Rulemaking Framework for Commercial Refrigeration Equipment

United States Department of Energy
Office of Energy Efficiency and Renewable Energy
Building Technologies Program

April 30, 2010

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AEO	*Annual Energy Outlook*
AHAM	Association of Home Appliance Manufacturers
AHRI	Air-Conditioning, Heating and Refrigeration Institute
ANOPR	advance notice of proposed rulemaking
ANSI	American National Standards Institute
ARI	Air-Conditioning and Refrigeration Institute (now AHRI)
ASHRAE	American Society of Heating, Refrigerating, and Air-Conditioning Engineers
BT	Building Technologies Program
°C	degrees Celsius
CAIR	Clean Air Interstate Rule
CAMR	Clean Air Mercury Rule
CEC	California Energy Commission
CFC	chlorofluorocarbon
CFR	Code of Federal Regulations
CO_2	carbon dioxide
CSL	candidate standard level
DC	(Washington) District of Columbia
DOE	U.S. Department of Energy
DOJ	U.S. Department of Justice
ECM	electronically commutated motors
EERE	Office of Energy Efficiency and Renewable Energy
EGU	electric generating unit
EIA	Energy Information Administration
EISA 2007	Energy Independence and Security Act of 2007
E.O.	Executive Order
EPACT 2005	Energy Policy Act of 2005
EPCA	Energy Policy and Conservation Act
°F	degrees Fahrenheit
FR	*Federal Register*
GHG	greenhouse gas
GRIM	Government Regulatory Impact Model
HCFC	hydrochlorofluorocarbon
HFC	hydrofluorocarbon
Hg	mercury
HVAC	heating, ventilating, and air conditioning
IQ	intelligence quotient
ImSET	Impact of Sector Energy Technologies
kWH	kilowatt-hour
LCC	life-cycle cost
LED	light-emitting diode
MIA	manufacturer impact analysis
MPC	manufacturer production cost
NCI	Navigant Consulting, Inc.

NEMS	National Energy Modeling System
NES	national energy savings
NIA	national impact analysis
NOPR	notice of proposed rulemaking
NO_x	nitrogen oxides
NPV	net present value
OIRA	Office of Information and Regulatory Affairs
OMB	Office of Management and Budget
PBP	payback period
PM	particulate matter
Pub. L.	Public Law
R&D	research and development
RIA	regulatory impact analysis
SCC	social cost of carbon
SG&A	selling, general, and administrative costs
SO_2	sulfur dioxide
TDA	total display area
TSD	technical support document
TSL	trial standard level
U.S.	United States
U.S.C.	U.S. Code
WACC	weighted-average cost of capital

1.0 INTRODUCTION

The United States (U.S.) Department of Energy (DOE) Appliances and Commercial Equipment Standards Program within the Office of Energy Efficiency and Renewable Energy's (EERE) Building Technologies Program (BT) develops and promulgates test procedures and energy conservation standards for certain consumer appliances and commercial equipment. The process for developing standards involves analysis, public notice and comment, and consultation with interested parties. "Interested parties" include manufacturers, consumers, energy conservation and environmental advocates, State and Federal agencies, and any other groups or individuals with an interest in these standards and test procedures.

The purpose of this document is to describe the procedural and analytical approaches DOE anticipates using to determine whether to amend the energy conservation standards for commercial refrigeration equipment and, if so, to evaluate potential amended standards (see section 1.1 for a discussion of the statutory authority for this rulemaking). This document is intended to inform interested parties of the process DOE will follow for this rulemaking for commercial refrigeration equipment and to encourage and facilitate the input of interested parties. This document is the starting point for determining whether to amend standards, and if so, developing such standards and is not a definitive statement on any issue to be determined in the rulemaking.

Section 1.0 of this report provides an overview of DOE's rulemaking process. Section 2.0 through section 17.0 discuss analyses DOE intends to conduct to fulfill the statutory requirements and guidance for this energy conservation standards rulemaking for commercial refrigeration equipment. DOE is required, as part of this rulemaking, to determine whether to amend existing energy conservations standards for this equipment. DOE believes that the conduct of these analyses will support its determination whether to amend the standards, as well as, if the determination is positive, to establish any amended standards. DOE will maintain information about this rulemaking on its website at: http://www1.eere.energy.gov/buildings/appliance_standards/commercial/refrigeration_equipment.html

While DOE invites comment on all aspects of the material presented in this document, several specific issues on which DOE seeks comment are set out in comment boxes like this one. DOE uses these comment boxes to highlight issues and ask specific questions on the approaches DOE plans to follow to conduct the analyses required for the energy conservation standards rulemaking. Such requests for feedback are numbered sequentially throughout the document and are repeated in appendix A.

1.1 The Appliances and Commercial Equipment Standards Program

Title III of the Energy Policy and Conservation Act (EPCA) of 1975, Pub. L. 94-163 (42 U. S. Code (U.S.C.) 6291 *et seq*.), established an energy conservation program for major household appliances. More specifically, Part A of Title III (42 U.S.C. 6291-6309) establishes the "Energy Conservation Program for Consumer Products Other Than Automobiles." Part A-1

of Title III (42 U.S.C. 6311–6317) establishes a similar program for "Certain Industrial Equipment," which includes commercial refrigeration equipment, which is the focus of this document.

The Energy Policy Act of 2005 (EPACT 2005), Pub. L. 109-58, included amendments to EPCA that updated several existing standards and test procedures; prescribed definitions, standards, and test procedures for certain new consumer products and commercial equipment; and mandated that DOE commence rulemakings to develop test procedures and standards for certain new consumer products and commercial equipment. With respect to the standards for commercial refrigeration equipment, EPCA, as amended by EPACT 2005, also states that:

> (A) Not later than January 1, 2013, the Secretary shall issue a final rule to determine whether the standards established under this subsection should be amended.
> (B) Not later than 3 years after the effective date of any amended standards under subparagraph (A) or the publication of a final rule determining that the standards should not be amended, the Secretary shall issue a final rule to determine whether the standards established under this subsection or the amended standards, as applicable, should be amended.
> (C) If the Secretary issues a final rule under subparagraph (A) or (B) establishing amended standards, the final rule shall provide that the amended standards apply to products manufactured on or after the date that is –
> (i) 3 years after the date on which the final amended standard is published; or
> (ii) if the Secretary determines, by rule, that 3 years is inadequate, not later than 5 years after the date on which the final rule is published.

42 U.S.C. 6313(c)(5).

1.2 Definitions

Section 136(a)(3) of EPACT 2005 amended section 340 of EPCA by inserting definitions for the following terms that describe commercial refrigeration equipment:

> (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);
> (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, semi-vertically, 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.

(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.

* * *

(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 F, can cool those beverages to an average stable temperature of 38 degrees F in 12 hours or less.

(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 one or more refrigerant compressors, refrigerant condensers, condenser fans and motors, and factory supplied accessories.

(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 one or more refrigerant compressors, refrigerant condensers, condenser fans and motors, and factory supplied accessories."

42 USC 6311(9).

1.3 Rulemaking History

Two subsets of commercial refrigeration equipment standards currently exist: standards prescribed by EPACT 2005 for certain equipment, and standards established by DOE for other equipment.

1.3.1 Standards Prescribed by Statute

Section 136(c) of EPACT 2005 amended EPCA to prescribe energy consumption standards for self-contained equipment consisting of refrigerators with solid doors, refrigerators with transparent doors, freezers with solid doors, freezers with transparent doors, refrigerator/freezers with solid doors, and refrigerators with transparent doors designed for pull-down temperature applications.(42 U.S.C. 6313(c)(1–3)) These standards became effective on January 1, 2010. See Table 1.1 in section 1.4.

1.3.2 Standards Established by Rulemaking

Section 136(c) of EPACT 2005 also amended EPCA to mandate that DOE set standards for the following additional categories of equipment: ice-cream freezers; 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)) DOE undertook a rulemaking process beginning in April 2006, when it published a *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. That framework described the procedural and analytical approaches DOE anticipated using to evaluate the establishment of energy conservation standards for these types of commercial refrigeration equipment. This document is available at: http://www1.eere.energy.gov/buildings/appliance_standards/commercial/pdfs/comml_refrig_framework.pdf

DOE held a public meeting on May 16, 2006, to discuss procedural and analytical approaches to the rulemaking, and to inform and facilitate the involvement of interested parties in the rulemaking process. The analytical framework presented at the public meeting described different analyses, such as the engineering analysis and the life-cycle cost (LCC) and payback period (PBP) analyses, the methods proposed for conducting them, and the relationships among the various analyses.

After the analytical framework public meeting, as part of the information gathering and sharing process for the preliminary manufacturer impact analysis (MIA), DOE organized and held interviews with commercial refrigeration equipment manufacturers. DOE selected companies that represented production of all types of equipment covered by the rulemaking, ranging from small to large manufacturers, and included both Air-Conditioning and Refrigeration Institute (ARI) [1] member companies and non-ARI member companies. DOE had four objectives for these interviews: (1) solicit feedback on the draft engineering analysis (including methodology, production costs, manufacturing processes, and findings); (2) solicit feedback on topics related to the preliminary MIA; (3) provide an opportunity, early in the rulemaking process, for these manufacturers to express specific concerns to DOE; and (4) foster cooperation between the manufacturers and DOE.

DOE developed a preliminary engineering analysis to estimate the cost of manufacturing equipment at efficiencies above the baseline levels. DOE also developed spreadsheets to conduct the LCC, PBP, and national impact analysis (NIA). The LCC spreadsheet calculates national distributions of life cycle cost savings at various energy efficiency levels above the baseline. It can also provide LCC savings based on typical input values for several business types that use commercial refrigeration equipment. The NIA spreadsheet calculates the national energy savings (NES) and national net present values (NPVs) at various energy efficiency levels. It also includes a model that forecasts shipments for the various equipment classes of commercial refrigeration equipment at different efficiency levels.

In July 2007, DOE published an *Advance Notice of Proposed Rulemaking* (ANOPR) *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*. In that ANOPR, DOE considered establishing energy conservation standards for these types of commercial refrigeration equipment and announced a public meeting to receive comments on a variety of issues. This document is available at

[1] On January 1, 2008, the Air-Conditioning and Refrigeration Institute (ARI) and the Gas Appliance Manufacturers Association (GAMA) merged to become the Air-Conditioning, Heating and Refrigeration Institute (AHRI), to represent the interests of cooling, heating, and commercial refrigeration equipment manufacturers.

http://www1.eere.energy.gov/buildings/appliance_standards/commercial/pdfs/comml_refrig_anopr_072607.pdf.

DOE held a public meeting on August 23, 2007, to provide interested parties the opportunity to comment on the proposed equipment classes DOE was considering; the analytical framework, models, and tools (*e.g.*, LCC and NES spreadsheets) that DOE had developed to perform analyses of the impacts of potential energy conservation standards; the results of the preliminary analyses; and the candidate energy conservation standard levels.

After the publication of the ANOPR (July 26, 2007, 72 Federal Register (FR) 41162-41210) and the presentation of the ANOPR to interested parties at the public meeting, DOE conducted additional interviews with commercial refrigeration equipment manufacturers as part of its development of the MIA for the notice of proposed rulemaking (NOPR). There were 13 general topics discussed during each of the interviews: (1) general key issues; (2) company overview and organizational characteristics; (3) company financial parameters; (4) production cost breakdown; (5) shipment projections and market shares; (6) equipment mixes; (7) conversion costs; (8) markups and profitability; (9) cumulative regulatory burden; (10) exports, foreign competition, and outsourcing; (11) direct employment impact assessment; (12) market consolidation; and (13) baseline products and different design options.

Based on findings from the preliminary engineering, analyses (LCC, NES, and NIA), and public comments provided in response to the ANOPR, DOE made certain updates to these analyses. In updating these analyses, DOE reviewed the recommendations made on April 21, 1998, by the Advisory Committee on Appliance Energy Efficiency Standards. (Advisory Committee, No. 96)[2] DOE's analysis implemented recommendations related to (1) defining a range of energy price futures for each fuel used in the economic analyses; and (2) defining a range of primary energy conversion factors and associated emission reductions based on the generation of energy and emissions that would be displaced by energy efficiency standards for each rulemaking. In addition, DOE performed additional analyses assessing impacts on national employment, consumer subgroups, utilities, and the environment. DOE also developed analysis of alternatives to efficiency standard regulations.

On August 25, 2008, DOE published a *Notice of Proposed Rulemaking 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*, to propose energy conservation standards for these types of commercial refrigeration equipment, and to announce a public meeting to receive comments on a variety of issues. 73 FR 50072–50137. This document is available at http://www1.eere.energy.gov/buildings/appliance_standards/commercial/pdfs/cre_nopr_fr_final.pdf.

[2] Advisory Committee, No. 96 refers to the recommendations of the Advisory Committee on Appliance Energy Efficiency Standards and is available for inspection at the U.S. Department of Energy, 950 L'Enfant Plaza SW., Suite 600, Washington, DC, 20024 (Resource Room) in the file under "Energy Conservation Program for Consumer Products: Procedures for Consideration of New or Revised Energy Conservation Standards for Consumer Products," RIN [1904–AA83], as document number 96.

DOE held a public meeting on September 23, 2008 to provide interested parties the opportunity to comment on the proposed standards, results of the analyses and the trial standard levels (TSLs).

After the publication of the NOPR and the presentation of the NOPR to interested parties at the public meeting, DOE received more than 100 comments from a diverse set of parties, including manufacturers and their representatives, trade associations, wholesalers and distributors, energy conservation advocates, and electric utilities. Comments addressed DOE methodology, the information DOE used in its analyses, results of and inferences drawn from the analyses, impacts of standards, the merits of the different TSLs, standards options DOE considered and other issues affecting adoption of standards for commercial refrigeration equipment.

DOE considered these comments in developing a final rule for commercial refrigeration equipment, published on January 9, 2009. 74 FR 1092 (herein referred to as the "2009 rulemaking" and the "2009 final rule," respectively). The 2009 rulemaking established standards for ice-cream freezers; self-contained commercial refrigerators, freezers, and refrigerator-freezers without doors; and remote condensing commercial refrigerators, freezers, and refrigerator-freezers, which will become effective in January 1, 2012.

1.4 Current Energy Conservation Standards

Table 1.1 and Table 1.2 show the current standards for the two subsets of commercial refrigeration equipment.

Table 1.1. Commercial Refrigeration Equipment Standards Prescribed by EPCA – Effective January 1, 2010

Category	Maximum daily energy consumption (kilowatt hours per day)
Refrigerators with solid doors	0.10 V + 2.04
Refrigerators with transparent doors	0.12 V + 3.34
Freezers with solid doors	0.40 V + 1.38
Freezers with transparent door	0.75 V + 4.10
Refrigerators/freezers with solid doors	the greater of 0.27 AV - 0.71 or 0.70
Self-contained refrigerators with transparent doors designed for pull-down temperature applications	0.126V + 3.51

Table 1.2. Commercial Refrigeration Equipment Standards Established in the 2009 Final Rule – Effective January 1, 2012

Equipment Class[†]	Standard Level [*,**] *kWh/day*)[***]		Equipment Class	Standard Level [*,**] *kWh/day*
VOP.RC.M	0.82 ×TDA + 4.07		VCT.RC.I	0.66 × TDA + 3.05
SVO.RC.M	0.83 × TDA + 3.18		HCT.RC.M	0.16 × TDA + 0.13
HZO.RC.M	0.35 × TDA + 2.88		HCT.RC.L	0.34 × TDA + 0.26
VOP.RC.L	2.27 × TDA + 6.85		HCT.RC.I	0.4 × TDA + 0.31
HZO.RC.L	0.57 × TDA + 6.88		VCS.RC.M	0.11 × V + 0.26
VCT.RC.M	0.22 × TDA + 1.95		VCS.RC.L	0.23 × V + 0.54
VCT.RC.L	0.56 × TDA + 2.61		VCS.RC.I	0.27 × V + 0.63
SOC.RC.M	0.51 × TDA + 0.11		HCS.RC.M	0.11 × V + 0.26
VOP.SC.M	1.74 × TDA + 4.71		HCS.RC.L	0.23 × V + 0.54
SVO.SC.M	1.73 × TDA + 4.59		HCS.RC.I	0.27 × V + 0.63
HZO.SC.M	0.77 × TDA + 5.55		SOC.RC.L	1.08 × TDA + 0.22
HZO.SC.L	1.92 × TDA + 7.08		SOC.RC.I	1.26 × TDA + 0.26
VCT.SC.I	0.67 × TDA + 3.29		VOP.SC.L	4.37 × TDA + 11.82
VCS.SC.I	0.38 × V + 0.88		VOP.SC.I	5.55 × TDA + 15.02
HCT.SC.I	0.56 × TDA + 0.43		SVO.SC.L	4.34 × TDA + 11.51
SVO.RC.L	2.27 × TDA + 6.85		SVO.SC.I	5.52 × TDA + 14.63
VOP.RC.I	2.89 × TDA + 8.7		HZO.SC.I	2.44 × TDA + 9.
SVO.RC.I	2.89 × TDA + 8.7		SOC.SC.I	1.76 × TDA + 0.36
HZO.RC.I	0.72 × TDA + 8.74		HCS.SC.I	0.38 × V + 0.88

[*] TDA is the total display area of the case, as measured in ARI Standard 1200-2006, Appendix D.
[**] V is the volume of the case, as measured in ARI Standard 1200-2006, Appendix C.
[***] Kilowatt-hours per day.
[†] For this rulemaking, equipment class designations consist of a combination (in sequential order separated by periods) of: (1) an equipment family code (VOP=vertical open, SVO=semivertical open, HZO=horizontal open, VCT=vertical transparent doors, VCS=vertical solid doors, HCT=horizontal transparent doors, HCS=horizontal solid doors, or SOC=service over counter); (2) an operating mode code (RC=remote condensing or SC=self-contained); and (3) a rating temperature code (M=medium temperature (38°Fahrenheit (°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 Table 3.1 and Table 3.2 for more information on equipment class nomenclature.

1.5 Standby Mode and Off Mode Standards

Section 310 of the Energy Independence and Security Act of 2007 (EISA 2007) amended EPCA to define the terms "active mode," "off mode," and "standby mode." "Active mode" is defined as the condition in which an energy-using product is connected to a main power source, has been activated, and provides one or more main functions. "Off mode" is defined as the condition in which an energy-using product is connected to a main power source, and is not providing any standby or active mode function. "Standby mode" is defined as the condition in which an energy-using product is connected to a main power source and offers one or more of the following user-oriented or protective functions: facilitating the activation or deactivation of other functions (including active mode) by remote switch (including remote control), internal sensor, or timer; or providing continuous functions, including information or status displays (including clocks) or sensor-based functions. 42 USC 6295(gg)(1)(A). DOE may by rule amend these definitions after considering the most current versions of certain industry standards. 42 USC 6295(gg)(1)(B).

DOE believes that the "off mode" and "standby mode" conditions of operation do not apply to the equipment covered by this rulemaking because commercial refrigeration equipment, whether in retail, foodservice, or other applications, operates continuously to maintain product at the necessary temperature for safe storage or retailing. DOE welcomes comment on standby and off mode energy consumption as it relates to commercial refrigeration equipment.

1.6 Overview of the Rulemaking Process

1.6.1 Rulemaking Process and Participation of Interested Parties

Under EPCA, any new or amended standards must achieve the maximum achievement in energy efficiency that is technologically feasible and economically justified. In setting any new or amended standards, DOE must consider: (1) the economic impact of the standard on the manufacturers and consumers of the affected products; (2) the savings in operating costs throughout the estimated average life of the product compared to any increases in the initial cost or maintenance expense; (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 products likely to result from the imposition of the standard; (5) the impact of any lessening of competition, as determined in writing by the Attorney General, that is likely to result from the imposition of the standard; (6) the need for national energy conservation; and (7) other factors the Secretary considers relevant. (42 U.S.C. 6295(o)(2)(B)(i) and 42 U.S.C. 6316(e)) As discussed in further detail below, the standards rulemaking process typically involves four public notices that are published in the *Federal Register*, including a notice announcing the availability of the framework document. Publication of the framework document, preliminary analysis, and NOPR are typically accompanied by public meetings to solicit comment from interested parties to enhance the rulemaking process. DOE encourages interested parties to develop and submit joint recommendations and will carefully consider such recommendations in its decision making. Preliminary analysis results could serve as the initial basis for the development of these recommendations. As stated previously, DOE believes that the conduct of the analyses accompanying these notices will support DOE's determination whether to amend the standards, as well as, if the determination is positive, to establish any amended standards.

- *Preliminary Analysis* (section 1.7). The preliminary analysis is designed to publicly vet the models and tools that DOE intends to use in the rulemaking, and to facilitate public participation before the proposed rule stage. Using these models and tools, DOE performs preliminary analyses to assess candidate standard levels (CSLs), which span the range of efficiencies from baseline equipment to the most efficient technology.

- *Notice of Proposed Rulemaking* (section 1.8). The NOPR presents a discussion of comments received in response to the preliminary analysis; DOE's analysis of the impacts of potential standards on consumers, manufacturers, and the Nation; DOE's weighting of these impacts; and any proposed standard levels for public comment.

- *Final Rule* (section 1.9). The final rule presents a discussion of comments received in response to the NOPR, revised analysis, as appropriate, of the impacts of any standards,

DOE's weighting of those impacts, and the standard levels, if any, that DOE is adopting. The final rule also establishes the date for compliance with any standards.

1.6.2 Test Procedures

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," as the DOE test procedure for this equipment. 71 FR 71340, 71369–70; Title 10 of the Code of Federal Regulations (10 CFR) parts 431.63–431.64. 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 -15 °F (±2 °F) for commercial ice-cream freezers. The standard also requires performance tests to be conducted according to the ANSI/American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) Standard 72–2005, "Method of Testing Commercial Refrigerators and Freezers." In the test procedure final rule, DOE also adopted a -15 °F (±2 °F) rating temperature for commercial ice-cream freezers. 71 FR 71370. In addition, DOE adopted ANSI/Association of Home Appliance Manufacturers (AHAM) Standard HRF– 1–2004, "Energy, Performance and Capacity of Household Refrigerators, Refrigerator-Freezers and Freezers," for measuring compartment volumes for this equipment. 71 FR 71369–70. Since the publication of the final rule, AHRI has updated its test procedure, the most recent version of which is AHRI 1200-2008, which includes changes to the equipment class nomenclature used within the test procedure, as well as the method of normalizing equipment energy consumption. These changes aligned the test procedure with the nomenclature and methodology used in the 2009 rulemaking. DOE believes that the aforementioned changes were largely editorial in nature, and would not affect the method of test or other technical aspects of the test procedure.

DOE is considering modifications to its test procedure to better address certain energy efficiency features that currently are not accounted for in the test procedure. Specific possible changes include provision for measuring the impact of lighting sensors and controls, night curtains, and anti-sweat heater controls on commercial refrigeration equipment energy consumption. DOE encourages input on how these technologies could best be addressed in a test procedure rulemaking. DOE will conduct a separate rulemaking process for any modifications to the test procedure.

Item 1-1	*DOE requests comment regarding the development of updated test procedures for the commercial refrigeration equipment covered under this rulemaking.*

1.7 Preliminary Analysis

As part of its initial rulemaking activity, DOE typically identifies equipment technology options and makes a preliminary determination on whether to retain each option for detailed analysis or to eliminate it from further consideration. This process includes a market and technology assessment (section 3.0) and a screening analysis (section 4.0). DOE applies four screening criteria in the screening analysis to determine which technology options to eliminate from further consideration: (1) technological feasibility; (2) practicability to manufacture, install,

and service; (3) adverse impacts on utility or availability; and (4) adverse impacts on health or safety. Technologies that pass through the screening analysis are evaluated, and referred to as design options, in the engineering analysis.

DOE consults with interested parties and independent technical experts, and conducts research into industry literature to identify the key issues and design options or efficiency levels that DOE will consider in the rulemaking. DOE initiates dialogue with interested parties with this framework document, the public meeting following its publication, and the request for public comment. This dialogue also provides an opportunity for input into the structural and analytical approach planned for this energy conservation standards rulemaking.

At the start of the preliminary analysis, DOE considers design options or efficiency levels for each equipment class. DOE uses these design options or efficiency levels to collect manufacturer cost data, historical shipment data, shipment-weighted average efficiency data, and preliminary manufacturer impact data (*e.g.*, capital conversion expenditures, marketing costs, and research and development costs). Concurrent with the preliminary analysis, DOE also conducts other principal analyses, including: (1) the engineering analysis (section 5.0); (2) the consumer LCC and PBP analyses (section 8.0); (3) the NIA, which considers NES and consumer NPV (section 10.0); and (4) a preliminary MIA (section 12.0). DOE will present the results of these analyses in the preliminary analysis technical support document (TSD).

DOE selects CSLs from the energy efficiency or energy use levels considered in the preliminary analysis. Discussion of various CSLs in the preliminary analysis will help interested parties review the spreadsheet models that underpin the analyses. DOE will use interested parties' comments to refine the models for the next stage of the rulemaking analyses. In addition to the efficiency corresponding to the maximum technologically feasible ("max-tech") design and the efficiency corresponding to the minimum LCC point, DOE generally considers levels or design options that span the full range of technologically-achievable efficiencies. The range of levels DOE typically analyzes includes:

- The baseline efficiency level (*i.e.*, the minimum level), which is typically the type of equipment with the lowest energy efficiency level on the market for a given category. For equipment categories where minimum energy conservation standards already exist, the baseline efficiency level is typically defined by the existing energy conservation standard;

- The level with the minimum LCC or greatest LCC savings;

- The highest energy efficiency level or lowest energy consumption level that is technologically feasible (*i.e.*, max-tech); and

- Levels that incorporate noteworthy technologies or fill in large gaps between other efficiency levels considered.

At the preliminary analysis stage, DOE uses analytical models and tools to assess the different equipment classes at each efficiency or energy use level analyzed. Many of these analytical models and tools are in the form of spreadsheets, which are used to conduct the LCC

and PBP analyses and to determine the national energy savings and NPV of prospective standards.

DOE will make the spreadsheet tools and results of the preliminary analysis available on its website for review.[3] When it publishes the preliminary analysis, DOE will also make a preliminary TSD available containing the details of all the analyses performed to date. After publication of the preliminary analysis, DOE will provide a public comment period and hold one public meeting.

1.8 Notice of Proposed Rulemaking

In developing the NOPR, DOE will consider all the comments it received after publication of the preliminary analysis. This process may result in revisions to the preliminary analysis, including the engineering and LCC analyses. At this point, DOE will conduct additional economic and environmental impact analyses. These analyses generally include a consumer LCC subgroup analysis (section 11.0), a complete MIA (section 12.0), a utility impact analysis (section 13.0), an employment impact analysis (section 14.0), an environmental assessment (section 15.0), and an RIA (section 17.0).

DOE will describe the methodology used and make the results of all the analyses available on its website for review. Based on comments from interested parties, further revisions to the analysis may be made. This analytical process ends with the selection of proposed standard levels, if any, that DOE will present in the NOPR. DOE selects the proposed standard levels from the TSLs analyzed during the NOPR phase of the rulemaking. The NOPR, published in the *Federal Register*, will document the evaluation and selection of any proposed standards levels, along with a discussion of other TSLs considered but not selected and the reasons DOE did not select them.

For each equipment class, DOE will identify the max-tech efficiency level. If DOE proposes a lower level, DOE will sequentially explain the reasons for eliminating higher levels, beginning with the highest level considered. DOE will present the analytical results in the NOPR, and provide the details of the analysis in an accompanying TSD.

DOE considers many factors in selecting proposed standards. These factors are contained in EPCA and take into consideration the benefits, costs, and impacts of energy conservation standards.

When DOE publishes the NOPR, it will provide the U.S. Department of Justice (DOJ) with copies of the NOPR and TSD to solicit feedback on the impact of any proposed standard levels on competition in the commercial refrigeration industry. DOJ reviews standard levels in light of any lessening of competition likely to result from the imposition of such standards (42

[3] All materials associated with the rulemakings for commercial refrigeration equipment test procedures and energy conservation standards are available on DOE's website at: http://www1.eere.energy.gov/buildings/appliance_standards/commercial/refrigeration_equipment.html

U.S.C. 6295(o)(2)(B)(i)(V) and (B)(ii)) Publication of the NOPR will be followed by a public comment period that includes a public meeting.

1.9 Final Rule

After publication of the NOPR, DOE will consider public comments it receives on the proposal and accompanying analyses. DOE will review the engineering and economic impact analyses and any proposed standards based on these comments and consider modifications where necessary. Before any final rule is issued, DOE also will consider DOJ comments on the NOPR relating to the impacts of any proposed standard levels on competition to determine whether changes to these standard levels are needed. DOE will publish the DOJ comments and DOE's response as part of the final rule.

In any final rule, DOE would determine whether to amend the standards, and if such determination is positive, would select the final standard level based on the complete record of the standards rulemaking. The final rule would promulgate any final standard levels and the compliance date, and would also explain the basis for the selection of any final standard levels. The final rule would be accompanied by a final TSD.

1.10 Overview of Commercial Refrigeration Equipment

The commercial refrigeration equipment covered under this rulemaking consists of four categories of equipment:

1. Ice-cream freezers;
2. Self-contained commercial refrigerators, freezers, and refrigerator-freezers (with and without doors);
3. Remote condensing commercial refrigerators, freezers, and refrigerator-freezers; and
4. Self-contained commercial refrigerators with transparent doors designed for pull-down temperature applications.

These four categories of equipment are discussed in sections 1.10.1, 1.10.2, 1.10.3, and 1.10.4.

1.10.1 Ice-Cream Freezers

"Ice-cream freezer" means "a commercial freezer that is designed to operate at or below -5 °F (-21 °Celsius (°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.

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 comments DOE received during the 2009 rulemaking, which indicated that DOE should not classify such freezers as ice-cream freezers. 74 FR 1103. 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 interested parties 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 below -5 °F.

1.10.2 Self-Contained Commercial Refrigerators, Freezers, and Refrigerator-Freezers

EPCA defines a “self-contained condensing unit,” in part, as “an integral part of the refrigerated equipment”. Under the definitions quoted in section 1.2, a self-contained commercial refrigerator, freezer, or refrigerator-freezer is a category of commercial refrigeration equipment that is connected to a self-contained condensing unit. Self-contained commercial refrigeration equipment is primarily used in small to medium-size grocery and similar retail stores (as distinguished from supermarkets), restaurants and hotels, and in cafeteria-style food service venues, for storing, displaying, and/or merchandising food products that include delicatessen items, eggs, meat, produce, seafood, prepared foods, beverages, frozen foods, and dairy items.

For self-contained commercial refrigerators, freezers, and refrigerator-freezers with doors, EPACT 2005 prescribed energy conservation standards. For self-contained commercial refrigerators, freezers, and refrigerator-freezers without doors, DOE established energy conservation standards in the 2009 final rule, specifying allowable daily electrical energy consumption levels as a function of total display area.

1.10.3 Remote Condensing Commercial Refrigerators, Freezers, and Refrigerator-Freezers

Under the definitions quoted in section 1.2, a remote condensing refrigerator, freezer, or refrigerator-freezer is a type of commercial refrigeration equipment that is connected to a remote condensing unit. Remote condensing commercial refrigeration equipment is generally used to display and merchandise supermarket goods in large scale installations. In addition, remote condensing equipment with doors is used for food storage in commercial locations where food is prepared and/or served.

EPCA defines a “remote condensing unit,” in part, as being “remotely-located from the refrigerated equipment.” (42 U.S.C. 6311(9)(F)) DOE concluded during the 2009 rulemaking that the difference in language from the definition of “self-contained condensing unit,” described above means that a remote condensing unit is not a part of the refrigerated equipment. 74 FR 1104–1105. Therefore in the 2009 final rule DOE adopted energy conservation standards for remote condensing commercial refrigerators, freezers, and refrigerator-freezers that apply to the refrigerated equipment, but not to the remote condensing unit.

1.10.4 Self-Contained Commercial Refrigerators Designed for Pull-Down Temperature Applications

As stated in section 1.2, EPCA defines “pull-down temperature application” to mean “a commercial refrigerator with doors that, when fully loaded with 12 ounce beverage cans at 90 degrees 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)) Units fitting this description are most typically known as beverage merchandisers or beverage coolers because of their use in displaying individually

packaged beverages for sale. EPCA prescribed standards for such equipment, and specifically only for self-contained units with transparent doors. (42 U.S.C. 6313(c)(3)) Correspondingly, DOE intends to keep this equipment as a separate class in this rulemaking. Additionally, DOE notes that EPCA does not currently contain a standard for self-contained commercial refrigerators for pull-down temperature applications with solid doors. DOE requests input on how to address this subject.

Item 1-2	*DOE seeks comment on the existence and/or prevalence of self-contained commercial refrigerators for pull-down temperature applications with doors other than transparent doors.*

1.11 Other Equipment Classification Issues

1.11.1 Niche Equipment

EPCA prescribed standards for self-contained equipment with doors based on the refrigerated volume of the unit. In the 2009 final rule, DOE developed standards for remote-condensing equipment with transparent doors based on the total display area of the unit and standards for remote-condensing equipment with solid doors based on the refrigerated volume of the unit. Manufacturers contend that for service over counter niche equipment covered by the ECPA standards, energy consumption should be calculated based on total display area, similar to the calculations for equipment with transparent doors covered by DOE's 2009 final rule.

DOE is interested in receiving comments from interested parties regarding issues pertaining specifically to the niche equipment.

Item 1-3	*DOE seeks comment on issues relating to the treatment of niche equipment under EPCA.*

1.11.2 Secondary Coolant Applications

In supermarket applications, secondary-coolant systems differ from direct-expansion systems in that the refrigeration of display cases is provided by a chilled, secondary-fluid, which is pumped between the central refrigeration system and the refrigerated display cases. The secondary coolant transfers heat from the display cases to the central refrigeration system, where the refrigeration cycle associated with liquid chilling occurs. By contrast, in direct expansion systems, liquid refrigerant is piped directly to each refrigerated display case, evaporated to produce cooling, then the resulting vapor is piped back to the central compressor system, completing the refrigeration cycle. DOE understands that these secondary coolant systems represent a small amount, at most 10 percent, of the commercial refrigeration market. 73 FR 50106.

In the 2009 rulemaking, DOE concluded the language in item (vii) of the EPCA definition for "commercial refrigerator, freezer, and refrigerator-freezer" (42 U.S.C. 6311(9)(A)(vii)) precluded coverage of secondary-coolant applications under that rulemaking. 72

FR 41171-41172. DOE concluded that this interpretation of EPCA is consistent with AHRI Standard 1200-2008, "Performance Rating of Commercial Refrigerated Display Merchandisers and Storage Cabinets," which explicitly excludes secondary-coolant applications. Therefore, DOE does not consider secondary coolant systems to be within the scope of this rulemaking.

2.0 ANALYSES FOR RULEMAKING

The purpose of the analyses is to support DOE's determination whether to amend the energy conservation standards for commercial refrigeration equipment, and if so to ensure that DOE selects standards that achieve the maximum improvement in energy efficiency that is technologically feasible and economically justified and will result in significant energy savings, as required by EPCA. Economic justification includes the consideration of the factors set forth in EPCA (see section 1.6.1 of this framework document), which encompass economic impacts on domestic manufacturers and consumers, national benefits including environmental impacts, issues of consumer utility, and impacts from any lessening of competition.

Figure 2.1 summarizes the analytical components of the DOE standards-setting process. The analyses are presented in the center column. Each analysis has a set of key inputs, which are data and information required for the analysis. "Approaches" are the methods that DOE will use to obtain key inputs, which may vary depending on the information in question. Some key inputs exist in public databases. DOE will also collect information from interested parties or others with special knowledge and develop information independently in support of the rulemaking. The results of each analysis are key outputs, which feed directly into the rulemaking. Arrows indicate the flow of information between the various analyses. DOE ensures a consistent approach to its analyses throughout the rulemaking by considering each analysis as a part of the overall standard-setting framework.

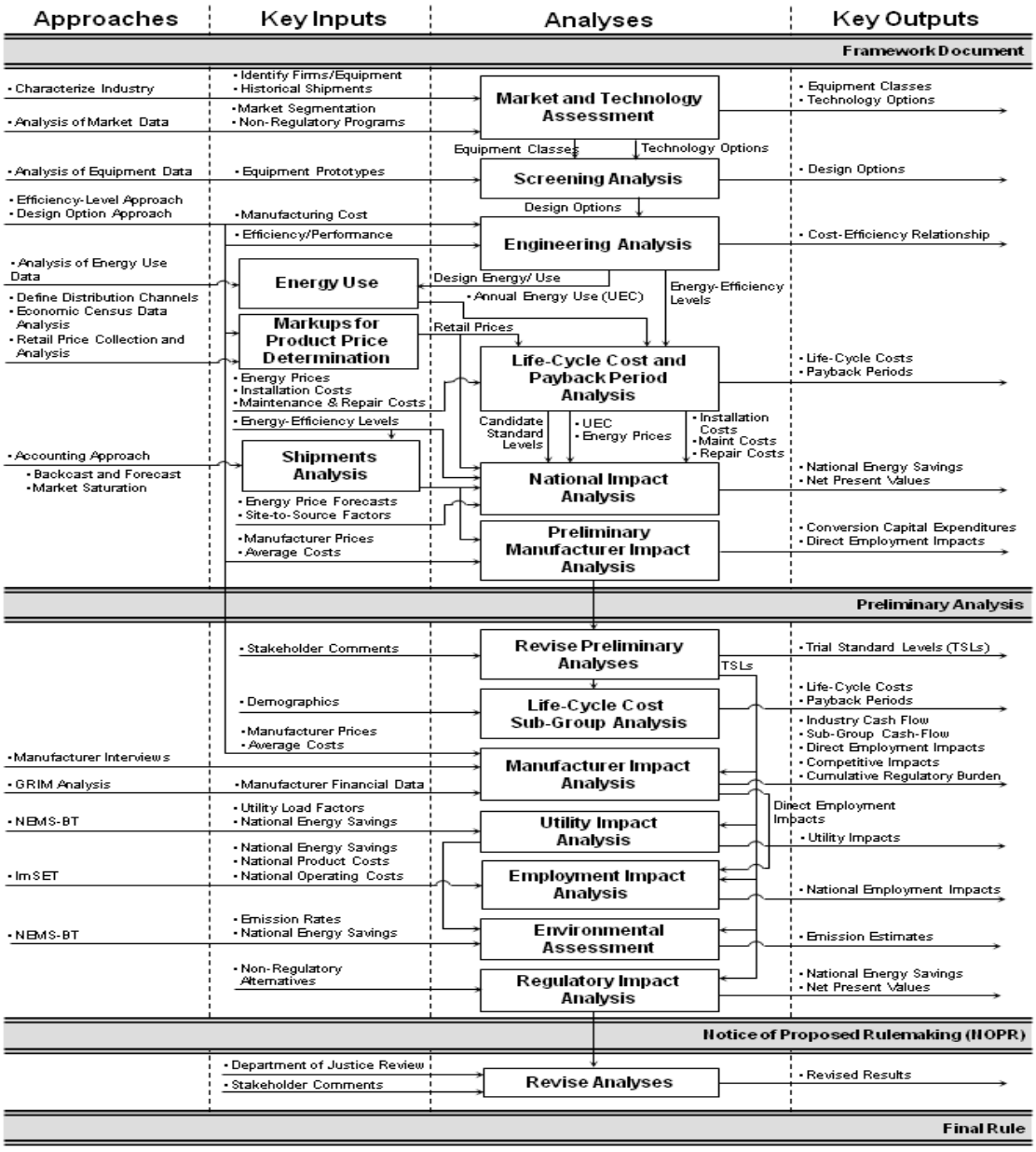

Figure 2.1. Flow Diagram of Analyses for the Commercial Refrigeration Equipment Standards Rulemaking Process

3.0 MARKET AND TECHNOLOGY ASSESSMENT

The market and technology assessment will provide information about the commercial refrigeration industry that DOE will use throughout the rulemaking. This assessment is particularly important at the outset of the rulemaking to determine equipment classes and to identify potential design options or efficiency levels for each equipment class.

3.1 Market Assessment

DOE will qualitatively and quantitatively characterize the structure of the commercial refrigeration industry and market. In the market assessment, DOE will identify and characterize the manufacturers of this equipment; estimate market shares and trends in the market; address regulatory and non-regulatory initiatives intended to improve the energy efficiency or reduce the energy consumption of the commercial refrigeration equipment covered under this rulemaking; and explore the potential for technological improvements in the design and manufacture of such equipment.

This market assessment will establish the context for this rulemaking, and it will serve as a resource to guide the analyses that follow. For example, DOE may use historical shipments and prices as indicators of future shipments and prices. Similarly, DOE plans to use market structure data for the MIA, data that will be particularly useful for assessing competitive impacts. This phase also allows DOE to start updating design options by reviewing equipment literature and industry publications.

The Commercial Refrigeration Manufacturers Division of AHRI is the trade association for manufacturers of equipment covered under this rulemaking. DOE expects that AHRI will play a critical role in providing market information, including input on characterizing current and historical trends in equipment shipments and energy efficiency. This type of data is an important input for analyses that determine whether any amended energy conservation standards are economically justified and will result in significant energy savings.

DOE encourages interested parties to submit data that will improve DOE's understanding of the commercial refrigeration equipment market. DOE aggregates data provided by manufacturers and other organizations for use in its analyses.

Item 3-1	*DOE seeks information that would contribute to the market assessment (*e.g.*, the manufacturers of this equipment in the United States and the equipment they sell, by equipment class). It is particularly important that DOE be aware of the major and small/niche manufacturers.*
Item 3-2	*DOE seeks information on annual shipments into the U.S. market from 1995 to 2010 (both domestic and imports) by equipment class, and the corresponding shipment-weighted average efficiency of these shipments.*
Item 3-3	*DOE seeks information on the proportion(s) of equipment shipped annually that replaces existing equipment.*

3.2 Equipment Classes

DOE separates the commercial refrigeration equipment covered under this rulemaking into equipment classes (Table 3.1 and Table 3.2). The criteria for separation into different classes are type of energy used and capacity or other performance-related features that justify the establishment of a separate energy conservation standard. DOE must consider such factors as

utility to the consumer or others deemed appropriate in setting standards for separate equipment classes. (42 U.S.C. 6295(q) and 6316(e).

DOE is considering the equipment classes listed below in Table 3.1 and Table 3.2. These classes are defined according to equipment category, condensing unit configuration, operating temperature, and orientation and type of doors. DOE developed the proposed classes in the 2009 rulemaking, which included equipment class designations for equipment for which EPCA had prescribed standards and the equipment covered by that rulemaking. 73 FR 50072, 50082-83 (Aug. 25, 2008).

Table 3.1. Commercial Refrigeration Equipment Classes Established in the 2009 Final Rule

Equipment Category	Condensing Unit Configuration	Equipment Family	Operating Temperature *°F*	Equipment Class Designation
Remote Condensing Commercial Refrigerators, Commercial Freezers, and Commercial Refrigerator-Freezers*	Remote	Vertical Open	≥ 32	VOP.RC.M
			< 32	VOP.RC.L
		Semivertical Open	≥ 32	SVO.RC.M
			< 32	SVO.RC.L
		Horizontal Open	≥ 32	HZO.RC.M
			< 32	HZO.RC.L
		Vertical Closed Transparent	≥ 32	VCT.RC.M
			< 32	VCT.RC.L
		Horizontal Closed Transparent	≥ 32	HCT.RC.M
			< 32	HCT.RC.L
		Vertical Closed Solid	≥ 32	VCS.RC.M
			< 32	VCS.RC.L
		Horizontal Closed Solid	≥ 32	HCS.RC.M
			< 32	HCS.RC.L
		Service Over Counter	≥ 32	SOC.RC.M
			< 32	SOC.RC.L
Self-Contained Commercial Refrigerators, Commercial Freezers, and Commercial Refrigerator-Freezers* without Doors	Self-Contained	Vertical Open	≥ 32	VOP.SC.M
			< 32	VOP.SC.L
		Semivertical Open	≥ 32	SVO.SC.M
			< 32	SVO.SC.L
		Horizontal Open	≥ 32	HZO.SC.M
			< 32	HZO.SC.L
Commercial Ice-Cream Freezers	Remote	Vertical Open	≤ -5	VOP.RC.I
		Semivertical Open		SVO.RC.I
		Horizontal Open		HZO.RC.I
		Vertical Closed Transparent		VCT.RC.I
		Horizontal Closed Transparent		HCT.RC.I
		Vertical Closed Solid		VCS.RC.I
		Horizontal Closed Solid		HCS.RC.I
		Service Over Counter		SOC.RC.I
	Self-Contained	Vertical Open		VOP.SC.I
		Semivertical Open		SVO.SC.I
		Horizontal Open		HZO.SC.I
		Vertical Closed Transparent		VCT.SC.I
		Horizontal Closed Transparent		HCT.SC.I
		Vertical Closed Solid		VCS.SC.I
		Horizontal Closed Solid		HCS.SC.I
		Service Over Counter		SOC.SC.I

*While DOE did not establish separate equipment classes for refrigerator-freezers in the 2009 final rule, DOE did provide a methodology for applying standards to commercial refrigerator-freezers in the rule. Please see 10 CFR 431.66.

Table 3.2. Proposed Classes for Commercial Refrigeration Equipment for which Standards were Prescribed by EPCA

Equipment Category	Condensing Unit Configuration	Equipment Family	Operating Temperature °F	Equipment Class Designation
Commercial Refrigerators, Commercial Freezers, and Commercial Refrigerator-Freezers With Doors	Self-Contained	Vertical Closed Transparent	≥ 32	VCT.SC.M
			< 32	VCT.SC.L
		Horizontal Closed Transparent	≥ 32	HCT.SC.M
			< 32	HCT.SC.L
		Vertical Closed Solid	≥ 32	VCS.SC.M
			< 32	VCS.SC.L
		Horizontal Closed Solid	≥ 32	HCS.SC.M
			< 32	HCS.SC.L
		Service Over Counter	≥ 32	SOC.SC.M
			< 32	SOC.SC.L
Commercial Refrigerators with Transparent Doors for Pull-Down Temperature Applications*	Self-Contained	Pull-Down	≥ 32	PD.SC.M

*For further discussion of equipment for pull-down temperature applications, please see section 1.10.4.

Item 3-4 DOE requests feedback on the proposed classes for the commercial refrigeration equipment covered under this rulemaking, and the criteria used in creating the classes.

3.3 Technology Assessment

The technology assessment centers on understanding how equipment uses energy and what measures can reduce energy consumption of commercial refrigeration equipment. Measures that could potentially improve the energy efficiency of equipment are called technology options, and they are based on existing technologies as well as prototype designs and concepts. In consultation with interested parties, DOE intends to develop a list of technology options that should be considered in the analysis.

DOE is studying technology options by reviewing manufacturer catalogues, recent trade publications, technical journals, and patent filings. DOE also intends to consult with technical experts within the field and to conduct manufacturer interviews about these technology options. For the preliminary analysis, DOE is currently considering the specific technologies and designs listed below.

The following technologies and designs are relevant to all of the equipment classes listed above:

1. Higher efficiency lighting (*e.g.*, T8 fluorescent lamps, light-emitting diodes (LEDs), fiber optic lighting);

2. Higher efficiency lighting ballasts (*e.g.*, electronic ballasts instead of magnetic ballasts);

3. Remote lighting ballast location (*i.e.*, outside the refrigerated space);

4. Higher efficiency expansion valves (*e.g.*, dual-port thermostatic expansion valves and electronic expansion valves);

5. Higher efficiency evaporator fan motors (*e.g.*, electronically commutated motors (ECMs));

6. Variable-speed evaporator fan motors;

7. Increased evaporator surface area or efficiency to achieve lower case-evaporator temperature differential (with a possible increase in fan energy);

8. Evaporator-fan-motor controllers;

9. Higher efficiency evaporator fan blades;

10. Low-pressure-differential evaporators;

11. Anti-sweat heater controls;

12. Case-insulation increases or improvements;

13. Defrost mechanism (hot-gas defrost rather than electric defrost);

14. Defrost-cycle control (partially or fully demand-based defrost rather than partially or fully time-based defrost);

15. Anti-fog films on transparent doors; and

16. Occupancy sensors for lighting controls.

The following designs are relevant to equipment without doors only:

1. Air curtain design (optimization of the discharge air grille (DAG) configuration and velocity profile to minimize ambient air infiltration);

2. Night curtains placed over open cases during non-business hours to aid in maintaining product temperature;

3. Strip curtains; and

4. Radiation shields.

The following technologies and designs are relevant to self-contained equipment only:

1. Higher efficiency compressors (*e.g.*, variable-speed compressors);

2. Liquid-to-suction heat exchanger (subcool liquid refrigerant with suction line);

3. Increased condenser surface area or efficiency to achieve lower ambient-condenser temperature differential (with a possible increase in fan energy);

4. Higher efficiency condenser fan motors (*e.g.*, ECMs);

5. Variable-speed condenser fan motors.

6. Condenser-fan-motor controllers; and

7. Higher efficiency condenser fan blades.

Item 3-5	*What technologies or designs, if any, should be added to or removed from the above list? If certain changes to the list are not applicable to all equipment classes, what equipment classes are affected?*

3.4 Baseline Units

Once DOE establishes equipment classes, it will select a baseline model as a reference point for each class, against which it can measure changes resulting from amended energy conservation standards. The baseline model in each class represents the characteristics of equipment in that class. For equipment covered by the 2009 final rule, DOE will select baseline models that are minimally compliant with the required energy conservation standards set forth in that final rule. For equipment classes for which EPCA prescribed standards, DOE will use models that are minimally compliant with these standards as the baseline units.

DOE will use the baseline models in the engineering analysis and may also use them in the LCC and PBP analyses. To determine energy savings and changes in price, DOE will compare each higher-energyefficiency or lower-energy-consumption design option with the baseline model.

Item 3-6	*DOE seeks information on what particular components and features characterize the baseline model in each equipment class (*e.g.*, materials, dimensions, insulation, refrigerant type, compressors, evaporators, condensers, expansion devices, fans, motors, air-curtains, anti-condensate devices and controls, defrost mechanisms and controls, lighting, etc.).*

4.0 SCREENING ANALYSIS

The purpose of the screening analysis is to screen out technology options that will not be further analyzed in the engineering analysis. DOE will follow the process set forth below to screen out technology options.

DOE will use the list of technology options (developed through its own research and in consultation with interested parties in the technology assessment) for consideration in the engineering analysis (section 5.0). DOE will review each technology option or best available technology in light of the following four criteria:

1. *Technological feasibility*. DOE will screen out technologies that are not incorporated in commercially available products or working prototypes.

2. *Practicability to manufacture, install, and service*. If DOE determines that mass production of a technology in commercial products and reliable installation and servicing of the technology could not be achieved on the scale necessary to serve the relevant market by the time of the effective date of the standard, it will not consider that technology further.

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

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

DOE will fully document its reasons for eliminating any technology options during the screening analysis and will publish this documentation for interested parties to review as part of the preliminary analysis. Those technology options not screened out by the above four criteria will be considered design options in the development of cost-efficiency curves in the engineering analysis.

Item 4-1	*DOE welcomes comments on how the above four screening criteria might apply to any additional technology option(s) that an interested party recommends to DOE.*

5.0 ENGINEERING ANALYSIS

After conducting the screening analysis, DOE performs an engineering analysis based on the remaining design options. The engineering analysis consists of estimating the costs of equipment at various levels of increased energy efficiency or reduced energy consumption. This section provides an overview of the engineering analysis (section 5.1), and includes discussion of (1) the approach for determining the cost-efficiency relationship (section 5.2), (2) manufacturer prices (section 5.3), (3) proprietary designs (section 5.4), and (4) regulatory changes outside the realm of DOE's energy conservation standards process (section 5.9).

5.1 Engineering Analysis Overview

The purpose of the engineering analysis is to determine the relationship between manufacturer selling price and energy consumption for commercial refrigeration equipment. In determining this relationship, DOE will estimate the increase in manufacturer selling price associated with technological changes that decrease the energy consumption of the baseline models.

DOE will obtain cost estimates for the engineering analysis (which it will also use in the MIA) from detailed incremental cost data disaggregated into the cost of incremental material, labor, and overhead. DOE will create an industry-wide analysis based primarily on cost estimates of specific design options.

Therefore, DOE seeks design and cost information to determine the cost of improving the energy consumption of the baseline models. In addition, DOE must identify the model with the lowest energy consumption that is technologically feasible within each equipment class (*i.e.*, the "max-tech" model).

Item 5-1	*Within each equipment class, for energy consumption levels below the baseline DOE seeks information on daily energy consumption and on incremental manufacturing costs and components (see Item 3-6) (*e.g.*, differentiation in components from the baseline, material costs,[4] labor costs,[5] factory overhead costs[6] (excluding depreciation), building conversion capital expenditures, tooling/equipment conversion capital expenditures, research and development (R&D) expenses, marketing expenses, etc.).*
Item 5-2	*DOE is also interested in receiving equipment test data (*e.g.*, test procedure used, rating conditions, refrigerated volume, total display area, case length, voltage, integrated average product temperature, daily energy consumption, etc.). Test data representative of the baseline model in each equipment class is particularly important.*

5.2 Proposed Approach for Determining the Cost-Efficiency Relationship

DOE typically structures its engineering analysis using one of three approaches: (1) design-option; (2) efficiency-level; or (3) reverse-engineering (or cost-assessment). A design-option approach uses individual design options, or combinations of design options, to identify increases in efficiency. Under this approach, cost estimates are based on manufacturer or component supplier data or engineering computer simulation models. Individual design options, or combinations of design options, are added to the baseline model in ascending order of cost-effectiveness. 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 manufacturer cost data for incremental increases in efficiency, without identifying the technology or design options they would use to achieve such

[4] This consists of costs of raw materials including scrap that can be traced to final or end products. Direct material costs do not include indirect material costs which are attributed to supplies that may be used in the production process but not incorporated into final products (*e.g.*, lubricating oil for production machinery).

[5] This refers to earnings of workers who assemble parts into a finished good or operate machines in the production process. Direct labor includes the fringe benefits of direct laborers such as group health care, as well as overtime pay. Direct labor does not include indirect labor which is defined as the earnings of employees who do not work directly in assembling a product such as supervisors, janitors, stockroom personnel, inspectors, and forklift operators.

[6] Factory overhead includes indirect labor, downtime, set-up costs, indirect material, expendable tools, maintenance, property taxes, insurance on assets, and utility costs. Factory overhead does not include depreciation, (SG&A); R&D; interest; or profit (accounted for by DOE separately).

increases. A reverse-engineering or cost-assessment approach involves purchasing representative units of commercial refrigeration equipment, disassembling the units, and reverse-engineering the manufacturing costs based on a "bottoms-up" manufacturing cost assessment.

In the 2009 rulemaking, DOE originally proposed to use an efficiency level approach. DOE planned to utilize a number of cost-efficiency curves provided by a trade association (ARI), representing the equipment classes with the highest volumes of shipments. This approach was to be augmented by a number of additional curves for other equipment classes, developed by DOE using a design-option approach. During the rulemaking, concerns developed over whether the industry-supplied data provided a sufficient basis for DOE's engineering analysis. ARI stated that the intent of providing the curves was only to validate analyses performed by DOE, rather than to serve as the basis for the analyses themselves. ARI also stated that the aggregated data provided may not have been sufficient in order to completely and fully describe the range of equipment available within the industry. As a result of these concerns, DOE modified its analyses for the NOPR stage of the rulemaking to use its own design option methodology for the engineering analysis, rather than cost-efficiency curves provided by ARI. This approach was also used as a basis for the 2009 final rule. 73 FR 50084.

Similarly, for this rulemaking, DOE plans to use a design-option approach for determining the cost-efficiency relationship.. This approach will involve consultation with outside experts, review of publicly available cost and performance information, and modeling of equipment cost and energy consumption.

For each equipment class, the engineering analysis will estimate manufacturer production cost (MPC) for each design option considered. DOE plans to use a cost model to estimate the cost of the case, refrigeration system (when applicable), and other energy-consuming components. This cost model was developed for the 2009 rulemaking.

Item 5-3	*DOE requests feedback on the use of a design option approach to determine the relationship between manufacturer selling price and energy consumption for commercial refrigeration equipment.*

5.3 Manufacturer Prices

DOE plans to apply markups to convert MPC to manufacturer selling prices. DOE will estimate manufacturer markups from publicly available financial information (*e.g.*, Securities and Exchange Commission 10-K reports).

Item 5-4	*DOE seeks comment on the markup approach proposed for developing estimates of manufacturer selling prices.*

5.4 Proprietary Designs

DOE considers in its engineering and economic analyses all design options that have not been screened out, including proprietary designs. DOE will consider proprietary designs in the analyses only if they are not part of a unique path to a given efficiency level. If the proprietary

design is the only approach available to achieve a given efficiency level, then DOE will reject that efficiency level from further analysis. Further, DOE is sensitive to manufacturer concerns regarding proprietary designs and will make provisions to maintain the confidentiality of any proprietary data submitted by manufacturers consistent with applicable law. This information will provide input to the competitive impacts assessment and other economic analyses.

Item 5-5 *Are there proprietary designs that DOE should consider for any of the equipment under consideration by this rulemaking? If so, how should DOE acquire the cost data necessary for evaluating these designs?*

5.5 Representative Sizes

In performing the engineering analysis, DOE will select equipment models from the range of available equipment with sizes that best represent the most typical offerings within that specific equipment class. Proper selection of representative sizes will allow for the analyses to accurately model the majority of available equipment. DOE plans to select a model with representative size for each equipment class, while considering the possible design constraints at very small and very large capacities. DOE plans to use the representative sizes it used in developing the 2009 final rule, shown in Table 5.1, as starting values for the engineering analysis in this rulemaking.

Table 5.1. Representative Equipment Sizes Used in 2009 Final Rule Engineering Analysis

Equipment Class	Case Length *ft*	Case Gross Refrigerated Volume ft^3	Case Total Display Area ft^2
VCT.RC.L	12.7	113.5	65.0
VOP.RC.M	12.0	130.2	53.3
SVO.RC.M	12.0	46.6	40.0
HZO.RC.L	12.0	55.0	46.0
HZO.RC.M	12.0	33.0	33.0
VCT.RC.M	12.7	142.0	65.0
VOP.RC.L	12.0	109.8	44.7
SOC.RC.M	12.0	66.0	51.0
VOP.SC.M	4.0	32.0	14.9
SVO.SC.M	4.0	9.4	12.8
HZO.SC.L	4.0	7.4	12.0
HZO.SC.M	4.0	7.5	12.0
HCT.SC.I	3.4	10.2	5.1
VCT.SC.I	4.3	48.0	26.0
VCS.SC.I	4.3	48.0	0.0

Item 5-6 *DOE requests feedback on representative sizes. Are the representative sizes used for the 2009 final rule adequate, and should they be retained or modified? What representative sizes should DOE use for analysis of the equipment for which EPCA prescribed standards?*

5.6 Normalization Metrics

Some of the equipment covered by this rulemaking is currently subject to standards developed by DOE in the 2009 final rule, while the remainder of the equipment is currently covered by standards set forth in EPCA. These two sets of standards use two different normalization metrics to quantify daily energy consumption. The standards EPCA prescribed are based on a normalization metric of chilled or frozen compartment volume (as measured with AHAM Standard HRF1-1979). This is true whether the equipment has transparent or opaque doors. The standards developed in the 2009 rulemaking, however, are largely based on a normalization metric of total display area (TDA), for equipment both without doors and with transparent doors, because this metric better reflects the effects of warm air infiltration and lighting in open display cases, as well as infiltration, lighting, and door heat gains (conduction and infiltration) in equipment with transparent doors. The standards developed in the 2009 rulemaking for equipment with no display area (*i.e.*, units with solid doors) are based on volume.

Because this rulemaking addresses equipment subject to both the DOE-developed and the EPCA standards, DOE is considering whether to use the same normalization metric for certain like product classes where it makes sense to do so. In particular, DOE considers that TDA could be used for all equipment types with transparent doors. In doing this however, DOE would have to develop a conversion from the existing volume-based normalization metric to a TDA-based normalization metric for baseline equipment in order to translate the existing standards into terms of the new normalization metric. Such a conversion would need to be fair and accurate across the entire range of equipment to which it would be applied. Additionally, certain existing equipment classes could potentially be subdivided further to develop an accurate mapping between metrics for baseline units. This could occur because use of the TDA metric for certain additional classes of equipment might demonstrate to DOE that distinctions exist among equipment designs that currently are in a single class, such as the service-over-counter and under-counter self contained niche products discussed previously section 1.11.1, and that separate classes are warranted for such equipment.

Item 5-7	*DOE requests feedback on the use of total display area as a normalization metric for all equipment with transparent doors.*
Item 5-8	*DOE requests feedback on the selection of a representative baseline for use in mapping between the existing volume metric and a total display area metric, as well as on the methodology needed to translate baseline energy use between the two metrics.*
Item 5-9	*DOE requests feedback regarding specific equipment classes which may need to be subdivided, or equipment categories which may need their own equipment classes, should revised normalization metrics be used in this rulemaking.*

5.7 Offset Factors

The energy use of commercial refrigeration equipment scales with equipment size, but smaller equipment tends to use more energy per unit of capacity than larger equipment of the

same design. This extra energy use is attributed to components of case load, commonly referred to as "end effects," that do not scale proportionally with equipment size, whether the metric is in terms of volume or TDA, and thus have a disproportionate effect on the energy consumption of small equipment.

In its engineering analysis for the 2009 rulemaking, DOE developed cost-energy consumption curves for a single size within each equipment class. For the remote condensing equipment in particular, the representative size selected for each class was generally nearer to the larger end of the equipment available within that class and reflected the most common equipment sizes sold. In the ANOPR public meeting for the 2009 rulemaking, interested parties raised concerns that standards developed for large sizes of equipment would be unfair when applied to smaller equipment in the same class, because of the end effects that disproportionately affect smaller equipment. In the NOPR, therefore, DOE developed offset factors and incorporated them into the equations for the proposed standard level and TSL for each product class. These offset factors are used to fix the energy consumption at a finite, non-zero value when the normalization metric goes to zero in the standards equation, effectively providing a proportionally higher limit on energy consumption for smaller equipment. DOE retained these offset factors in the 2009 final rule, as a way to adjust the energy consumption requirements to make them more equitable for smaller equipment. Similar factors exist in the standards incorporated into EPCA in 2005.

For this rulemaking, DOE intends to continue the use of offset factors as a method for compensating for the inherent relative inefficiency of smaller-capacity equipment.

Item 5-10 DOE welcomes data from interested parties that could aid in accurately quantifying the impact of end effects on smaller equipment.

5.8 Extension of Standards

For the 2009 final rule, DOE did not directly analyze all covered equipment classes but focused its engineering, LCC, and impact analyses on 15 high-shipment equipment classes, which represented 98 percent of the shipments of covered commercial refrigeration equipment. Once DOE established TSLs for these classes, it developed an extension approach to apply the TSLs developed for these 15 "primary" classes to the remaining 23 "secondary" classes. This approach involved extension multipliers developed with the 15 sets of primary results and a set of focused matched-pair analyses. In addition, standards for certain primary equipment classes could be directly applied to other similar secondary equipment classes.

In the NOPR, TSLs were presented for each of the 15 primary equipment classes in the form of standards equations that used the selected normalization metrics. DOE examined the relationships between similar primary and secondary equipment types and developed multipliers based on these relationships of the performance of the specific equipment classes. The standards equations consisted of capacity-dependent multipliers (slope) and offset factors. DOE applied the extension multipliers to the slopes and offset factors of the primary standards equations to reflect energy consumption for each secondary equipment class using similar technologies. In this rulemaking DOE intends to employ the same method of using standards it develops for a number of high-shipment equipment classes to derive standards for the remaining equipment classes.

Item 5-11 DOE welcomes data from interested parties that could aid in supplementing the matched pair analyses performed in developing extension multipliers for secondary equipment classes.

5.9 Outside Regulatory Changes Affecting the Engineering Analysis

In conducting an engineering analysis, DOE must consider the effects of regulatory changes outside DOE's statutory energy conservation standards rulemaking process that can affect the energy efficiency or energy consumption of the covered equipment, and/or the cost of improving such efficiency or consumption. DOE will attempt to identify all such outside regulatory issues that could impact the engineering analysis. The consideration of these issues is closely related to the cumulative regulatory burden assessment that DOE will carry out as part of the MIA. Based on consideration of the comments received for the preliminary analysis, DOE will make the necessary changes to the analysis. These changes will be reflected in the documentation of the NOPR.

One issue that may be relevant to this equipment is alternative refrigerants. Federal phaseouts of chlorofluorocarbon (CFC) refrigerants are complete, and phaseouts of hydrochlorofluorocarbon (HCFC) refrigerants have already begun. In the case of the HCFC R-22, new equipment cannot incorporate or use this refrigerant. 74 FR 66450 (December 15, 2009). Manufacturers and purchasers of commercial refrigeration equipment are far along in the transition to hydrofluorocarbon (HFC) refrigerants. Thus, DOE did not consider CFC and HCFC refrigerants in its analysis for the 2009 final rule. The most common alternatives used in commercial refrigeration are the HFC blends R-404A and R-507 for remote condensing equipment and the HFC R-134A for self-contained equipment. Although alternative refrigerants such as hydrocarbons, ammonia, and carbon dioxide (CO_2) are used in Europe and elsewhere in the world, there was no evidence at the time of the analyses for the 2009 rulemaking that they are widely used for commercial refrigeration applications in the United States. In addition, DOE found that current state and local building codes would not allow the use of many alternative refrigerants (Safety Class A3—most hydrocarbon refrigerants) in remote condensing equipment due to flammability concerns. These codes would also severely limit the use of ammonia due to toxicity concerns. However, both hydrocarbon refrigerants and ammonia could be considered for use with secondary loop refrigeration systems. Also, hydrocarbon refrigerants could possibly be used for small self-contained commercial refrigeration equipment covered in this rulemaking if they contain less than 3 pounds of refrigerant and if they have been certified by Underwriters Laboratories or another product-safety certification lab. However, DOE received no information in the previous rulemaking that would indicate that any such equipment has been certified for the U.S. market.

The majority of the U.S. commercial refrigeration industry uses HFC refrigerants in commercial refrigeration equipment. For this reason, DOE used HFC refrigerants as the basis for its technical analyses in the 2009 final rule, and plans to do so for this rule as well. However, DOE would like to receive any available information from interested parties regarding the prevalence and feasibility of systems utilizing alternative refrigerants.

Item 5-12 Should DOE consider any alternatives to the HFCs mentioned for its analysis of commercial refrigeration equipment?

Item 5-13 Are there additional outside regulatory issues that DOE should consider in its engineering analysis of commercial refrigeration equipment?

6.0 ENERGY USE AND END-USE LOAD CHARACTERIZATION

The purpose of the energy use and end-use load characterization analysis is to assess the energy- and peak-demand-savings potential of different equipment efficiencies for various commercial building types and across a range of climate zones in which commercial refrigeration equipment is used. As part of the energy use analysis, DOE must make certain engineering assumptions regarding equipment application, including how the equipment is operated and under what conditions. Characterizing the energy use of commercial refrigeration equipment is a critical part of the standards rulemaking analysis, as it establishes the per-unit energy-savings potential achievable from energy conservation standards.

Studies conducted by Navigant Consulting, Inc. (NCI), Southern California Edison, Lawrence Berkeley National Laboratory, and others provide information on the energy consumption of commercial refrigeration equipment. These studies have primarily focused on refrigerated display cases packaged with remote condensing units. These studies could assist in characterizing the annual energy consumption of commercial refrigeration equipment for certain equipment classes. The equipment classes, building types, and climate zones covered by the studies are limited, and thus may not be applicable for the broad-based NIA necessary for this rulemaking.

Lighting is a significant fraction of the energy use and the internal refrigeration load in certain equipment classes. Limited monitoring data for display case lighting energy is available and could assist in characterizing the annual energy consumption baseline as well as the benefits of improving lighting technologies. In the 2009 rulemaking, DOE requested information on display case lighting operating hours, but received little firm data. DOE assumed 24-hour/day lighting for the engineering analysis. DOE also assumed 24-hour/day case lighting for the energy use characterization, but provided a sensitivity of the energy savings of higher efficiency levels to 20-hour/day and 16-hour/day lighting schedules. Manufacturers commenting on the sensitivity analysis in the ANOPR stated that due to re-start issues and moisture related maintenance issues with fluorescent lighting, store owners commonly leave lighting on for 24 hours. They also commented that this is not necessary with LED lighting. While acknowledging that 24-hour lighting was a worst case scenario, commenters stated it was an appropriate assumption for the 2009 CRE rulemaking. DOE requests information on whether it should continue to use a 24-hour/day assumption for the current rulemaking.

A second issue is the impact of higher efficiency standards on the overall building energy use. The recent energy conservation standards rulemaking on commercial refrigeration equipment utilized a number of industry sources to characterize the types of businesses that use this type of equipment. For buildings using commercial refrigeration equipment, the primary energy consumption and demand impact of energy conservation standards will be from the reduction of energy and power usage of the equipment itself, with the energy response of the

building heating, ventilating, and air conditioning (HVAC) equipment having a secondary impact.

In the analysis for the 2009 final rule, DOE determined through building simulation modeling that the refrigeration equipment design improvements considered did not have a significant impact on building space-conditioning loads in food sales applications (*i.e.*, grocery application). The majority of the equipment examined in that rulemaking was remote condensing equipment where much of the lighting and other energy-related heat generation of the equipment was rejected outside of the building by the refrigeration system. For this reason, DOE relied on energy consumption estimates developed from the engineering analysis for the calculation of energy savings at different efficiency levels. Based on the previous rulemaking experience, DOE proposes not to model building interactive effects for remote-condensing equipment for the current analysis. DOE seeks input on the value of including building interactive effects for self-contained commercial refrigeration equipment.

In the current rulemaking, a larger fraction of the equipment is self-contained and is used in food service (self-service restaurant or cafeteria-type) applications as opposed to food sales applications. In this type of equipment, a reduction in electric consumption for the equipment results in a direct reduction of the heat load in the building, decreasing building cooling loads and increasing building heating loads. DOE is considering whether or not to try to incorporate these HVAC energy use impacts into its analysis of energy savings.

Item 6-1	*DOE seeks data or data sources that could be used to characterize the energy use of commercial refrigeration equipment and how this may deviate from that estimated using the DOE test procedure.*
Item 6-2	*DOE seeks data or data sources that could be used to characterize the operating hours assumptions that could be used to assess lighting energy for different lighting and lighting control technologies used in commercial refrigeration equipment.*
Item 6-3	*DOE seeks input on whether the impact of higher efficiency refrigeration equipment in self-contained equipment on the building space conditioning loads is significant enough to warrant taking them into account in the energy analysis If so, what methods could best be used to estimate the net energy consumption and load impacts of higher efficiency commercial refrigeration equipment in buildings using this equipment?*
Item 6-4	*DOE seeks feedback on this approach to the energy use and end-use load characterization.*

7.0 MARKUPS FOR EQUIPMENT PRICE DETERMINATION

DOE uses manufacturer-to-consumer markups to convert the manufacturer-selling-price estimates from the engineering analysis to consumer prices, which are then used in the LCC and PBP analyses and the MIA. Retail prices are needed for the baseline efficiency level and all other efficiency levels under consideration. DOE will obtain these retail prices by applying

manufacturer-to-consumer markups (consisting of shipping and transportation charges, distribution channel markups, and sales tax) to the manufacturer-selling-price estimates.

Before it can develop markups, DOE must identify distribution channels (*i.e.*, how the equipment is distributed from the manufacturer to the consumer). Once it establishes proper distribution channels for each of the equipment classes, DOE will rely on economic census data from the U.S. Census Bureau and input from the industry as it did in the 2009 rulemaking to define how equipment is marked up from the manufacturer to the consumer. To the extent possible, DOE also will use collected retail price data to help qualify overall manufacturer-to-consumer markups.

This analysis will generate retail prices for each efficiency level that DOE considers. Because it expects to generate a range of price estimates, DOE plans to describe new retail prices within a range of uncertainty. If the range of retail prices for the equipment is large enough, DOE will conduct a sensitivity analysis to determine how high or low estimates of retail price impact the economic feasibility of potential energy conservation standard levels.

In the past, DOE has done a great deal of work to estimate manufacturer-to-consumer markups for commercial refrigeration equipment. Virtually all commercial refrigeration equipment is sold either to food sales establishments (supermarkets and grocery stores, convenience stores, specialty stores such as butchers and liquor stores, and multiline department stores) or to food service establishments (restaurants). A comparative handful is sold to other specialty retail establishments such as florists. For the 2009 final rule, analysis of distribution channel markups focused on distributors, mechanical contractors, and national accounts. DOE also made estimates of the distribution of sales of equipment among the states based on sales of refrigerated and frozen food from 2002 Census of Business. These state-level sales were used to determine what state and local sales taxes applied to equipment sales.

For the 2009 rulemaking, DOE's review of information for commercial refrigeration equipment distribution suggested a set of distribution channels described as follows:

Manufacturer → Wholesaler → Mechanical Contractor → Consumer ("Contractor" Channel)

Manufacturer → Wholesaler → Consumer ("Distributor" Channel)

Manufacturer → Customer ("National Account" Channel)

DOE determined that, for the equipment covered by that rulemaking, sales were distributed among the three channels in the percentages shown in the following table (Table 7.1). In the 2009 rulemaking remote-condensing units comprised about 92 percent of the linear feet of commercial refrigeration equipment shipped. DOE expects that the equipment covered by the current rulemaking will consist of a greater proportion of self-contained units. The overall percentages by market channel will be adjusted accordingly.

Table 7.1. Percentage Distribution of Shipments of Commercial Refrigeration Equipment Covered by the 2009 Rulemaking, by Market Channel

Remote Condensing Equipment %			
New and Replacement Construction	National Account	Distributor	Contractor
	70	15	15
Self-Contained Equipment %			
New and Replacement Construction	National Account	Distributor	Contractor
	30	35	35

DOE's understanding is that a general contractor would not normally enter into the distribution path for this equipment. DOE also understands that the relative fractions of equipment distributed in each channel could be different depending on whether the equipment is self-contained or remote condensing, as indicated by Table 7.1, and on whether the equipment is sold to a food sales establishment or a food service establishment.

Item 7-1 *DOE also requests information on the fraction of shipments expected for each distribution channel for the commercial refrigeration equipment covered under this rulemaking; specifically, whether the distribution channels derived for food sales establishments adequately covers sales to food service establishments.*

DOE intends to develop both markups for baseline equipment and incremental markups which are applied only to the incremental cost of higher-efficiency equipment. DOE proposes to base the LCC analysis on the markups developed in the 2009 commercial refrigeration equipment rulemaking, but possibly adding shipping costs to the markups or to the manufacturer's sales price, as appropriate. DOE calculated markups in the 2009 rulemaking from data supplied by Heating, Air Conditioning and Refrigeration Distributors International and the U.S. Census of Business. State and local tax data came from the Sales Tax Clearinghouse.

Item 7-2 *DOE requests feedback on its proposal to use incremental distribution channel markups for the LCC analysis.*

Item 7-3 *DOE seeks comment on other sources of relevant data that could be used to characterize markups for the commercial refrigeration industry.*

Item 7-4 *DOE seeks comment on appropriate transportation and shipping costs to include in the analysis and whether those costs are likely to vary for higher efficiency equipment.*

8.0 LIFE-CYCLE COST AND PAYBACK PERIOD ANALYSIS

The effects of amended energy conservation standards on consumers include a change in operating expense (usually decreased) and a change in purchase price (usually increased). The LCC of a piece of equipment is the cost it incurs over its lifetime, taking into account both purchase price and operating expenses. The PBP represents the time it takes to recover the additional installed cost of the more-efficient device through annual operating cost savings. DOE analyzes the net effect of new or amended standards on individual consumers by calculating the LCC and PBP using the engineering performance data (section 5.0), the energy-use and end-use

load characterization data (section 6.0), and the markups for equipment price determination (section 7.0). Inputs to the LCC calculation include the installed cost to the consumer (purchase price, including transportation and markups, plus installation cost), operating expenses (energy expenses, repair costs, and maintenance costs), the lifetime of the equipment or other defined period of analysis, and a discount rate appropriate to the consumer of the equipment. Inputs to the PBP calculation include the installed cost to the consumer and annual operating costs.

In addition to the LCC and PBP calculations, DOE also conducts a rebuttable presumption analysis for certain equipment. Under 42 U.S.C. 6295(o)(2)(B)(iii) and 6316(e)(1), the statute establishes a rebuttable presumption that a standard for commercial refrigeration equipment is economically justified "[i]f 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."

While the rebuttable presumption calculation is helpful in understanding that certain standard levels have short PBPs, DOE routinely conducts a full economic analysis that considers the full range of impacts, including those to the consumer, manufacturer, Nation, and environment, as required under 42 U.S.C. 6295(o)(2)(B)(i). The results of this analysis serve as the basis for DOE to definitively evaluate the economic justification for a potential standard level (thereby supporting or rebutting the results of any preliminary determination of economic justification).

For the preliminary analysis, DOE will conduct the LCC and PBP analyses using typical values for the following to reflect actual conditions for the purchase and use of the equipment: retail price, installation costs, lifetime, energy costs, energy usage, repair and maintenance costs, and discount rates. If DOE determines that there is significant variability in any of these inputs, it will conduct uncertainty analyses (*e.g.*, Monte Carlo analysis) to determine how the statistical distribution of estimates for each input affects the LCC and PBP. The detailed impact calculation, which DOE will conduct after the preliminary analysis, will include an assessment of LCC and PBP impacts on consumer subgroups, as described in section 11.0. For the NOPR, DOE will augment the analysis with inputs received from interested parties.

The following sections discuss the methodologies DOE plans to use to develop (1) energy prices, (2) discount rates, (3) maintenance, repair, and installation costs, and (4) lifetimes for commercial refrigeration equipment. Table 8.1 lists some of the major inputs DOE anticipates it will develop for the LCC and PBP analyses.

Table 8.1. Inputs to the Life-Cycle Cost and Payback Period Analyses Input

Input Type	Description
Equipment Price	DOE will establish the price of commercial refrigeration equipment including transportation charges, based on manufacturer's sales prices developed in the Engineering Analysis and the markups established in section 7, Markups for Equipment Price Determination.
Sales Tax	Sales tax is applied to convert the product price to a final consumer price. DOE will develop sales tax mark-ups as described in section 7, Markups for Equipment Price Determination.
Installation, Maintenance, and Repair Costs	These inputs represent the cost to customers of installing and maintaining commercial refrigeration equipment.
Annual Operating Hours	The annual operating hours are the estimated hours that commercial refrigeration equipment is in use over 1 year. DOE will develop operating hours as described in section 6, Energy-Use and End-Use Load Characterization.
Product Energy Consumption Rate	The product energy consumption rate is the site-energy usage rate associated with operating the commercial refrigeration equipment. DOE will develop this rate as described in section 6, Energy-Use and End-Use Load Characterization.
Electricity Prices	Electricity prices used in the analysis are the average price per kilowatt-hour (*e.g.*, $/kWh) that customers pay in each state for each type of business (*e.g.*, grocery, convenience store, restaurant) that uses the equipment.
Electricity Price Trends	Electricity price trends estimate the future cost of electricity.
Lifetime	Lifetime is the number years a commercial refrigeration case is in operation before the consumer retires the case from service.
Discount Rate	The discount rate is the consumer rate at which DOE discounts future expenditures to establish their present value.
Analysis Period	The analysis period is the time span over which DOE calculates the LCC.

8.1 Energy Prices

DOE will survey average state-level electricity prices for consumers of commercial refrigeration equipment. Average prices will be used because commercial refrigeration equipment runs on a 24-hour, 7-day basis and the cost of operation is effectively captured using average electricity prices. DOE will conduct a sensitivity analysis to determine how high and low electricity price estimates might affect the economic feasibility of any amended energy conservation standards. DOE will use projections of national average energy prices—principally from the most recent Energy Information Administration (EIA) *Annual Energy Outlook* (*AEO*)[7]—as inputs for future energy prices in the LCC analysis.

Item 8-1 DOE seeks comment on the proposed approaches for estimating current and forecasted energy prices.

8.2 Life-Cycle Cost Discount Rates

Calculation of consumer LCC requires use of an appropriate discount rate. DOE uses the discount rate to determine the present value of lifetime operating expenses. Because consumers of commercial refrigeration equipment are typically commercial entities, DOE will derive the discount rates for consumers by estimating the cost of capital of these types of companies. 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

[7] www.eia.doe.gov/oiaf/aeo/.

investments, so the cost of capital is the weighted-average cost of equity and debt financing. This corporate finance approach is referred to as the weighted-average cost of capital (WACC). DOE proposes to use the same method as it used in the 2009 rulemaking to calculate WACC from equity and debt cost data on individual Value Line reported companies from the Damodaran Online website.[8]

Because the set of commercial companies purchasing commercial refrigeration equipment may differ from those who purchase other types of commercial equipment, each rulemaking requires development of its own targeted discount rates. DOE will develop the discount rates and associated calculations and provide an opportunity for comment on them in the preliminary analysis. Interested parties may comment on this issue during the preliminary analysis comment period. DOE will make necessary changes to the preliminary analysis based on the comments it receives on the LCC and PBP analyses, and will reflect those changes in the NOPR.

Item 8-2	*DOE seeks comment on the proposed approaches for estimating discount rates for consumers of the equipment covered under this rulemaking.*
Item 8-3	*Given the relatively narrow commercial application of most of the equipment covered under this rulemaking, which, if any, commercial sectors beyond grocery stores and restaurants should be considered in the evaluation of discount rates? In addition, are government purchases of this equipment large enough to require that they be included in the evaluation of discount rates?*

8.3 Maintenance, Repair, and Installation Costs

DOE will consider expected changes to maintenance, repair, and installation costs for the equipment covered in this rulemaking. In the 2009 rulemaking, DOE based repair costs on annualized costs of key components and frequency of replacement in the field. Maintenance costs were based on estimates of preventative maintenance and a separate estimate of maintenance for different lighting system technologies. DOE took annualized maintenance costs for commercial refrigeration equipment from data in *RS Means Facilities Maintenance & Repair Cost Data*. Because data were not available to indicate how preventative maintenance costs vary with equipment efficiency level, DOE used preventative maintenance costs that remain constant as equipment efficiency is increased. Because the lighting configurations and the frequency of lighting replacement can vary by efficiency level and lighting technology incorporated, DOE estimated the relative maintenance costs for lighting by each case type where case lighting was employed and for which DOE performed a design option analysis. DOE will rely on input from manufacturers and other interested parties in deciding whether to use a different approach for developing appropriate repair and maintenance costs for this rulemaking.

Unless the efficiency increases considered for this rulemaking result in significantly larger or heavier equipment, DOE expects that more-efficient commercial refrigeration equipment will not incur increased installation costs.

[8] See http://pages.stern.nyu.edu/~adamodar/

Item 8-4	*DOE seeks feedback on whether it is correct to assume that changes in preventative maintenance, repair, and installation costs will be negligible for equipment with lower energy consumption.*
Item 8-5	*If it is not appropriate to assume that changes in maintenance, repair, or installation costs would be negligible for equipment with lower energy consumption, DOE seeks comment on appropriate methodologies for assessing how these costs would change for equipment with lower energy consumption.*

8.4 Equipment Lifetimes

In the 2009 rulemaking, DOE determined that commercial refrigeration equipment is typically replaced when stores are renovated—about every 7 to 10 years for large grocery chains—which is before the units would have physically worn out. In that rulemaking, DOE used an average lifetime of 10 years for large grocery and multi-line retailers and an average lifetime of 15 years for small grocery and convenience stores. As appropriate, DOE will also use information from various literature sources (*e.g.*, *Appliance Magazine*, handbooks published by ASHRAE, etc.) and input from manufacturers and other interested parties to better establish average equipment lifetimes for use in the LCC and subsequent analyses.

Item 8-6	*DOE seeks comment on appropriate equipment lifetimes for the classes of equipment covered in this rulemaking.*

9.0 SHIPMENTS ANALYSIS

Shipment forecasts are required to calculate the national impacts of standards on energy use, NPV, and future manufacturer cash flows. DOE plans to develop shipment forecasts based on an analysis of key market drivers for commercial refrigeration equipment.

9.1 Base Case Forecast

To evaluate the various impacts of standards, DOE must develop a base case forecast against which to compare forecasts for higher efficiency levels. The base case forecast is designed to depict what will happen to energy consumption and energy costs over time if DOE does not adopt amended energy conservation standards for the equipment covered under this rulemaking. In determining the base case forecast, DOE will consider historical shipments, the mix of efficiencies sold under current standards, and how that mix might change over time. For these purposes, DOE needs data on historical shipments and the market shares of the different efficiency levels offered in each equipment class.

In the 2009 rulemaking, DOE relied on the limited historical shipments data available in a few sources. AHRI provided DOE with shipments data broken out by specific commercial refrigeration equipment class for 1 year (2005) that allowed DOE to allocate sales of equipment to equipment classes. DOE calculated the proportion of these sales that were sales to new grocery outlets and then scaled this estimate by using *AEO* estimates of new construction for food sales buildings. Replacements were based on the number of units removed from the inventory in each year. The stock of equipment was based on the proportion of 2005 equipment

sales believed to be for replacement, divided by the average equipment life. Data were checked against estimates by the Freedonia market consulting firm. The 2005 AHRI data covered self-contained equipment with doors, but did not state whether it included pull-down units. In addition, it covered only shipments from AHRI members. During the current rulemaking DOE plans to review the 2005 AHRI data and any other data that becomes available to determine the most appropriate distribution of shipments among equipment classes and the most appropriate distribution for equipment stock.

Appliance Magazine reports historical shipments for commercial refrigerated display cases as a single group. The U.S. Census Bureau (the Bureau) has also published limited statistics on the quantity and value of shipments for those companies with shipments over $100,000 in both 1997 and 2002. Similar shipments data are expected to be published during 2010 for shipments in 2007. While the Bureau data identifies several equipment classes separately, the data by equipment class are limited. Data for remote condensing and self-contained refrigeration equipment are provided separately. Additionally, this data provides the dollar-value of shipments rather than the actual shipment quantities in most cases.

DOE intends to collect shipment data within each equipment class, as well as market-share efficiency data (*i.e.*, data on the distribution of product shipments by efficiency) for each class. Based on experience in the 2009 rulemaking, DOE recognizes that this information may be difficult to collect, and may therefore consider other methods to estimate the efficiency distribution in the market. For example, when market-share efficiency data are not available, DOE may use efficiency distributions based on available equipment models as a proxy. DOE may also request separate shipment information for equipment sold with specific design features (*e.g.*, ECM evaporator fan motors).

9.2 Accounting Methodology

DOE proposes to determine annual shipments in the base case by accounting for new building construction and historical rates of ownership (saturation rates) in buildings. For equipment retirements, DOE will use the same equipment lifetimes and retirement functions that it generates for the LCC and PBP analysis. This method has the distinct advantage of separately accounting for units installed in new construction and existing buildings. More importantly, DOE can express saturation rates as a function of consumer price and operating cost to capture their impact on future shipments. DOE plans to rely on EIA's *AEO* to forecast new commercial construction.

DOE will also consider any other input provided by interested parties.

Item 9-1	*DOE seeks information on historical shipments of commercial refrigeration equipment for each equipment class covered under this rulemaking, as well as industry-trend data regarding relative growth in each equipment class.*
Item 9-2	*DOE seeks information on representative saturation rates for each equipment class covered under this rulemaking, as well as industry-trend data regarding relative growth in each equipment class.*

9.3 Standards Impacts on Shipments

For each equipment class, DOE will develop a set of shipment forecasts for the covered equipment for each set of potential standards analyzed. These standards case forecasts will be used to evaluate the impacts of standards on shipments. Standards case forecasts are derived using the same data-sets as base case forecasts; however, because the standards case forecasts take into account the increase in purchase price and the decrease in operating costs caused by new or amended standards, forecasted shipments could deviate from the base case. The magnitude of the difference between the standards case and base case shipment forecasts depends on the estimated purchase-price-increase as well as the operating-cost-savings caused by the standard. Because the purchase price tends to have a larger impact than operating cost on equipment purchase decisions, standards case forecasts typically show a drop in shipments relative to the base case.

DOE's past standards analyses have attempted to quantify the sensitivity of shipments to purchase price and operating-cost-savings. Because the data required to develop these sensitivities are limited and often difficult to obtain, DOE will consider modeling standards case shipments forecasts with scenarios (*i.e.*, specified impacts to equipment shipments) rather than developing sensitivities to purchase price or operating-cost-savings.

Market-pull programs, such as consumer rebate programs that encourage the purchase of more-efficient equipment and manufacturer tax credits that encourage the production of more-efficient equipment, also affect standards case forecasts. When such programs exist, DOE considers their impact on the forecast of both standards case and base case shipments.

Item 9-3	*DOE requests input from manufacturers on the potential impact of new energy conservation standards on equipment shipments. Other interested parties are also welcome to provide input. DOE also requests input on any market-pull programs that currently exist to promote the adoption of more-efficient equipment.*

10.0 NATIONAL IMPACT ANALYSIS

The NIA discusses DOE's assessment of the aggregate impacts of potential efficiency standards at the national level. Measures of impact that DOE will report include future NES from CSLs (*i.e.*, the cumulative incremental primary energy savings from an increased energy conservation standard relative to a base case that assumes no change in the energy conservation national standard over a specific forecast period) and the NPV for consumers in the aggregate from CSLs (*i.e.*, the cumulative incremental LCC from an increased energy conservation standard relative to the base case over a specific forecast period).

10.1 Inputs to Forecast

Analyzing impacts of Federal energy conservation standards requires a comparison of projected United States energy consumption for the commercial refrigeration equipment covered under this rulemaking with, and without, new or amended energy conservation standards. The forecasts contain projections of unit energy consumption for new equipment, annual equipment

shipments, and the price of purchased equipment. The derivations of the base case shipments forecasts are discussed in section 9.1. Approaches to determining retail prices are described in section 7.0, while approaches to determining per unit net energy consumption impact are described in section 6.0.

One factor often considered in DOE rulemakings is the rebound effect, generally considered in the input to the NIA. Often, consumers that encounter lower operating costs associated with more energy-efficient equipment will use that equipment more often than less-efficient equipment. The rebound effect analysis accounts for this increase in consumer use. In the 2009 rulemaking—because of the fixed circumscribed nature of the services provided by commercial refrigeration equipment (*i.e.*, fixed temperature regime in a specific marketing context and 24-hour continuous operation) —DOE determined that there would be limited scope for a rebound effect to occur. Interested parties in the 2009 rulemaking generally agreed that a rebound effect, if any, would likely be minimal. DOE did not incorporate a rebound effect in the 2009 rulemaking. DOE will investigate incorporating a rebound effect based on the economics literature concerning energy efficiency in the commercial sector.

Table 10.1 describes some of the major inputs DOE anticipates it will develop for the NIA.

Table 10.1. Inputs to the National Impact Analysis

Input Data	Description of Data Sources
Shipments	DOE develops annual shipments over a 30 year analysis period as described in section 9.0, Shipment Analysis.
Stock of Commercial Refrigeration Cases	This stock is calculated from the service life of equipment developed as described in section 8.0, Life-Cycle Cost Analysis, and annual shipments of equipment developed as described in section 9.0, Shipment Analysis.
Compliance Date of Standard	The compliance date of the standard is January 1, 2016.
Analysis Period	This analysis period is 2016 to 2045 (30 years).
Base-Case Forecasted Efficiency	Distribution of base-case shipments by efficiency level over time developed as described in section 9.0, Shipment Analysis.
Standards-Case Forecasted Efficiency	Distribution of shipments by efficiency level for each standards case over time as described in section 9.0, Shipment Analysis.
Unit Energy Consumption (*kWh/yr*)	This is the average energy consumption of commercial refrigeration equipment established as described in section 6.0, Energy-Use and End-Use Load Characterization.
Total Installed Cost	Established as described in section 7.0, Markups for Equipment Price Determination, and section 8.0, Life-Cycle Cost Analysis.
Electricity Price Forecast	Established as described in section 8.0, Life-Cycle Cost Analysis.
Electricity Site-to-Source Conversion	Conversion varies yearly and is generated from detailed EIA *AEO* forecasts of electricity generation by technology and electricity-related losses.
Discount Rate	The discount rate is the rate at which DOE discounts future expenditures to establish their present value. DOE will use 3- and 7-percent discount rates mandated by the Office of Management and Budget (OMB).
Present Year	Future costs and savings will be discounted to 2010.
Rebound Effect	The difference between the projected and actual savings due to increased efficiency. DOE may base this effect on economics literature on energy efficiency in the commercial and industrial

	sectors.

10.2 Calculation of Energy Savings

DOE intends to calculate national energy consumption for each year beginning with the expected compliance date of the standards. It will calculate national energy consumption by fuel type for the base case and each standard level analyzed. DOE plans to perform this calculation through the use of a spreadsheet model that effectively multiplies annual equipment stock forecasts by efficiency level (based on shipments and retirements in each year) by unit electricity use at the site of use, for each efficiency level. DOE then plans to multiply the site electricity use by year-by-year marginal site-to-source conversion factors that account for energy losses in generation, transmission, and distribution of electricity in order to estimate national primary energy savings. In the 2009 rulemaking, DOE based the site-to-source conversion factors on modeled savings of primary energy in the electric utility industry of EIA's National Energy Modeling System (NEMS) (section 13.0). DOE plans to use the same method for this rulemaking.

In response to comments by interested parties who asked for a simple, transparent model, DOE developed NES spreadsheet models for its standards rulemakings starting in 1996. These models project energy savings and demonstrate how to account for the growth in efficiency over time.[9] DOE expects the NES spreadsheet model to provide a credible, stand-alone forecast of national energy savings and aggregate consumer NPV for commercial refrigeration equipment. DOE will make any necessary changes to the preliminary analysis based on the comments it receives. It will reflect those changes in the NOPR.

Item 10-1	*DOE welcomes comments from interested parties on the NES spreadsheet models it plans to use for estimating national impacts of amended energy conservation standards for commercial refrigeration equipment.*

10.3 Net Present Value of Consumer Savings

DOE calculates the national NPV of the standards in conjunction with the NES. It calculates annual energy expenditures from annual energy consumption by incorporating forecasted energy prices, using the shipment forecasts described in section 9.1, Shipment Analysis and electricity savings forecasts described in section 10.2. DOE calculates annual equipment expenditures by multiplying the price per unit by the forecasted shipments. The difference between a base case and a standards case scenario gives the national energy bill savings and increased equipment expenditures in dollars. The difference each year between energy bill savings and increased equipment expenditures is the net savings (if positive) or net cost (if negative). DOE discounts these annual values to the present time and sums them to give an NPV. Since the national cost of capital may differ from the consumer cost of capital, the discount rate used in the NIA can be different from the rate used in the LCC. In accordance with

[9] Several examples of NES spreadsheet models from previous rulemakings can be found on DOE's website at www.eere.energy.gov/buildings/appliance_standards

OMB guidance, DOE will conduct two NPV calculations, one using a real discount rate of 3 percent and another using a real discount rate of 7 percent.[10]

Based on consideration of the comments received for the preliminary analysis, DOE will make any necessary changes to the analysis and the CSLs..

11.0 LIFE-CYCLE COST SUBGROUP ANALYSIS

DOE recognizes that there are potential subgroups of commercial customers/purchasers of commercial refrigeration equipment who may be impacted by standards differently than customers/purchasers generally. DOE analyzes such differences in impacts by dividing consumers into subgroups and accounting for variations in key inputs to the LCC analysis. A customer subgroup comprises a subset of the purchaser population that is likely, for one reason or another, to be impacted disproportionately by new or revised energy conservation standards. The purpose of a subgroup analysis is to determine the extent of this disproportional impact. In the 2009 rulemaking, after considering available Census statistics on small businesses in the food sales business, DOE used owners of small grocery and convenience stores as representative of likely small business purchasers of commercial refrigeration equipment affected by the rulemaking. Because the scope of this rulemaking also includes greater number of equipment shipments to food services (as opposed to food sales) applications, DOE will also consider whether to analyze independent restaurant owners as small businesses affected by the rulemaking. DOE will work with interested parties early in the rulemaking process to identify any subgroups for this consideration and will analyze the consumer subgroups in the NOPR stage of the analysis.

In comparing potential impacts on the different consumer subgroups, DOE will evaluate variations in regional energy prices, variations in energy use, and variations in installation costs that might affect the NPV of a standard to consumer subgroups. To the extent possible, DOE may obtain estimates of the variability in each input variable and consider this variability in its calculation of consumer impacts. It will discuss the variability in each input variable and likely sources of information with interested parties.

Item 11-1	*DOE seeks input as to what customer subgroups DOE should consider in the present rulemaking. Examples of possible subgroups DOE could consider appropriate for commercial refrigeration equipment include small independent grocery stores and small convenience stores and independently owned restaurants.*

12.0 MANUFACTURER IMPACT ANALYSIS

DOE will collect, evaluate, and report preliminary manufacturer impact information and data in the preliminary analysis. (Standards Activities, p. 48) Such preliminary manufacturer impact information includes the anticipated conversion capital expenditures by efficiency level and the corresponding, anticipated impacts on jobs. DOE will solicit this information during the engineering analysis manufacturer interviews for the preliminary analysis..

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

The analysis of impacts on manufacturers is intended to provide DOE with an assessment of the potential impacts of energy conservation standards on manufacturers. In addition to financial impacts, a wide range of quantitative and qualitative effects may occur following adoption of a standard that may require changes to the manufacturing practices for this equipment. DOE will identify these effects through interviews with manufacturers and other interested parties.

12.1 Sources of Information

Many of the analyses described earlier provide important information that DOE uses as inputs for the MIA. Such information includes financial parameters developed in the market assessment (section 3.1), manufacturing costs and prices from the engineering analysis (sections 5.2 and 5.3), retail price forecasts (section 7.0), and shipments forecasts (section 9.1). DOE supplements this information with information gathered during manufacturer interviews. The interview process will play a key role in the MIA, as it provides an opportunity for interested parties to express their views on important issues.

DOE will conduct detailed interviews with manufacturers to gain insight into the range of potential impacts of standards. During the interviews, DOE will solicit information on the possible impacts of standards on manufacturing costs, equipment prices, sales, direct employment, capital assets, and industry competitiveness. Both qualitative and quantitative information are valuable. In addition, an interview guide will be provided before the interviews to allow the manufacturers to gather the appropriate information. Although a written response to the questionnaire is acceptable, DOE prefers an interactive interview process because it helps clarify responses and provides the opportunity for additional issues to be identified.

DOE will ask that interview participants identify all confidential information provided, both in writing and orally. While it will consider information gathered, as appropriate, in its decision-making process, DOE will protect confidential information from disclosure consistent with applicable law.

DOE will collate the completed interview questionnaires and prepare a summary of the major issues and outcomes. This summary will become part of the TSD produced for this rulemaking.

Item 12-1	*What procedures should DOE follow when scheduling interviews and requesting information?*

12.2 Industry Cash Flow Analysis

The industry cash flow analysis relies primarily on the Government Regulatory Impact Model (GRIM). DOE uses the GRIM to analyze the financial impacts of more stringent energy conservation standards on the industry that produces the equipment covered by the standard.

The GRIM analysis uses a number of factors—annual expected revenues; manufacturer costs such as costs of goods sold; selling, general, and administrative (SG&A) costs; taxes; and capital expenditures related to depreciation, new standards, and maintenance—to arrive at a series of annual cash flows beginning from the announcement of the new standard and continuing for several years after its implementation. DOE compares the results against base case projections that involve no new standards. The financial impact of new standards then is the difference between the two sets of discounted annual cash flows. Other performance metrics, such as return on invested capital, also are available from the GRIM.

DOE will gather this information from two primary sources: (1) the analyses conducted to this point; and (2) interviews with manufacturers and other interested parties. Information gathered from previous analyses will include financial parameters, manufacturing costs, price forecasts, and shipments forecasts. Interviews with manufacturers and other interested parties will be essential in supplementing this information.

12.3 Manufacturer Subgroup Analysis

It is possible that the use of average industry cost values will not adequately assess differential impacts among subgroups of manufacturers. DOE recognizes that smaller manufacturers, niche players, and manufacturers exhibiting a cost structure that differs largely from the industry average may be differentially impacted by the imposition of standards. Ideally, DOE would consider the impact on every firm individually. In highly concentrated industries, this may be possible. In industries having numerous participants, however, DOE will use the results of the market and technology assessment to group manufacturers into subgroups, as appropriate.

Item 12-2 DOE seeks comment on the establishment of manufacturer subgroups for commercial refrigeration equipment.

12.4 Competitive Impacts Assessment

EPCA directs DOE to consider any lessening of competition that is likely to result from the imposition of standards. (42 U.S.C. 6295(o)(2)(B)(i)(V) and 6316(e). It further directs the Attorney General to determine, in writing, the impacts, if any, of any lessening of competition. (42 U.S.C. 6295(o)(2)(B)(ii) and 6316(e).

DOE will make a determined effort to gather firm-specific financial information and impacts. DOE will then report the aggregated impact of the standard on manufacturers. The competitive impacts assessment will include a focus on the assessment of the impacts to smaller manufacturers. DOE will provide the Attorney General with a copy of the NOPR for consideration in his/her evaluation of the impact, if any, of standards on any lessening of competition. DOE will base the assessment on manufacturing cost data and on information collected from interviews with manufacturers. One focus of the manufacturer interviews will be to gather information that would help in assessing asymmetrical cost increases to some manufacturers, increased proportion of fixed costs potentially increasing business risks, and potential barriers to market entry (*e.g.*, proprietary technologies).

12.5 Cumulative Regulatory Burden

Finally, DOE is aware that other regulations may be placed on equipment covered under this rulemaking as well as on other equipment which may be manufactured by the manufacturers of equipment covered under this rulemaking. Multiple regulations may result in a cumulative regulatory burden on these manufacturers. DOE will address and seek to mitigate the overlapping effects on manufacturers of amended DOE standards and other regulatory actions affecting the same equipment or companies.

Item 12-3 What regulations or pending regulations should DOE consider in the analysis of cumulative regulatory burden?

13.0 UTILITY IMPACT ANALYSIS

The utility impact analysis will include an analysis of the electric utility industry. DOE is considering adapting NEMS produced by the EIA for this analysis. NEMS (EIA 2009) is a large multi-sectoral partial-equilibrium model of the United States energy sector that has been developed over the past decade by the EIA, primarily to prepare DOE's *AEO*. In prior rulemakings, a variant of NEMS (currently termed NEMS-BT, BT referring to the DOE Building Technologies Program) was developed to better address the specific impacts of equipment efficiency standards.[11]

The NEMS produces a widely recognized baseline energy forecast for the United States through 2035 and is available in the public domain. The typical NEMS outputs include forecasts of electricity sales, price, and avoided capacity. DOE plans to conduct the utility impact analysis as a scenario departing from the latest *AEO* reference case. In other words, the energy savings impacts from amended energy conservation standards will be modeled using NEMS-BT to generate forecasts that deviate from the *AEO* reference case.[12]

Item 13-1 DOE seeks input from interested parties on its proposed use of NEMS-BT to conduct the utility impact analysis.

14.0 EMPLOYMENT IMPACT ANALYSIS

The imposition of standards can impact employment both directly and indirectly. Direct employment impacts are changes in the number of employees at the plants that produce the covered equipment, along with the affiliated distribution and service companies, resulting from

[11] For more information on NEMS, please refer to DOE EIA documentation. A useful summary is *National Energy Modeling System: An Overview 2009*, DOE/EIA-0581 (October 2009), available at www.eia.doe.gov/oiaf/aeo/overview/index.html. 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 EIA assumptions, DOE refers to the model by the name NEMS-BT. (-BT refers to DOE's Building Technologies Program, under whose aegis this work is performed.)

[12] Several descriptions of NEMS-BT models and utilization from previous commercial equipment rulemakings, including beverage vending machines, can be found on DOE's website at: http://www1.eere.energy.gov/buildings/appliance_standards/commercial/beverage_machines_final_rule_tsd.html

the imposition of standards. DOE will evaluate direct employment impacts in the MIA, as described in section 12.0.

Indirect employment impacts may result from expenditures shifting between goods (the substitution effect) and changes in income and overall expenditure levels (the income effect) that occur due to the imposition of standards. The combined direct and indirect employment impacts will be investigated in the employment impact analysis using the Pacific Northwest National Laboratory's "Impact of Sector Energy Technologies" (ImSET) model.[13] The ImSET model was developed for EERE and estimates the employment and income effects of energy-saving technologies in buildings, industry, and transportation. In comparison with simple economic multiplier approaches, ImSET allows for more complete and automated analysis of the economic impacts of energy conservation investments.

Item 14-1 DOE requests feedback on this approach to assessing employment impacts.

15.0 ENVIRONMENTAL ASSESSMENT

The intent of the environmental assessment is to quantify and consider the environmental effects of amended energy conservation standards for commercial refrigeration equipment. The primary environmental effects of these standards would be reduced power plant emissions resulting from reduced consumption of electricity. DOE will assess these environmental effects by using NEMS-BT to provide key inputs to its analysis. The portion of the environmental assessment that will be produced by NEMS-BT considers CO_2, sulfur dioxide (SO_2), nitrogen oxides (NO_x), and mercury (Hg). After a brief discussion of general methodology, this section will address each of the relevant emissions. Section 16.0, explains how DOE plans to monetize the benefits associated with emissions reductions.

The NEMS-BT is run similarly to the *AEO2010* NEMS, except that commercial refrigeration equipment energy use is reduced by the amount of energy saved due to each TSL. The inputs of national energy savings come from the NIA spreadsheet model; the output is the forecasted physical emissions at each TSL. The net benefit of the standard is the difference between emissions estimated by NEMS-BT at each TSL and the *AEO* Reference Case. NEMS-BT tracks emissions using a detailed module that provides results with broad coverage of all sectors and inclusion of interactive effects. To assess the environmental impact on CO_2 emissions, DOE analyzes forecasted physical emissions.

15.1 Carbon Dioxide

In the absence of any Federal emissions control regulation of power plant emissions of CO_2, a DOE standard is likely to result in reductions of these emissions. The CO_2 emission reductions likely to result from a standard will be estimated using NEMS-BT and national energy savings estimates drawn from the NIA spreadsheet model. The net benefit of the standard is the

[13] Scott M.J., O.V. Livingston, J.M. Roop, R.W. Schultz, and P.J. Balducci. *ImSET 3.1:Impact of Sector Energy Technologies Model Description and User's Guide*. 2009. PNNL-18412, Pacific Northwest National Laboratory, Richland, WA).

difference between emissions estimated by NEMS-BT at each standard level considered and the *AEO* Reference Case. NEMS-BT tracks CO_2 emissions using a detailed module that provides results with broad coverage of all sectors and inclusion of interactive effects.

15.2 Sulfur Dioxide

DOE has preliminarily determined that SO_2 emissions from affected electric generating units (EGUs) are subject to nationwide and regional emissions cap and trading programs that create uncertainty about the amended standards' impact on SO_2 emissions. Title IV of the Clean Air Act sets an annual emissions cap on SO_2 for all affected EGUs. SO_2 emissions from 28 eastern States and the District of Columbia (DC) are also limited under the Clean Air Interstate Rule (CAIR, 70 FR 25162 (May 12, 2005)), which creates an allowance-based trading program that will gradually replace the Title IV program in those States and DC. (The recent legal history surrounding CAIR is discussed below.) The attainment of the emissions caps is flexible among EGUs and is enforced through the use of emissions allowances and tradable permits. The standard could lead EGUs to trade allowances and increase SO_2 emissions that offset some or all SO_2 emissions reductions attributable to the amended standard. As a result, DOE is not certain that there will be reduced overall SO_2 emissions from the amended standards. The NEMS-BT modeling system that DOE plans to use to forecast emissions reductions currently indicates that no physical reductions in power sector emissions would occur for SO_2. However, remaining uncertainty prevents DOE from estimating SO_2 reductions from the standards at this time.

15.3 Nitrogen Oxides

NEMS-BT also has an algorithm for estimating NO_x emissions from power generation. The impact of these emissions, however, will be affected by the CAIR, which the U.S. Environmental Protection Agency (EPA) issued on May 12, 2005. CAIR will permanently cap emissions of NO_x in 28 eastern states and DC. 70 FR 25162 (May 12, 2005).

Much like SO_2 emissions, a cap on NO_x emissions means that the amended commercial refrigeration equipment standards may have little or no physical effect on these emissions in the 28 eastern States and the DC covered by CAIR. Although CAIR has been remanded to the EPA by the DC Circuit, it will remain in effect until it is replaced by a rule consistent with the Court's July 11, 2008, opinion in *North Carolina v. EPA*. 531 F.3d 896 (DC Cir. 2008); see also *North Carolina v. EPA*, 550 F.3d 1176 (DC Cir. 2008). Because all States covered by CAIR opted to reduce NO_x emissions through participation in cap-and-trade programs for EGUs, emissions from these sources are capped across the CAIR region.

DOE plans to use NEMS-BT to estimate the emissions reductions from possible standards in the 22 States where emissions are not capped.

15.4 Mercury

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

15.5 Particulate Matter

DOE acknowledges that particulate matter (PM) impacts are of concern due to human exposures that can impact health. But impacts of PM emissions reduction are much more difficult to estimate than other emissions reductions due to the complex interactions between PM, other power plant emissions, meteorology, and atmospheric chemistry that impact human exposure to particulates. Human exposure to PM usually occurs at a significant distance from the power plants that are emitting particulates and particulate precursors. When power plant emissions travel this distance, they undergo highly complex atmospheric chemical reactions. Although the EPA does keep inventories of direct PM emissions of power plants, in its source attribution reviews, the EPA does not separate direct PM emissions from power plants from the sulfate particulates indirectly produced through complex atmospheric chemical reactions. The great majority of PM emissions from power plants are of these secondary particles (secondary sulfates). Thus, it is not useful to examine how the amended standard impacts direct PM emissions independent of indirect PM production and atmospheric dynamics. Therefore, DOE is not planning to assess the impact of these standards on particulate emissions. Further, even the cumulative impact of PM emissions from power plants and indirect emissions of pollutants from other sources is unlikely to be significant.

Item 15-1	*DOE seeks input on its plans to use NEMS-BT to conduct the environmental impact analysis on the equipment covered by this rulemaking. DOE is particularly interested in whether there are any other approaches to the environmental assessment that it should consider and the advantages and disadvantages for each approach.*

16.0 MONETIZATION OF EMISSIONS REDUCTIONS

For those emissions for which real national emission reductions are anticipated (CO_2, Hg, and NO_x), only a range of estimated economic values based on environmental damage studies of varying quality and applicability are available. Therefore, DOE plans on reporting and weighing these values. According to OMB guidance, DOE will then conduct two calculations: one using a real discount rate of 3 percent and another using a real discount rate of 7 percent.[14]

In order to estimate the monetary value of benefits resulting from reduced emissions of CO_2 emissions, it is DOE's intent to use in its analysis the most current social cost of carbon (SCC) values developed and/or agreed to by interagency reviews. The SCC is intended to be a monetary measure of the incremental damage resulting from greenhouse gas (GHG) emissions, including but not limited to net agricultural productivity loss, human health effects, property damage from sea level rise, and changes in ecosystem services. Any effort to quantify and to monetize the harms associated with climate change will raise serious questions of science, economics, and ethics. But with full regard for the limits of both quantification and monetization, the SCC can be used to provide estimates of the social benefits of reductions in GHG emissions.

At the time of this notice, these estimates are $5, $21, $35, and $65 per metric ton of CO_2 (in 2007$). These values are then adjusted to 2009$ using the standard GDP deflator value for 2008 and 2009. For emissions (or emission reductions) that occur in later years, these values grow in real terms over time. Additionally, the interagency group determined that a range of values from 7 percent to 23 percent should be used to adjust the global SCC to calculate domestic effects, although preference will be given to consideration of the global benefits of reducing CO2 emissions.

DOE recognizes that scientific and economic knowledge continues to evolve rapidly as to the contribution of CO_2 and other GHG to changes in the future global climate and the potential resulting damages to the world economy. Thus, these values are subject to change.

DOE will investigate the potential monetary benefit of reduced NO_x emissions from the standard levels. For NO_X emissions, available estimates suggest a very wide range of monetary values for NO_X emissions, ranging from $370 per ton to $3,800 per ton of NO_X from stationary sources, measured in 2001$ (equivalent to a range of $442 to $4,540 per ton in 2008$). Refer to the OMB, Office of Information and Regulatory Affairs, "2006 Report to Congress on the Costs and Benefits of Federal Regulations and Unfunded Mandates on State, Local, and Tribal Entities," for additional information.

DOE does not plan to monetize estimates of Hg in this rulemaking. DOE is aware of multiple agency efforts to determine the appropriate range of values used in evaluating the potential economic benefits of reduced Hg emissions. DOE has decided to await further guidance regarding consistent valuation and reporting of Hg emissions before it once again monetizes Hg in its rulemakings.

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

Item 16-1 DOE invites comments on its approach to monetization of emissions.

17.0 REGULATORY IMPACT ANALYSIS

Pursuant to section 6(a)(3) of Executive Order (E.O.) 12866, "Regulatory Planning and Review," 58 FR 51735 (October 4, 1993), if DOE determines that amended energy conservation standards for commercial refrigeration equipment would constitute a significant regulatory action, during the NOPR stage DOE will prepare and submit to OMB (1) an assessment of the costs and benefits of the proposed regulation, and (2) if the proposed rule is also significant under section 3(f)(1)of the E.O., a Regulatory Impact Analysis (RIA) which is subject to review under the Executive Order by the OIRA at OMB. The RIA would address the potential for non-regulatory approaches to supplant or augment energy conservation standards to improve the energy efficiency or reduce the energy consumption of the commercial refrigeration equipment covered under this rulemaking in the market.

DOE recognizes that voluntary or other non-regulatory efforts by manufacturers, utilities and other interested parties can result in substantial improvements to energy efficiency or reductions in energy consumption. DOE intends to consider the likely effects of non-regulatory initiatives on equipment energy use, consumer utility, and LCCs. DOE will base its assessment on the actual impacts of any such initiatives to date and will consider information presented regarding the impacts that any existing initiative might have in the future.

DOE is aware of the existence of non-regulatory programs that specifically target the commercial refrigeration equipment covered under this rulemaking. Most of these programs are utility rebate programs that provide incentives for users to purchase equipment with specific design features or add certain defined components to improve efficiency of existing equipment. Some of the benefits of these features, such as occupancy sensors controls, are not captured in the current test procedure. A few classes of self-contained equipment are listed under a commercial refrigerator freezer Energy Star program where Energy Star rating is based on equipment performance ratings. DOE seeks comment regarding programs that should be examined as optional non-regulatory approaches

Item 17-1 DOE seeks comment regarding programs that should be examined as optional, non-regulatory approaches.

APPENDIX A – LIST OF ITEMS FOR COMMENT

This appendix lists all the items for comment contained in this framework document and the page numbers on which those items can be found.