufacture, transport, or store chilled or frozen food and other perishable items. Industrial refrigeration equipment used to process or manufacture chilled or frozen food primarily includes equipment used to flash-freeze or chill food on an assembly line or in a batch manufacturing process. Industrial refrigeration equipment used to transport chilled or frozen food or other perishable items primarily includes refrigerated rail cars and tractor-trailers. In industrial buildings, temporary storage of chilled or frozen food is also necessary, as the manufactured product is often held at

[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.

the manufacturing facility for processing or while awaiting transport. Industrial refrigeration equipment used to store chilled or frozen food is accomplished with refrigerated warehouses and/or refrigerated walk-in rooms (''walk-ins'').

The term ''commercial refrigerator, freezer, and refrigerator-freezer'' is defined as refrigeration equipment that, in part, ''displays or stores merchandise and other perishable materials'' (see section I.D of this ANOPR). DOE interprets this language to mean that equipment used in the *processing, manufacture* or *transport* of chilled or frozen food is not considered commercial refrigeration equipment because it is not used to ''display or store.'' However, equipment that is used to *store* chilled or frozen food is considered covered equipment. This language does not make mention of the intended destination of the equipment, so DOE believes that walk-ins are covered under the definition because they *store* chilled or frozen food, regardless of whether the application is commercial or industrial. However, it is unclear whether this rulemaking would be the appropriate place to address walk-ins. The test procedures for self-contained commercial refrigerators, commercial freezers, and commercial refrigerator-freezers with doors specified in EPCA section 343(a)(6)(A)(ii) specifically exclude walk-ins and therefore DOE believes that the standards in EPCA sections 342(c)(2) and (3) do not apply to walk-ins. Since the test procedures DOE adopted for equipment covered under this rulemaking also specifically exclude walk-ins, DOE believes that the standards being developed in this rulemaking under EPCA section 342(c)(4)(A) also do not apply to walk-ins.[10] DOE could, however, address walk-ins under EPCA section 342(c)(4)(B), which states that DOE may issue standard levels, by rule, for other categories of commercial refrigerators, commercial freezers and commercial refrigerator-freezers.

c. Remote Condensing Commercial Refrigerators, Commercial Freezers, and Commercial Refrigerator-Freezers

Under EPCA, this equipment includes commercial refrigerators, commercial freezers, and commercial refrigerator-freezers that have a remote condensing unit, except for any remote condensing equipment that would meet DOE's definition of ''ice-cream freezer'' as set forth at 10 CFR 431.62, 71 FR 71369.[11] This equipment is typically used to store and display merchandise for direct sale to the consumer, and referred to as ''display cases,'' ''display cabinets,'' or ''merchandisers.'' The remote condensing unit has at least one compressor and a condenser coil, and most remote condensing units consist of multiple compressors (a compressor ''rack'') that serve multiple display cases.

EPCA does not specifically define the term ''commercial refrigerator-freezer,'' nor is DOE aware of an existing, written definition for such equipment. Therefore, in its Framework Document, DOE sought feedback on use of the definition of ''electric refrigerator-freezer'' for consumer products (set forth in 10 CFR 430.2) as a basis for defining the term ''remote condensing commercial refrigerator-freezer.'' (As discussed below, DOE also sought input on using this definition as a basis for defining self-contained commercial refrigerator-freezers.) The consumer product definition in 10 CFR 430.2 states that ''electric refrigerator-freezer means a cabinet which consists of two or more compartments with at least one of the compartments designed for the refrigerated storage of food at temperatures above 32°F. [*sic*] and with at least one of the compartments designed for the freezing and storage of food at temperatures below 8°F. [*sic*] which may be adjusted by the user to a temperature of 0°F. [*sic*] or below. The source of refrigeration requires single phase, alternating current [(AC)] electric energy input only.'' During the Framework comment period, three stakeholders commented on this definition. (ARI, No. 7 at p. 3; Public Meeting Transcript, No. 3.4 at p. 45; and Public Meeting Transcript, No. 3.4 at pp. 50–53) ARI and Zero Zone believe the definition is inappropriate for commercial equipment. ARI proposed that a remote condensing commercial refrigerator, freezer, or refrigerator-freezer be defined as ''a cabinet cooled by a remote refrigerating system for displaying and/or storing chilled and/or frozen food to be maintained within prescribed temperature limits. The cabinet is connected to one or more power sources ranging from 120 to 240 volts AC.'' (ARI, No. 7 at p. 3) During the Framework public meeting, ASAP indicated that DOE should look at the detailed definition given in EPACT 2005 for refrigerator-freezers. (Public Meeting Transcript, No. 3.4 at p. 53)

Based on the comments, DOE now believes that it need not adopt a definition of ''remote condensing commercial refrigerator-freezer.'' The comments by Zero Zone indicate the difficulties of adapting the residential product definition of refrigerator-freezer to the commercial setting. ARI did not comment on the need for a definition of commercial refrigerator-freezer discrete from definitions of refrigerator and freezer, and its suggested definition of ''commercial refrigerator, commercial freezer, and commercial refrigerator-freezer'' both duplicates and, in some ways, is inconsistent with the EPCA definition of this term. For example, one inconsistency is that the ARI definition states that the cabinet is connected to one or more power sources ranging from 120 to 240 volts AC, whereas the EPCA definition does not have any requirements for power sources. Further, ASAP did not address the fact that the definition in EPACT 2005 does not distinguish refrigerator-freezers from refrigerators and freezers. The comments by ARI and ASAP, however, indicate that they believe DOE does not need to adopt a separate definition for refrigerator-freezers.

DOE intends to rely here on the definition of ''commercial refrigerator, freezer, and refrigerator-freezer'' in EPCA (42 U.S.C. 6311(9)(A), added by EPACT 2005, section 136(a)(3)), and on its understanding of the well-accepted meaning of ''refrigerator-freezer.'' Thus, DOE construes the EPCA term ''remote condensing commercial refrigerator-freezer'' (see 42 U.S.C. 6313(c)(4)(A), added by EPACT 2005, section 136(c)) to mean refrigeration equipment that operates at both chilled and frozen temperatures and that is connected to a remote condensing unit. This term refers to equipment with two or more separate compartments, at least one of which is capable of maintaining food or other perishable items at temperatures above freezing and at least one of which maintains its contents frozen. By contrast, refrigerators operate only at temperatures above freezing, and freezers only at or below freezing temperatures.

In its Framework Document, DOE pointed out that EPCA defines a ''self-contained condensing unit,'' in part, as an assembly of refrigerating components ''that is an integral part of the refrigerated equipment * * * '' (42

[10] Test procedures are found at 10 CFR 431.64.

[11] The EPCA provision that requires this rulemaking identifies ''ice-cream freezers'' separately from ''self-contained commercial refrigerators, commercial freezers, and commercial refrigerator-freezers without doors'' and ''remote condensing commercial refrigerators, commercial freezers, and commercial refrigerator-freezers.'' (42 U.S.C. 6313(c)(4)(A), added by EPACT 2005, section 136(c)) Since the Act neither specifies nor indicates that ''ice-cream freezers'' are limited to equipment with a particular type of condensing unit (*i.e.*, remote or self-contained), equipment that has a remote condensing unit and also meets DOE's definition of ''ice-cream freezer'' would be considered an ''ice-cream freezer.''

U.S.C. 6311(9)(F), added by EPACT 2005, section 136(a)(3)) EPCA also defines a ''remote condensing unit,'' in part, as an assembly of refrigerating components ''that is remotely located from the refrigerated equipment * * *.'' (42 U.S.C. 6311(9)(E), added by EPACT 2005, section 136(a)(3)) DOE also stated in the Framework Document that this difference in the definitions may mean that, under EPCA, remote condensing units are not a part of the refrigerated equipment and that energy conservation standards for remote condensing commercial refrigerators, commercial freezers, and commercial refrigerator-freezers would apply only to the refrigerated equipment (*i.e.*, storage cabinets and display cases), but not to the remote condensing units. DOE specifically requested stakeholder comments on this topic.

ARI asserted that it was responsible for the language in EPACT 2005 on this subject and the intent was to cover the display case and storage cabinet only, not the remote condensing unit. (Public Meeting Transcript, No. 3.4 at pp. 47–48, 49) ACEEE responded by stating that it may be worth trying to cover the remote condensing unit so that the whole system is regulated. (Public Meeting Transcript, No. 3.4 at p. 48) Zero Zone pointed out that regulating the remote condensing unit would prove to be difficult because of the wide range of design differences in compressors and condensing units, and recommended not regulating them now. (Public Meeting Transcript, No. 3.4 at p. 48) ARI stated that it agreed with DOE's interpretation of EPACT 2005 that the rulemaking should be limited to the refrigerated display merchandisers and storage cabinets only. Furthermore, ARI asserted that including the remote condensing unit in this rulemaking would significantly complicate the analysis and likely delay the completion date, and it recommended that DOE reassess the situation in the future to determine whether energy conservation standards should be established for remote condensing equipment. (ARI, No. 7 at p. 3) Finally, the Joint Comment stated that DOE should cover remote condensing units under this rulemaking because it would provide more opportunity for energy savings and for manufacturers to trade off performance between different parts of the system. However, if DOE determines that including the entire system in this rulemaking is impractical, then the balance of the system should not be included under ''covered'' equipment for now, but instead, DOE should consider such coverage in a subsequent revision to the standard. (Joint Comment, No. 9 at p. 5).

Clearly, stakeholders differed on whether a remote condensing unit is considered part of the equipment to which it is connected, and whether such units are covered by the EPCA directive that DOE set standards for remote condensing commercial refrigerators, commercial freezers, and commercial refrigerator-freezers. (42 U.S.C. 6313(c)(4)(A), added by EPACT 2005, section 136(c)) ARI indicated that it believes EPCA does not authorize application of standards to remote condensing units, while ACEEE and the Joint Comment argued that remote condensing units should be covered but not necessarily in this rulemaking. However, DOE agrees with the stakeholders who stated that including remote condensing units in the present rulemaking would significantly complicate the rulemaking. There would be many difficulties in establishing standards for the display cases and the remote condensing units as a system. For example, display cases and remote condensing units are typically purchased from different manufacturers and installed at the site. Multiple display cases may be connected to one or more remote condensing units through an extensive network of refrigerant piping. Since each system is custom designed for its location, each individual system will have unique aspects to its design and operation (*e.g.*, number of display cases, variation in temperature control, use of heat recovery, etc.). Further, because the intended configuration of the final system design is not known when the components are manufactured, it would be difficult, if not impossible, to set an energy conservation standard for the entire system at the point of manufacture.

For these reasons, the energy conservation standards DOE intends to develop in this rulemaking for remote condensing commercial refrigeration equipment will apply to display cases only, not to the remote condensing units. DOE will address at a later time whether and to what extent it has the authority to regulate remote condensing units and, if so, whether standards that address these units are warranted and feasible.

d. Secondary Coolant Applications

In its Framework Document, DOE stated that it construed the language in section 136(a)(3) of EPACT 2005, 42 U.S.C. 6311(9)(A)(vii), the definition for ''commercial refrigerator, freezer, and refrigerator-freezer,'' to mean that so-called ''secondary-coolant applications'' are not covered under this rulemaking. DOE stated that it believed this interpretation of EPACT 2005 was consistent with ANSI/ARI Standard 1200–2006, which explicitly excludes secondary-coolant applications.

During the Framework comment period, several stakeholders commented on the coverage of equipment that uses secondary coolant systems.[12] ACEEE stated that DOE should have a broad scope of coverage and should in general cover as much as possible in the rulemaking. (Public Meeting Transcript, No. 3.4 at p. 26) ARI stated that it agrees with the interpretation DOE expressed in the Framework Document that secondary coolant applications should not be covered under this rulemaking. ARI explained that these systems represent a very small percentage of currently installed commercial refrigeration systems in the United States, and that there are no test procedures currently available for measuring the energy consumption of such systems. ARI noted, however, that DOE should revisit the secondary coolant issue in the next three to four years. (ARI, No. 7 at p. 2) Hill Phoenix stated that based on its experience, display cases that use secondary coolant make up less than five percent of what it sells and that this statistic is probably representative of the market in general. (Public Meeting Transcript, No. 3.4 at p. 30) Further, Southern Company stated, and EEI agreed, that it opposes the inclusion of secondary-coolant systems in this rulemaking because of timing and complexity. Since ANSI/ARI Standard 1200–2006 excludes secondary-coolant applications, their inclusion would complicate the development of a test procedure for commercial refrigeration equipment. Also, Southern Company and EEI oppose the inclusion of secondary coolant systems based on the small size of the secondary coolant market. (Southern Company, No. 6 at p. 2 and EEI, No. 8 at p. 1) The Joint Comment stated that they do not object to DOE's interpretation that secondary-coolant equipment is not covered under this rulemaking, provided that this equipment in fact accounts for no more than five percent of remote equipment sold, as asserted by Hill Phoenix. (Joint Comment, No. 9 at p. 5)

Section 340(9)(A)(vii) of EPCA (42 U.S.C. 6311((9)(A)(vii), added by EPACT 2005, section 136(a)(3)), states that the term ''commercial refrigerator, freezer,

[12] Secondary coolant systems use a direct expansion refrigeration cycle to cool a secondary single-phase fluid, which is pumped to heat exchangers in remote condensing display cases and is used to cool food or other perishable items.

and refrigerator-freezer means equipment that ''is connected to a self-contained condensing unit or to a remote condensing unit.'' (See section I.D.1 of this ANOPR.) In the Framework Document, DOE stated that it construes this language to mean that secondary coolant applications are not covered under this rulemaking. As indicated in the Framework Document, equipment using such applications are not directly connected to a self-contained or remote condensing unit. DOE further stated that it believed its interpretation to be consistent with ANSI/ARI Standard 1200–2006. DOE has considered the comments it received, but continues to believe that the language in section 340(9)(A)(vii) of EPCA means that equipment using secondary coolant systems are not covered under this rulemaking because they are not directly connected to a self-contained or remote condensing unit and, therefore, do not fit within the definition of ''commercial refrigerator, freezer, and refrigerator-freezer'' in EPCA.

e. Self-Contained Commercial Refrigerators, Commercial Freezers, and Commercial Refrigerator-Freezers Without Doors

Under EPCA, this equipment includes all types of commercial refrigerators, commercial freezers, and commercial refrigerator-freezers that have a self-contained condensing unit and have no doors, except for self-contained equipment that meets DOE's definition of ''ice-cream freezer'' as set forth at 10 CFR 431.62. 71 FR 71369. As with remote condensing equipment, self-contained equipment is typically used to store and display merchandise for direct sale to the consumer, and is commonly referred to as a ''refrigerated display case,'' ''display cabinet,'' or ''merchandiser.'' Self-contained equipment is defined as having an integral condensing unit (*i.e.*, the condensing unit is not remote from the refrigerated cabinet). (See 42 U.S.C. 6311(9)(F), added by EPACT 2005, section 136(a)(3)) The 2006 ASHRAE Refrigeration Handbook (see chapter 47, p. 47.1) defines ''reach-in'' refrigerators or freezers as being upright and box shaped, and having hinged or sliding doors. Given this definition, self-contained reach-in commercial refrigerators, commercial freezers, and commercial refrigerator-freezers (*i.e.*, self-contained units with doors) are not covered in this rulemaking because the rulemaking only covers self-contained equipment without doors.

In its Framework Document, as with the term ''remote condensing commercial refrigerator-freezers,'' DOE sought feedback on use of the definition of ''electric refrigerator-freezer'' for consumer products (as set forth in 10 CFR 430.2) as a basis for defining the term ''self-contained commercial refrigerator-freezer.'' The comments on this subject were virtually identical to those received with respect to the remote condensing equipment, which are discussed above in section II.A.1.c, and DOE has reached the same conclusion here as it reached with respect to that equipment. Specifically, DOE does not intend at this point to adopt a definition for ''self-contained commercial refrigerator-freezer without doors.'' Rather, DOE intends to rely on EPCA's definition of ''commercial refrigerator, freezer, and refrigerator-freezer,'' and on its understanding of the well-accepted meaning of ''refrigerator-freezer.'' DOE construes the EPCA term ''self-contained commercial refrigerator-freezer without doors'' (see 42 U.S.C. 6313(c)(4)(A), added by EPACT 2005, section 136(c)) to mean refrigeration equipment that operates at both chilled and frozen temperatures, is connected to a self-contained condensing unit, and has no doors. Such equipment has two or more separate compartments, at least one of which is capable of maintaining food or other perishable items at temperatures above freezing and at least one of which maintains its contents frozen.

f. Commercial Ice-Cream Freezers

The EPCA provision that requires this rulemaking identifies ''ice-cream freezers'' separately from ''self-contained commercial refrigerators, freezers, and refrigerator-freezers without doors'' and ''remote condensing commercial refrigerators, freezers, and refrigerator-freezers.'' (42 U.S.C. 6313(c)(4)(A), added by EPACT 2005, section 136(c)) EPCA neither specifies nor indicates that ''ice-cream freezers'' are limited to equipment with a particular door configuration (*e.g.*, with or without doors) or type of condensing unit (*i.e.*, remote or self-contained). Thus, pursuant to EPCA's definition of ''commercial refrigerator, freezer, and refrigerator-freezer'' (42 U.S.C. 6311(9)(A), added by EPACT 2005, section 136(a)(3)), DOE believes commercial ice-cream freezers include equipment with all door types (*i.e.*, solid doors, transparent doors, or no doors) and configurations (*e.g.*, vertical or horizontal), as well as equipment with either integral or remote condensing units (*i.e.*, self-contained or remote condensing).

During the Framework comment period, several stakeholders commented on the definition of commercial ice-cream freezer. ARI stated that the majority of equipment intended for ice cream operates at −5 °F or 0 °F, with a minority that operates at −30 °F, and stated that DOE should focus on those ice-cream freezers with high shipment volumes. (Public Meeting Transcript, No. 3.4 at pp. 32–33) Zero Zone stated that there are many interpretations of what an ice-cream freezer is. Zero Zone asserted that California and Canada define an ice-cream freezer ''along the lines of a dipping cabinet.'' (Public Meeting Transcript, No. 3.4 at p. 35) Zero Zone further commented that the display-type freezers it sells for ice cream and frozen food are the same, that these cases have adjustable temperatures, and that the user sets the temperature of the equipment a little lower when it uses the equipment for ice cream. Typically, the equipment has two ratings, one for use of frozen food and for ice cream, because customers want to know the energy use for each. Zero Zone also characterized as ''true ice-cream cabinets'' those which have specific functions for the processing and storage of ice cream, rather than its display, and asserted that comparatively few of these are sold. (Public Meeting Transcript, No. 3.4 at p. 38) Zero Zone asserted that the term ''ice-cream freezer'' cannot be specifically defined because ice cream can be stored or displayed in a number of cabinets that have different cabinet styles and that may also be used to store other, non-ice-cream equipment. In addition, it stated that not all ice cream is stored at the same temperature. Zero Zone recommended that freezers be divided into three categories: ice-cream dipping cabinets, 0 °F to −15 °F, and below −15 °F. (Zero Zone, No. 5 at p. 1) Hill Phoenix stated that its freezer cases also can operate at either 0 °F or −5 °F, but there is no distinction in the design of the case used for ice cream and that used for frozen food, only in how the customer uses it. Hill Phoenix added that because these two temperatures are so close, there is a linear relationship between temperature and energy usage. Hill Phoenix also stated there is a category of cases that operate at −15 °F to −30 °F, called ''hardening'' cabinets, which have a different design than typical freezer cases. (Public Meeting Transcript, No. 3.4 at p. 41) Both Southern Company and EEI stated that it is important that DOE develop definitions for commercial freezer and ice-cream freezer that are all-inclusive, and do not leave any loopholes for States to regulate. (Southern Company, No. 6 at p. 2; EEI, No. 8 at p. 1) ARI stated that there is very little difference between freezers designed to operate at 0 °F and −5 °F, both in terms of features and in terms of energy consumption. ARI added that a recent survey of its members revealed that a significant number of ice-cream freezers operate at −15 °F. It requested that freezers that operate at −5 °F be included in the freezer category. ARI intends to amend ANSI/ARI Standard 1200–2006 to reflect an ice-cream freezer temperature of −15 °F. In addition, ARI proposed that specialty freezers, such as hardening cabinets that operate far below the ice-cream freezer temperature, be excluded from this rulemaking. (ARI, No. 7 at p. 2) The Joint Comment agreed with ARI that freezers that operate at −5 °F be tested at 0 °F, and that testing at −5 °F will only be for information purposes, not for setting standards. (Joint Comment, No. 9 at p. 3)

As part of the December 8, 2006 final rule, in which it adopted test procedures for commercial refrigeration equipment, DOE adopted the following definition for ''ice-cream freezer:'' ''a commercial freezer that is designed to operate at or below −5 °F (−21 °C) and that the manufacturer designs, markets, or intends for the storing, displaying, or dispensing of ice cream.'' 71 FR 71369; 10 CFR 431.62. In addition, this final rule prescribed the rating temperature at −15 °F for ice-cream freezers. 71 FR 71370; 10 CFR 431.64.

Under this definition, unless equipment is designed, marketed, or intended specifically for the storage, display or dispensing of ice cream, it would not be considered an ''ice-cream freezer.'' Multi-purpose commercial freezers, manufactured for storage and display, for example, of frozen foods as well as ice cream would not meet this definition, and DOE would not treat them as commercial ice-cream freezers in this rulemaking. This is in accord with the comments listed above, which indicated that DOE should not classify such freezers as ice-cream freezers. On the other hand, any commercial freezer that is specifically manufactured for storing, displaying or dispensing ice cream, and that is designed so that in normal operation it can operate at or below −5 °F (−21 °C), would meet the definition. This includes equipment that some stakeholders referred to as true ice-cream cabinets—freezers designed to operate considerably below −5 °F and that are sometimes referred to as ''hardening'' cabinets and are specifically designed for ice cream storage, for example—as well as those ice-cream dipping cabinets that are designed to operate at least to some extent below −5 °F. DOE intends to classify and address these types of equipment as commercial ice-cream freezers in this rulemaking.

2. Equipment Classes

In general, when evaluating and establishing energy conservation standards, DOE divides covered equipment into equipment classes by the type of energy used, capacity or other performance-related features that affect efficiency, and factors such as the utility of the equipment to users. (See 42 U.S.C. 6295(q).) Different energy conservation standards may apply to different equipment classes.

Commercial refrigeration equipment can be divided into various equipment classes categorized by physical characteristics that affect the efficiency of the equipment. Most of these characteristics affect the merchandise that the equipment can be used to display, and how that merchandise can be accessed by the customer. Key physical characteristics 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 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). ARI agreed that definitions for the terms horizontal, semivertical, and vertical be based upon the angle of the air curtain. (ARI, No. 7 at p. 7)

DOE could not identify an existing industry definition of air-curtain angle, but developed a preliminary definition for consideration. DOE is considering defining 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 specifically seeks feedback on this definition of air-curtain angle. This is identified as Issue 2 under ''Issues on Which DOE Seeks Comment'' in section IV.E of this ANOPR.

DOE proposed an organization of equipment classes in its Framework Document based on the equipment classes for self-contained commercial refrigerators, commercial freezers and commercial refrigerator-freezers with doors described in section 136(c)(2) of EPACT 2005. Another organization of equipment classes for commercial refrigeration equipment was proposed by ARI during the Framework comment period, and presented by DOE during the Framework public meeting. ARI organized commercial refrigeration equipment by equipment family (where equipment family is considered as broad groups of covered equipment that have similar geometric characteristics), condensing unit type, and operating temperature.[13] (ARI, No. 7 at pp. 5–7) During the public meeting, DOE noted that ARI's equipment families included a ''service over counter'' equipment family, which was absent from DOE's equipment class organization. DOE understands that the service over counter equipment family is unique in that access to merchandise on display is provided only to sales personnel from the rear of the cabinet. ARI noted that DOE did not categorize equipment with doors based on whether the doors are solid or transparent, and ARI explained that this is a necessary distinction. (ARI, No. 7 at p. 7) The Joint Comment stated that the equipment families proposed by ARI are reasonable. (Joint Comment, No. 9 at p. 3)

DOE agrees with ARI that the characteristics of the service over counter design affect efficiency, and is proposing an equipment class organization that includes a service over counter equipment family. DOE also agrees with ARI that the energy consumption of commercial refrigeration equipment with doors is affected by whether the doors are solid or transparent, and is proposing to include this distinction in its equipment class organization.

In its Framework Document, DOE suggested that equipment without doors be divided into equipment classes based on air-curtain angles of 0° to 30° (vertical), 30° to 60° (semivertical), and 60° to 90° (horizontal) from the vertical. During the Framework public meeting, DOE asked for comments on these proposed ranges of air-curtain angle. Hill Phoenix stated that the industry defines these as 0° to 10° for vertical, 10° to 80° for semivertical, and 80° to 90° for horizontal. (Public Meeting Transcript, No. 3.4 at p. 86) The Joint Comment stated that the ranges for vertical and semivertical should be closer to those used in DOE's proposal. Specifically, the Joint Comment stated that because vertical equipment will tend to be more efficient and thus likely

[13] For this rulemaking, equipment class designations consist of a combination (in sequential order separated by periods) of an (1) 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.

to have more stringent standards, if the equipment family delineations allow manufacturers to substitute semivertical for vertical, they could unintentionally shift the market to the less efficient standard. Therefore, the Joint Comment stated that DOE should determine a divide between vertical and semivertical that will not result in one type of equipment being substituted for the other. (Joint Comment, No. 9 at pp. 3–4)

The cost-efficiency data DOE received from ARI for four covered equipment classes were based on the industry definitions of 0° to 10° for vertical equipment, 10° to 80° for semivertical equipment, and 80° to 90° for horizontal equipment, as measured from the vertical. Therefore, DOE conducted its analyses for the ANOPR based on these definitions of equipment families, but recognizes the concern raised by the Joint Comment that these delineations may result in one type of equipment being substituted for another. To investigate the relationship of air-curtain angle to energy consumption for remote condensing medium temperature open display cases (VOP.RC.M, SVO.RC.M, and HZO.RC.M equipment classes), DOE collected market data, which is documented in the market and technology assessment (see chapter 3 of the TSD).[14 15] These data show significant clusters of equipment divided by air-curtain angles of 10°, 30° and 65° from the vertical. The most significant cluster of equipment is in the range of 0° to 10° from the vertical (this cluster corresponds to the VOP.RC.M equipment class as currently defined), with less significant clusters between 10° and 30°, 30° and 65°, and 65° and 90° from the vertical. The large cluster of equipment between 0° to 10° from the vertical has a high frequency of units at 6° to 9° from the vertical. With the delineation between vertical and semivertical equipment families at an angle of 10°, if the SVO.RC.M equipment class had a less stringent standard than the VOP.RC.M equipment class, DOE is concerned that manufacturers may adjust their equipment designs slightly to take advantage of the lower standard for SVO.RC.M equipment. A piece of equipment could be redesigned with a small change in air-curtain angle (*e.g.*, from 9° to 11° from the vertical), that would not significantly affect energy consumption or utility. This redesign would move the equipment from the VOP.RC.M equipment class to the SVO.RC.M equipment class, where it would not be subject to as stringent a standard.

DOE understands that there is the potential for manufacturers to redesign equipment to move from one equipment class to another regardless of where the air-curtain angle delineation is made. However, the concern raised above is heightened by the concentration of equipment in the 0° to 10° from the vertical range, and the potential for mass redesign of the majority of equipment currently classified as VOP.RC.M in order to be classified as SVO.RC.M. According to DOE's market data, there is a clear region of low density at an air-curtain angle of 30° from the vertical, and DOE believes that drawing the delineation between the VOP and SVO equipment families here could potentially result in less equipment migration from the VOP.RC.M equipment class to the SVO.RC.M equipment class.

Additionally, DOE's market data provides little support for delineating the SVO.RC.M and the HZO.RC.M equipment families at 80° from the vertical. A significant group of equipment with similar characteristics (but clearly distinguished from the SVO.RC.M and VOP.RC.M equipment classes) is present with air curtain angles of 65° to 90° from the vertical. This supports drawing the SVO.HZO equipment family delineation at 60° to 65° from the vertical. In light of this market data, DOE welcomes any additional data or feedback regarding the proposed ranges of air-curtain angles or shipments of equipment in the VOP.RC.M, SVO.RC.M and HZO.RC.M equipment classes broken down by energy use and air-curtain angle.

DOE believes that the orientation of doors affects the energy consumption of commercial refrigeration equipment with doors and that this equipment can be broadly categorized by the angle of the door. DOE did not receive stakeholder feedback on how to define the door angle for equipment with doors, but is considering 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.'' DOE specifically seeks feedback on this definition of door angle. This is identified as Issue 3 under ''Issues on Which DOE Seeks Comment'' in section IV.E of this ANOPR.

During the Framework comment period, no objections were raised to the proposal of equipment families of ''horizontal'' and ''vertical'' equipment with doors. In addition, Hill Phoenix commented that ARI eliminated the ''semivertical with doors'' equipment family (doors with an angle that deviated substantially from 0° or 90° with respect to the vertical) because no manufacturers could identify any shipments of semivertical equipment with doors. (Public Meeting Transcript, No. 3.4 at p. 63) Therefore, for equipment with solid and transparent doors, DOE is considering defining two equipment families each, based on door angles of 0° to 45° (vertical) and 45° to 90° (horizontal). DOE specifically seeks feedback on these ranges of door angles for equipment with doors. This is identified as Issue 4 under ''Issues on Which DOE Seeks Comment'' in section IV.E of this ANOPR.

Based on the above information, DOE intends to use eight equipment families, which are shown in Table II.1.

TABLE II.1.—EQUIPMENT FAMILY DESIGNATIONS

Equipment family	Description
Vertical Open (VOP)	Equipment without doors and an air-curtain angle greater than or equal to 0° and less than 10° from the vertical.
Semivertical Open (SVO)	Equipment without doors and an air-curtain angle greater than or equal to 10 and less than 80° from the vertical.
Horizontal Open (HZO)	Equipment without doors and an air-curtain angle greater than or equal to 80° from the vertical.

[14] See Table II.1 through Table II.3, which set forth the meaning of the equipment class lettering designations. Also, see chapter 3 of the TSD for more details on the equipment class lettering designations. For example, ''VOP.RC.M'' refers to the ''vertical open, remote condensing, medium temperature'' equipment class.

[15] The market data that DOE collected represents equipment offerings of major commercial refrigeration equipment manufacturers as of 2006. Each data point represents a particular model offered, not a piece of equipment shipped, and is not intended to represent shipments of equipment in the VOP.RC.M, SVO.RC.M, and HZO.RC.M equipment classes. However, in the absence of detailed shipment information broken down by energy use and air-curtain angle, DOE believes this market data provides a reasonable estimate of the distribution of equipment by energy use and air-curtain angle within these equipment classes.

TABLE II.1.—EQUIPMENT FAMILY DESIGNATIONS—Continued

Equipment family	Description
Vertical Closed Transparent (VCT)	Equipment with hinged or sliding transparent doors and a door angle less than 45°.
Horizontal Closed Transparent (HCT)	Equipment with hinged or sliding transparent doors and a door angle greater than or equal to 45°.
Vertical Closed Solid (VCS)	Equipment with hinged or sliding solid (opaque) doors and a door angle less than 45°.
Horizontal Closed Solid (HCS)	Equipment with hinged or sliding solid (opaque) doors and a door angle greater than or equal to 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 these eight equipment families are equipment that have one of the two condensing unit configurations shown in Table II.2.

TABLE II.2.—CONDENSING UNIT CONFIGURATION DESIGNATIONS

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.

Equipment classes would also be organized based on the three rating temperatures shown in Table II.3.

TABLE II.3.—RATING TEMPERATURE DESIGNATIONS

Rating temperature	Description
38 °F (M)	Medium temperature (refrigerators).
0 °F (L)	Low temperature (freezers).
−15 °F (I)	Ice-cream temperature (ice-cream freezers).

Based on stakeholder feedback, DOE is considering 38 of the 48 equipment classes shown in Table II.4.[16] The equipment classes are organized by equipment family, compressor operating mode, and rating temperature. The right hand column in Table II.4, which has 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 the equipment family for that class, the next two letters represent the condensing unit configuration, and the last letter represents the rating temperature. Table II.1 through Table II.3 set forth the meaning of the equipment class lettering designations. (Also, see chapter 3 of the TSD for more details on the equipment class lettering designations.)

TABLE II.4.—COMMERCIAL REFRIGERATION EQUIPMENT CLASSES

Equipment family	Condensing unit configuration	Rating temperature (°F)	Equipment class designation
Vertical Open	Remote	38	VOP.RC.M.
		0	VOP.RC.L.
		−15	VOP.RC.I
	Self-Contained	38	VOP.SC.M.
		0	VOP.SC.L.
		−15	VOP.SC.I.
Semivertical Open	Remote	38	SVO.RC.M.
		0	SVO.RC.L.
		−15	SVO.RC.I.
	Self-Contained	38	SVO.SC.M.
		0	SVO.SC.L.
		−15	SVO.SC.I.
Horizontal Open	Remote	38	HZO.RC.M.

[16] Table II.4 identifies 48 classes of commercial refrigeration equipment. 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)) Therefore, these 10 classes are not covered under this rulemaking.

TABLE II.4.—COMMERCIAL REFRIGERATION EQUIPMENT CLASSES—Continued

Equipment family	Condensing unit configuration	Rating temperature (°F)	Equipment class designation
		0	HZO.RC.L.
		−15	HZO.RC.I.
	Self-Contained	38	HZO.SC.M.
		0	HZO.SC.L.
		−15	HZO.SC.I.
Vertical Closed Transparent	Remote	38	VCT.RC.M.
		0	VCT.RC.L.
		−15	VCT.RC.I.
	Self-Contained	38	VCT.SC.M.*
		0	VCT.SC.L.*
		−15	VCT.SC.I.
Horizontal Closed Transparent	Remote	38	HCT.RC.M.
		0	HCT.RC.L.
		−15	HCT.RC.I.
	Self-Contained	38	HCT.SC.M.*
		0	HCT.SC.L.*
		−15	HCT.SC.I.
Vertical Closed Solid	Remote	38	VCS.RC.M.
		0	VCS.RC.L.
		−15	VCS.RC.I.
	Self-Contained	38	VCS.SC.M.*
		0	VCS.SC.L.*
		−15	VCS.SC.I.
Horizontal Closed Solid	Remote	38	HCS.RC.M.
		0	HCS.RC.L.
		−15	HCS.RC.I.
	Self-Contained	38	HCS.SC.M.*
		0	HCS.SC.L.*
		−15	HCS.SC.I.
Service Over Counter	Remote	38	SOC.RC.M.
		0	SOC.RC.L.
		−15	SOC.RC.I.
	Self-Contained	38	SOC.SC.M.*
		0	SOC.SC.L.*
		−15	SOC.SC.I.

*These equipment classes have standards established by EPCA and are therefore 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)); therefore this equipment is not included in this rulemaking. Table II.5 identifies, by sets of letters, 10 potential equipment classes for this equipment. DOE has based the designations of these possible equipment classes on the equipment class designations presented in Table II.1 through Table II.3. Because these equipment classes are not included in this rulemaking, they are indicated with an asterisk in Table II.4.

TABLE II.5.—POTENTIAL EQUIPMENT CLASSES NOT INCLUDED IN THIS RULEMAKING

VCT.SC.M	VCS.SC.M	HCT.SC.M	HCS.SC.M	SOC.SC.M.
VCT.SC.L	VCS.SC.L	HCT.SC.L	HCS.SC.L	SOC.SC.L.

During the Framework public meeting, Hill Phoenix asserted that equipment with separate refrigerator and freezer compartments (*i.e.*, refrigerator-freezers) is custom built and is a low shipment-volume type of equipment. Hill Phoenix believes that spending time on these equipment categories might unnecessarily slow the rulemaking. (Public Meeting Transcript, No. 3.4 at p. 52) Based on this comment and DOE's own analysis of the shipments data, DOE has not established equipment classes for remote condensing commercial refrigerator-freezers or self-contained commercial refrigerator-freezers without doors (also called ''dual temperature'' units). DOE addresses how it might set standards for this equipment in sections III and IV.E.1.

In sum, Table II.6 presents the equipment classes covered under this rulemaking organized by the three equipment categories, in accordance with EPCA section 325(p)(1)(A). (42 U.S.C. 6295(p)(1)(A)) Pursuant to EPCA section 325(p)(1)(B), DOE specifically seeks feedback on these equipment classes and invites interested persons to submit written presentations of data, views, and arguments. (42 U.S.C. 6295(p)(1)(B)) This is identified as Issue 5 under ''Issues on Which DOE Seeks Comment'' in section IV.E of this ANOPR.

TABLE II.6.—COMMERCIAL REFRIGERATION EQUIPMENT CLASSES BY CATEGORY

Equipment category	Condensing unit configuration	Equipment family	Rating temperature (°F)	Equipment class designation
Remote Condensing Commercial Refrigerators, Commercial Freezers, and Commercial Refrigerator-Freezers.	Remote	Vertical Open	38	VOP.RC.M.
		Semivertical Open	0	VOP.RC.L.
			38	SVO.RC.M.
		Horizontal Open	0	SVO.RC.L.
			38	HZO.RC.M.
		Vertical Closed Transparent	0	HZO.RC.L.
		Horizontal Closed Transparent	38	VCT.RC.M.
		Vertical Closed Solid	0	VCT.RC.L.
		Horizontal Closed Solid	38	HCT.RC.M.
		Service Over Counter	0	HCT.RC.L.
			38	VCS.RC.M.
			0	VCS.RC.L.
			38	HCS.RC.M.
			0	HCS.RC.L.
			38	SOC.RC.M.
			0	SOC.RC.L.
Self-Contained Commercial Refrigerators, Commercial Freezers, and Commercial Refrigerator-Freezers without Doors.	Self-Contained	Vertical Open	38	VOP.SC.M.
			0	VOP.SC.L.
		Semivertical Open	38	SVO.SC.M.
			0	SVO.SC.L.
		Horizontal Open	38	HZO.SC.M.
			0	HZO.SC.L.
Commercial Ice-Cream Freezers	Remote	Vertical Open	−15	VOP.RC.I.
		Semivertical Open	−15	SVO.RC.I.
		Horizontal Open	−15	HZO.RC.I.
		Vertical Closed Transparent	−15	VCT.RC.I.
		Horizontal Closed Transparent	−15	HCT.RC.I.
		Vertical Closed Solid	−15	VCS.RC.I.
		Horizontal Closed Solid	−15	HCS.RC.I.
		Service Over Counter	−15	SOC.RC.I.
	Self-Contained	Vertical Open	−15	VOP.SC.I.
		Semivertical Open	−15	SVO.SC.I.
		Horizontal Open	−15	HZO.SC.I.
		Vertical Closed Transparent	−15	VCT.SC.I.
		Horizontal Closed Transparent	−15	HCT.SC.I.
		Vertical Closed Solid	−15	VCS.SC.I.
		Horizontal Closed Solid	−15	HCS.SC.I.
		Service Over Counter	−15	SOC.SC.I.

3. Normalization Metric

The standards being developed in this rulemaking must apply to equipment of varying size and capacity within an equipment class, so they must be normalized by some factor that is representative of the varying energy use of the equipment. A ''normalization metric'' is a measure of capacity or utility that allows comparison of energy use of various sizes of equipment on a unit capacity basis. During the Framework public meeting, DOE asked what normalization metric would be most appropriate for the equipment in this rulemaking—total display area (TDA), refrigerated volume, or length. ARI commented that in remote condensing equipment, the trend has been to use TDA, not only in the United States, but in Europe as well. ARI is trying to align itself with standards like those from the International Standards Organization (ISO) that use TDA, and wants DOE to be consistent with these ISO standards. ARI's certification program will be based on TDA, and that is how the data will be listed in its certification directory. (Public Meeting Transcript, No. 3.4 at pp. 95–96) ARI also proposed that daily energy consumption be calculated as a function of the refrigerated volume for self-contained equipment with doors, and as a function of TDA for self-contained equipment without doors, because these respective normalization metrics are most representative of the energy consumption of these two types of equipment. (ARI, No. 7 at p. 9) ARI also stated that it will collect and analyze data for daily energy consumption as a function of refrigerated volume and TDA for remote condensing equipment in order to develop an appropriate recommendation for that type of equipment. (ARI, No. 7 at p. 9) The Joint Comment stated that they do not agree with DOE's proposal to use TDA as the metric for cases without doors, because, they assert, such an approach would favor ''shallow'' and ''tall'' equipment over ''deeper'' and ''shorter'' equipment of equivalent volume. The Joint Comment proposed that DOE instead use volume, length, or potentially a combination of TDA and volume. One compromise would be to use a multiple regression equation that would consider both refrigerated volume and length or refrigerated volume and TDA. (Joint Comment, No. 9 at p. 5, and Public Meeting Transcript, No. 3.4 at pp. 94–95)

In this rulemaking, DOE intends to establish standards for remote condensing commercial refrigerators, commercial freezers and commercial refrigerator-freezers, as well as commercial ice-cream freezers, with solid or transparent doors. Equipment with transparent doors is subject to significant radiation loads (as much as 50 percent of the total refrigeration load) as well as loads due to anti-sweat heaters that are required to keep the door free of condensation. In addition, transparent doors are inherently poorer insulators than solid doors with an insulation value of roughly R–2 compared with R–16, respectively, for a typical freezer. For equipment with transparent doors, TDA is a good indicator of the magnitude of the radiation load, the anti-sweat load, and the conduction load through the door. Additionally, TDA is representative of the ability of the equipment to display merchandise, which is a measure of its utility or usefulness to the owner. Thus, DOE believes that TDA is an appropriate normalization metric for all remote condensing refrigerators and freezers with transparent doors, as well as all commercial ice-cream freezers with transparent doors. Remote condensing commercial refrigerators, commercial freezers and commercial refrigerator-freezers with solid doors and commercial ice-cream freezers with solid doors (*i.e.*, ''storage cabinets'') inherently have no TDA, since there is no visible product and thus no glass or other transparent opening. Therefore, DOE believes refrigerated volume is an appropriate normalization metric for this equipment. This is consistent with the fact that EPCA sets standards for self-contained units with solid doors in the form of upper limits on daily energy consumption using refrigerated volume as the normalization metric (42 U.S.C. 6313(c)(2), added by EPACT 2005, section 136(c)). DOE also believes that length is not an appropriate metric for equipment with solid or transparent doors because it does not capture the physical relationship between heat loads and equipment capacity as accurately as either TDA or volume.

DOE will also establish in this rulemaking standards for remote condensing and self-contained commercial refrigerators, commercial freezers and commercial refrigerator-freezers, and commercial ice-cream freezers, without doors. The physical relationship between heat loads and energy consumption is fundamentally different for this equipment than for the equipment that has standards set by EPCA (*i.e.*, self-contained commercial refrigerators, commercial freezers, and commercial refrigerator-freezers with doors).[17] Equipment without doors is subject to large loads due to infiltration of warm moist air from the area around the equipment. These loads are typically 25 percent to 85 percent of the total refrigeration load (depending on the air-curtain angle and other factors), while the conduction loads experienced by equipment without doors are typically less than 5 percent and are rarely more than 25 percent. TDA is a much better indicator of infiltration load than volume because the open area of the equipment is directly related to the amount of infiltrated air. Current standards in Europe (EUROVENT—CECOMAF), the United Kingdom (Enhanced Capital Allowance Program), and Australia (Australian Greenhouse Office Minimum Energy Performance Standards) use TDA as a normalization metric for equipment without doors. Moreover, similar to equipment with transparent doors, TDA is representative of the ability of equipment without doors to display merchandise, which is a measure of its utility or usefulness to the owner. Thus, DOE believes that TDA should be the normalization metric for all remote condensing and self-contained commercial refrigerators, commercial freezers and commercial refrigerator-freezers without doors, and all commercial ice-cream freezers without doors. DOE also believes that length is not an appropriate metric for equipment without doors because it does not capture the physical relationship between heat loads and equipment capacity as accurately as TDA.

4. Extension of Standards

During the Framework public meeting, DOE asked stakeholders if it would be appropriate to extend the standards prescribed for self-contained refrigeration equipment with doors in EPCA to similar remote condensing equipment with doors and commercial ice-cream freezers with doors covered in this rulemaking, and if so, what methodology would be appropriate. ARI commented that it would not be appropriate to extend the standards from self-contained equipment because that equipment is normalized by volume, and the remote condensing equipment industry uses TDA or some other metric. (Public Meeting Transcript, No. 3.4 at p. 89) Hill Phoenix commented that as DOE has the opportunity to look at energy data, it will see that for remote condensing cases, energy consumption would be lower than for the self-contained cases. However, Hill Phoenix did not explain how to make the comparison. (Public Meeting Transcript No. 3.4 at p. 91) ARI also asserted that an extension of the EPCA standards for self-contained commercial refrigeration equipment with doors to remote condensing commercial refrigeration equipment with doors is not appropriate. ARI explained that the interior volume of self-contained equipment is calculated using the ANSI/AHAM Standard HRF–1–2004, whereas the interior volume of remote condensing equipment should be calculated according to ANSI/ARI Standard 1200–2006. (ARI, No. 7 at p. 8)

Because of the differences in energy consumption, and calculation of interior volume, DOE will not apply the standards prescribed by EPCA for self-contained equipment with doors to remote condensing equipment with doors. Instead, DOE will perform an analysis of the impacts of potential standards and will adopt levels that meet the requirements of EPCA section 325(o). (42 U.S.C. 6295(o)) As to commercial ice-cream freezers with doors, in the market and technology assessment (see chapter 3 of the TSD), DOE identified 16 commercial ice-cream freezer equipment classes. During the engineering analysis (see chapter 5 of the TSD), DOE developed cost-efficiency curves directly for 3 of the 16 commercial ice-cream freezer equipment classes (HCT.SC.I, VCT.SC.I, and VCS.SC.I) because of their high shipment volumes. For these three classes, this eliminated the issue of extending standards from self-contained commercial freezers with doors. For the remaining 13 equipment classes, DOE is considering use of the cost-efficiency curves (or standards) developed in this rulemaking for certain equipment classes of remote condensing commercial freezers and self-contained commercial freezers without doors, for equivalent equipment classes of commercial ice-cream freezers. For a portion of these 13 low-shipment-volume commercial ice-cream freezer equipment classes (as well as other low-shipment-volume equipment classes) DOE is also considering use of the EPACT 2005 standards for self-contained commercial freezers with doors. The intent of this approach is to save time and resources by eliminating direct analysis of equipment classes that have low shipment volumes and lower overall potential energy savings. At this point in the rulemaking, DOE only demonstrated this approach with two commercial ice-cream freezer equipment classes, as well as one other commercial refrigeration equipment class, (see chapter 5 of the TSD) and not the full set of covered equipment classes. DOE specifically seeks feedback on this approach to extending cost-efficiency curves (or standards) from high-shipment-volume equipment classes to low-shipment-volume equipment classes, and of extending EPCA standards to equipment classes in this rulemaking. This is identified as

[17] Standards for self-contained commerical refrigerators, commercial freezers, and commercial refrigerator-freezers with doors were added to 42 U.S.C. 6313(c)(2), by EPACT 2005, section 136(c).

Issue 1 under ''Issues on Which DOE Seeks Comment'' in section IV.E of this ANOPR.

5. Market Assessment

In the market assessment, DOE develops a qualitative and quantitative characterization of the commercial refrigeration equipment industry and market structure based on publicly available information and data and information submitted by manufacturers and other stakeholders.

DOE identified 34 manufacturers of commercial refrigeration equipment. Four of these companies hold approximately 85 percent of the domestic market share of refrigerated display cases. These four manufacturers produce self-contained commercial refrigerators, commercial freezers, and commercial refrigerator-freezers without doors and commercial ice-cream freezers, although their primary business is in remote condensing commercial refrigerators and commercial freezers with and without doors. Like most industries, there exists a second tier of smaller, but well-known manufacturers. These other manufacturers make up the remaining 15 percent of U.S. market share. See chapter 3 of the TSD for more information regarding manufacturers of commercial refrigeration equipment.

DOE is considering the possibility that small businesses would be particularly impacted by the promulgation of energy conservation standards for commercial refrigeration equipment. The Small Business Administration (SBA) defines small business manufacturing enterprises for commercial refrigeration equipment as those having 750 employees or fewer. SBA lists small business size standards for industries as they are described in the North American Industry Classification System (NAICS). The size standard for an industry is the largest that a for-profit concern can be in that industry and still qualify as a small business for Federal Government programs. These size standards are generally expressed in terms of the average annual receipts or the average employment of a firm. For commercial refrigeration equipment, the size standard is matched to NAICS code 333415, Air-Conditioning and Warm Air Heating Equipment and Commercial and Industrial Refrigeration Equipment Manufacturing, and is 750 employees. DOE will study the potential impacts on these small businesses in detail during the MIA, which will be conducted as a part of the NOPR analysis. See chapter 3 of the TSD for more information regarding commercial refrigeration equipment for small businesses.

ARI submitted annual shipment data by equipment class for its member companies. (ARI, No. 7 Exhibit B at p. 1) DOE understands that these data do not include the entire industry, since not all major manufacturers are represented by ARI (most notably, True Manufacturing, which DOE understands has a large market share of self-contained commercial equipment with doors and commercial ice-cream freezers). However, because these data cover the vast majority of the commercial refrigeration equipment sold, and because no other detailed data were available, the ARI shipment data became the basis of DOE's analysis.

The market and technology assessment (see chapter 3 of the TSD) provides detailed shipment information from ARI for each category of commercial refrigeration equipment by equipment class for 2005. The ARI data included shipments for equipment that operates at an ''application'' temperature (*e.g.*, wine chillers that operate at 45°F and freezers that operate at −30°F). However, DOE only considered shipments of equipment at the three operating temperatures considered in this rulemaking (38°F, 0°F, and −15°F). The shipments of equipment that operate at one of these three temperatures constitute approximately 98 percent of the shipments reported by ARI. See chapter 3 of the TSD for more information regarding commercial refrigeration equipment shipments.

DOE reviewed available literature and consulted with experts on commercial refrigeration equipment in order to establish typical equipment lifetimes. The literature and individuals consulted estimated a wide range of typical equipment lifetimes. Based on the literature reviewed and discussions with industry experts and other stakeholders, DOE concluded that a typical lifetime of 10 years is appropriate for commercial refrigeration equipment. See chapter 3 of the TSD for more information regarding equipment lifetimes.

DOE characterized commercial refrigeration equipment energy consumption by conducting a survey of existing remote condensing refrigeration equipment from major manufacturers and compiling a performance database. The primary source of information for the database was equipment data sheets that were publicly available on manufacturers' websites. From these data sheets, equipment information such as total refrigeration load, evaporator temperature, lighting power draw, defrost power draw, and motor power draw allowed determination of calculated daily energy consumption (CDEC) according to the test procedure in ANSI/ARI Standard 1200–2006. See chapter 3 of the TSD for more information regarding the performance data for selected remote condensing equipment classes.

6. Technology Assessment

In the technology assessment, DOE identified technologies and design options that could improve the efficiency of commercial refrigeration equipment. This assessment provides the technical background and structure on which DOE bases its screening and engineering analyses. For commercial refrigeration equipment, DOE based its list of technologically feasible design options on input from manufacturers, industry experts, component suppliers, trade publications, and technical papers. See chapter 3 of the TSD for additional detail on the technology assessment and technologies analyzed.

B. Screening Analysis

The purpose of the screening analysis is to evaluate the technologies that improve the efficiency of equipment, to determine which technologies to consider further and which options to screen out. DOE consulted with industry, technical experts, and other interested parties to develop a list of technologies for consideration. DOE then applied the following four screening criteria to determine which technologies are unsuitable for further consideration in the rulemaking (10 CFR Part 430, Subpart C, Appendix A at 4(a)(4) and 5(b)):

1. Technological feasibility. Technologies incorporated in commercial equipment or in working prototypes will be considered technologically feasible.

2. Practicability to manufacture, install, and service. If mass production of a technology in commercial equipment and reliable installation and servicing of the technology could be achieved on the scale necessary to serve the relevant market at the time of the effective date of the standard, then that technology will be considered practicable to manufacture, install and service.

3. Adverse impacts on equipment utility or equipment availability. If a technology is determined to have significant adverse impact on the utility of the equipment to significant subgroups of consumers, or result in the unavailability of any covered equipment type with performance characteristics (including reliability), features, sizes,

capacities, and volumes that are substantially the same as equipment generally available in the United States at the time, it will not be considered further.

4. Adverse impacts on health or safety. If it is determined that a technology will have significant adverse impacts on health or safety, it will not be considered further.

DOE eliminated five of the technologies considered in the market and technology assessment. The specific technologies that were eliminated are: (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 will 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 will not consider these technologies as design options for improving the energy efficiency of commercial refrigeration equipment.

For more details on how DOE developed the technology options and the process for screening these options, refer to the market and technology assessment (see chapter 3 of the TSD) and the screening analysis (see chapter 4 of the TSD).

C. Engineering Analysis

The purpose of the engineering analysis is to establish the relationship between the cost and efficiency of commercial refrigeration equipment. For each equipment class, this relationship estimates the baseline manufacturer cost, as well as the incremental cost for equipment at efficiency levels above a baseline. In determining the performance of higher efficiency equipment, DOE considers technologies and design option combinations not eliminated in the screening analysis. The output of the engineering analysis is a set of cost-efficiency ''curves'' that are used in downstream analyses (*i.e.*, the LCC and PBP analyses and the NIA).

DOE typically structures its engineering analysis around one of three methodologies. These are: (1) The design-option approach, which calculates the incremental costs of adding specific design options to a baseline model; (2) the efficiency-level approach, which calculates the relative costs of achieving increases in energy efficiency levels; and (3) the reverse-engineering or cost-assessment approach, which involves a ''bottoms-up'' manufacturing cost assessment based on a detailed bill of materials derived from commercial refrigeration equipment tear-downs.

1. Approach

In this rulemaking, DOE is adopting an efficiency-level approach, supplemented by a design-option approach. For the four equipment classes with the highest shipment volumes, DOE used industry-supplied cost-efficiency curves developed using an efficiency-level approach in downstream analyses.[18] These industry-supplied curves are qualified using analytically derived curves developed by DOE using a design-option approach. In addition, for the equipment classes where industry-supplied curves were not available, DOE used the analytically derived curves developed using a design-option approach in the downstream analyses.

In the Framework Document, DOE requested feedback on the use of an efficiency-level approach supported, as needed, by a design-option approach to determine the cost-efficiency relationship for commercial refrigeration equipment. ACEEE expressed concern about the use of an efficiency-level approach because it effectively creates a ''black box'' that does not allow for any independent analyses. ACEEE prefers the design-option approach because of its transparency and the ability to be independently verified. ACEEE noted that in the past, DOE has taken both approaches simultaneously. By doing both, DOE can calibrate one approach against another and have data that are publicly available so all parties can comment. (Public Meeting Transcript, No. 3.4 at p. 110) ASAP stated that the design-option approach remains very important because it validates the data and shows the benefits of different technical options. (Public Meeting Transcript, No. 3.4 at p. 119) ARI stated that it supports DOE's suggested approach for determining the cost-efficiency relationship for commercial refrigeration equipment. (ARI, No. 7 at p. 9) The Joint Comment stated that it supports the use of an efficiency-level approach, provided that the estimates used are sufficiently supported with design-option data for purposes of both qualification and adding transparency to the ''black box'' of the efficiency-level data. In particular, the Joint Comment pointed out that this will require DOE to qualify multiple points for each equipment class, carrying out further design-option analysis as necessary to identify the most reasonable costs to use if the design-options and efficiency-level data are not in alignment. (Joint Comment, No. 9 at p. 1)

As previously described, DOE used an efficiency-level approach supported by a design-option approach. DOE supplemented the industry-supplied data with its own design-option analysis, which involved consultation with outside experts, review of publicly available cost and performance information, and modeling of equipment cost and energy consumption. The supplemental design-option analysis provides validation of the industry efficiency-level data, transparency of assumptions and results, and the ability to perform independent analyses for verification. In addition, the supplemental design-option analysis allows analytically derived cost-efficiency curves to be generated for equipment classes where no industry-supplied curves are available. The methodology used to perform the design-option analysis is described in detail in chapter 5 of the TSD.

2. Equipment Classes Analyzed

Because of the large number of equipment classes in this rulemaking (see Table II.6), DOE did not directly analyze all equipment classes in the engineering analysis for this ANOPR. Instead, DOE prioritized the engineering analysis by examining only the equipment classes with shipment volumes greater than 100 units per year. Table II.7 lists the 15 equipment classes that DOE directly analyzed in the engineering analysis. This table includes the 14 equipment classes with greater than 100 annual unit shipments, as well as the VOP.RC.L equipment class.[19] According to the 2005 ARI

[18] The four equipment classes with the highest shipment volumes are: vertical closed transparent, remote condensing, low temperature (VCT.RC.L); vertical open, remote condensing, medium temperature (VOP.RC.M); semivertical open, remote condensing, medium temperature (SVO.RC.M); and horizontal open, remote condensing, low temperature (HZO.RC.L).

[19] 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 a recommendation from a manufacturer during the preliminary manufacturer impact analysis interviews. This manufacturer estimated that shipments of the VOP.RC.L equipment class are actually around 2500 units per year. Regardless of the actual shipment volume, DOE believes it is unlikely that this equipment class has zero annual shipments, and likely has more than 100 annual

shipments data, these 15 equipment classes represent 98 percent of the shipments of covered commercial refrigeration equipment.

TABLE II.7.—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. A cost model was used to estimate the manufacturer production cost (MPC) in dollars, and an energy consumption model was used to estimate the daily energy consumption in kilowatt hours (kWh) of covered commercial refrigeration equipment.

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.

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 earn a profit. A market-share-weighted average industry markup was developed by examining several major commercial refrigeration equipment manufacturers' gross margin information from annual reports and Securities and Exchange Commission (SEC) 10–K reports. The manufacturers whose gross margin information was examined by DOE represent approximately 80 percent of the commercial refrigeration equipment market, and each of these companies is a subsidiary of a more diversified parent company that manufactures equipment other than commercial refrigeration equipment. Because the SEC 10–K reports do 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 offerings.

Markups were evaluated for the years 2000 to 2005, inclusively. The manufacturer markup is calculated as 100/(100 − *average gross margin)*, where gross margin is calculated as *revenue − cost of goods sold* (COGS). To validate the SEC 10–K and annual report information, Internal Revenue Service industry statistics were used as a check. DOE estimated the average manufacturer markup within the industry as 1.39.

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

DOE understands that manufacturers typically offer a discount off the MLP, which depends on various 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 self-contained equipment manufacturers for this equipment. A review of the data for self-contained equipment 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. Because the list price markup can vary significantly from manufacturer to manufacturer and from customer to customer, DOE applied the same estimated list price markup across each

shipments. DOE believes this warrants inclusion of the VOP.RC.L equipment class in the analysis.

equipment class to simplify the 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. For the baseline level, a corresponding cost is calculated using the cost model, and for each level above the baseline, the cost increases resulting from the addition of various design options are used to recalculate the cost.

In the market and technology assessment (see chapter 3 of the TSD), DOE defined an initial list of technologies that can reduce the energy consumption of commercial refrigeration equipment. In the screening analysis, DOE screened out technologies based on four screening criteria: Technological feasibility, practicability to manufacture, changes to product utility, and safety. The remaining list of technologies becomes one of the inputs to the engineering analysis. However, for reasons noted below, DOE did not incorporate all of these technologies in the energy consumption model. Technologies that were not used include: Remote lighting ballast location, evaporator fan motor controllers, higher efficiency evaporator and condenser fan blades, insulation increases or improvements, low pressure differential evaporators, defrost cycle controls, and defrost mechanisms.

Relocation of fluorescent lamp ballasts 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 doors this way 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. In addition, the potential energy savings are small, since modern electronic ballasts are very efficient and typically contribute only a few watts each to the refrigeration load. Therefore, DOE did not consider remote relocation of ballasts as a design option.

Evaporator fan motor controllers allow fan motors to run at variable speed, to match changing conditions in the case. For evaporator fan motor controllers, there is some opportunity for savings as 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, 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 could disrupt the air curtain. The potential of disturbance to the air curtain, which could lead to higher infiltration loads, does not warrant the use of evaporator fan motor controllers in equipment without doors, even if there were some reduction in fan energy use. In addition, DOE believes that savings from evaporator fan motor controllers in all equipment types would be small. Therefore, DOE did not consider evaporator fan motor controllers as a design option.

Higher efficiency evaporator and condenser fan blades reduce motor shaft power requirements by moving air more efficiently. Current technology used in commercial refrigeration equipment is stamped sheet metal or plastic axial fan blades. These fan blades are lightweight and inexpensive. DOE was not able to identify any axial fan blade technology that is significantly more efficient than what is currently used, but did identify one alternative fan blade technology that could potentially improve efficiency: Tangential fan blades. Tangential fan blades can produce a wide, even airflow, and have the potential to allow for increased saturated evaporator temperature (SET) through improved air distribution across the evaporator coil, which would reduce compressor power. However, tangential fan blades in small sizes are themselves less efficient at moving air, and thus require greater motor shaft power. Because of these competing effects, DOE did not consider tangential fan blades as a design option.

Increases in or improvements to insulation thickness reduce the heat load due to conduction and thus reduce compressor power. Increases in the thickness of foam insulation are problematic because they must either borrow volume from the refrigerated space or increase the overall size of the equipment cabinet. Because the outer dimensions of commercial refrigeration equipment are limited, it is often not practical to increase the overall size of the cabinet (*i.e.*, case exterior dimensions are optimized for packing equipment into freight and shipping containers). In addition, reducing the size of the refrigerated space would reduce the utility of the equipment. Therefore, increasing the thickness of foam insulation is not practical. Furthermore, many display cases do not have significant conduction loads, so insulation improvements do not offer large energy savings. Improvements to insulation material 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 most 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. In addition, vacuum panels cannot be penetrated by fasteners, and do not provide the rigidity of "foamed-in-place" panels that polyurethane insulation creates. Therefore, DOE did not consider insulation thickness increases or improvements as a design option. DOE did, however, consider improvements to the efficiency (*e.g.*, thermal conductance) of doors in the design options analysis. Higher efficiency doors reduce the overall heat gain to the case by using better frame materials, more panes of glass and better (or more) insulation in the doorframe.

Low pressure differential evaporators reduce energy consumption by reducing the power of evaporator fan motors. However, in space-constrained equipment such as commercial refrigeration equipment, this reduction usually comes from a decrease in evaporator coil surface area, which generally requires a lower SET to achieve the same discharge air temperature and cooling potential. This, in turn, results in a reduction in compressor efficiency. Because of these competing effects, DOE did not consider low pressure differential evaporators as a design option.

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 a method of detecting frost buildup and initiating defrost. As described in the market and technology assessment (see chapter 3 of the TSD), this could be accomplished through an optical sensor or sensing the temperature differential across the evaporator coil. However, both of these methods are unreliable due to problems with fouling of the coil due to 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.

Defrosting for medium temperature equipment is typically accomplished with off-cycle defrost. Because off-cycle defrost uses no energy (and decreases compressor on-time) there is no defrost design option capable of reducing defrost energy in cases that use off-cycle defrost. Some medium temperature equipment and all low temperature and ice-cream temperature equipment use supplemental heat for defrost. Commonly, electric resistance heating (electric defrost) is used in this equipment. An alternative to electric defrost in equipment that requires supplemental defrost heat is hot-gas defrost. Hot-gas defrost is most often used in remote condensing equipment and involves the use of the hot compressor discharge gas to warm the evaporator from the refrigerant side. The test procedure for commercial refrigeration equipment is not capable of quantifying the energy expenditure of the compressor during a hot-gas defrost cycle. Therefore, DOE did not consider it as a design option.

The design options DOE considered in the 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;
- 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).[20]

In developing the energy consumption model, DOE made certain assumptions including general assumptions about the analysis methodology as well as specific numerical assumptions regarding load components and design options. DOE based its energy consumption estimates on new equipment tested in a controlled-environment chamber subjected to ANSI/ARI Standard 1200–2006, which references the ANSI/ASHRAE Standard 72–2005 test method.[21] Manufacturers that are certifying their equipment to comply with Federal standards will be required to test new units with this test method, which specifies a certain ambient temperature, humidity, light level, and other requirements. One specification which DOE noted was absent from this standard is the operating hours of the display case lighting in a 24-hour period. DOE considered the operating hours to be 24 hours (*i.e.*, that lights are on continuously). Other commercial refrigeration equipment considerations are detailed in chapter 5 of the TSD.

The energy consumption model calculates CDEC as two major components: compressor energy consumption and component energy consumption (expressed as kilowatt hours per day (kWh/day)). Component energy consumption is a 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 as British thermal units per hour (Btu/h)) and one of two compressor models: one version for remote condensing equipment and one for self-contained equipment. The total heat load is a sum of the component load and the non-electric load. The component load is a 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 a 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. Details of component energy consumption, compressor energy consumption, and load models are shown in chapter 5 of the TSD.

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 establish 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 of the equipment classes 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 representative unit for each equipment class with average characteristics for physical parameters (*e.g.*, volume, TDA), and minimum performance of energy-consuming components (*e.g.*, fans, lighting). The cost model was used to develop the basic case cost for each equipment class. See appendix B of the TSD for these specifications.

5. Cost-Efficiency Results

The results of the engineering analysis are reported as cost-efficiency data (or ''curves'') in the form of CDEC[22] (in

[20] 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.

[21] Test procedures are found at 10 CFR 431.64.

[22] The ANSI ARI Standard 1200–2006 test procedure uses CDEC as the metric for remote condensing equipment and total daily energy consumption (TDEC) as the metric for self-contained equipment. In the engineering analysis, DOE used CDEC as the metric for both equipment

Continued

kWh) versus MSP (in dollars), which form the basis for subsequent analyses in the ANOPR. DOE created 15 cost-efficiency curves and received 4 industry aggregated curves from ARI. The industry-supplied curves are in the form of CDEC versus MLP, both normalized by TDA. To compare the analytically derived curves to the industry-supplied curves, DOE discounted the industry data with the list price markup and normalized the analytically derived curves by TDA. For the four equipment classes with the highest shipment volumes DOE used the industry-supplied cost-efficiency curves in the downstream analyses. For the equipment classes where industry-supplied curves were not available, DOE used the analytically derived curves in the downstream analyses. See chapter 5 for additional detail on the engineering analysis and appendix B of the TSD for complete cost-efficiency results.

D. Markups To Determine Equipment Price

This section explains how DOE developed the supply chain markups to determine installed prices for commercial refrigeration equipment (see chapter 6 of the TSD). DOE used the supply chain markups it developed (along with sales taxes and installation costs) in conjunction with the MSPs developed from the engineering analysis to arrive at the final installed equipment prices for baseline and higher efficiency equipment. As shown in Table II.8, DOE defined three distribution channels for commercial refrigeration equipment to describe how the equipment passes from the manufacturer to the customer. In the first distribution channel, the manufacturer sells the equipment directly to the customer through a national account. In the second and third distribution channels, the manufacturer sells the commercial refrigeration equipment to a wholesaler, who in turn may sell it directly to the customer or sell it to a mechanical contractor who may sell it and its installation to the customer. The wholesaler in this case can be a refrigeration wholesaler focusing on commercial refrigeration equipment, or a grocery warehouser (supply chain distributor) who sells food and retail store equipment to the retailer. Table II.8 also gives the estimated distribution channel shares (in percentage of total sales) through each of the three distribution channels.

TABLE II.8.—DISTRIBUTION CHANNELS AND SHARES FOR COMMERCIAL REFRIGERATION EQUIPMENT

Channel 1	Channel 2	Channel 3
Manufacturer Customer 86 percent	Manufacturer, Wholesaler Customer 7 percent	Manufacturer, Wholesaler, Contractor. Customer. 7 percent.

For each of the steps in the distribution channels presented above, DOE estimated a baseline markup and an incremental markup. A baseline markup is applied to the purchase of equipment with the baseline efficiency. An incremental markup is applied to the incremental increase in MSP for the purchase of higher efficiency equipment. The overall baseline or overall incremental markup is then given by the product of all the markups at each step in the distribution channel plus sales tax. Overall baseline or overall incremental markups for the entire commercial refrigeration equipment market can be determined using the shipment weights through each distribution channel and the corresponding overall baseline markup or the corresponding overall incremental markup, respectively, for each distribution channel including the applicable sales tax.

Markups for each step of the distribution channel were developed based on available financial data. DOE based the wholesaler markups on firm balance-sheet data from the Heating, Airconditioning & Refrigeration Distributors International (HARDI), the trade association representing wholesalers of refrigeration and heating, ventilating and air-conditioning (HVAC) equipment. DOE used median financial statistics reported by the controls and refrigeration industry segment of this trade association in HARDI's 2005 Profit Planning Report. DOE based the mechanical contractor markups on U.S. Census Bureau financial data for the plumbing, heating, and air conditioning industry as a whole. Average markups for sales through national accounts were estimated as one-half that of the wholesaler to customer distribution channel.

Baseline markups for wholesalers and for contractors are calculated as total revenue (equal to all expenses paid plus profit) divided by the COGS. Expenses include direct costs for equipment, labor expenses, occupancy expenses, and other operating expenses (*e.g.*, insurance, advertising). Some of these are presumed to be fixed costs (labor, occupancy) that do not change with the distribution of higher efficiency equipment. Other expenses are variable costs that may change in response to changes in COGS. In developing incremental markup, DOE considered the labor and occupancy costs to be fixed, and the other operating costs and profit to scale with the MSP.

The overall markup is the product of all the markups plus sales tax within a distribution channel. Both baseline and incremental overall markups were calculated for each distribution channel. Sales taxes were calculated based on State-by-State sales tax data reported by the Sales Tax Clearinghouse. Both contractor costs and sales tax vary by State, so the markup analysis develops distributions of markups within each distribution channel as a function of State and business type (*e.g.*, supermarket, convenience store, convenience store with gas station, or superstore). Because the State-by-State distribution of commercial refrigeration equipment units varies by business type (*e.g.*, supermarkets may be more prevalent relative to convenience stores in one part of the country than another), a national level distribution of the markups is different for each business type.

Average overall markups in each distribution channel can be calculated using estimates of the shipments of commercial refrigeration equipment units by business type and by State. The ANOPR analysis used estimates of relative total frozen and refrigerated food sales by State and each business type as reported by the U.S. Census Bureau as a proxy for relative shipments of commercial refrigeration equipment. Overall baseline and incremental markups for sales to supermarkets

types, but will refer to each equipment type's specific metric when developing standard equations.

within each distribution channel are shown in Table II.9 and Table II.10.

TABLE II.9.—BASELINE MARKUPS BY DISTRIBUTION CHANNEL INCLUDING SALES TAX FOR SUPERMARKETS

	Wholesaler	Mechanical contractor (includes wholesaler)	National account (manufacturer-direct)	Overall
Distributor(s) Markup	1.436	2.182	1.218	1.301
Sales Tax	1.068	1.068	1.068	1.068
Overall Markup	1.533	2.330	1.300	1.389

TABLE II.10.—INCREMENTAL MARKUPS BY DISTRIBUTION CHANNEL INCLUDING SALES TAX FOR SUPERMARKETS

	Wholesaler	Mechanical contractor (includes wholesaler)	National account (manufacturer-direct)	Overall
Distributor(s) Markup	1.107	1.362	1.054	1.079
Sales Tax	1.068	1.068	1.068	1.068
Overall Markup	1.182	1.454	1.125	1.152

Additional detail on markups can be found in chapter 6 of the TSD.

E. Energy Use Characterization

The energy use characterization estimates the annual energy consumption of commercial refrigeration equipment systems (including remote condensing units). This estimate is used in the subsequent LCC and PBP analyses (see chapter 8 of the TSD) and NIA (see chapter 10 of the TSD). DOE estimated the energy consumption of the 15 equipment classes analyzed in the engineering analysis (see chapter 5 of the TSD) using the relevant test procedure. These energy consumption estimates were then validated with annual simulation modeling of selected equipment classes and efficiency levels.

ANSI/ARI Standard 1200–2006, which references ANSI/ASHRAE Standard 72–2005, is an industry-developed test procedure for measuring the energy consumption of commercial refrigeration equipment. ANSI/ARI Standard 1200–2006 provides a method for estimating the daily energy consumption for a piece of commercial refrigeration equipment under steady-state conditions. ANSI/ARI Standard 1200–2006 treats remote condensing and self-contained commercial refrigeration equipment differently. In the case of remote condensing equipment, the test procedure measures the energy use of each component (*e.g.*, fans and lights) as well as the total refrigeration load of the equipment. The total refrigeration load is used to calculate compressor energy consumption based on a standardized relationship of evaporator temperature and compressor energy efficiency ratio. In the case of self-contained commercial equipment, the test procedure measures the total energy use of the equipment as a whole, including both component energy use and compressor energy use. The resulting daily energy consumption estimate is either CDEC for remote condensing equipment or TDEC for self-contained equipment. Both metrics represent the sum of compressor energy consumption and the energy consumption of all other energy consuming components in the equipment (*i.e.*, evaporator fan motors, lighting, anti-sweat heaters, defrost and drain heaters, and condensate evaporator pan heaters).

Several options were considered to provide estimates of the energy consumption of commercial refrigeration equipment. These options include: using a whole building simulation which would analyze case, compressor, and HVAC impacts; using an existing simulation program that would analyze display case and compressor energy use on an annual basis; and using estimates of energy consumption for various categories of equipment as developed in the engineering analysis. For the ANOPR, DOE used energy consumption estimates from the engineering analysis directly in the LCC analysis. To validate these estimates, DOE conducted a whole building energy use simulation for seven equipment classes at selected design-option levels.

A whole building simulation was the option first considered by DOE and was discussed during DOE?s Framework public meeting. During that meeting Southern Company and ARI commented that a whole building analysis is the desired approach (Public Meeting Transcript No. 3.4 at p. 151). The Northwest Power Planning Council (NWPPC) and ASAP were concerned about the additional difficulty and complexity of the resulting analysis (Public Meeting Transcript No. 3.4 at p. 161 and Public Meeting Transcript No. 3.4 at p. 155). The approach taken by DOE was to use energy estimates developed from the engineering analysis but to validate those estimates with whole building simulation of supermarkets, which included simulation of the refrigeration system. There were four reasons for adopting this approach.

1. The energy consumption ratings provided by ANSI/ARI Standard 1200–2006 do not distinguish between energy consumption by the compressor (which may vary as a function of environmental conditions) and energy consumption by other components in the case (*e.g.*, lighting), which do not vary as a function of environmental conditions. These two types of energy consumption are roughly similar in magnitude, and it is difficult to assess where the energy savings are coming from or what the impact on a building HVAC load might be.

2. The initial engineering analysis (see chapter 5 of the TSD) did not suggest design options that would provide significant changes to the building load relative to the commercial refrigeration system energy consumption.

3. The net interaction between the refrigeration system and HVAC energy consumption is a function of the variation in HVAC designs. HVAC system designs for food sales buildings, like supermarkets, may incorporate such features as separate dehumidification and refrigerant condenser reheat systems, which make assessing overall HVAC impact complicated. Also, detailed data on the relative prevalence

of different HVAC system designs incorporating these features is not readily available.

4. The interaction between the refrigeration and overall HVAC energy consumption is a function of the ratio of the total heat removed from the space by the display cases relative to the other internal loads (lighting, occupancy, and plug load) and external loads (building envelope and ventilation driven) in the building. This ratio determines the fraction of the year that the building is either in heating or cooling mode. However, the balance of refrigeration-driven space loads to the other space loads is impacted by the efficiency levels for all commercial refrigeration equipment classes, complicating the analysis of each equipment class individually. For the equipment classes with the largest shipment, which make up the largest base of equipment in a typical store and have the biggest overall impact on the space load balance, the industry-supplied efficiency curves do not provide information about changes in equipment design that could be used to assess this change in refrigeration-driven space loads.

In its validation effort, DOE used a modified version of the DOE developed DOE–2 whole-building energy analysis tool, DOE–2.2 refrigeration version (DOE–2.2R), to model whole-building energy use in a typical supermarket in five U.S. climate locations (Baltimore, Chicago, Houston, Los Angeles, and Memphis). Each of these locations has a climate that typifies one of five distinct U.S. climate zones developed by DOE for use in building energy codes development work. These five climate zones taken together encompass approximately three-fourths of the U.S. population. Annual energy use for seven equipment classes was simulated at four representative efficiency levels. Data on refrigeration loads from the engineering analysis supported the development of the energy efficiency levels analyzed. These refrigeration loads included those from internal features (*e.g.*, lighting and fans inside the case), and externally driven loads from radiation, convection/infiltration, and conduction through the case wall. These loads and other direct energy-consuming features (*e.g.*, fan and lights) were mapped to corresponding inputs in DOE–2.2R for the simulation analysis. Pull-down loads from shelving of food are not part of the test procedure and were therefore not considered.

To examine the impacts of ambient relative humidity, refrigerant piping heat loss, and climate location on energy consumption of commercial refrigeration equipment, annual simulation data from the DOE 2.2R model was converted to average daily energy consumption and average daily refrigeration load comparison with the engineering analysis estimates. DOE also assessed the magnitude of interactions between the refrigeration system and the building HVAC system.

The results of the whole-building simulation showed that climate location has no influence on energy consumption of the refrigerated case components for the remote condensing equipment classes examined. For a given efficiency level, the energy consumption of case components is the same for the simulation and the engineering analysis. In addition, climate location was shown to have relatively little influence on compressor energy consumption for equipment classes with doors, where display case infiltration levels are relatively low. Climate conditions do have a significant impact on compressor energy consumption for open equipment. Compressor energy consumption is determined by total refrigeration load and compressor efficiency, both of which are affected by climate conditions for remote condensing equipment.

In general, the average daily refrigeration load from the DOE 2.2R simulations was smaller than that predicted by the engineering analysis, due to differences between the building space conditions throughout the year captured by the simulations and the space conditions used for the steady-state rating of equipment used in the engineering analysis. The actual energy consumption of the compressors was, however, generally higher than that predicted by the engineering analysis. The difference in energy consumption is due to the aforementioned differences in refrigeration loads, the fact that the simulation accounts for changes in condensing temperatures over the year for each climate, and the additional superheat loads calculated by the simulation software to bring the return refrigerant return vapor up to the compressor suction temperature conditions, which is estimated to be 65°F (the ARI rating condition used to provide rated compressor performance).

Analysis of the annual refrigeration system energy savings for each of 3 efficiency levels above the baseline level were all within 14 percent of that predicted by the engineering analysis for 6 equipment classes across all efficiency levels and climates examined. Net energy savings averaged 8 percent higher for the highest efficiency level examined. For the remote condensing VOP.RC.L equipment class the annual energy savings deviated by as much as 21 percent. No shipments for this equipment class were reported by ARI. Actual shipments, if any, are expected to be small. This suggests that for the majority of commercial refrigeration equipment, the energy savings predicted by the test procedure agreed reasonably well with the annual simulation results, although the impact of individual design options may differ.

Estimates of whole-building energy consumption and refrigeration energy consumption were examined at selected efficiency levels and climate locations to determine if the design options considered in the engineering analysis would have a significant effect on building HVAC energy use. The influence of refrigeration equipment efficiency changes on HVAC system energy use varies depending on the design option. For example, improved display case lighting efficiency would reduce the energy consumption of the refrigeration system and potentially the air-conditioning system, depending on lighting placement. Reduced conduction and radiation loads in the refrigeration equipment would, by contrast, increase the air-conditioning load and subsequent energy consumption while decreasing the heating load. For all equipment classes and efficiency levels examined, the annual whole-building energy savings was within 10 percent of that calculated for the refrigeration system alone. For the highest efficiency level examined, savings were within 1.4 percent. The simulation results suggest that the collective impact of the design options considered does not significantly affect the HVAC energy consumption.

In the energy use characterization, DOE used whole-building simulation to explore the relative energy savings of refrigeration systems and whole-building energy use for supermarkets. While there were some differences in the annual energy use predicted by the whole-building simulation and that derived in the engineering analysis, DOE concludes that these differences were generally small.

Both the engineering analysis and the whole-building simulation presumed that display case lighting operated 24 hours per day. In many applications, display case lighting may not be required 24 hours per day. DOE conducted a sensitivity analysis to explore how variation in display case lighting operating hours affected the energy savings. This sensitivity analysis was done for all equipment classes using the engineering analysis spreadsheet and the design options considered for each equipment class. No such analysis could be done using the industry-supplied efficiency curves as details on component energy consumption were not provided with these curves. The sensitivity analysis showed that energy savings were reduced as lighting operating hours were reduced for all equipment classes that used display case lighting. The magnitude of this effect depended upon the equipment class. For a 20-hour lighting time assumption, the reduction in energy savings was between 1 percent and 6 percent. For a 16-hour lighting time assumption, the reduction in energy savings was between 2 percent and 15 percent. DOE's analysis suggests that typical lighting operating hours for most classes of commercial refrigeration equipment would fall within the range of 16 to 24 hours per day, depending on store operating hours, use of lighting during after-hours case stocking, and typical lighting operation or controls used for unoccupied periods. Display case lighting hours may also depend on the business type as convenience stores have distinctly different operating hours than other segments of the food retail industry.

Because of the sensitivity of the annual energy savings to display case lighting hours and the lack of data on actual lighting use, DOE specifically seeks feedback on the assumption of 24 hours for case lighting operation. This is identified as Issue 6 under ''Issues on Which DOE Seeks Comment'' in section IV.E of this ANOPR.

Also, DOE specifically seeks feedback on operation and maintenance practices for commercial refrigeration equipment, which may be prevalent in the field and may differ from standardized conditions, such as those represented in a test procedure. Operation and maintenance practices could potentially affect the energy consumption savings experienced in the field as a result of increased energy efficiency as compared to those savings estimated in the TSD's energy consumption analysis under idealized testing conditions. These factors include: compressor operation that is inefficient due to age or some other condition associated with the compressor unit; location of a commercial refrigeration unit adjacent to an outside door or in direct sunlight; operation of a room-cooling fan nearby the commercial refrigeration unit; a unit routinely stocked with products that are significantly under or over the ambient room temperature; overstocking of a unit; frequency and promptness of repair/maintenance of a unit; operation of doors during periods of high volume use; frequency of cooling coil cleaning; maintenance of sufficient space surrounding a unit for proper air circulation or proper operation of air vents; and wear/tear of, or damage to, door seals and hinges on a unit. Such factors may or may not be associated with use of a unit in the field, and thus their impacts would be difficult to analyze in a quantitative manner. Nevertheless, these factors are among those commonly highlighted in energy use reduction guidelines as important to achieving the maximum energy efficiency for the given unit. Therefore, DOE requests comment on the frequency that such factors come in to play in energy use in the field, and whether and how DOE might account for these factors in assessing the overall impacts of the candidate standards levels for commercial refrigeration equipment. This is identified as Issue 7 under ''Issues on Which DOE Seeks Comment'' in section IV.E of this ANOPR.

In determining the reduction in energy consumption of commercial refrigeration equipment due to increased efficiency, DOE did not take into account a rebound effect. The rebound effect occurs when a piece of equipment that is made more efficient is used more intensively, so that the expected energy savings from the efficiency improvement do not fully materialize. Because commercial refrigeration equipment is operated 24 hours a day, 7 days a week to maintain adequate conditions for the merchandise being retailed, a rebound effect resulting from increased refrigeration energy consumption seemed unlikely. The engineering estimates of energy use also used a 24-hour lighting schedule; although a sensitivity analysis to a reduced lighting schedule was performed. It is possible that under a reduced lighting schedule, lower lighting power draw resulting from energy conservation standards could lead to equipment operation strategies with increased lighting operating hours; however, DOE has no data with which to examine this impact for the commercial refrigeration equipment market and has not taken it into account in the energy use characterization.

Additional detail on the energy use characterization can be found in chapter 7 of the TSD.

F. Rebuttable Presumption Payback Periods

Section 345(e)(1)(A) of EPCA (42 U.S.C. 6316(e)(1)(A)) establishes a rebuttable presumption for commercial refrigeration equipment. The rebuttable presumption states that a standard is economically justified if the Secretary finds that ''the additional cost to the consumer of purchasing a product complying with an energy conservation standard level will be less than three times the value of the energy * * * savings during the first year that the consumer will receive as a result of the standard, as calculated under the applicable test procedure * * *.'' (42 U.S.C. 6295(o)(2)(B)(iii))

To evaluate the rebuttable presumption, DOE estimated the additional cost of a more efficient, standard-compliant unit, 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 a distribution of installed costs and energy prices that included four types of businesses and all 50 States. The rebuttable presumption PBPs differ from the other PBPs calculated in the LCC analysis (see section II.G.14 of this ANOPR) in that they do not include maintenance or repair costs. The baseline efficiency level for the rebuttable presumption calculation is the baseline established in the engineering analysis. From the range of efficiency levels for which cost data was determined in the engineering analysis, DOE selected up to eight efficiency levels in each equipment class, including the baseline efficiency level, for the LCC and subsequent ANOPR analysis. The selection of these efficiency levels is discussed in chapter 8 and appendix F of the TSD. For each equipment class the rebuttable presumption PBP was calculated for each efficiency level higher than the baseline.

Inputs to the PBP calculation are the first seven inputs shown in Table II.12 found in section II.G.2 of this ANOPR.

Table II.11 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 II.11 for each equipment class. For all equipment classes analyzed in the ANOPR analysis with the exception of the SOC.RC.M equipment class, the rebuttable presumption criteria were satisfied at either the maximum efficiency level examined or the next lower efficiency level examined. 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 setting of candidate standard levels (CSLs) by DOE 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))

TABLE II.11.—REBUTTABLE PRESUMPTION PAYBACK PERIODS BY EFFICIENCY LEVEL AND EQUIPMENT CLASS

Equipment type	Rebuttable presumption payback period (years)								Highest level with PBP <3 years
	Level 1	Level 2	Level 3	Level 4	Level 5	Level 6	Level 7	Level 8	
VOP.RC.M	NA	3.2	2.8	2.6	2.7	2.8	2.9	3.1	Level 7.
VOP.RC.L	NA	0.5	0.8	1.1	1.2	1.9	NA	NA	Level 6.
VOP.SC.M	NA	0.7	0.7	0.8	1.1	1.3	2.0	2.9	Level 8.
VCT.RC.M	NA	0.3	0.4	0.6	0.8	2.6	3.7	NA	Level 6.
VCT.RC.L	NA	1.4	1.6	1.8	2.1	2.2	2.3	2.7	Level 8.
VCT.SC.I	NA	0.2	0.4	0.4	0.6	1.3	1.5	2.0	Level 8.
VCS.SC.I	NA	0.3	0.6	0.6	0.7	0.7	0.8	1.2	Level 8.
SVO.RC.M	NA	3.2	2.8	2.7	2.8	2.9	3.0	NA	Level 6.
SVO.SC.M	NA	0.8	0.8	0.9	1.1	1.3	1.7	2.3	Level 8.
SOC.RC.M	NA	0.6	1.0	1.1	1.3	2.9	3.6	NA	Level 6.
HZO.RC.M	NA	0.8	1.2	1.5	NA	NA	NA	NA	Level 4.
HZO.RC.L	NA	1.2	1.6	1.7	1.8	1.9	NA	NA	Level 6.
HZO.SC.M	NA	0.7	1.0	1.1	1.1	1.2	1.4	1.8	Level 8.
HZO.SC.L	NA	0.6	0.6	0.8	0.8	0.9	1.3	1.3	Level 8.
HCT.SC.I	NA	0.7	0.7	1.3	1.4	1.4	NA	NA	Level 6.

G. Life-Cycle Cost and Payback Period Analyses

The LCC and PBP analyses determine the economic impact of potential standards on consumers. The effects of standards on individual commercial consumers include changes in operating expenses (usually lower) and changes in total installed cost (usually higher). DOE analyzed the net effect of these changes for commercial refrigeration equipment, first, by calculating the changes in consumers' LCCs likely to result from a CSL as compared to a base case (no new standards). The LCC calculation considers total installed cost (includes MSP, sales taxes, distribution channel markups, and installation cost), operating expenses (energy, repair, and maintenance costs), equipment lifetime, and discount rate. DOE performed the LCC analysis from the perspective of the user of commercial refrigeration equipment.

DOE calculated the LCC for all customers as if each would purchase a new commercial refrigeration equipment unit in the year the standard takes effect. The effective date is the future date when a new standard becomes operative. Section 136(c) of EPACT 2005 amends EPCA to add section 342(c)(4), 42 U.S.C. 6313(c)(4), which directs the Secretary to issue a final rule for commercial refrigeration equipment not later than January 1, 2009, with the energy conservation standards levels effective for equipment manufactured on or after January 1, 2012. Further, the Secretary may issue, by rule, energy conservation standards levels for other types of commercial refrigeration equipment, with the standard levels effective for equipment three or more years after a final rule is published. (42 U.S.C. 6313(c)(4)(B), added by EPACT 2005, section 136(c)) Consistent with EPCA, DOE used these dates in the ANOPR analyses. Further, DOE based the cost of the equipment on projected costs in 2012. However, all dollar values are expressed in 2006 dollars. Annual energy prices are considered for the life of the commercial refrigeration equipment.

DOE also analyzed the effect of changes in operating expenses and installed costs by calculating the PBP of potential standards relative to a base case. The PBP estimates the amount of time it would take the commercial consumer to recover the incrementally higher purchase expense of more energy efficient equipment through lower operating costs. Similar to the LCC, the PBP is based on the total installed cost and the operating expenses. However, unlike the LCC, only the first year's operating expenses are considered in the calculation of the PBP. Because the PBP does not account for changes in operating expense over time or the time value of money, it is also referred to as a simple PBP. For more details on the LCC and PBP analyses, refer to chapter 8 of the ANOPR TSD.

1. Approach

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 (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. Within a given prototype of store, various types of commercial refrigeration equipment can serve the store's refrigeration needs.

Aside from energy, the most important factors influencing the LCC and PBP analyses are related to the State to which each commercial refrigeration equipment unit is shipped. These factors include energy prices, installation cost, markup, and sales tax. The LCC analysis presented here used the predicted energy consumption based on the engineering analysis (see chapter 5 of the TSD) and reviewed in the energy use characterization (see chapter 7 of the TSD). Energy consumption of commercial refrigeration equipment calculated using this approach is not sensitive to climatic conditions, so energy consumption in the LCC analysis does not vary by geographical location.

At the national level, the analysis explicitly modeled both the uncertainty and the variability in the model's inputs using probability distributions based on the shipment of units to different States.

2. Life-Cycle Cost Analysis Inputs

For each efficiency level analyzed, the LCC analysis requires input data for the total installed cost of the equipment, the operating cost, and the discount rate. Table II.12 summarizes the inputs and key assumptions used to calculate the economic impacts of various efficiency levels. A more detailed discussion of the inputs follows.

TABLE II.12.—SUMMARY OF INPUTS AND KEY ASSUMPTIONS USED IN THE LIFE-CYCLE COST ANALYSIS

Input	Description
Baseline Manufacturer Selling Price	Price charged by manufacturer to either a wholesaler or large customer for baseline equipment.
Standard-Level Manufacturer Selling Price Increases.	Incremental change in manufacturer selling price for equipment at each of the higher efficiency standard levels.
Markups and Sales Tax	Associated with converting the manufacturer selling price to a customer price (see chapter 6 of TSD).
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.
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.
Electricity Prices	Average commercial electricity price ($/kWh) in each State and for four classes of commercial customers, as determined from Energy Information Administration (EIA) data for 2003 converted to 2006$.
Electricity Price Trends	Used the AEO2006 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).
Repair Costs	Labor and material costs associated with repairing or replacing components that have failed.
Equipment Lifetime	Age at which the commercial refrigeration equipment is retired from service (estimated to be 10 years).
Discount Rate	Rate at which future costs are discounted to establish their present value to commercial refrigeration equipment users.
Rebound Effect	A rebound effect was not taken into account in the LCC analysis.

3. Baseline 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 minimum efficiency (or baseline) standards. 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. MSPs were developed for equipment classes consisting of eight possible equipment families, two possible condensing unit configurations (remote condensing and self-contained) and three possible rating temperatures. Not all covered equipment classes have significant actual shipments (see chapter 3 of the TSD). The LCC and PBP analyses have been carried out on a set of 15 equipment classes identified earlier.

DOE was not able to identify data on relative shipments for equipment classes by efficiency level, nor were equivalent data found by DOE in the literature or studies examined by DOE. For the equipment for which DOE performed a design option analysis as the basis for the engineering analysis, DOE designated the highest-energy-use equipment as Level 1, and selected this as the baseline equipment.

4. 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. Refer to chapter 5 of the TSD for details. MSP increases as a function of equipment energy consumption were developed for each of the 15 equipment classes. Although the engineering analysis produced up to 11 energy consumption levels, depending on equipment type, only up to 8 selected energy consumption levels were used in the LCC and PBP analyses.

5. Markups

As discussed earlier, overall markups are based on one of three distribution channels, as well as whether the equipment is being purchased for the new construction or the replacement market. Based on input received by DOE, approximately 7 percent of equipment purchased by end-use customers is from wholesaler/distributors, 7 percent is from mechanical contractors, and 86 percent is through national accounts. DOE's understanding is that most equipment replacements are done through store remodels (as opposed to equipment failure), and that the distribution channels and installation process are similar for the new and replacement markets. Available information suggests that the fraction of equipment purchased through the distribution channels is the same for new and replacement equipment.

6. Installation Costs

DOE derived installation costs for commercial refrigeration equipment from data provided in RS Means Mechanical Cost Data.[23] 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. The installation cost was calculated by multiplying the number of person-hours by the corresponding labor rate. RS Means provides specific person-hour and labor rate data for the installation of so-called ''mercantile equipment'' (CSI Masterformat Number 11100), which includes commercial refrigeration equipment. Labor rates vary significantly from region to region of the

[23] R.S. Means Company, Inc. 2005. Mechanical Cost Data 28th Annual Edition. Kingston, Massachusetts.

country and the RS Means data provide the necessary information to capture this regional variability. RS Means provides cost indices that reflect the labor rates for 295 cities in the United States. Several cities in all 50 States and the District of Columbia are identified in the RS Means data. These cost indices were incorporated into the analysis to capture variation in installation cost, depending on the location of the customer. To arrive at an average index for each State, the city indices in each State were weighted by their population. Population weights for the year 2000 from the U.S. Census Bureau were used to calculate a weighted-average index for each State. Further, since data was not available to indicate how installation costs vary with the commercial refrigeration equipment type or its efficiency, DOE considered the installation costs to be fixed, independent of the cost or efficiency of the equipment. Even though the LCC spreadsheet allows for alternative scenarios, DOE did not find a basis for changing its basic premise for the ANOPR analysis.

As described earlier, 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 all 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 rather a distribution of values.

7. Energy Consumption

The electricity consumed by the commercial refrigeration equipment was based on the engineering analysis estimates as described previously in section II.C.1 after the whole-building simulations validation described in section II.E.

8. Electricity Prices

Electricity prices are necessary to convert the electric energy savings into energy cost savings. DOE received several comments on the development of electricity prices for its life cycle cost analysis. In its Framework Document, DOE suggested the use of average commercial electric prices. Comments received from Southern Company suggested that due to high load factors, the price of electricity for commercial refrigeration customers would be lower than the commercial average. (Southern Company No. 3.4 at p. 170) Pacific Gas & Electric Company (PG&E) commented it has a heavy ratcheting charge and is converting customers to time-of-use metering. The very high coincident demand for commercial refrigeration units could result in DOE underestimating the cost of electricity. (PG&E No. 3.4 at p. 171) PG&E also questioned how DOE would handle the time dependent valuation of energy. (PG&E No. 3.4 at p. 191) Southern Company responded that customers in its region were not exposed to marginal rates because it has cost-based rates. (Southern Company No. 3.4 at p. 193) Both groups supported the use of a sensitivity analysis by DOE in this area. In another area of discussion, ACEEE also commented that *AEO* electricity price forecasts might require revision. (Public Meeting Transcript No. 3.4 at p. 174; Joint Comment, No. 9 at p. 2) In the latter comment received, the Joint Comment also suggested that DOE adopt the load profile and rate schedule- (tariff-) based approach to electricity prices that DOE used in the commercial unitary air conditioner rulemaking. (Joint comment, No. 9 at p. 2)

DOE decided to use average electricity prices for four classes of commercial refrigeration equipment customers on a State-by-State basis. This approach will include the regional variations in energy prices and provide for estimated electricity prices suitable for the target market, yet reduce the analysis complexity. An effort to build tariff-based costs would have significantly increased the complexity and time needed for the analysis and it is not clear whether the results of the analysis will be improved. The development and use of State-average electricity prices by building type is described below and in more detail in chapter 8 of the TSD.

9. Electricity Price Trends

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 effective commercial electricity prices at the State level from the Energy Information Administration (EIA) publication, *State Energy Consumption, Price, and Expenditure Estimates*. The latest available prices from this source are for the calendar year 2003. These were adjusted to represent 2006$ prices in two steps. First, national data on the reported average commercial electricity prices from the EIA website, *Average Retail Price of Electricity to Ultimate Customers by End-Use Sector*, were used to adjust the 2003 prices to 2005 prices. Next, because actual prices were not yet available for the entire year of 2006, the forecasted ratio between 2006 and 2005 national commercial retail electricity prices from AEO2006 was used to adjust the 2005 State-level prices to 2006$. Furthermore, DOE recognized that 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 set to identify the average prices paid by the four kinds of businesses in this analysis compared with the average prices paid by all commercial customers. 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 as necessary for each of the four kinds of businesses. Once the electricity prices for the four types of businesses have been adjusted, the resulting prices are used in the analysis. To obtain a weighted-average national electricity price, the prices paid by each business in each State is 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 14 cents per kWh.

The electricity price trend provides the relative change in electricity prices for future years out to the year 2030. Estimating future electricity prices is difficult, especially considering that there are efforts in many States throughout the country to restructure the electricity supply industry. DOE applied the *AEO2006* reference case as the default scenario and extrapolated the trend in values from the years 2020 to 2030 of the forecast to establish prices in the years 2030 to 2042. This method of extrapolation is in line with methods currently being used by the EIA to forecast fuel prices for the Federal Energy Management Program (FEMP). DOE provides a sensitivity analysis of the life cycle costs saving and PBP results to future electricity price scenarios using both the *AEO2006* high-growth and low-growth forecasts in chapter 8 of the TSD.

10. Repair Costs

The equipment repair cost is the cost to the consumer for replacing or repairing components in the commercial refrigeration equipment that have failed. DOE based the annualized repair cost for baseline efficiency equipment on the following expression:

RC = kx 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)

Because data were not available for how the repair costs vary with equipment efficiency, DOE held repair costs constant as the default scenario for the LCC and PBP analyses.

11. Maintenance Costs

DOE estimated the annualized maintenance costs for commercial refrigeration equipment from data in RS Means Facilities Maintenance & Repair Cost Data. 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 $156/year (2006$) for preventative maintenance for all classes of commercial refrigeration equipment. Because data were not available for how the maintenance costs vary with equipment efficiency, DOE held 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 preventative maintenance, and were not itemized in the preventative maintenance activities described by RS Means. Different commercial refrigeration equipment classes have different numbers of lamps (and ballasts) and many of the efficiency options considered in DOE's engineering analysis involved changes to the lighting configuration (lamp, ballast, or use of light emitting diode (LED) lighting systems). Because the lighting configurations can vary by energy consumption level, DOE estimated the relative maintenance costs for lighting by each case type for which a design-option analysis was performed. The methodology used was to estimate the frequency of failure and replacement of individual lighting components, to estimate the cost of replacement in the field, and to develop an annualized maintenance cost based on the sum of the total lighting maintenance costs (in 2006$) over the estimated life of the equipment divided by the estimated life of the equipment.

Costs for fluorescent lamp and ballast replacements were based on review of the original equipment manufacturer (OEM) costs used in the engineering analysis, RS Means estimates and 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 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.

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 that costs for replacing LED lighting fixtures (believed to occur 6 years after the effective date of the standard) are 140 percent of the OEM installed cost of LED lighting fixtures today (in 2006$). These LED fixture replacement costs represent a 30 percent reduction to the current costs for in-the-field replacement. DOE recognizes that both life and cost estimates for LED replacement are speculative and believes it has taken a conservative approach to estimating price reduction over time for this technology. Overhead and profit factors from RS Means were not considered.

12. Lifetime

DOE defines lifetime as the age when a commercial refrigeration equipment unit is retired from service. DOE based equipment lifetime on discussions with industry experts and other stakeholders, and concluded that a typical lifetime of 10 years is appropriate for commercial refrigeration equipment. Commercial refrigeration equipment units are typically replaced when stores are renovated—about every 10 years—which is before the commercial refrigeration equipment units would have physically worn out. Because of this, there is a used-equipment market for commercial refrigeration equipment. DOE understands, however, that the salvage value to the original purchaser is very low and thus this has not been taken into account in the LCC. Chapter 3 of the TSD, Market and Technology Assessment, contains a discussion of equipment life data and the sources of such data.

DOE understands that the actual lifetime of a commercial refrigeration equipment unit in the field might vary from the estimated average 10-year lifetime, to some degree, by equipment class, variations associated with components and manufacturing methods, as well as store type where the unit is placed in service. Nevertheless, the 10-year lifetime estimate is an important benchmark for testing to a standard level of performance, making comparisons of different units for purchasing decisions, and making a reasonable quantitative analysis of the impacts that could result from different standard levels of efficiency. Therefore, DOE specifically requests feedback on the lifetime of commercial refrigeration equipment and whether, in fact, this is a significant issue. Where the lifetime data indicate a substantial variation from the assumed 10-year lifetime, DOE will perform a sensitivity analysis of this variable in the LCC and NES analyses and may adjust the best estimate of equipment lifetime as well. In particular, DOE seeks comment on how long these units are typically maintained in service, on average, either for all equipment covered under this rulemaking or by equipment class and store type. Also, DOE seeks comment on the existence of used-equipment markets for commercial refrigeration equipment, and the importance of considering such markets in its analysis. This is identified as Issue 8 under ''Issues on Which DOE Seeks Comment'' in section IV.E of this ANOPR.

13. Discount Rate

The discount rate is the rate at which future expenditures are discounted to establish their present value. DOE received comments on the development of discount rates at the Framework Public Meeting. FPA suggested that DOE's analysis should consider discount rates for convenience stores separately from other food stores, but considered superstores in the same general market as the traditional grocery store. (FPA No. 3.4 at p. 179) ARI suggested that DOE consider developing discount rates explicitly for supercenters. (ARI No. 3.4 at p. 179)

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 groceries and multi-line retailing drawn from a database of 7,319 U.S. companies on the Damodaran Online website. The WACC approach taken for the determination of the discount rates takes into account the current tax status of the individual firms on an overall corporate basis. The marginal effects of increased costs and thus depreciation due to higher cost equipment on the overall tax status was not evaluated.

DOE used a sample of 23 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 at the Damodaran Online Web site. It 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 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 4.76 percent for large grocery stores, 5.66 percent for multi-line retailers, and 7.26 percent for convenience stores and convenience stores associated with gasoline stations.

14. 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,
ΔIC = 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
ΔOC = difference in annual operating 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 data inputs to 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, the year 2012. The electricity price used in the PBP calculation of electricity cost was the price projected for 2012, expressed in 2006$, but not discounted to 2006. Discount rates are not used in the PBP calculation.

15. Life-Cycle Cost and Payback Period Results

This section presents the LCC and PBP results for the energy consumption levels analyzed. Because the values of most inputs to the LCC analysis are uncertain, DOE represents them as a distribution of values rather than a single-point value. Thus, DOE derived the LCC results also as a distribution of values.

DOE provides a summary of the change in LCC from the baseline by percentile groupings of the distribution of results for each of the equipment classes in chapter 8 and appendix G of the TSD. A sample for one equipment class (VOP.RC.M) is shown in Table II.13. Table II.13 also shows the mean LCC savings and the percent of units with LCC savings at each of the efficiency levels.

TABLE II.13.—DISTRIBUTION OF LIFE-CYCLE COST SAVINGS FROM A BASELINE LEVEL (LEVEL 1) BY EFFICIENCY LEVEL FOR THE VERTICAL OPEN, REMOTE CONDENSING, MEDIUM TEMPERATURE (VOP.RC.M) EQUIPMENT CLASS

Efficiency level	Decrease in LCC from baseline (Level 1) shown by percentiles of the distribution of results (2006$)											Mean savings	Percent of units with LCC savings
	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%		
Level 2	$145	$238	$301	$340	$361	$398	$425	$509	$711	$878	$1,285	$485	100
Level 3	317	471	569	634	665	730	775	911	1,238	1,512	2,169	871	100
Level 4	473	686	822	911	952	1,044	1,106	1,294	1,748	2,127	3,036	1,239	100
Level 5	717	1,048	1,260	1,399	1,464	1,606	1,703	1,995	2,701	3,290	4,704	1,910	100
Level 6	797	1,186	1,435	1,600	1,681	1,845	1,958	2,303	3,135	3,828	5,497	2,203	100
Level 7	842	1,288	1,576	1,769	1,863	2,047	2,177	2,574	3,533	4,330	6,255	2,459	100
Level 8	835	1,349	1,694	1,911	2,021	2,230	2,379	2,839	3,950	4,871	7,105	2,707	100

As an example of how to interpret the information in Table II.13, here is a review of the results for the VOP.RC.M equipment class. The efficiency Level 4 in Table II.13 (row 3) shows that the change in LCC (zero percentile column) is a minimum saving of $473. For 90 percent of the cases studied (90th percentile), the change in LCC is a reduction of $2,127 or less. The largest reduction in LCC is $3,036 (100th percentile). The mean change in LCC is a net savings of $1,239. The last column shows that 100 percent of the sample have LCC savings (*i.e.*, reductions in LCC greater than zero) when compared to the baseline efficiency level.

Table II.14 provides the national average life cycle cost savings calculated for each efficiency level when compared to the baseline efficiency (Level 1) for all equipment classes. Review of Table II.14 shows that every efficiency level analyzed generated national average life-cycle cost savings compared with the baseline efficiency level. It should be pointed out that 100 percent of the units analyzed have positive LCC savings.

TABLE II.14.—AVERAGE LIFE-CYCLE COST SAVINGS FROM A BASELINE LEVEL (LEVEL 1) BY EFFICIENCY LEVEL AND EQUIPMENT CLASS

Equipment class	National average LCC savings (2006$)							
	Level 1	Level 2	Level 3	Level 4	Level 5	Level 6	Level 7	Level 8
VOP.RC.M	0	485	871	1239	1910	2203	2459	2707
VOP.RC.L	0	1209	2604	3512	3470	3443	NA	NA
VOP.SC.M	0	759	883	1006	1265	1328	1487	1482
VCT.RC.M	0	1046	1309	1596	1750	2362	1925	NA
VCT.RC.L	0	1179	1650	2105	2949	3333	3684	4272
VCT.SC.I	0	1371	2581	3020	3285	5313	5613	5398
VCS.SC.I	0	398	961	1383	1451	1559	1619	1609
SVO.RC.M	0	227	500	758	1000	1223	1458	NA
SVO.SC.M	0	552	588	644	824	841	1200	1186
SOC.RC.M	0	835	1779	1718	1901	1868	1540	NA
HZO.RC.M	0	208	435	490	NA	NA	NA	NA
HZO.RC.L	0	234	591	935	1267	1459	NA	NA
HZO.SC.M	0	66	286	354	381	445	466	543
HZO.SC.L	0	68	555	1071	1136	1155	1448	1457
HCT.SC.I	0	250	315	731	809	835	NA	NA

DOE specifically seeks feedback on the validity of selecting Level 1 as the baseline in the LCC analysis. Since higher efficiency equipment are known to be sold into the market, the LCC savings estimates presented above represent overestimates with respect to the life-cycle savings anticipated for base case efficiencies higher than Level 1. DOE seeks input on whether a distribution of efficiencies should be used for the LCC analysis baseline (instead of a single efficiency level), and if so, what data could be used to populate this distribution. This is identified as Issue 9 under ''Issues on Which DOE Seeks Comment'' in section IV.E of this ANOPR.

Table II.15 summarizes the PBP results for each of the efficiency levels for the VOP.RC.M equipment class. Results are summarized for PBP by percentile groupings of the distribution of results. The chart also shows the mean PBP for each efficiency level.

TABLE II.15.—SUMMARY OF PAYBACK PERIOD RESULTS FOR THE VERTICAL OPEN, REMOTE CONDENSING, MEDIUM TEMPERATURE (VOP.RC.M) EQUIPMENT CLASS

Efficiency level	Payback period in years shown by percentiles of the distribution of results											Mean PBP
	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%	
Level 2	1.4	2.1	2.3	2.8	3.1	3.3	3.5	3.6	3.8	4.1	4.7	3.2
Level 3	1.2	1.8	2.0	2.4	2.7	2.9	3.0	3.1	3.3	3.6	4.1	2.8
Level 4	1.1	1.8	1.9	2.3	2.5	2.7	2.9	3.0	3.2	3.4	3.9	2.6
Level 5	1.2	1.8	1.9	2.3	2.6	2.8	2.9	3.0	3.2	3.5	4.0	2.7
Level 6	1.2	1.8	2.0	2.4	2.7	2.9	3.0	3.1	3.3	3.6	4.1	2.8
Level 7	1.3	1.9	2.1	2.5	2.8	3.0	3.2	3.3	3.5	3.8	4.3	2.9
Level 8	1.4	2.1	2.2	2.7	3.0	3.2	3.4	3.5	3.8	4.0	4.6	3.1

Table II.16 provides the national average payback calculated for each efficiency level when compared to the baseline efficiency level (Level 1) for all equipment classes. Table II.16 also shows the percentage of units reporting PBPs of less than three years. The results of the analysis shows that purchases of higher efficiency levels resulted in PBPs (with respect to purchase of baseline efficiency units) of less than four years for any of the efficiency levels considered for any equipment class.

TABLE II.16.—NATIONAL AVERAGE PAYBACK PERIODS BY EFFICIENCY LEVEL AND EQUIPMENT CLASS

Equipment class	Level 1	Level 2	Level 3	Level 4	Level 5	Level 6	Level 7	Level 8
	National Average Payback Period (Years)							
VOP.RC.M	NA	3.2	2.8	2.6	2.7	2.8	2.9	3.1
VOP.RC.L	NA	0.5	0.8	1.1	1.2	2.0	NA	NA
VOP.SC.M	NA	0.7	0.7	0.8	1.1	1.4	2.0	3.1
VCT.RC.M	NA	0.3	0.4	0.7	0.9	2.7	3.9	NA
VCT.RC.L	NA	1.4	1.6	1.8	2.1	2.2	2.3	2.7
VCT.SC.I	NA	0.3	0.4	0.5	0.6	1.3	1.5	2.1
VCS.SC.I	NA	0.3	0.6	0.6	0.7	0.7	0.8	1.2
SVO.RC.M	NA	3.2	2.8	2.7	2.8	2.9	3.0	NA
SVO.SC.M	NA	0.8	0.8	0.9	1.1	1.3	1.8	2.4
SOC.RC.M	NA	0.6	1.0	1.2	1.4	3.1	3.9	NA
HZO.RC.M	NA	0.8	1.2	1.5	NA	NA	NA	NA
HZO.RC.L	NA	1.2	1.6	1.7	1.8	1.9	NA	NA
HZO.SC.M	NA	0.7	1.0	1.1	1.1	1.2	1.4	1.8
HZO.SC.L	NA	0.6	0.6	0.8	0.8	0.9	1.3	1.3
HCT.SC.I	NA	0.7	0.7	1.3	1.4	1.4	NA	NA
	Percent of Units With Payback Period of Less Than 3 Years							
VOP.RC.M	0	38	58	74	64	58	50	40
VOP.RC.L	0	100	100	100	100	100	NA	NA
VOP.SC.M	0	100	100	100	100	100	98	41
VCT.RC.M	0	100	100	100	100	60	24	NA
VCT.RC.L	0	100	100	100	98	94	88	64
VCT.SC.I	0	100	100	100	100	100	100	98
VCS.SC.I	0	100	100	100	100	100	100	100
SVO.RC.M	0	38	57	60	58	50	42	NA
SVO.SC.M	0	100	100	100	100	100	100	87
SOC.RC.M	0	100	100	100	100	40	25	NA
HZO.RC.M	0	100	100	100	NA	NA	NA	NA
HZO.RC.L	0	100	100	100	100	100	NA	NA
HZO.SC.M	0	100	100	100	100	100	100	100
HZO.SC.L	0	100	100	100	100	100	100	100
HCT.SC.I	0	100	100	100	100	100	NA	NA

DOE emphasizes that the PBPs shown in Table II.16 as well as the rebuttable PBPs shown in Table II.11 take into account the cumulative impact of all technologies used in a design option to reach a specific energy efficiency level when compared to the baseline equipment. Shorter PBP resulting from the most cost-effective technologies can offset longer PBP from less cost-effective technologies to yield a low overall PBP for the design option. For this reason, the choice of baseline efficiency level affects the PBP for higher efficiency levels. The LCC spreadsheet allows the user to select alternate baseline efficiency levels for each equipment class and calculate the LCC savings and PBP for all higher levels compared to the selected baseline.

Table II.17 illustrates the impact of the selection of baseline level on the VCT.RC.M equipment class for the supermarket business type and using national average energy prices. Note that the values shown in Table II.17 differ from the values shown in Table II.14 since the values in Table II.17 do not represent a national average developed through the weighting of all business types and fuel costs. Nevertheless, they serve to illustrate the impact of the selected baseline efficiency level on LCC savings and PBP. The LCC savings and PBP are shown for four alternate baseline efficiency levels: Level 1, Level 2, Level 3 and Level 4. As the baseline efficiency is moved from Level 1 to Level 4, the life-cycle-cost savings are correspondingly reduced for each of the higher efficiency levels. The efficiency level with the maximum life-cycle-cost savings (level 6) is, however, the same regardless of choice of baseline level. Selection of the baseline level at level 6 would show no life-cycle-cost savings for higher levels.

The calculated PBP also changes with selection of alternate baseline efficiency levels. As the baseline efficiency is moved from Level 1 to Level 4, the PBP for each of the higher efficiency levels, relative to the selected baseline, increases, with the Level 7 PBP moving from 3.9 years—using Level 1 as the baseline efficiency level—to 6.2 years using Level 4 as the baseline efficiency level.

TABLE II.17.—SENSITIVITY OF AVERAGE LIFE-CYCLE COST SAVINGS AND PAYBACK PERIOD TO SELECTION OF BASELINE EFFICIENCY LEVEL FOR THE VERTICAL TRANSPARENT DOOR, REMOTE CONDENSING, MEDIUM TEMPERATURE (VCT.RC.M) EQUIPMENT CLASS

Baseline level	Level 1	Level 2	Level 3	Level 4	Level 5	Level 6	Level 7	Level 8
	Average LCC Savings (2006$)							
Level 1	0	983	1232	1503	1646	2175	1709	NA
Level 2	NA	0	249	520	664	1193	726	NA

TABLE II.17.—SENSITIVITY OF AVERAGE LIFE-CYCLE COST SAVINGS AND PAYBACK PERIOD TO SELECTION OF BASELINE EFFICIENCY LEVEL FOR THE VERTICAL TRANSPARENT DOOR, REMOTE CONDENSING, MEDIUM TEMPERATURE (VCT.RC.M) EQUIPMENT CLASS—Continued

Baseline level	Level 1	Level 2	Level 3	Level 4	Level 5	Level 6	Level 7	Level 8
Level 3	NA	NA	0	271	414	944	477	NA
Level 4	NA	NA	NA	0	144	673	206	NA
	Average Payback Period (Years)							
Level 1	NA	0.3	0.4	0.7	0.9	2.7	3.9	NA
Level 2	NA	NA	0.8	1.2	1.5	3.7	5.2	NA
Level 3	NA	NA	NA	1.6	1.9	4.0	5.6	NA
Level 4	NA	NA	NA	NA	2.4	4.5	6.2	NA

DOE provided a sensitivity analysis of the life-cycle-cost savings as well as the PBP to the choice of baseline efficiency level in Chapter 8 of the TSD. DOE presents these findings to facilitate stakeholder review of the LCC and PBP analyses. DOE seeks information and comments relevant to the assumptions, methodology, and results of this analysis. See chapter 8 of the TSD for additional detail on the LCC and PBP analyses.

H. Shipments Analysis

This section presents DOE's shipments analysis, which is an input to the NIA (section II.I) and MIA (section II.K). DOE will undertake the MIA after the ANOPR is published, and will report the results of the MIA in the NOPR.

The results of the shipments analysis are driven primarily by historical shipments data for the 15 equipment classes of commercial refrigeration equipment under consideration. 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 analyze all efficiency levels analyzed in the LCC in the NIA. Because DOE is assessing impacts presuming each level analyzed represents a possible standard level, DOE refers to the efficiency levels analyzed in the NIA as "candidate standard levels" (CSLs). Shipments forecasts were determined for all of the CSLs analyzed in the NIA and NPV analysis.

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 and without coupling between them. 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 forecast 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; and (6) DOE allocated sales in each year to the 15 equipment classes in proportion to their relative historical sales.

Table II.18 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 could 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. Therefore, for the ANOPR analysis, DOE presumed that the shipments do not change in response to the changing CSLs.

TABLE II.18.—FORECASTED SHIPMENTS FOR COMMERCIAL REFRIGERATION EQUIPMENT, 2012–2042, LEVEL 1 (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	423	446	490	538	591	649	714	742	17574
VOP.RC.L*	0	0	0	0	0	0	0	0	0
VOP.SC.M	28	30	33	36	40	44	48	50	1182
VCT.RC.M	30	32	35	38	42	46	51	53	1255
VCT.RC.L	420	443	487	535	587	645	709	737	17456
VCT.SC.I	10	11	12	13	14	16	17	18	430
VCS.SC.I	3	3	3	3	4	4	4	5	107
SVO.RC.M	323	340	374	411	451	495	545	566	13405
SVO.SC.M	43	45	49	54	59	65	72	75	1769
SOC.RC.M	81	86	94	104	114	125	137	143	3379

TABLE II.18.—FORECASTED SHIPMENTS FOR COMMERCIAL REFRIGERATION EQUIPMENT, 2012–2042, LEVEL 1 (BASE CASE)—Continued

Equipment class	Thousands of linear feet shipped by year and equipment class								
	2012	2015	2020	2025	2030	2035	2040	2042	Cumulative
HZO.RC.M	50	52	57	63	69	76	84	87	2060
HZO.RC.L	156	164	181	198	218	239	263	273	6476
HZO.SC.M	4	4	4	5	5	6	6	6	152
HZO.SC.L	8	8	9	10	11	12	13	13	315
HCT.SC.I	34	35	39	43	47	52	57	59	1397

* Estimated shipments of this equipment class were zero. The industry requested that this equipment class be included in the rulemaking.

Additional details on the shipments analysis can be found in chapter 9 of the TSD.

I. National Impact Analysis

The NIA assesses future NES and the national economic impacts of CSLs. 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. For a given CSL, DOE calculated the NPV, as well as the NES, as the difference between a base case forecast and the standards case. Additional details on the national impacts analysis for commercial refrigeration equipment are found in chapter 10 of the TSD.

DOE determined national annual energy consumption as the product of the annual energy consumption per commercial refrigeration equipment unit and the number of commercial refrigeration equipment units of each vintage. This approach accounts for differences in unit energy consumption from year to year. Cumulative energy savings are the sum of the annual NES determined over the period of analysis. DOE calculated net economic savings each year as the difference between total operating cost savings and increases in total installed costs. Cumulative savings are the sum of the annual NPV.

1. Approach

Over time, in the standards case, more efficient equipment gradually replaces less efficient equipment. This affects the calculation of both the NES and NPV, both of which are a function of the total number of units in use and their efficiencies, and thus are dependent upon annual shipments and the lifetime of equipment. Both calculations start by using the estimate of shipments and the quantity of units in service, which are derived from the shipments model. With regard to the estimation of NES, because more efficient commercial refrigeration equipment units gradually replace less efficient ones, the energy per unit of capacity used by the commercial refrigeration equipment in service gradually decreases in the standards case relative to the base case. To estimate the total energy savings for each candidate efficiency level, DOE first calculated the national site energy consumption (site energy is the energy directly consumed by the units in operation) for commercial refrigeration equipment each year, beginning with the expected effective date of the standards (2012). This calculation was done for the base case forecast and the standards case forecast. Second, DOE determined the annual site energy savings, which is the difference between site energy consumption in the base case and in the standards case. Third, DOE converted the annual site energy savings into the annual amount of energy saved at the source of electricity generation (the source energy). Finally, DOE summed the annual source energy savings from 2012 to 2042 to calculate the total NES for that period. DOE performed these calculations for each CSL.

2. 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 of the standards cases. 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). Because key inputs to the calculation of the NES and NPV are dependent on the estimated efficiencies, they are of great importance to the analysis. In the case of the NES, the per-unit annual energy consumption is a direct function of efficiency. With regard to the NPV, two inputs, the per-unit total installed cost and the per-unit annual operating cost, both depend on efficiency. The per-unit total installed cost is a direct function of efficiency while the per-unit annual operating cost, because it is a direct function of the per-unit energy consumption, is indirectly dependent on equipment efficiency.

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 a 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 equipment based on its own analysis. First, DOE 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. Then, 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. Therefore, DOE specifically seeks feedback on this economic-based approach to estimating market shares. This is identified as Issue 10 under ''Issues on Which DOE Seeks Comment'' in section IV.E of this ANOPR.

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—the year 2042). Realizing that this prediction very likely has the effect of causing the estimates of savings associated with these efficiency standards to be overstated, DOE seeks comment on this prediction and the potential significance of the over-estimate of savings. In particular, DOE requests data that would enable it to better characterize the likely increases in efficiency that would occur over the 30-year modeling period in absence of this rule.

For its determination of standards case forecasted efficiencies, DOE used a ''roll-up'' scenario to establish the market shares by efficiency level for the year that standards become effective (*i.e.*, 2012). 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. Also, available information suggests that all equipment efficiencies in the base case that were above the standard level under consideration would not be affected.

DOE specifically seeks feedback on its basis for the forecasted base case and standards case efficiencies and its prediction on how standards impact efficiency distributions in the year that standards take effect. This is identified as Issue 11 under ''Issues on Which DOE Seeks Comment'' in section IV.E of this ANOPR. In addition, DOE specifically seeks feedback on whether higher standard levels in specific equipment classes are likely to cause commercial refrigeration equipment customers to shift to using other, less-efficient equipment classes for displaying merchandise. This is identified as Issue 12 under ''Issues on Which DOE Seeks Comment'' in section IV.E of this ANOPR.

3. National Impact Analysis Inputs

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. For purposes of the ANOPR NES and NPV analyses, DOE estimated that approximately 10 percent of the existing commercial refrigeration equipment units are retired each year (based on a 10-year average lifetime) and that for units shipped in 2042, any units still remaining at the end of 2052 are replaced.

The site-to-source conversion factor is the multiplicative factor used for converting site energy consumption, expressed in kWh, into primary or source energy consumption, expressed in quads (quadrillion Btu). DOE used annual 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).

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 (which consists of MSP, sales taxes, distribution channel markups, and installation cost). DOE calculated the NPV of each CSL over the life of the equipment, using three steps. First, DOE determined the difference between the equipment costs under the CSL case and the base case, to get the net equipment cost increase resulting from the CSL. Second, DOE determined the difference between the base case operating costs and the CSL operating costs, to get the net operating cost savings from the CSL. Third, DOE determined the difference between the net operating cost savings and the net equipment cost increase to get 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 the year 2007, and summed the discounted values to provide the NPV of a CSL. An NPV greater than zero shows net savings (*i.e.*, the CSL would reduce overall customer expenditures relative to the base case in present value terms). An NPV that is less than zero indicates that the candidate energy standard level would result in a net increase in customer expenditures in present value terms.

Table II.19 summarizes the NES and NPV inputs to the NES spreadsheet model. For each input a brief description of the data source is given.

TABLE II.19.—NATIONAL ENERGY SAVINGS AND NET PRESENT VALUE INPUTS

Input data	Description
Shipments	Annual shipments from shipments model (see chapter 9 Shipments Analysis).
Effective Date of Standard	2012.
Base-Case Efficiencies	Distribution of 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.
Annual Energy Consumption per Linear Foot.	Annual weighted-average values are a function of energy consumption level, which are established in the Engineering Analysis (see chapter 5 of the TSD). Converted to a per linear foot basis.
Total Installed Cost per Linear Foot	Annual weighted-average values are a function of energy consumption level (see chapter 8 of the TSD). Converted to a per linear foot basis.
Repair Cost per Linear Foot	Annual weighted-average values are constant with energy consumption level (see chapter 8 of the TSD). Converted to a per linear foot basis.
Maintenance Cost per Linear Foot	Annual weighted-average value equals $156 (see chapter 8 of the TSD), plus lighting maintenance cost. Converted to a per linear foot basis.
Escalation of Electricity Prices	EIA *AEO2006* forecasts (to 2030) and extrapolation for beyond 2030 (see 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).
Discount Rate	3 and 7 percent real.
Present Year	Future costs are discounted to year 2007.

TABLE II.19.—NATIONAL ENERGY SAVINGS AND NET PRESENT VALUE INPUTS—Continued

Input data	Description
Rebound Effect	A rebound effect (due to changes in shipments resulting from standards) was not considered in the National Impact Analysis.

* Chapter 13 (utility impact analysis) and chapter 14 (environmental assessment) provide more detail on NEMS.

4. National Impact Analysis Results

Below are the NES results for each efficiency level considered for the 15 equipment classes of commercial refrigeration equipment analyzed. Results are cumulative to 2042 and are shown as primary energy savings in quads. Inputs to the NES spreadsheet model are based on weighted-average values, yielding results that are discrete point values, rather than a distribution of values as in the LCC analysis.

Table II.20 shows the NES results for the CSLs analyzed for each equipment class of commercial refrigeration equipment. DOE based all the results on electricity price forecasts from the *AEO2006* reference case. The range of overall cumulative energy impacts for establishing standards above the baseline level (Level 1) for all equipment classes is from 0.12 quad for a standard at Level 2 to 1.73 quads with all equipment at the highest efficiency level.

TABLE II.20.—CUMULATIVE NATIONAL ENERGY SAVINGS FOR COMMERCIAL REFRIGERATION EQUIPMENT (2012–2042) (QUADS)

Equipment class	National energy savings (quads*,**) by standard level						
	Level 2	Level 3	Level 4	Level 5	Level 6	Level 7	Level 8
VOP.RC.M	0.04	0.07	0.13	0.26	0.33	0.41	0.52
VOP.RC.L†	0.00	0.00	0.00	0.00	0.00	0.00	NA
VOP.SC.M	0.00	0.01	0.01	0.02	0.02	0.04	0.06
VCT.RC.M	0.00	0.00	0.01	0.01	0.03	0.03	NA
VCT.RC.L	0.04	0.08	0.13	0.27	0.36	0.45	0.66
VCT.SC.I	0.00	0.00	0.01	0.01	0.02	0.02	0.03
VCS.SC.I	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SVO.RC.M	0.01	0.03	0.06	0.10	0.14	0.20	NA
SVO.SC.M	0.00	0.01	0.01	0.01	0.02	0.04	0.05
SOC.RC.M	0.01	0.02	0.02	0.03	0.06	0.06	NA
HZO.RC.M	0.00	0.00	0.01	NA	NA	NA	NA
HZO.RC.L	0.00	0.01	0.03	0.05	0.07	NA	NA
HZO.SC.M	0.00	0.00	0.00	0.00	0.00	0.00	0.00
HZO.SC.L	0.00	0.00	0.00	0.00	0.00	0.01	0.01
HCT.SC.I	0.00	0.00	0.02	0.02	0.02	NA	NA

* A value of NA means that no energy savings were calculated for this level of efficiency. For example, a vertical open, remote condensing, low temperature unit (VOP.RC.L) had only six possible energy consumption levels and, therefore, only six possible standards. Level 1 = Baseline, so there would be no savings at Level 1 and it has been omitted from the table.
** 0.00 indicates savings are less than 0.005 quadrillion Btu.
† The VOP.RC.L equipment class had no projected shipments. It was included in the analysis at the request of the industry.

Below are the NPV results for the CSLs considered for the 15 equipment classes of commercial refrigeration equipment. Results are cumulative and are shown as the discounted value of these savings in dollar terms. The present value of increased total installed costs is the total installed cost increase (*i.e.*, the difference between the standards case and base case), discounted to 2007, and summed over the time period in which DOE evaluates the impact of standards (*i.e.*, from the effective date of standards, 2012, to the year 2052 when the last commercial refrigeration equipment unit is retired).

Savings are decreases in operating costs (including electricity, repair, and maintenance) associated with the higher energy efficiency of commercial refrigeration equipment units purchased in the standards case compared to the base case. Total operating cost savings are the savings per unit multiplied by the number of units of each vintage (*i.e.*, the year of manufacture) surviving in a particular year. Commercial refrigeration equipment consumes energy and must be maintained over its entire lifetime. For units purchased in 2042, the operating cost includes energy consumed and maintenance and repair costs incurred until the last unit is retired from service in 2052.

Table II.21 shows the NPV results for the standard levels considered for commercial refrigeration equipment based upon a seven percent discount rate. DOE based all results on electricity price forecasts from the *AEO2006* reference case. Detailed results showing the breakdown of the NPV into national equipment costs and national operating costs are provided in appendix I of the TSD. At a seven percent discount rate, the range of overall national NPV benefits calculated for different CSL scenarios above the baseline was from $120 million to $1.4 billion. The present value of the installed cost increase varied from a low of $70 million to a high of $1.82 billion. The present value of the operating cost savings for higher standards varied from a low of $210 million to a high of $3.14 billion.

TABLE II.21.—CUMULATIVE NET PRESENT VALUE RESULTS BASED ON A SEVEN PERCENT DISCOUNT RATE (BILLION 2006$)

Equipment class	Standard level (billion 2006$) * **						
	Level 2	Level 3	Level 4	Level 5	Level 6	Level 7	Level 8
VOP.RC.M	0.03	0.07	0.12	0.25	0.31	0.36	0.40
VOP.RC.L†	0.00	0.00	0.00	0.00	0.00	NA	NA
VOP.SC.M	0.01	0.01	0.01	0.02	0.02	0.03	0.02
VCT.RC.M	0.00	0.01	0.01	0.01	0.02	0.00	NA
VCT.RC.L	0.06	0.10	0.16	0.30	0.37	0.44	0.55
VCT.SC.I	0.00	0.01	0.01	0.01	0.02	0.03	0.02
VCS.SC.I	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SVO.RC.M	0.01	0.03	0.06	0.09	0.13	0.17	NA
SVO.SC.M	0.01	0.01	0.01	0.02	0.02	0.04	0.04
SOC.RC.M	0.01	0.03	0.02	0.03	0.02	−0.01	NA
HZO.RC.M	0.00	0.01	0.01	NA	NA	NA	NA
HZO.RC.L	0.00	0.02	0.04	0.06	0.08	NA	NA
HZO.SC.M	0.00	0.00	0.00	0.00	0.00	0.00	0.00
HZO.SC.L	0.00	0.00	0.01	0.01	0.01	0.01	0.01
HCT.SC.I	0.00	0.01	0.02	0.03	0.03	NA	NA

* A value of NA means that no energy savings were calculated for this level of efficiency. For example, a vertical open, remote condensing, low temperature unit (VOP.RC.L) had only six possible energy consumption levels and, therefore, only six possible standards. Level 1 = Baseline, so there would be no savings at Level 1 and it has been omitted from the table.
** 0.00 indicates savings are less than 0.005 quadrillion Btu.
† The VOP.RC.L equipment class had no projected shipments. It was included in the analysis at the request of the industry.

Table II.22 provides the NPV results based on the three percent discount rate and electricity price forecasts from the *AEO2006* reference case. As with the NPV results based upon a seven percent discount rate, detailed results showing the breakdown of the NPV into national equipment costs and national operating costs based upon a three percent discount rate are provided in appendix I of the TSD. At a three percent discount rate, the range of overall NPV benefits calculated for different CSL scenarios above the assumed baseline was from $360 million to $4.03 billion. The present value of the installed cost varied from a low of $150 million to a high of $3.57 billion. The present value of the operating cost savings for higher standards varied from a low of $510 million to a high of $7.51 billion.

TABLE II.22.—CUMULATIVE NET PRESENT VALUE RESULTS BASED ON A THREE PERCENT DISCOUNT RATE (BILLION 2006$)

Equipment class	Standard level (billion 2006$) * **						
	Level 2	Level 3	Level 4	Level 5	Level 6	Level 7	Level 8
VOP.RC.M	0.09	0.20	0.35	0.69	0.86	1.03	1.20
VOP.RC.L †	0.00	0.00	0.00	0.00	0.00	NA	NA
VOP.SC.M	0.02	0.02	0.03	0.06	0.06	0.08	0.08
VCT.RC.M	0.01	0.01	0.02	0.03	0.05	0.03	NA
VCT.RC.L	0.15	0.27	0.42	0.80	1.00	1.21	1.59
VCT.SC.I	0.01	0.01	0.02	0.02	0.07	0.07	0.07
VCS.SC.I	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SVO.RC.M	0.03	0.09	0.17	0.26	0.36	0.49	NA
SVO.SC.M	0.02	0.02	0.03	0.05	0.05	0.12	0.12
SOC.RC.M	0.02	0.07	0.06	0.08	0.07	0.03	NA
HZO.RC.M	0.00	0.02	0.02	NA	NA	NA	NA
HZO.RC.L	0.01	0.05	0.10	0.17	0.21	NA	NA
HZO.SC.M	0.00	0.00	0.00	0.00	0.00	0.00	0.00
HZO.SC.L	0.00	0.01	0.01	0.01	0.02	0.02	0.02
HCT.SC.I	0.01	0.01	0.06	0.07	0.08	NA	NA

* A value of NA means that no energy savings were calculated for this level of efficiency. For example, a vertical open, remote condensing, low temperature unit (VOP.RC.L) had only six possible energy consumption levels and, therefore, only six possible standards. Level 1 = Baseline, so there would be no savings at Level 1 and it has been omitted from the table.
** 0.00 indicates savings are less than 0.005 quadrillion Btu.
† The VOP.RC.L equipment class had no projected shipments. It was included in the analysis at the request of the industry.

J. Life-Cycle Cost Sub-Group Analysis

The LCC sub-group analysis evaluates impacts of standards on identifiable groups of customers, such as customers of different business types, which may be disproportionately affected by standards. In the NOPR phase of this rulemaking, DOE will analyze the LCCs and PBPs for customers that fall into those groups. The analysis will determine whether any particular group of commercial consumers would be adversely affected by any of the CSLs.

Also, DOE plans to examine variations in energy prices and energy use that might affect the NPV of a standard to customer sub-populations. To the extent possible, DOE will obtain estimates of the variability of each input parameter and consider this variability in the calculation of customer impacts. Variations in energy use for a particular equipment type may depend on factors such as climate and type of business.

DOE will determine the effect on customer sub-groups using the LCC spreadsheet model. The spreadsheet model used for the LCC analysis can be used with different data inputs. The standard LCC analysis includes various customer types that use commercial refrigeration equipment. DOE can analyze the LCC for any sub-group, such as a convenience store, by using the LCC spreadsheet model and sampling only that sub-group. Details of this model are explained in section II.G, which describes the LCC and PBP analyses. DOE will be especially sensitive to purchase price increases (''first-cost'' increases) to avoid negative impacts on identifiable population groups such as small businesses (*i.e.*, those with low annual revenues), which may not be able to afford a significant increase in the price of commercial refrigeration equipment. For such customers that are sensitive to price increases, increases in first costs of equipment can preclude the purchase of a new model. As a result, some customers may retain equipment past its useful life. This older equipment is generally less efficient to begin with, and its efficiency may deteriorate further if it is retained beyond its useful life. Large increases in first cost also can possibly preclude the purchase and use of equipment altogether, resulting in a potentially large loss of utility to the customer.

Although business income and annual revenues are not known for the types of businesses analyzed in the LCC analysis, the floor space occupied by a business may be an indicator of its annual income. If this is generally true, then DOE will be able to perform sub-group analyses on smaller businesses. As stated earlier, DOE can also use SBA data for businesses with 750 or fewer employees as a proxy for ''smaller businesses.''

K. Manufacturer Impact Analysis

The purpose of the manufacturer impact analysis is to identify the likely impacts of energy conservation standards on manufacturers. DOE will conduct this analysis with input from manufacturers and other interested parties and will apply this methodology to its evaluation of standards. DOE will also consider financial impacts and a wide range of quantitative and qualitative industry impacts that might occur following the adoption of a standard. For example, a particular standard level, if adopted by DOE, could require changes to commercial refrigeration equipment manufacturing practices. DOE will identify and understand these impacts through interviews with manufacturers and other stakeholders during the NOPR stage of its analysis.

Recently, DOE announced changes to the format of the manufacturer impact analysis through a report submitted to Congress on January 31, 2006 (as required by section 141 of EPACT 2005), entitled ''Energy Conservation Standards Activities.'' Previously, DOE did not report any manufacturer impact analysis results during the ANOPR phase; however, under this new format, DOE has collected, evaluated, and reported preliminary information and data in the ANOPR (see section II.K.6 of this ANOPR). Such preliminary information includes the anticipated conversion capital expenditures by efficiency level and the corresponding anticipated impacts on jobs. DOE solicited this information during the ANOPR engineering analysis manufacturer interviews and reported the results in the preliminary manufacturer impact analysis (see chapter 12 of the TSD).

DOE conducts the manufacturer impact analysis in three phases, and further tailors the analytical framework based on stakeholder comments. In Phase I, an industry profile is created to characterize the industry, and a preliminary manufacturer impact analysis is conducted to identify important issues that require consideration. Results of the Phase I analysis are presented in the ANOPR TSD. In Phase II, an industry cash flow model and an interview questionnaire are prepared to guide subsequent discussions. In Phase III, manufacturers are interviewed, and the impacts of standards are assessed both quantitatively and qualitatively. Industry and sub-group cash flow and net present value are assessed through use of the Government Regulatory Impact Model (GRIM). Then impacts on competition, manufacturing capacity, employment, and regulatory burden are assessed based on manufacturer interview feedback and discussions. Results of the Phase II and Phase III analyses are presented in the NOPR TSD. For more detail on the manufacturer impact analysis, refer to chapter 12 of the TSD.

1. Sources of Information for the Manufacturer Impact Analysis

Many of the analyses described above provide important information applicable to the MIA. Such information includes manufacturing costs and prices from the engineering analysis, retail price forecasts, and shipments forecasts. DOE will supplement this information with company financial data and other information gathered during interviews its contractor conducts with manufacturers. This interview process plays a key role in the manufacturer impact analysis because it allows interested parties to privately express their views on important issues. To preserve confidentiality, DOE aggregates these perspectives across manufacturers, creating a combined opinion or estimate for DOE. This process enables DOE to incorporate sensitive information from manufacturers in the rulemaking process without specifying precisely which manufacturer provided a certain set of data.

DOE conducts detailed interviews with manufacturers to gain insight into the range of potential impacts of standards. During the interviews, DOE typically solicits both quantitative and qualitative information on the potential impacts of efficiency levels on sales, direct employment, capital assets, and industrial competitiveness. DOE prefers an interactive interview process, rather than a written response to a questionnaire, because it helps clarify responses and identify additional issues. Before the interviews, DOE will circulate a draft document showing the estimates of the financial parameters based on publicly available information. DOE will solicit comments and suggestions on these estimates during the interviews.

DOE will ask interview participants to identify any confidential information that they have provided, either orally or in writing. DOE will consider all information collected, as appropriate, in its decision-making process. However, DOE will not make confidential information available in the public record. DOE also will ask participants to identify all information that they wish to have included in the public record, but that they do not want to have associated with their interview. DOE will incorporate this information into the public record, but will report it without attribution.

DOE will collate the completed interview questionnaires and prepare a summary of the major issues. For more detail on the methodology used in the manufacturer impact analysis, refer to chapter 12 of the TSD.

2. Industry Cash Flow Analysis

The industry cash flow analysis relies primarily on the GRIM. DOE uses the GRIM to analyze the financial impacts of more stringent energy conservation standards on the industry.

The GRIM analysis uses several factors to determine annual cash flows from a new standard: Annual expected revenues; manufacturer costs (including COGS, depreciation, research and development, selling, general and administrative expenses); taxes; and conversion capital expenditures. DOE compares the results against base case projections that involve no new standards. The financial impact of new standards is the difference between the two sets of discounted annual cash flows. For more information on the industry cash flow analysis, refer to chapter 12 of the TSD.

3. Manufacturer Sub-Group Analysis

Industry cost estimates are not adequate to assess differential impacts among sub-groups of manufacturers. For example, small and niche manufacturers, or manufacturers whose cost structure differs significantly from the industry average, could experience a more negative impact. Ideally, DOE would consider the impact on every firm individually; however, it typically uses the results of the industry characterization to group manufacturers exhibiting similar characteristics.

During the interview process, DOE will discuss the potential sub-groups and sub-group members it has identified for the analysis. DOE will encourage the manufacturers to recommend sub-groups or characteristics that are appropriate for the sub-group analysis. For more detail on the manufacturer sub-group analysis, refer to chapter 12 of the TSD.

4. Competitive Impacts Assessment

DOE must also consider whether a new standard is likely to reduce industry competition, and the Attorney General must determine the impacts, if any, of any reduced competition. DOE will make a determined effort to gather and report firm-specific financial information and impacts. The competitive analysis will focus on assessing the impacts on smaller manufacturers. DOE will base this assessment on manufacturing cost data and on information collected from interviews with manufacturers. The manufacturer interviews will focus on gathering information to help assess asymmetrical cost increases to some manufacturers, increased proportions of fixed costs that could increase business risks, and potential barriers to market entry (*e.g.*, proprietary technologies).

5. Cumulative Regulatory Burden

DOE recognizes and seeks to mitigate the overlapping effects on manufacturers of new or revised DOE standards and other regulatory actions affecting the same equipment. DOE will analyze and consider the impact on manufacturers of multiple, equipment-specific regulatory actions.

Based on its own research and discussions with manufacturers, DOE identified several regulations relevant to commercial refrigeration equipment, including: existing or new standards for commercial refrigeration equipment, phaseout of hydrochlorofluorocarbons and foam insulation blowing agents, standards for other equipment made by commercial refrigeration equipment manufacturers, State energy conservation standards, and international energy conservation standards. DOE will study the potential impacts of these cumulative burdens in greater detail during the MIA conducted during the NOPR phase.

6. Preliminary Results for the Manufacturer Impact Analysis

DOE received views from manufacturers about what they perceived to be the possible impact of potential new standards on their future profitability. As stated by manufacturers, a new energy conservation standard has the potential to impact financial performance in several different ways. The capital investment needed to upgrade or redesign equipment and equipment platforms before they have reached the end of their useful life can require conversion costs that otherwise would not be expended, resulting in stranded investments. In addition, more stringent standards can result in higher per-unit costs that may deter some customers from buying higher-margin units with more features, thereby decreasing manufacturer profitability.

DOE estimates that a commercial refrigeration equipment production line would have a life cycle of approximately 15 to 20 years in the absence of standards. During that period, manufacturers would not make major changes that altered the underlying platforms. Thus, a standard that took effect and resulted in a major equipment platform redesign before the end of the platform's life would strand a portion of the earlier capital investments.

DOE asked manufacturers what level of conversion costs they anticipated if energy conservation standards were to take effect. In general, manufacturers expected only conversion costs associated with redesigning of insulation foaming fixtures. One manufacturer estimated this to be approximately $10 million in new fixtures, research, and testing. Manufacturers indicated there would not be a significant amount of stranded assets because of standards, but any stranded assets that did exist would be primarily in the insulation foaming fixtures. The manufacturers also indicated that standards would have little effect on capacity and utilization.

The impact of new energy conservation standards on employment is an important consideration in the rulemaking process. To assess how domestic employment patterns might be affected by new energy conservation standards for commercial refrigeration equipment, DOE posed several questions related to this topic to manufacturers.

Over the past several years, some commercial refrigeration equipment manufacturers have moved a portion of their production out of the United States, primarily driven by concerns about profitability and the opportunity for lower labor costs. Mexico is the most common location for U.S. manufacturers to establish new production capacity, since it offers low labor rates relative to the United States and proximity to the U.S. market. Manufacturers indicated that they anticipate new standards will accelerate the trend to manufacture commercial refrigeration equipment outside of the United States. Further, new standards may accelerate the rate at which commercial refrigeration equipment production is moved to Mexico because if manufacturers need to make large capital investments to produce redesigned equipment platforms, they have strong financial incentives to invest in a location with lower labor costs.

Manufacturers indicated that new standards could cause them to exit one or more portions of the markets affected by the standards. Thus, standards could affect the degree of industry consolidation, that is, the degree to which a limited number of companies dominate a market. At present, four companies account for a large majority of commercial refrigeration equipment sales.

DOE asked manufacturers to what degree they expected industry consolidation to occur in the absence of standards. In general, manufacturers felt that there would be little industry consolidation in the future. Historically, the commercial refrigeration equipment industry has not seen extensive consolidation, although several manufacturers have been bought and sold by parent companies in the past.

For more preliminary results for the manufacturer impact analysis such as other impacts on financial performance, impacts on utility and performance, and additional details on the impacts of cumulative regulatory burden, refer to chapter 12 of the TSD.

L. Utility Impact Analysis

The utility impact analysis estimates the effects on the utility industry of reduced energy consumption due to improved appliance efficiency. The analysis compares modeling results for the base case with results for each candidate standards case. It consists of forecasted differences between the base and standards cases for electricity generation, installed capacity, sales, and prices.

To estimate these effects of proposed commercial refrigeration equipment standard levels on the electric utility industry, DOE intends to use a variant of the EIA's NEMS.[24] EIA uses NEMS to produce the *2007 Annual Energy Outlook (AEO).* DOE will use a variant known as NEMS–Building Technologies (BT) to provide key inputs to the analysis. NEMS–BT produces a widely recognized reference case forecast for the United States and is available in the public domain.

The use of NEMS–BT for the utility impact analysis offers several advantages. As the official DOE energy forecasting model, it relies on a set of assumptions that are transparent and have received wide exposure and commentary. NEMS–BT allows an estimate of the interactions between the various energy supply and demand sectors and the economy as a whole. The utility impact analysis will determine the changes in installed capacity and generation by fuel type produced by each CSL, as well as changes in electricity sales to the commercial sector.

DOE conducts the utility analysis as a policy deviation from the *AEO2007,* applying the same basic set of premises. For example, the operating characteristics (*e.g.*, energy conversion efficiency, emissions rates) of future electricity generating plants are as specified in the *AEO2007* reference case, as are the prospects for natural gas supply. DOE also will explore deviations from some of the reference case premises, to represent alternative futures. Two alternative scenarios use the high and low economic growth cases of *AEO2007.* (The reference case corresponds to medium growth.) The high economic growth case projects higher growth rates for population, labor force, and labor productivity, resulting in lower predicted inflation and interest rates relative to the reference case and higher overall aggregate economic growth. The opposite is true for the low growth case. Starting in 2012, the high growth case predicts growth in per capita gross domestic product of 3.5 percent per year, compared with 3.0 percent per year in the reference case and 2.5 percent per year in the low growth case. While supply-side growth determinants are varied in these cases, *AEO2007* uses the same reference case energy prices for all three economic growth cases. Different economic growth scenarios will affect the rate of growth of electricity demand.

The electric utility industry analysis will consist of NEMS–BT forecasts for generation, installed capacity, sales, and prices. The NEMS–BT provides reference case load shapes for several end uses, including commercial refrigeration. The model uses predicted growth in demand for each end use to build up a projection of the total electric system load growth for each region, which it uses in turn to predict the necessary additions to capacity. The NEMS–BT accounts for the implementation of energy conservation standards by decrementing the appropriate reference case load shape. DOE determines the size of the decrement using data for the per-unit energy savings developed in the LCC and PBP analyses (see chapter 8 of the TSD) and the forecast of shipments developed for the NIA (see chapter 9 of the TSD).

The predicted reduction in capacity additions is sensitive to the peak load impacts of the standard. DOE will investigate the need to adjust the hourly load profiles that include this end use in NEMS–BT. Since the *AEO2007* version of NEMS–BT forecasts only to the year 2030, DOE must extrapolate the results to 2042. DOE will use the approach developed by EIA to forecast fuel prices for the FEMP. FEMP uses these prices to estimate LCCs of Federal equipment procurements. For petroleum products, EIA uses the average growth rate for the world oil price over the years 2010 to 2025, in combination with the refinery and distribution markups from the year 2025, to determine the regional price forecasts. Similarly, EIA derives natural gas prices from an average growth rate figure in combination with regional price margins from the year 2025. Results of the analysis will include changes in commercial electricity sales, and installed capacity and generation by fuel type, for each trial standard level, in five-year, forecasted increments extrapolated to the year 2040.

M. Employment Impact Analysis

DOE estimates the impacts of standards on employment for equipment manufacturers, relevant service industries, energy suppliers, and the economy in general. Both indirect and direct employment impacts are covered. Direct employment impacts would result if standards led to a change in the number of employees at manufacturing plants and related supply and service firms. Direct impact estimates are covered in the MIA.

Indirect employment impacts are impacts on the national economy other than in the manufacturing sector being regulated. Indirect impacts may result both from expenditures shifting among goods (substitution effect) and changes in income which lead to a change in overall expenditure levels (income effect). DOE defines indirect employment impacts from standards as net jobs eliminated or created in the general economy as a result of increased spending driven by the increased equipment prices and reduced spending on energy.

DOE expects new standards to increase the total installed cost of equipment (includes MSP, sales taxes, distribution channel markups, and installation cost). DOE also expects the new standards to decrease energy consumption, and thus expenditures on energy. Over time, increased total installed cost is paid back through energy savings. The savings in energy expenditures may be spent on new commercial investment and other items.

Using an input/output model of the U.S. economy, this analysis seeks to estimate the effects on different sectors and the net impact on jobs. DOE will estimate national employment impacts for major sectors of the U.S. economy in the NOPR, using public and commercially available data sources and software. DOE will make all methods and documentation available for review.

DOE developed Impact of Sector Energy Technologies (ImSET), a spreadsheet model of the U.S. economy that focuses on 188 sectors most relevant to industrial, commercial, and residential building energy use.[25] ImSET is a special-purpose version of

[24] For more information on NEMS, please refer to the U.S. Department of Energy, Energy Information Administration documentation. A useful summary is *National Energy Modeling System: An Overview 2000,* DOE/EIA–0581(2000), March 2000. DOE/EIA approves use of the name NEMS to describe only an official version of the model without any modification to code or data. Because this analysis entails some minor code modifications and the model is run under various policy scenarios that are variations on DOE/EIA assumptions, in this analysis, DOE refers to it by the name NEMS–BT.

[25] Roop, J. M., M. J. Scott, and R. W. Schultz. 2005. ImSET: Impact of Sector Energy Technologies. PNNL–15273. Pacific Northwest National Laboratory, Richland, WA.

the U.S. Benchmark National Input-Output (I–O) model, which has been designed to estimate the national employment and income effects of energy saving technologies that are deployed by the DOE Office of Energy Efficiency and Renewable Energy. In comparison with previous versions of the model used in earlier rulemakings, the current version allows for more complete and automated analysis of the essential features of energy efficiency investments in buildings, industry, transportation, and the electric power sectors.

The ImSET software includes a personal computer-based I–O model with structural coefficients to characterize economic flows among the 188 sectors. ImSET's national economic I–O structure is based on the 1997 Benchmark U.S. table (Lawson, et al. 2002),[26] specially aggregated to 188 sectors. The time scale of the model is 50 years.

The model is a static I–O model, which allows a great deal of flexibility concerning the types of energy efficiency effects that can be accommodated. For example, certain economic effects of energy efficiency improvements require an assessment of inter-industry purchases, which is handled in the model. Some energy efficiency investments will not only reduce the costs of energy in the economy but the costs of labor and other goods and services as well, which is accommodated through a recalculation of the I–O structure in the model. Output from the ImSET model can be used to estimate changes in employment, industry output, and wage income in the overall U.S. economy resulting from changes in expenditures in the various sectors of the economy.

Although DOE intends to use ImSET for its analysis of employment impacts, it welcomes input on other tools and factors it might consider. For more information on the employment impacts analysis, refer to chapter 14 of the TSD.

N. Environmental Assessment

DOE will assess the impacts of proposed commercial refrigeration equipment standard levels on certain environmental indicators, using NEMS–BT to provide key inputs to the analysis. The environmental assessment produces results in a manner similar to those provided in the *AEO.*

The intent of the environmental assessment is to provide estimates of reduced powerplant emissions and to fulfill requirements to properly quantify and consider the environmental effects of all new Federal rules. The environmental assessment that will be produced by NEMS–BT considers two pollutants (sulfur dioxide (SO_2) and nitrogen oxides (NO_X)) and one other emission (carbon). The only form of carbon the NEMS–BT model tracks is carbon dioxide (CO_2). Therefore, the only carbon discussed in this analysis is in the form of CO_2. For each of the CSLs, DOE will calculate total undiscounted and discounted emissions using NEMS–BT and will use external analysis as needed.

DOE will conduct the environmental assessment as an incremental policy impact (i.e., a commercial refrigeration equipment standard) of the *AEO2007* forecast, applying the same basic set of assumptions used in *AEO2007.* For example, the emissions characteristics of an electricity generating plant will be exactly those used in *AEO2007.* Also, forecasts conducted with NEMS–BT consider the supply-side and demand-side effects on the electric utility industry. Thus, DOE's analysis will account for any factors affecting the type of electricity generation and, in turn, the type and amount of airborne emissions generated by the utility industry. The NEMS–BT model tracks carbon emissions with a specialized carbon emissions estimation subroutine, producing reasonably accurate results due to the broad coverage of all sectors and inclusion of interactive effects. Past experience with carbon results from NEMS–BT suggests that emissions estimates are somewhat lower than emissions based on simple average factors. One of the reasons for this divergence is that NEMS–BT tends to predict that conservation displaces generating capacity in future years. On the whole, NEMS–BT provides carbon emissions results of reasonable accuracy, at a level consistent with other Federal published results.

NEMS–BT also reports SO_2 and NO_X, which DOE has reported in past analyses. The Clean Air Act Amendments of 1990 set an SO_2 emissions cap on all power generation. The attainment of this target, however, is flexible among generators through the use of emissions allowances and tradable permits. Although NEMS–BT includes a module for SO2 allowance trading and delivers a forecast of SO_2 allowance prices, accurate simulation of SO_2 trading implies that the effect of energy conservation standards on physical emissions will be zero because emissions will always be at or near the ceiling. This fact has caused considerable confusion in the past. However, there may be an SO_2 benefit from energy conservation, in the form of a lower SO_2 allowance price. Since the impact of any one standard on the allowance price is likely small and highly uncertain, DOE does not plan to monetize any potential SO_2 benefit.

NEMS also has an algorithm for estimating NO_X emissions from power generation. The impact of these emissions, however, will be affected by the Clean Air Interstate Rule (CAIR), which the U.S. Environmental Protection Agency issued on March 10, 2005.[27] CAIR will permanently cap emissions of NO_X in 28 eastern States and the District of Columbia. 70 FR 25162 (May 12, 2005). As with SO_2 emissions, a cap on NO_X emissions means that equipment energy conservation standards may have no physical effect on these emissions. When NO_X emissions are subject to emissions caps, DOE's emissions reduction estimate corresponds to incremental changes in the prices of emissions allowances in cap-and-trade emissions markets rather than physical emissions reductions. Therefore, while the emissions cap may mean that physical emissions reductions will not result from standards, standards could produce an environmental-related economic benefit in the form of lower prices for emissions allowances. However, as with SO_2 allowance prices, DOE does not plan to monetize this benefit because the impact on the NO_X allowance price from any single energy conservation standard is likely small and highly uncertain.

The results for the environmental assessment are similar to a complete NEMS run as published in the *AEO2007*. These results include power sector emissions for SO2, NOX, and carbon in five-year forecasted increments extrapolated to 2042. The outcome of the analysis for each CSL is reported as a deviation from the *AEO2007* reference (base) case.

For more detail on the environmental assessment, refer to the environmental assessment report of the TSD.

O. Regulatory Impact Analysis

DOE will prepare a draft regulatory impact analysis in compliance with Executive Order 12866, ''Regulatory Planning and Review,'' which will be subject to review by the Office of Management and Budget's Office of Information and Regulatory Affairs (OIRA). 58 FR 51735 (September 30, 1993).

[26] Lawson, Ann M., Kurt S. Bersani, Mahnaz Fahim-Nader, and Jiemin Guo. 2002. ''Benchmark Input-Output Accounts of the U.S. Economy, 1997,'' Survey of Current Business, December, pp. 19–117.

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

As part of the regulatory impact analysis (and as discussed in section II.K of this ANOPR), DOE will identify and seek to mitigate the overlapping effects on manufacturers of new or revised DOE standards and other regulatory actions affecting the same equipment. Through manufacturer interviews and literature searches, DOE will compile information on burdens from existing and impending regulations affecting commercial refrigeration equipment. DOE also seeks input from stakeholders about regulations it should consider.

The regulatory impact analysis also will address the potential for non-regulatory approaches to supplant or augment energy conservation standards to improve the efficiency of commercial refrigeration equipment. The following list includes non-regulatory means of achieving energy savings that DOE can consider.

- No new regulatory action
- Consumer tax credits
- Manufacturer tax credits
- Performance standards
- Rebates
- Voluntary energy efficiency targets
- Early replacement
- Bulk government purchases

The TSD, in support of DOE's NOPR, will include an analysis of each alternative, the methodology for which is discussed briefly below.

DOE will use the NES spreadsheet model (as discussed in sections I.B.5 and II.I of this ANOPR) to calculate the NES and the NPV corresponding to each alternative to the proposed standards. The details of NES spreadsheet model are discussed in chapter 10 of the TSD. To compare each alternative quantitatively to the proposed conservation standards, it will be necessary to quantify the effect of each alternative on the purchase and use of energy efficient commercial equipment. Once each alternative is properly quantified, DOE will make the appropriate revisions to the inputs in the NES spreadsheet model. The following are key inputs that DOE may revise in the NES spreadsheet model.

- Energy prices and escalation factors
- Implicit market discount rates for trading off purchase price against operating expense when choosing equipment efficiency
- Customer purchase price, operating cost, and income elasticities
- Customer price versus efficiency relationships
- Equipment stock data (purchase of new equipment or turnover rates for inventories)

The following are the key measures of the impact of each alternative.

- Commercial energy use (EJ = 10^{18} joule) is the cumulative energy use of the equipment from the effective date of the new standard to the year 2035. DOE will report electricity consumption as primary energy.
- NES is the cumulative national energy use from the base case projection less the alternative policy case projection.
- NPV is the value of future operating cost savings from commercial refrigeration equipment bought in the period from the effective date of the new standard to the year 2035. DOE calculates the NPV as the difference between the present value of equipment and operating expenditures (including energy) in the base case, and the present value of expenditures in each alternative policy case. DOE discounts future operating and equipment expenditures to 2006 using a seven percent real discount rate. It calculates operating expenses (including energy) for the life of the equipment.

For more information on the regulatory impact analysis, refer to the regulatory impact analysis report in the TSD.

III. Candidate Energy Conservation Standards Levels

DOE will specify CSLs in the ANOPR, but will not propose a particular standard. DOE selected between four and eight energy consumption levels for each commercial refrigeration equipment class for use in the LCC and NIA. Based on the results of the ANOPR analysis, DOE selects from the CSLs analyzed in the ANOPR a subset for a more detailed analysis for the NOPR stage of the rulemaking. The range of CSLs selected includes: the most energy efficient level or most energy efficient combination of design options, the combination of design options or efficiency level with the minimum LCC, and a combination of design options or efficiency level with a PBP of not more than three years. Additionally, CSLs that incorporate noteworthy technologies or fill in large gaps between efficiency levels of other CSLs may be selected.

DOE will include the most energy efficient level analyzed as a CSL. The level with the maximum LCC savings was identified for each equipment category. In some instances this was identical to the most efficient level analyzed. In other cases it was the next most efficient level analyzed. The calculated national average PBPs from the LCC analysis suggested that many of the energy efficiency levels analyzed provided a national average payback of less than three years when compared with the baseline equipment. DOE opted to designate as a CSL the maximum energy efficiency level that provided for a payback of less than three years. These three selection criteria provided only one or two CSLs selections per equipment class. Therefore, DOE selected two or three lower energy consumption levels for each equipment class in order to provide greater variation in CSLs for its future analysis. The selection of these additional levels reflects DOE review of the relative cost effectiveness of the levels when compared with the baseline equipment and when compared with other efficiency levels. Four CSLs were selected for each equipment class. Table III.1 shows the selected CSLs based on the energy consumption for the specific equipment analyzed in the engineering analysis. DOE specifically seeks feedback on its selection of specific candidate standard levels for the post ANOPR analysis phase. This is identified as Issue 13 under ''Issues on Which DOE Seeks Comment'' in section IV.E of this ANOPR.

DOE will refine its final selection of CSLs for further analysis after receiving input from stakeholders on the ANOPR and after any revision of the ANOPR analyses. At that point, the CSLs will be recast as Trial Standard Levels (TSLs). DOE will analyze specific TSLs during the post-ANOPR analysis and will report the results of that analysis in the NOPR.

TABLE III.1.—CANDIDATE STANDARD LEVELS AND FACTORS CONSIDERED IN THEIR SELECTION FOR FUTURE ANALYSIS

Equipment class	Candidate standard level selection considerations						
	Maximum efficiency level	Maximum efficiency level with positive LCC savings	Efficiency level with minimum LCC	Highest efficiency level with PBP <3 years	Additional candidate standard level selected for future analysis		
VOP.RC.M	Level 8	Level 8	Level 8	Level 7	Level 6	Level 4.	
VOP.RC.L	Level 6	Level 6	Level 4	Level 6	Level 5	Level 3.	
VOP.SC.M	Level 8	Level 8	Level 7	Level 7	Level 5	Level 3.	
VCT.RC.M	Level 7	Level 7	Level 6	Level 6	Level 5	Level 3.	
VCT.RC.L	Level 8	Level 8	Level 8	Level 8	Level 7	Level 5	Level 3.
VCT.SC.I	Level 8	Level 8	Level 7	Level 8	Level 6	Level 3.	
VCS.SC.I	Level 8	Level 8	Level 7	Level 8	Level 6	Level 5.	
SVO.RC.M	Level 7	Level 7	Level 7	Level 6	Level 4	Level 2.	
SVO.SC.M	Level 8	Level 8	Level 7	Level 8	Level 5	Level 3.	
SOC.RC.M	Level 7	Level 7	Level 5	Level 5	Level 4	Level 3.	
HZO.RC.M	Level 4	Level 4	Level 4	Level 4	Level 3	Level 2.	
HZO.RC.L	Level 6	Level 6	Level 6	Level 6	Level 5	Level 4	Level 3.
HZO.SC.M	Level 8	Level 8	Level 8	Level 8	Level 7	Level 6	Level 4.
HZO.SC.L	Level 8	Level 8	Level 8	Level 8	Level 7	Level 6	Level 3.
HCT.SC.I	Level 6	Level 6	Level 6	Level 6	Level 5	Level 4	Level 3.

Because the equipment classes cover a variety of equipment sizes, DOE has suggested defining the standard in terms of upper limits on daily energy consumption (CDEC or TDEC as provided for remote condensing and self-contained equipment, respectively) normalized by TDA for remote condensing commercial equipment with transparent doors or without doors, commercial ice-cream freezers with transparent doors, and self-contained commercial equipment without doors. DOE has suggested defining the standard levels in terms of maximum rated daily energy consumption (CDEC or TDEC as provided for remote condensing and self-contained equipment, respectively) normalized by refrigerated volume (V, as measured by ANSI/AHAM Standard HRF–1–2004) for remote condensing commercial refrigerators, commercial freezers, and commercial refrigerators-freezers with solid doors and for commercial ice-cream freezers with solid doors. The industry supplied cost-efficiency curves are in the form of CDEC normalized by TDA (kWh/day/ft^2). In the engineering analysis, DOE normalized the CDEC for each efficiency level by TDA or refrigerated volume. Table III.2 presents the CSLs for the analyzed equipment classes in terms of these normalized metrics.

TABLE III.2.—CANDIDATE STANDARD LEVELS FOR ANALYZED EQUIPMENT CLASSES EXPRESSED IN TERMS OF THE NORMALIZED TEST METRICS

Equipment class	Test metric	Candidate standard level in order of efficiency					Candidate standard levels for equipment analyzed expressed in terms of the test metric				
		Baseline	CSL1	CSL2	CSL3	CSL4	Baseline	CSL1	CSL2	CSL3	CSL4
VOP.RC.M	CDEC/TDA kWh/day/ft^2	Level 1	Level 4	Level 6	Level 7	Level 8	1.08	0.90	0.75	0.70	0.64
VOP.RC.L	CDEC/TDA kWh/day/ft^2	Level 1	Level 3	Level 4	Level 5	Level 6	2.93	2.61	2.47	2.46	2.39
VOP.SC.M	TDEC/TDA kWh/day/ft^2	Level 1	Level 3	Level 5	Level 7	Level 8	2.55	2.23	2.07	1.84	1.65
VCT.RC.M	CDEC/TDA kWh/day/ft^2	Level 1	Level 3	Level 5	Level 6	Level 7	0.54	0.42	0.38	0.24	0.19
VCT.RC.L	CDEC/TDA kWh/day/ft^2	Level 1	Level 3	Level 5	Level 7	Level 8	1.06	0.90	0.75	0.65	0.55
VCT.SC.I	TDEC/TDA kWh/day/ft^2	Level 1	Level 3	Level 6	Level 7	Level 8	1.58	1.24	0.77	0.69	0.63
VCS.SC.I	TDEC/V kWh/day/ft^3	Level 1	Level 5	Level 6	Level 7	Level 8	0.27	0.19	0.18	0.17	0.17
SVO.RC.M	CDEC/TDA kWh/day/ft^2	Level 1	Level 2	Level 4	Level 6	Level 7	1.05	1.00	0.90	0.80	0.74
SVO.SC.M	TDEC/TDA kWh/day/ft^2	Level 1	Level 3	Level 5	Level 7	Level 8	2.24	1.99	1.87	1.62	1.54
SOC.RC.M	CDEC/TDA kWh/day/ft^2	Level 1	Level 3	Level 4	Level 5	Level 7	0.95	0.76	0.74	0.71	0.60
HZO.RC.M	CDEC/TDA kWh/day/ft^2	Level 1	Level 1	Level 2	Level 3	Level 4	0.16	0.16	0.14	0.11	0.10
HZO.RC.L	CDEC/TDA kWh/day/ft^2	Level 1	Level 3	Level 4	Level 5	Level 6	0.83	0.75	0.70	0.65	0.62
HZO.SC.M	TDEC/TDA kWh/day/ft^2	Level 1	Level 4	Level 6	Level 7	Level 8	0.78	0.61	0.56	0.54	0.48
HZO.SC.L	TDEC/TDA kWh/day/ft^2	Level 1	Level 3	Level 6	Level 7	Level 8	2.05	1.80	1.52	1.33	1.32
HCT.SC.I	TDEC/TDA kWh/day/ft^2	Level 1	Level 3	Level 4	Level 5	Level 6	1.63	1.28	0.73	0.61	0.57

When an energy conservation standard is defined for an equipment class, DOE must consider how to express the level in a manner suitable for all equipment within that class. This is of particular concern when the rating is in terms of energy consumption and there is variation of energy consumption within a class due to variation in equipment size or capacity. DOE believes that TDA captures the most significant driver behind capacity-related energy consumption differences between like equipment designs within an equipment class (see section II.A.2 of the ANOPR). For this reason, DOE has suggested that the maximum energy consumption standards for this equipment be expressed as:

$MEC_{SC} = A_{SC} \times TDA$ (self-contained equipment)

$MEC_{RC} = A_{RC} \times TDA$ (remote condensing equipment)

Where:

MEC_{SC} = maximum TDEC (kWh/day) from ANSI/ARI Standard 1200–2006,

MEC_{RC} = maximum CDEC (kWh/day) from ANSI/ARI Standard 1200–2006,
A_{RC} = a minimum normalized energy consumption factor (expressed in kWh/day/ft² TDA),
A_{SC} = a minimum normalized TDEC factor (expressed in kWh/day/ft² TDA), and
TDA = Total Display Area (ft²).

Commercial refrigerators, commercial freezers and commercial refrigerator-freezers with a self-contained condensing unit designed for holding temperature applications manufactured on or after January 1, 2010, will have energy conservation standards in terms of:

Maximum energy consumption M (kWh/yr) = $B \times V + K$

Where:
B is expressed in terms of kWh/yr/ft³ of rated volume,
V is the adjusted volume (ft³) calculated for the equipment class, and
K is an offset factor expressed in kWh/yr.

In similar fashion, DOE has suggested that the energy conservation standards for remote condensing refrigerators, commercial freezers, and commercial refrigerators-freezers with solid doors and for commercial ice-cream freezers with solid doors, respectively, be expressed as:

$MEC_{RC} = B_{RC} \times V + K_{RC}$ (remote condensing equipment)
$MEC_{SC} = B_{SC} \times V + K_{SC}$ (self-contained equipment)

Where:
MEC_{RC} = maximum CDEC (kWh/day) from ANSI/ARI Standard 1200–2006,
MEC_{SC} = maximum TDEC (kWh/day) from ANSI/ARI Standard 1200–2006,
B_{RC} = a minimum normalized energy consumption factor (expressed in kWh/day/ft³ gross refrigerated volume) calculated using the CDEC rating from the DOE adopted test procedure (ANSI/ARI Standard 1200–2006),
B_{SC} = a minimum normalized TDEC factor (expressed in kWh/day/ft³ gross refrigerated volume) and calculated using the TDEC rating from the DOE adopted test procedure (ANSI/ARI Standard 1200),
V = Gross Refrigerated Volume (ft³),
K_{RC} = an offset factor in kWh/day for remote condensing equipment, and
K_{SC} = an offset factor in kWh/day for self-contained equipment.

DOE is concerned that V may not completely capture the most significant driver behind capacity- or size-related energy consumption differences between equipment designs within these equipment classes. In particular, for these equipment classes, the surface area for heat gain may not vary linearly with volume. The VCS.SC.I equipment class falls under this category.

DOE specifically seeks feedback on its approach for characterizing energy conservation standards for commercial refrigeration equipment. If the approach to characterizing standards for remote condensing commercial refrigerators, commercials freezers, and commercial refrigerators-freezers with solid doors and for commercial ice-cream freezers with solid doors is acceptable, DOE seeks comments on how it could develop appropriate offset factors (K_{SC} and K_{RC}) for these classes of equipment. This is identified as Issue 14 under ''Issues on Which DOE Seeks Comment'' in section IV.E of this ANOPR.

Commercial refrigerator-freezers (also called dual temperature units) are equipment that have two or more compartments that operate at different temperatures. During the Framework public meeting, Hill Phoenix stated that shipments of this equipment are very low. (Public Meeting Transcript, No. 3.4 at p. 52) In the engineering analysis (section II.C of this ANOPR), DOE only analyzed those equipment classes with the highest shipment volumes, and therefore did not include an analysis of commercial refrigerator-freezers. However, DOE explained in the market and technology assessment (section II.A of this ANOPR) that it intended to adapt the analytical results for commercial refrigerators and commercial freezers to commercial refrigerator-freezers.

DOE understands that 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, and thus the temperature of one or more compartments) or one compressor. Accordingly, for the purposes of implementing standards, DOE is considering the following method for implementing standards for commercial refrigerator-freezers.

- For remote condensing commercial refrigerator-freezers where two or more chilled and frozen compartments are cooled by independent remote condensing units, each compartment should have its total refrigeration load measured separately according to the ANSI/ASHRAE Standard 72–2005 test procedure. Compressor energy consumption (CEC) for each compartment shall be calculated using Table 1 in ANSI/ARI Standard 1200–2006 using the evaporator temperature for that compartment. The 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). Determine the maximum limit on CDEC for each compartment, based on that compartment's respective equipment class and TDA or volume. The maximum limit on CDEC for the entire case is the sum of all the maximum limits on CDEC of all compartments.
- For remote condensing commercial refrigerator-freezers where two or more chilled and frozen compartments are cooled by one condensing unit (with EPR valves or similar devices used to raise the evaporator pressure, and thus the temperature of one or more compartments), the total case shall have its total refrigeration load measured according to the ANSI/ASHRAE Standard 72–2005 test procedure. CEC for the entire case shall be calculated using Table 1 in ANSI/ARI Standard 1200–2006 using the lowest evaporator temperature of all compartments. The CDEC for the entire case shall be the sum of the CEC, FEC, LEC, AEC, DEC, and PEC. Determine the maximum limit on CDEC for the compartment with the lowest integrated average temperature (IAT), based on that compartment's respective equipment class and the total TDA or volume of all compartments. This value is the maximum limit on CDEC for the entire case.
- For self-contained commercial refrigerator-freezers without doors where two or more chilled and frozen compartments are cooled by independent self-contained condensing units, the CDEC for the entire case shall be measured according to the ANSI/ASHRAE Standard 72–2005 test procedure. Determine the maximum limit on CDEC for each compartment, based on that compartment's respective equipment class and TDA. The maximum limit on CDEC for the entire case is the sum of all the maximum limits on CDEC of all compartments.
- For self-contained commercial refrigerator-freezers without doors where two or more chilled and frozen compartments are cooled by one condensing unit (with EPR valves or similar devices used to raise the evaporator pressure, and thus the temperature of one or more compartments), the daily energy consumption for the entire case shall be measured according to the ANSI/

ASHRAE Standard 72–2005 test procedure. Determine the maximum limit on CDEC for the compartment with the lowest IAT, based on that compartment's respective equipment class and the total TDA of all compartments. This value is the maximum limit on CDEC for the entire case.

DOE specifically seeks feedback on its approach for setting standards for remote condensing commercial refrigerator-freezers. Additionally, DOE seeks feedback on how to implement standards for self-contained commercial refrigerator-freezers without doors. These are identified as Issue 15 under ''Issues on Which DOE Seeks Comment'' in section IV.E of this ANOPR.

IV. Public Participation

A. Attendance at Public Meeting

The time, date and location of the public meeting are set forth 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-Jones 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 ANOPR, 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 ANOPR, or by e-mail to *Brenda.Edwards-Jones@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, Forrestal Building, Room 1J–018 (Resource Room of the Building Technologies Program), 1000 Independence Avenue, SW., Washington, DC, (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 ANOPR before or after the public meeting, but no later than October 9, 2007. 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 Part 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 interested in receiving comments on all aspects of this ANOPR. DOE particularly invites comments or data to improve DOE's analysis, including data or information that will respond to the following questions or concerns that were addressed in this ANOPR:

1. Equipment Class Prioritization and Extending Analyses

Because of the large number of equipment classes included in this rulemaking, DOE focused on conducting a thorough examination of the equipment classes with the greatest energy-savings potential. To address low-shipment equipment classes, DOE could either conduct a full technical analysis of these equipment classes or develop correlations to extend analyses or standard levels in the NOPR phase of the rulemaking. DOE requests feedback on the approach to equipment type prioritization and its approach to address low-shipment volume equipment classes, and of extending EPCA standards to equipment classes in this rulemaking. (See section I.D.3.c and II.A.2 of this ANOPR and chapter 5 of the TSD for further details.)

2. Air-Curtain Angle

For equipment without doors, DOE believes that the orientation of the air curtain affects the energy consumption (both remote condensing and self-contained equipment) and that equipment without doors can be broadly categorized by the angle of the air curtain that divides the refrigerated compartment from the ambient space. DOE is considering defining 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 requests feedback on this definition of air-curtain angle. (See section II.A.2 of this ANOPR for further details.)

3. Door Angle

For equipment with doors, DOE believes that the orientation of doors affects the energy consumption and that equipment with doors can be broadly categorized by the angle of the door. DOE is considering 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." DOE requests feedback on this on this definition of door angle. (See section II.A.2 of this ANOPR for further details.)

4. Equipment Classes for Equipment With Doors

DOE is proposing to define 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). DOE requests comments on these ranges of door angles in defining equipment classes with doors. (See section II.A.2 of this ANOPR for further details.)

5. Equipment Classes

In accordance with EPCA section 325(p)(1)(A), DOE identified the equipment classes covered under this rulemaking in Table II.6. (42 U.S.C. 6295(p)(1)(A)) Pursuant to EPCA section 325(p)(1)(B), DOE requests comments on these equipment classes and invites interested persons to submit written presentations of data, views, and arguments. (42 U.S.C. 6295(p)(1)(B)) (See section II.A.2 of this ANOPR for further details.)

6. Case Lighting Operating Hours

DOE's analysis suggests that typical lighting operating hours for most classes of commercial refrigeration equipment would fall in the range of 16 to 24 hours per day, depending on store operating hours, use of lighting during after-hours case stocking, and typical lighting operation or controls used for unoccupied periods. Display case lighting hours may also depend on business type as convenience stores have distinctly different operating hours than other segments of the food retail industry. DOE requests comments on whether the 24-hour basis for case lighting operating hours is valid for DOE's continued analysis, and if not, what changes should be made to better characterize the case lighting operating hours? (See section II.E of this ANOPR for further details.)

7. Operation and Maintenance Practices

DOE requests comments on operation and maintenance practices for commercial refrigeration equipment that may be prevalent in the field which may differ from standardized conditions, such as those represented in a test procedure. These field conditions could potentially affect the energy consumption savings experienced in the field as a result of increased energy efficiency as compared to those savings estimated in the TSD's energy consumption analysis under idealized conditions. DOE requests comment on the frequency to which such factors come in to play in energy use in the field, and whether and how DOE could account for these factors in assessing the overall impacts of the candidate standards levels for commercial refrigeration equipment. (See section II.E of this ANOPR for further details.)

8. Equipment Lifetime

DOE requests comments on the lifetime of commercial refrigeration equipment and whether, in fact, this is a significant issue and whether DOE should perform a sensitivity analysis of this variable in the LCC and NES analyses. In particular, DOE seeks comment on how long these units are typically maintained in service by equipment class and store type. Also, DOE seeks comment on the existence and importance of a used-equipment market for commercial refrigeration equipment, and the importance of considering such a market in its analysis. (See section II.E of this ANOPR for further details.)

9. Life-Cycle Cost Baseline Level

DOE did not receive data from industry concerning the average energy efficiency of commercial refrigeration equipment currently being shipped, nor was data provided in further discussion with manufacturers. An analysis of the literature suggests little data on the energy characteristics of display cases in the general market is available. Based on this, DOE used the Level 1 (minimum energy efficiency level) established in the engineering analysis as the baseline for the LCC analysis.

The selection of baseline level has two impacts in the LCC and PBP analyses. It can affect the PBP calculated since payback is calculated from the baseline level, and it can affect the maximum level showing LCC savings. It can also affect the fraction of users on the market who experience LCC savings at any level. The selection of the baseline level does not generally affect the level identified as having the maximum LCC savings. DOE requests feedback on whether the Level 1 baseline selected by DOE is valid for the LCC analysis, and if not, what changes should be made to provide a more realistic baseline level. Since higher efficiency equipment is known to be sold into the market, DOE also seeks input on whether a distribution of efficiencies should be used for the LCC analysis baseline, and if so, what data could be used to populate this distribution. If more detailed data to develop a distribution of efficiencies in the baseline cannot be provided, DOE seeks input on how a sensitivity analysis to alternative baselines could best be used to inform the LCC and NES analyses supporting the rulemaking. (See section II.G.15 of this ANOPR for further details.)

10. Characterizing the National Impact Analysis Base Case

No data have been found on the market shares of various commercial refrigeration equipment classes by energy consumption level. Therefore, for the National Impact Analysis base case, DOE adapted a cost-based method used in the NEMS to estimate market shares for each equipment class by efficiency level. DOE did not have data to calibrate this approach to actual market shipments. Does the economic-based approach DOE used to establish base case shipments by efficiency level provide a valid base case assumption for the NIA and future analyses? If not, what should DOE do to improve the base case efficiency forecast? (See section II.I.2 of this ANOPR for further details.)

11. Base Case and Standards Case Forecasts

Because key inputs to the calculation of the NES and NPV are dependent on the estimated efficiencies under the base case (without standards) and the standards case (with standards), forecasted efficiencies are of great importance to the analysis. Information available to DOE suggests that forecasted market shares would remain frozen throughout the analysis period (*i.e.*, 2012–2042). For its determination of standards case forecasted efficiencies, DOE used a ''roll-up'' scenario to establish the market shares by efficiency level for the year that standards become effective (*i.e.*, 2012). Available information 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. Also, available information suggests that all equipment efficiencies in the base case that were above the standard level under consideration would not be affected. DOE requests feedback on its development of standards case efficiency forecasts from the base case efficiency forecast and its basis for how standards would impact efficiency distributions in the year that standards are to take effect. (See section II.I.2 of this ANOPR for further details.)

12. Differential Impact of New Standards on Future Shipments by Equipment Classes

The shipment models used in the NES and NIA presume that the relative market share of the different classes of commercial refrigeration equipment remains constant over the time period analyzed. While DOE is aware that market preferences for certain types of products may change in the future, DOE has no data with which to predict or characterize those changes. DOE is however particularly concerned whether higher standards for certain classes of commercial refrigeration equipment are likely to generate significant market shifts to other equipment that may have higher energy consumption. By developing standards for all classes of commercial refrigeration equipment within the scope of this rulemaking using the same economic criteria, DOE hopes to mitigate this concern. However, DOE specifically requests stakeholder input on the potential for standards-driven market shifts between equipment classes that could reduce national energy savings as well as stakeholder input on how the standards setting process can reduce or eliminate these shifts. (See section II.I.2 of this ANOPR for further details.

13. Selection of Candidate Standard Levels for Post-Advance Notice of Proposed Rulemaking Analysis

DOE is required to examine specific criteria for the selection of CSLs for further analysis. Some of these criteria are economic based and the resulting CSLs selected may be impacted by updates to the ANOPR analysis after input from stakeholders. DOE has discretion in the selection of additional standard levels it may choose to analyze. DOE seeks input on the candidate standard levels selected for future analysis shown in Table III.1 (See section III of this ANOPR for further details.)

14. Approach to Characterizing Energy Conservation Standards

When an efficiency or energy consumption standard is defined for a class of equipment, DOE must consider how to express the level in a manner suitable for all equipment within that class. DOE seeks input on its approach for characterizing energy conservation standards for commercial refrigeration equipment as discussed in section III. If the approach to characterizing standards for remote condensing commercial refrigerators, commercial freezers, and commercial refrigerators-freezers with solid doors and for commercial ice-cream freezers with solid doors is acceptable, DOE seeks comments on how it could develop appropriate offset factors (K_{SC} and K_{RC}) for these classes of equipment. (See section III of this ANOPR for further details.)

15. Standards for Commercial Refrigerator-Freezers

DOE is addressing standards for commercial refrigerator-freezers (both remote condensing and self-contained). For equipment served by independent condensing units, the maximum limit on CDEC for the entire case is the sum of the maximum limits on CDEC of all compartments, based on each compartment's respective equipment class and TDA or volume. For equipment served by one condensing unit, the maximum limit on CDEC for the entire case is the maximum limit on CDEC for the compartment with the lowest IAT, based on the equipment class of that compartment and the total TDA or volume of all compartments. DOE requests feedback on this approach to implementing standards for commercial refrigerator-freezers. (See section III of this ANOPR for further details.)

V. Regulatory Review and Procedural Requirements: Executive Order 12866

DOE submitted this ANOPR for review to the Office of Management and Budget, under Executive Order 12866, ''Regulatory Planning and Review.'' 58 FR 51735 (October 4, 1993). If DOE later proposes energy conservation standards for certain commercial refrigeration equipment, and if the proposed rule constitutes a significant regulatory action, DOE would prepare and submit to OMB for review the assessment of costs and benefits required under section 6(a)(3) of the Executive Order. The Executive Order requires agencies to identify the specific market failure or other specific problem that it intends to address that warrant new agency action, as well as assess the significance of that problem, to enable assessment of whether any new regulation is warranted. (Executive Order 12866, § 1(b)(1)). Without a market failure, a regulation cannot result in net benefits.

DOE's preliminary analysis suggests that accounting for the market value of energy savings alone (*i.e.*, excluding any possible ''externality'' benefits such as those noted below) would produce enough benefits to yield net benefits across a wide array of equipment and circumstances. These results, if correct, imply the existence of a market failure in the commercial refrigeration equipment market. DOE requests data on, and suggestions for testing the existence and extent of, these potential market failures to complete an assessment in the proposed rule of the significance of these failures and thus the net benefits of regulation.

First, DOE believes that there is a lack of consumer information and/or information processing capability about energy efficiency opportunities in the commercial refrigeration equipment market. If this is in fact the case, DOE would expect the energy efficiency for commercial refrigeration equipment to be randomly distributed across key variables such as energy prices and usage levels. DOE seeks data on the efficiency levels of existing commercial refrigeration equipment in use by store type (*e.g.*, large grocery, multi-line retailer, small grocery/convenience store) and electricity price (and/or geographic region of the country). DOE plans to use these data to test the extent to which purchasers of this equipment behave as if they are unaware of the costs associated with their energy consumption. Also, DOE seeks comment on knowledge of the Federal ENERGYSTAR program, and it's penetration into the commercial refrigeration equipment consumer market as a resource for knowledge of the availability and benefits of energy efficient refrigeration units.

Second, for small businesses in particular, DOE believes there may be ''split incentives'' for more energy efficient equipment. The commercial space owner may not invest in efficient equipment because the owner of the space does not pay the energy bill, and the retail establishment owner (building tenant) does not want to invest so as not to risk losing the capital investment at the end of the lease. If this is in fact the case, DOE would expect that, other things equal, establishments that own the equipment purchase higher efficiency commercial refrigeration equipment on average than those who rent the equipment through building lease arrangements. DOE seeks data on owner-occupied buildings versus leased/non-owner occupied buildings for given store types (*e.g.*, large grocery) and their associated use of high-efficiency units. With these data, DOE plans to assess the significance of this market failure by comparing the energy efficiencies of the units in place by building occupancy status.

Of course, there are likely to be certain ''external'' benefits resulting from the improved efficiency of units that are not captured by the users of such equipment. These include both environmental and energy security-related externalities that are not already reflected in energy prices such as reduced emissions of greenhouse gases and reduced use of natural gas (and oil) for electricity generation. DOE invites comments 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.

In addition, various other analyses and procedures may apply to such future rulemaking action, including those required by the National Environmental Policy Act, Pub. L. 91–190, 42 U.S.C. 4321 *et seq.*; the Unfunded Mandates Act of 1995, Pub. L. 104–4; the Paperwork Reduction Act, 44 U.S.C. 3501 *et seq.*; the Regulatory Flexibility Act, 5 U.S.C. 601 *et seq.*; and certain Executive Orders.

The draft of today's action and any other documents submitted to OIRA for review are part of the rulemaking record and are available for public review at the U.S. Department of Energy, Forrestal Building, Room 1J–018, (Resource Room of the Building Technologies Program), 1000 Independence Avenue, SW., Washington, DC, (202) 586–2945, between 9 a.m. and 4 p.m., Monday through Friday, except Federal holidays.

VI. Approval of the Office of the Secretary

The Secretary of Energy has approved publication of today's ANOPR.

Issued in Washington, DC, on July 19, 2007.

John Mizroch,

Principal Deputy Assistant Secretary, Energy Efficiency and Renewable Energy.

[FR Doc. 07–3640 Filed 7–25–07; 8:45 am]

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