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

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LIST OF ACRONYMS

AEO	Annual Energy Outlook
ANOPR	advance notice of proposed rulemaking
ASHRAE	American Society of Heating, Refrigerating, and Air-Conditioning Engineers
BT	Building Technologies Program
CBECS	Commercial Building Energy Consumption Survey
CFC	chlorofluorocarbon
CFR	Code of Federal Regulations
CO_2	carbon dioxide
CSL	candidate standard level
CUAC	Commercial Unitary Air-Conditioner
DOE	United States Department of Energy
DOJ	United States Department of Justice
EERE	Office of Energy Efficiency and Renewable Energy
EIA	Energy Information Administration
E.O.	Executive Order
EPACT 1992	Energy Policy Act of 1992
EPACT 2005	Energy Policy Act of 2005
EPCA	Energy Policy and Conservation Act
FR	Federal Register
GRIM	Government Regulatory Impact Model
HCFC	hydrochlorofluorocarbon
HFC	hydrofluorocarbon
ImSET	Impact of Sector Energy Technologies
LCC	life-cycle cost
MIA	manufacturer impact analysis
NECPA	National Energy Conservation Policy Act of 1978
NEMS	National Energy Modeling System
NES	national energy savings
NOPR	notice of proposed rulemaking
NO_x	oxides of nitrogen
NPV	net present value
OIRA	Office of Information and Regulatory Affairs
R&D	research and development
RECS	Residential Energy Consumption Survey
RIA	regulatory impact analysis
SG&A	selling, general, and administrative costs
SO_2	sulfur dioxide
TSD	technical support document
TSL	trial standard level
U.S.C.	United States Code
WACC	weighted-average cost of capital

Rulemaking Framework for Commercial Refrigeration Equipment

1 INTRODUCTION

The purpose of this document is to describe the procedural and analytical approaches the United States Department of Energy (the Department or DOE) anticipates using to evaluate and establish energy conservation standards for three equipment types: ice-cream freezers; self-contained commercial refrigerators, freezers, and refrigerator-freezers without doors; and remote condensing commercial refrigerators, freezers, and refrigerator-freezers (herein collectively referred to as commercial refrigeration equipment). These energy conservation standards apply to commercial refrigeration equipment manufactured on or after January 1, 2012, as mandated by section 136(c) of the Energy Policy Act of 2005 (EPACT 2005).

The DOE Appliances and Commercial Equipment Standards Program, of the Office of Energy Efficiency and Renewable Energy's (EERE's) Building Technologies Program (BT), develops and promulgates test procedures and energy conservation standards for consumer appliances and commercial equipment.

The process for developing standards involves analysis, public notice, and consultation with interested parties. Such parties, collectively referred to as stakeholders, include manufacturers, consumers, energy conservation and environmental advocates, State and Federal agencies, and any other groups or individuals with an interest in the standards.

This document is intended to inform stakeholders of the process for the standards rulemaking for the covered commercial refrigeration equipment, and to encourage and facilitate stakeholder input during the rulemaking. This document is the starting point for developing standards and is not a definitive statement with respect to any issue to be determined in the rulemaking.

Section 1 provides an overview of the rulemaking process. Sections 2 through 16 discuss analyses DOE intends to conduct to fulfill the statutory requirements and guidance for this standards rulemaking. Although DOE is bundling the above three equipment types into a single rulemaking, it will conduct separate analyses for each equipment type to determine whether energy conservation standards are technologically feasible and economically justified. In other words, for each of the three equipment types examined in this rulemaking, the Department will perform a set of separate analyses, including an engineering analysis, a life-cycle cost and payback period analysis, a national impact analysis, and a manufacturer impact analysis.

Information regarding this rulemaking will be maintained on the DOE website at http://www.eere.energy.gov/buildings/appliance_standards/

This document contains comment boxes that highlight issues on which DOE seeks comment and requests feedback from interested parties. These boxes are also used to ask specific questions on the approaches the Department is proposing to follow in conducting the analyses required for the standards rulemaking. Such requests for stakeholder feedback are numbered according to the section in which they appear.

1.1 The Appliances and Commercial Equipment Standards Program

Part B of Title III of the Energy Policy and Conservation Act (EPCA) sets forth a variety of provisions designed to improve energy efficiency of various products and equipment. Part B of Title III provides for the "Energy Conservation Program for Consumer Products Other Than Automobiles." (42 U.S.C. 6291–6309)

The National Energy Conservation Policy Act (NECPA) amended EPCA to add Part C of Title III (42 U.S.C. 6311-6317), which established an energy conservation program for certain industrial equipment. Part C provides for a program similar to Part B for certain industrial equipment. The Energy Policy Act of 1992 (EPACT 1992), Public Law 102-486, included amendments to EPCA that expanded Title III to include additional commercial equipment. The recent Energy Policy and Conservation Act of 2005 (EPACT 2005), Public Law 109-58, updates several existing standards and test procedures; prescribes definitions, standards, and test procedures for certain new consumer products and commercial equipment; and mandates that the Secretary of Energy (the Secretary) commence rulemakings to develop test procedures and standards for certain new consumer products and commercial equipment.

In particular, section 136(c) of EPACT 2005 amends section 342 of EPCA by adding new subsection 342(c)(4)(A) (42 U.S.C. 6313(c)(4)(A)), which directs the Secretary to issue by rule, no later than January 1, 2009, energy conservation standards for the following equipment, manufactured on or after January 1, 2012: ice-cream freezers; self-contained commercial refrigerators, freezers, and refrigerator-freezers without doors; and remote-condensing commercial refrigerators, freezers, and refrigerator-freezers. This equipment is the subject of this Framework Document.

Additionally, section 136(f)(1)(B) of EPACT 2005 amends section 343 of EPCA (42 U.S.C. 6314) by adding new subsection 343(a)(6)(A)-(D) (42 U.S.C. 6314(a)(6)(A)-(D)), which directs the Secretary to adopt test procedures and establish, by rule, appropriate rating temperatures for the above commercial refrigeration equipment. Accordingly, the Department intends to propose such test procedures and rating temperatures under a separate rulemaking.

Section 136(a)(3) of EPACT 2005 amends section 340 of EPCA by replacing subsection 340(9) (42 U.S.C 6311(9)) with 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 1 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 1 or more refrigerant compressors, refrigerant condensers, condenser fans and motors, and factory supplied accessories."

EPACT 2005 does not explicitly define the terms "self-contained commercial refrigerator, freezer, or refrigerator-freezer" and "remote condensing commercial refrigerator, freezer, or refrigerator-freezer." The Department construes these two terms to mean "commercial refrigerator, freezer, or refrigerator-freezer that is connected to a self-contained condensing unit" and "commercial refrigerator, freezer, or refrigerator-freezer that is connected to a remote condensing unit," respectively.

The Department construes the language in item (vii) of the above EPACT 2005 definition for "commercial refrigerator, freezer, and refrigerator-freezer" to mean that so-called "secondary-coolant applications" are not covered under this rulemaking. The Department believes this interpretation of EPACT 2005 is consistent with the Air-Conditioning and Refrigeration Institute (ARI) Standard 1200-2006, "Performance Rating of Commercial Refrigerated Display Merchandisers and Storage Cabinets," which explicitly excludes 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. 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.

Item 1-1	*The Department seeks comment on whether secondary-coolant applications should be covered under this rulemaking.*

1.2 Overview of the Rulemaking Process

1.2.1 Test Procedures

The Department is developing test procedures and rating temperatures for the commercial refrigeration equipment covered under this rulemaking, as mandated in EPACT 2005, in a separate rulemaking. The test procedure under consideration for the equipment covered under this rulemaking is Air-Conditioning and Refrigeration Institute (ARI) Standard 1200, "Performance Rating of Commercial Refrigerated Display Merchandisers and Storage Cabinets." The current version is ARI 1200-2006.

The Department will issue the final rule in the test procedures rulemaking before it publishes the standards notice of proposed rulemaking (NOPR).

1.2.2 Rulemaking Process and Stakeholder Participation

Under EPCA, when DOE is studying new or amended standards, it must consider to the greatest extent practicable: (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), added by section 136(h)(3) of EPACT 2005) Other statutory requirements are set forth in 42 U.S.C. 6295 (o)(1)–(2)(A), (2)(B)(ii)–(iii), and (3)–(4) and 42 U.S.C. 6316(e).

The Department considers stakeholder participation to be a very important part of the process for setting energy conservation standards. The Department actively encourages the participation and interaction of all stakeholders during the comment period in each stage of the rulemaking. Beginning with the framework document and during subsequent comment periods, interactions among stakeholders provide a balanced discussion of the information that is required for the standards rulemaking.

In conducting the test procedures rulemaking and the energy conservation standards rulemakings, the Department involves stakeholders through formal public notifications (i.e., Federal Register Notices). For this commercial refrigeration equipment energy conservation standards rulemaking, the Department will employ the procedures set forth in the Department's Process Rule (*Procedures for Consideration of New or Revised Energy Conservation Standards for Consumer Products*, 61 FR 36974, July 15, 1996, 10 CFR Part 430, Subpart C, Appendix A) to the extent they are appropriate for the development of energy conservation standards for the commercial refrigeration equipment covered under this rulemaking.

The standards rulemaking process involves three formal, major public notices, which are published in the Federal Register. The first of the rulemaking notices is an advance notice of proposed rulemaking (ANOPR, see section 1.3). The ANOPR is designed to publicly vet the models and tools used in the rulemaking, and to facilitate public participation before the proposed rule stage. The second notice is a notice of proposed rulemaking (NOPR, see section 1.4), which presents a discussion of comments received in response to the ANOPR; analysis of the impacts of standards on consumers, manufacturers, and the nation; the Department's weighting of the impacts; and the proposed standards. The third notice is the final rule (see section 1.5), which presents a discussion of comments received in response to the NOPR; the revised analysis of the impacts of standards; the Department's weighting of the impacts; the standards adopted by DOE; and the effective dates of the standards.

1.3 Advance Notice of Proposed Rulemaking

As part of its initial rulemaking activities, the Department typically identifies the product design options or efficiency levels that it will analyze in detail, and those it should eliminate from further consideration. This process includes a market and technology assessment (see section 3) and a screening analysis (see section 4). These activities include consultations with stakeholders and independent technical experts who can assist with identifying the key issues and design options or efficiency levels to be considered by the Department in the rulemaking.

At the start of the ANOPR analysis, the Department considers efficiency levels for each product class. The Department uses these 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, research and development costs). During the ANOPR stage, DOE presents consumer life-cycle cost (LCC) impact and payback period results (see section 8); national energy savings (NES) and consumer net present value (NPV) results (see section 10) for a range of efficiency or energy use levels; and a preliminary manufacturer impact analysis (MIA) (see section 12).

The Department's selection of efficiency or energy use levels to analyze is based on the costs and benefits of efficiency levels or design options. The Department generally selects levels or design options for consideration that span the full range of technologically achievable efficiencies, specifically including:

1. The highest energy efficiency level or lowest energy consumption level that is technologically feasible (the "max-tech" level);

2. The level with the lowest LCC; and

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

The efficiency or energy use levels analyzed serve to demonstrate the functions and outputs of the models and tools. During the ANOPR, models and tools are tested for the different product classes at each efficiency or energy use level analyzed. In addition, preliminary ANOPR results may facilitate negotiations among interested parties.

The Department will make the results of the analyses available on its website for review and will consider comments on them after the publication of the ANOPR. When the Department publishes the ANOPR, the Department will also make available a technical support document (TSD) containing the details of all the analyses performed to date.

1.4 Notice of Proposed Rulemaking

After the publication of the ANOPR, there is a 75-day public comment period and a public meeting. At this point, the Department encourages stakeholders to develop joint recommendations for standard levels.

After the ANOPR, DOE will conduct further economic impact analyses. These analyses may include refinements of previous analyses, and will include a consumer LCC sub-group analysis (see section 11), a manufacturer impact analysis (see section 12), a utility impact analysis (see section 13), an employment impact analysis (see section 14), an environmental assessment (see section 15), and a regulatory impact analysis (see section 16).

The Department will make the results of all the analyses available on its website for review and will consider comments after the publication of the NOPR. This review and comment process may result in revisions to the analyses. This analytical process ends with the selection of proposed energy conservation levels that will be presented in the NOPR. The Department selects the proposed standard levels from the trial standard levels analyzed. The NOPR, published in the Federal Register, will document the evaluation and selection of any proposed standards.

For each product class, the Department will identify the maximum improvement in energy efficiency or maximum reduction in energy use that is technologically feasible. If the Department proposes a level that is below this "max-tech" level, it will explain the reasons for eliminating higher levels beginning with the highest level considered. The Department will present the results of the analysis in the NOPR and the details of the analysis in an accompanying TSD.

The Department considers many factors in selecting proposed standards. These factors or criteria are established by statute and capture the many benefits, costs, and impacts of the standards. Additionally, the Department encourages stakeholders to develop joint recommendations for standard levels. The Department will carefully consider such recommendations in its decision process.

When the Department publishes the NOPR, it will provide the Department of Justice (DOJ) with a copy of the NOPR and TSD and will solicit feedback on the impact of the proposed standard levels on competition. The DOJ will review these standard levels in light of any lessening of competition that is likely to result from the imposition of standards. The Department will consider DOJ's determination on the impacts of the proposed standard on competition in preparing the final rule. The NOPR is followed by a 75-day public comment period that includes one public meeting.

1.5 Final Rule

Revisions to the analyses may result from the public comments on the NOPR. On the basis of the public comments, DOE will review the engineering and economic impact analyses and proposed standards and make modifications as necessary.

After the publication of the NOPR, the Department will conduct a thorough review of all analyses performed, and of the trial standard levels. Final revisions to the analyses and trial standard levels will be made as appropriate.

Before the final rule is issued, the Department will consider DOJ comments on the NOPR relating to the impacts of the proposed standard levels on competition to determine whether changes to these standard levels are needed.

The standards rulemaking will conclude with the publication of the final rule. The Department will select the final standard levels based on the complete record of the standards rulemaking. The final rule will promulgate the final standard levels and their effective date and explain the basis for their selection. The final rule will be accompanied by a final TSD.

1.6 Overview of Commercial Refrigeration Equipment

The commercial refrigeration equipment covered under this rulemaking consists of three types of equipment, as listed in section 136(a)(3) of EPACT 2005 and addressed above:

1. Ice-cream freezers;
2. Self-contained commercial refrigerators, freezers, and refrigerator-freezers without doors; and
3. Remote condensing commercial refrigerators, freezers, and refrigerator-freezers.

These three types of equipment are discussed in sections 1.6.1, 1.6.2, and1.6.3.

1.6.1 Ice-Cream Freezers

Sections 136(c) and (f) of EPACT 2005 require that the Department establish energy conservation standards and test procedures for ice-cream freezers; however, EPACT 2005 does not define or specify any restrictions or qualifications on the term "ice-cream freezer." For purposes of these rulemakings, DOE will review existing State, International, and voluntary definitions, and will establish a definition for "ice-cream freezer." Based on its initial review of existing definitions, the Department is currently considering the following definition:

> " The term 'ice-cream freezer' means a commercial freezer that is designed to operate at or below -5°F (-21°C) and that the manufacturer designs, markets, or intends for the storing, displaying, or dispensing of ice-cream."

Several types of freezer could be covered as ice-cream freezers under this definition, including:

1. chest- or coffin-style and upright-style ice-cream and frozen-novelty display cases with transparent doors, which are commonly used in convenience, grocery, and similar stores for product sales;

2. chest- or coffin-style and upright-style ice-cream and frozen novelty storage cases with solid doors, which are commonly used in convenience, grocery, and similar stores for product storage;

3. ice-cream dipping-cabinets, which are commonly seen in ice-cream parlors and from which servers scoop ice-cream by hand for serving in cones, dishes, and similar containers; and

4. soft-serve ice-cream extruders, which are used to serve or self-serve soft-serve ice-cream into a dish or cone at restaurants, ice-cream parlors, cafeterias, and similar food-service locations.

Item 1-2 *The Department is not aware of any industry-standard test methods for ice-cream dipping-cabinets or soft-serve ice-cream extruders. The Department requests information on what, if any, test methods exist for these types of equipment. The Department seeks comment on how it should address these types of equipment in this rulemaking. Should soft-serve ice-cream extruders and ice-cream dipping-cabinets be considered "ice-cream freezers"?*

Item 1-3 *The Department seeks comment on the definition of "ice-cream freezer."*

Item 1-4 *In what way are ice-cream freezers different from commercial freezers? The Department requests feedback on whether it should establish energy conservation standards for ice-cream freezers that are different and apart from other commercial freezers.*

Item 1-5 *The Department seeks comment on whether to extend energy conservation standards for self-contained commercial freezers with doors and without doors to ice-cream freezers with doors and without doors, respectively.*

1.6.2 Self-Contained Commercial Refrigerators, Freezers, and Refrigerator-Freezers without Doors

As defined in section 1.1, a self-contained commercial refrigerator, freezer, or refrigerator-freezer is a type of commercial refrigeration equipment that is connected to a self-contained condensing unit. Self-contained commercial refrigeration equipment without doors is generally used in grocery and similar retail stores and in cafeteria-style food service venues for displaying and merchandising food products that include delicatessen items, eggs, meat, produce, seafood, prepared foods, beverages, frozen foods, and dairy items.

Item 1-6	*What, if any, self-contained commercial refrigeration equipment without doors does not meet the EPACT 2005 definition?*

As stated in section 1.1, the Department must establish energy conservation standards for self-contained commercial refrigerators, freezers, and refrigerator-freezers without doors. However, EPACT 2005 does not specify a definition for "commercial refrigerator-freezer."

The term "electric refrigerator-freezer" is defined for residential products in the Code of Federal Regulations (10 CFR section 430.2) as:

> " … a cabinet which consists of two or more compartments with at least one of the compartments designed for the refrigerated storage of food at temperatures above 32°F. and with at least one of the compartments designed for the freezing and storage of food at temperatures below 8°F which may be adjusted by the user to a temperature of 0°F. or below. The source of refrigeration requires single phase, alternating current electric energy input only."

Item 1-7	*How could this definition be modified to be applicable to self-contained commercial refrigerator-freezers without doors?*

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

As defined in section 1.1, 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 on a large scale. In addition, remote condensing equipment with doors is used for food storage in commercial locations where food is prepared and/or served, such as hotels and restaurants.

EPACT 2005 defines a "self-contained condensing unit," in part, as "an integral part of the refrigerated equipment" and a "remote condensing unit," in part, as being "remotely-located from the refrigerated equipment." (EPACT 2005, Section 136(a)(3)) The Department believes this difference in language may mean that a remote condensing unit is not a part of the refrigerated equipment. The Department is therefore considering developing 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. The Department believes that this approach is consistent with ARI Standard 1200-2006.

Item 1-8	*The Department seeks comment on regulating the energy consumption of the refrigerated equipment, but not the associated remote condensing unit for remote condensing commercial refrigerators, freezers, and refrigerator-freezers.*
Item 1-9	*What, if any, remote condensing commercial refrigeration equipment does not meet the EPACT 2005 definition?*

Item 1-10 How could the above definition for electric refrigerator-freezer be modified to be applicable to remote condensing commercial refrigerator-freezers?

2 ANALYSES FOR RULEMAKING

Ultimately, the Department intends to select energy conservation standards that achieve the maximum improvement in energy efficiency that is technologically feasible and economically justified. The selection of such standards is expected to achieve the maximum energy savings that are economically justified without putting an unjust financial burden on any particular party. Economic justification includes consideration of the economic impacts on domestic manufacturers and consumers, national benefits including environmental impacts, issues of consumer utility, and impacts from any lessening of competition. The purpose of the analyses conducted in support of the standards rulemaking will be to insure that the final standards meet these criteria of technological feasibility and economic justification.

This section offers an overview of DOE's analytical methodology and discusses the major components of the analyses DOE will conduct. A consistent approach to analysis throughout the rulemaking will be ensured through the consideration of each analysis as a part of the overall standards-setting framework.

Figure 1 summarizes the analytical components of the 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 will be used to obtain key inputs. For example, some key inputs exist in public databases, some will be collected from stakeholders or others with special knowledge, and some will be developed by the project team in support of the rulemaking. The results of each analysis are key outputs, which feed directly into the rulemaking. Dotted lines connecting one analysis to another indicate the flow of information.

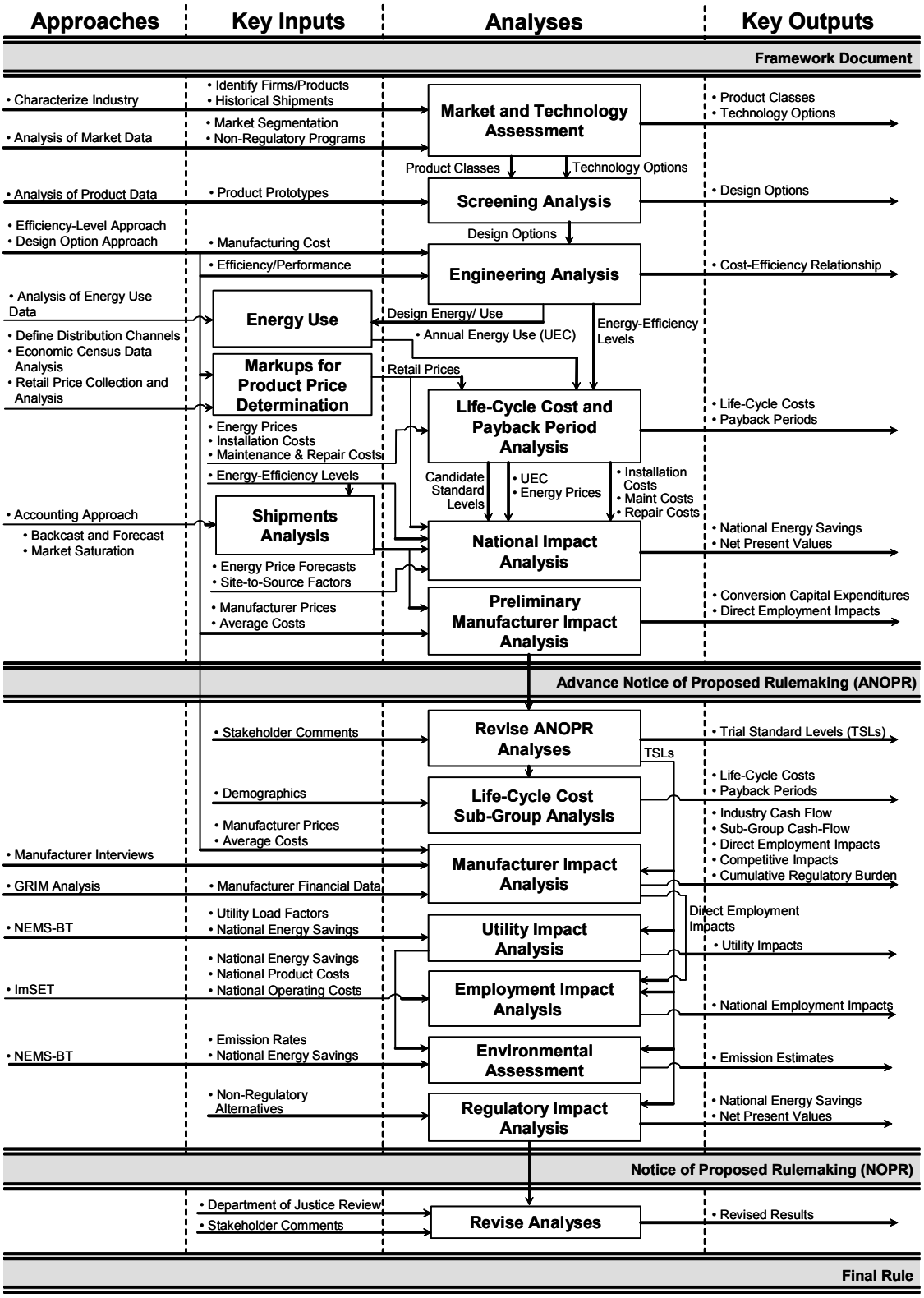

Figure 1. Flow Diagram of Analyses for the Commercial Refrigeration Equipment Standards Rulemaking Process

3 MARKET AND TECHNOLOGY ASSESSMENT

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

3.1 Market Assessment

The Department will qualitatively and quantitatively characterize the structure of the commercial refrigeration industry and market. In the market assessment, the Department 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 manufacturing of such equipment.

The Air-Conditioning and Refrigeration Institute (ARI), and specifically the Commercial Refrigeration Manufacturers Division (CRMD) of ARI, is the trade association for manufacturers of equipment covered under this rulemaking. The Department expects that ARI will play a critical role in providing market information, including input on characterizing current and historical trends in equipment shipments and energy efficiency.

As stated above, the collected information will serve as a resource for use throughout the rulemaking. For example, the Department will use historical equipment shipments and prices as an aid in creating shipment scenarios and predicting future prices. Market structure data will be particularly useful for assessing competitive impacts as part of the manufacturer impact analysis.

The commercial refrigeration equipment covered under this rulemaking has never before been the object of energy conservation regulation at the Federal level. The Department understands that little or no energy consumption or energy efficiency data are available for this equipment. In addition, a preliminary investigation by the Department indicates that there are little or no data available on product classes for this equipment, the cost of manufacturing this equipment, manufacturers' market shares, shipments, or channels of distribution. Such data are essential to the development of technologically feasible, economically justified energy conservation standards. Stakeholders are therefore encouraged to submit any available, applicable data to the Department for consideration.

Item 3-1	*The Department seeks information that would contribute to the market assessment (e.g., the manufacturers of this equipment in the United States and the products they sell, by product class). It is particularly important that the Department be aware of the major and small/niche manufacturers?*

Item 3-2	*The Department seeks information on annual product shipments from 1990 to 2005 (both domestic and imports), and the corresponding shipment-weighted average efficiency of these shipments. Additionally, what units of measure are typically used for annual shipments of this equipment (e.g., cases per year, linear-feet per year, square-feet per year (display-area-based), cubic-feet per year (refrigerated-volume-based), etc)?*

3.2 Product Classes

The Department intends to separate the commercial refrigeration equipment covered under this rulemaking into product classes. The criteria for separation into different classes are: type of energy used and capacity or other performance-related features, such as those that provide utility to the consumer or others deemed appropriate by the Secretary, that justify the establishment of a separate energy conservation standard. (42 U.S.C. 6295(q) and 6316(e) added by section 136(h)(3) of EPACT 2005)

The Department proposes the product classes listed below, defined according to equipment characteristics such as door-type and orientation. The proposed product classes differentiate equipment without doors by orientation because the Department expects that orientation provides utility that has a significant impact on the energy efficiency and energy consumption of equipment without doors.

1. Self-contained commercial refrigerators without doors
   - (a) horizontal
   - (b) semi-vertical
   - (c) vertical

2. Self-contained commercial freezers without doors
   - (a) horizontal
   - (b) semi-vertical
   - (c) vertical

3. Self-contained commercial refrigerator-freezers without doors
   - (a) horizontal
   - (b) semi-vertical
   - (c) vertical

4. Remote condensing commercial refrigerators with doors
   - (a) solid doors
   - (b) transparent doors

5. Remote condensing commercial refrigerators without doors
   - (a) horizontal
   - (b) semi-vertical
   - (c) vertical

6. Remote condensing commercial freezers with doors
   (a) solid doors
   (b) transparent doors

7. Remote condensing commercial freezers without doors
   (a) horizontal
   (b) semi-vertical
   (c) vertical

8. Remote condensing commercial refrigerator-freezers with doors
   (a) solid doors
   (b) transparent doors

9. Remote condensing commercial refrigerator-freezers without doors
   (a) horizontal
   (b) semi-vertical
   (c) vertical

10. Ice-cream freezers with doors
    (a) solid doors
    (b) transparent doors

11. Ice-cream freezers without doors
    (a) horizontal
    (b) semi-vertical
    (c) vertical

Item 3-3	*The Department requests feedback on the proposed classes for the commercial refrigeration equipment covered under this rulemaking, and the criteria used in creating the classes.*
Item 3-4	*Can the terms "horizontal," "semi-vertical," and "vertical" be used to describe equipment orientation? If so, how should these be defined (e.g., based on the angle of the air-curtain or load-line with the vertical, with 0–30° being vertical, 30–60° being semi-vertical, and 60–90° being horizontal)?*
Item 3-5	*What product classes, if any, can be combined for standards-setting purposes because of their similarities?*
Item 3-6	*Can analyses for any one of these product classes be applied or extrapolated to another product class?*
Item 3-7	*Should all of these product classes be considered (e.g., do any of these product classes have few or no shipments)?*
Item 3-8	*Would it be appropriate to extend the standards prescribed for self-contained commercial refrigeration equipment with doors in EPACT 2005 to similar remote condensing equipment with doors and ice-cream freezers with doors covered in this rulemaking? If so, what methodology would be appropriate?*

The energy conservation standards prescribed in EPACT 2005 for self-contained commercial refrigerators, freezers, and refrigerator-freezers with doors take the form of upper limits on daily energy consumption as a function of the volume of the refrigerated space.

Metrics were not specifically established in EPACT 2005 for any of the commercial refrigeration equipment covered under this rulemaking.

Item 3-9	*The Department seeks feedback on appropriate test metrics for the commercial refrigeration equipment covered under this rulemaking (e.g., a metric based on volume for equipment with doors and a metric based on case length, total display area or volume for products without doors).*

3.3 Technology Assessment

The Department typically uses information about existing and past technology options and prototype designs as input in identifying technologies manufacturers could use to attain higher energy efficiency levels. In consultation with interested parties, the Department intends to develop a list of technologies that should be considered in the analysis. Initially, this list will include all those technologies considered to be technologically feasible and will serve to establish the maximum technologically feasible design. In the screening analysis, DOE will eliminate from consideration technologies that have not been incorporated in commercial equipment or in working prototypes, or that fail to meet certain criteria as to practicability to manufacture, install, and service, as to impacts on product utility or availability, or as to health or safety. (Process Rule, sections 4(a)(4) and 5(b))

The Department is collecting information on technologies that could be used to improve the energy efficiency of commercial refrigeration equipment. The Department is currently considering the specific technologies and designs listed below.

The following technologies and designs are relevant to all product classes:

1. Higher efficiency lighting (e.g., T8 fluorescent lamps, light-emitting diodes (LEDs));
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 (TXVs) and electronic expansion valves (EEVs));
5. Higher efficiency evaporator fan motors (e.g., electronically commutated motors (ECM));
6. Increased evaporator surface area or efficiency to achieve lower case-evaporator temperature differential (with a possible increase in fan energy);
7. Evaporator-fan-motor controllers;
8. Higher efficiency evaporator fan blades;
9. Low-pressure-differential evaporators;
10. Anti-sweat heater controls;
11. Case-insulation increases or improvements;
12. Defrost mechanism (hot-gas defrost rather than electric defrost); and
13. Defrost-cycle control (partially or fully demand-based defrost rather than partially or fully time-based defrost).

The following design is relevant to equipment without doors only:

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

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 (LSHX) (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., electronically commutated motors (ECM));
5. Condenser-fan-motor controllers; and
6. Higher efficiency condenser fan blades.

Item 3-10	*What technologies or designs, if any, should be added to or removed from the above list?*

3.4 Baseline Units

Once the Department establishes product classes, it will select a baseline model as a reference point for each product class, against which it can measure changes resulting from energy conservation standards. The baseline model in each product class represents the characteristics of equipment in that class. Typically, a baseline model would be a model that just meets current required energy conservation standards. Because there are no existing standards for the commercial refrigeration equipment covered under this rulemaking, the Department will select baseline models using a different method (e.g., the unit with the highest energy consumption or the typical unit). The Department proposes to use information provided by stakeholders in selecting appropriate baseline models.

Item 3-11	*The Department seeks feedback on how to select a baseline model for each product class.*

The Department will use the baseline models in the engineering analysis and the life-cycle cost and payback-period analysis. To determine energy savings and changes in price, the Department will compare each higher-energy-efficiency or lower-energy-consumption design option with the baseline model.

Item 3-12	*The Department seeks information on what particular components and features characterize the baseline model in each product 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 SCREENING ANALYSIS

The purpose of the screening analysis is to screen out design options that will not be considered in the rulemaking for commercial refrigeration equipment.

In consultation with interested parties, the Department will develop a list of design options for consideration. Initially, the candidate design options will encompass all those technologies considered to be technologically feasible. Following development of this initial list of design options, the Department will review each design option based on the following four criteria, as addressed in sections 4(a)(4) and 5(b) of the Process Rule:

1. *Technological feasibility.* Technologies that are not incorporated in commercial products or in working prototypes will not be considered further.

2. *Practicability to manufacture, install, and service.* If it is determined 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 at the time of the effective date of the standard, then that technology will not be considered further.

3. *Impacts on product utility to consumers.* If a technology is determined to have significant adverse impact on the utility of the product to significant subgroups of consumers, or 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 be considered further.

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

The reasons for eliminating any design options during the screening analysis will be fully documented and published as part of the ANOPR.

5 ENGINEERING ANALYSIS

After conducting the screening analysis, the Department performs an engineering analysis based on the remaining design options. Potentially, as a result of screening out some design options which may enable the achievement of the highest efficiencies, the Department may, in effect, be limiting the efficiency levels considered in the engineering analysis. 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 discusses the approach for determining the cost-efficiency relationship (section 5.2), manufacturer prices (section 5.3), proprietary designs (section 5.4), and regulatory changes outside the realm of the Department's energy conservation standards process, or outside regulatory changes, that affect the engineering analysis (section 5.5).

5.1 Engineering Analysis Overview

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

The Department will obtain cost estimates for the engineering analysis (which it will also use in the manufacturer impact analysis) from detailed incremental cost data disaggregated into the cost of incremental material, labor, and overhead. The Department will create an industry-wide

analysis based primarily on the manufacturer-supplied data. The Department may supplement this analysis with cost estimates of specific design options.

Therefore, the Department seeks design, efficiency, and cost information to determine the cost of improving the efficiency of the baseline model. In addition, the Department must identify the model with the highest efficiency that is technologically feasible within each product class (i.e., the "max tech" model).

Item 5-1	*For each product class, the Department seeks information on incremental manufacturing costs and components (see Item 3-12) for four energy-efficiency levels above the baseline (e.g., daily energy consumption, what components are different from the baseline, material costs[1], labor costs[2], overhead costs[3] (excluding depreciation), building conversion capital expenditures, tooling/equipment conversion capital expenditures, R&D expenses, marketing expenses, etc.).*
Item 5-2	*The Department is also interested in any equipment test data that stakeholders can provide (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 for the baseline model in each product class is particularly important.*

5.2 Proposed Approach for Determining the Cost-Efficiency Relationship

In support of this rulemaking effort, the Department seeks to collect incremental cost data. The data are intended to represent the average incremental production cost to improve a baseline model to a specified efficiency level. The Department will aggregate the data by weighting each individual data point by company-level sales volumes for each product class. This methodology constitutes an efficiency-level approach to the engineering analysis because the Department will examine aggregated incremental increases in manufacturer selling price at specified levels of energy efficiency.

To be useful in the manufacturer impact analysis, manufacturer cost information should reflect the variability in baseline models, design strategies, and cost structures that can exist among manufacturers. The Department will attempt to qualify the aggregated cost-efficiency data supplied by stakeholders through engineering expertise and consultation with stakeholders or

[1] 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 are not assigned to final products (e.g., lubricating oil for production machinery).

[2] The 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.

[3] Factory overhead excluding depreciation. 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 selling, general, and administrative costs (SG&A); research and development (R&D); interest; or profit (accounted for by the Department separately).

technical experts. Specifically, the Department will supplement these aggregated cost data with information obtained through follow-up manufacturer interviews. These confidential interviews will provide a deeper understanding of the various combinations of technologies used to increase equipment efficiency, and their associated manufacturing costs.

If the Department is unable to reconcile information collected during the manufacturer interviews with the aggregated cost data, or with information contained in the market and technology assessment, the Department will supplement the manufacturer-provided data through a design options approach involving consultation with outside experts and/or further review of publicly available cost and performance information.

The Department will estimate the contribution of the depreciation of conversion capital expenditures to the incremental overhead. During the interviews, the Department will gather information about the capital expenditures that would be necessitated by increasing the efficiency of the baseline models to various efficiency levels (i.e., conversion capital expenditures by efficiency or energy use level). The Department will also request information about the depreciation method used to expense the conversion capital.

The approach proposed above will allow the Department to represent commercial refrigeration equipment throughout the entire efficiency range without depending on time-consuming simulation modeling. The Department will maintain the confidentiality of proprietary data while allowing the public to examine the cost and design assumptions that underlie the cost-efficiency estimates.

Item 5-3	*The Department requests feedback on the use of an efficiency-level approach to determining the relationship between manufacturer selling price and energy efficiency for commercial refrigeration equipment, supported, as needed, by a design-options approach.*

5.3 Manufacturer Prices

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

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

5.4 Proprietary Designs

The Department will consider in its engineering and economic analyses all design options that have not been screened out, including proprietary designs. The Department will consider proprietary designs in the subsequent analyses only if it is not 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 the efficiency level (that can only be achieved by a proprietary design) from further analysis. Furthermore, the Department is sensitive to manufacturer concerns regarding proprietary designs and will make provisions to maintain the confidentiality of any proprietary

data submitted by manufacturers. This information will provide input to the competitive impacts assessment and other economic analyses.

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

5.5 Outside Regulatory Changes Affecting the Engineering Analysis

In conducting an engineering analysis, the Department must consider the effects of regulatory changes outside the Department's statutory energy conservation standards rulemaking process that can impact the manufacturers of the covered equipment. Some of these changes can also affect the energy efficiency or energy consumption of the covered equipment. For example, due to the phase-out of chlorofluorocarbons (CFCs) and hydrochlorofluorocarbons (HCFCs), the commercial refrigeration industry must transition to non-ozone-depleting refrigerants. As a result, the industry will likely use hydrofluorocarbon-based (HFC-based) refrigerants in their products.

The Department will attempt to identify all such outside engineering issues that could impact the engineering analysis. The consideration of these issues is closely related to the cumulative regulatory burden assessment that the Department will carry out as part of the manufacturer impact analysis.

Based on consideration of the comments received for the ANOPR, DOE will make the necessary changes to the analysis. These changes will be reflected in the documentation of the NOPR.

Item 5-6	*Are there additional outside issues that the Department should consider in its analysis of commercial refrigeration equipment?*

6 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, the Department 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 and its effect on building heating and cooling loads 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 Arthur D. Little, Inc., Southern California Edison, Lawrence Berkeley National Laboratory, and Caneta Research 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

product 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 national impact analysis necessary for this rulemaking.

The recent energy conservation standards rulemaking on commercial unitary air conditioners and heat pumps utilized the Energy Information Administration's (EIA) Commercial Building Energy Consumption Survey (CBECS) as a basis for characterizing the types of buildings that used the covered equipment. This was necessitated by the diversity of types, occupancies, and characteristics of buildings using this type of heating and cooling equipment, all of which strongly influence heating and cooling loads and equipment energy consumption. For buildings using commercial refrigeration equipment, the primary energy consumption and demand impact will be from the energy and power use of the equipment itself, with building characteristics having only a secondary impact.

The Department proposes to define two specific building prototypes (a grocery store and a convenience store) for modeling energy impacts. The Department will use whole building energy analysis software with the capability to model refrigeration equipment to model the building prototypes in different climate regions to capture the commercial refrigeration energy use, whole building energy use, and peak-demand impacts.

Item 6-1	*The Department seeks stakeholder input on whether the impact of higher efficiency refrigeration equipment on the building space conditioning loads is significant enough to warrant taking them into account in the energy analysis, and if so, what methods could be used to estimate the net energy consumption and load impacts of higher efficiency commercial refrigeration equipment in buildings using this equipment.*
Item 6-2	*The Department specifically requests input on the viability of defining a limited set of building prototypes for each equipment class in order to characterize energy use. If a limited set of building prototypes is acceptable, the Department seeks stakeholder input on how to properly characterize the building prototypes.*
Item 6-3	*The Department seeks data or data sources that could be used to characterize the energy use and loading of commercial refrigeration equipment.*
Item 6-4	*The Department seeks feedback on this approach to the energy use and end-use load characterization.*

7 MARKUPS FOR EQUIPMENT PRICE DETERMINATION

The Department 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 payback period analysis and the manufacturer impact analysis. Retail prices are needed for the baseline efficiency level and all other efficiency levels under consideration. The Department will obtain these retail prices by applying manufacturer-to-consumer markups to the

manufacturer-selling-price estimates. To validate these markups, the Department will attempt to collect data on existing prices in the market either by purchasing large data sets or by downloading data from distributor Internet sites.

Before it can develop markups, the Department 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 product classes, DOE will rely on economic census data from the United States Census Bureau and input from the industry to define how products are marked up from the manufacturer to the consumer. To the extent possible, the Department also will use collected retail price data to help qualify overall manufacturer-to-consumer markups.

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

In the past, the Department has done a great deal of work to estimate manufacturer-to-consumer markups for residential air-conditioning products and commercial air-conditioning equipment. In the recent commercial unitary air-conditioner (CUAC) rulemaking, analysis of distribution-chain markups focused on three distribution-chain paths and calculated markups for individual points along these paths. Two of these paths involved sales of product through a mechanical contractor and then through a general contractor before reaching the final customer (82.5% of sales). A third "national account" path involved sales directly from manufacturer to the end consumer/customer (17.5% of sales). The CUAC analysis noted that in the case of replacement equipment (approximately 70 percent of the CUAC market), a general contractor typically was not involved and therefore no general contractor markups were incurred for replacement equipment.

The Department's review of information for commercial refrigeration equipment distribution suggested a set of three distribution chains would be appropriate, described as follows:

Manufacturer → Distributor → Mechanical Contractor → Consumer

Manufacturer → Distributor → Consumer

Manufacturer → Customer (National Account)

The Department's understanding is that a general contractor would not normally enter into the distribution path for this equipment. The Department understands that the relative fractions of equipment distributed in each path could be different depending on whether the equipment is self-contained or remote condensing.

Item 7-1	*The Department requests information from stakeholders on whether the distribution paths for the commercial refrigeration equipment covered under this rulemaking would be similar to those for CUAC, and, if not, how the two might differ. The Department also requests information on the relative fractions of shipments expected for each path in an appropriate distribution chain for the commercial refrigeration equipment covered under this rulemaking.*

The CUAC analysis of wholesaler markups used data from a 1998 Air-Conditioning & Refrigeration Wholesalers Association (ARW) profit survey. The ARW is now part of the Heating, Air-Conditioning, and Refrigeration Distributors International (HARDI).[4] HARDI represents wholesalers for the commercial refrigeration equipment covered under this rulemaking, as well as other HVAC products.

The Department based the CUAC analysis of mechanical contractor markups on analysis of financial data from the Air Conditioning Contractors of America and direct revenue reported per dollar of direct sales costs. The Department used these data to develop both average markups for mechanical contractors and incremental markups. Incremental markups assume that certain industry costs, such as labor and building occupancy expenses, do not increase with an increase in cost of goods sold, but that other costs would scale with cost of goods sold.

The Department based the CUAC analysis of general contractor markups on United States Census bureau data for the commercial and institutional building construction sector. These data are not disaggregated by individual firms, but examines the sector as a whole. Sector-average data for general contractors were developed in terms of contractor revenue per dollar of direct sale costs. The Department used this data to develop both average markups for the general contractors and incremental markups. Incremental markups assume that certain industry costs, such as labor and building occupancy expenses, do not increase with an increase in cost of goods sold.

The overall markups developed for the CUAC analysis resulted in a multiplier of 2.31 for the manufacturer price for the average markups in the distribution chain, and a multiplier of 1.56 for the incremental markup. These multipliers were applied to any increase in manufacturer prices that resulted from standards for higher efficiency equipment. Both markups include an average multiplier of 1.07 to account for sales tax applied at the last stage of the distribution chain.

The Department's intention is to develop both average and incremental markups in the LCC analysis, and to base the LCC analysis on the incremental markups developed.

Item 7-2	*The Department requests feedback on if the overall markups for the commercial refrigeration equipment covered under this rulemaking for each path in the distribution chain are likely to be similar to those developed for commercial unitary air conditioners for the same distribution paths.*

[4] HARDI is a recent consolidation of two long-time wholesale trade organizations—the North American Heating, Refrigeration & Air-Conditioning Wholesalers (NHRAW) and the Air-Conditioning & Refrigeration Wholesalers International (ARWI).

Item 7-3	*The Department requests feedback on its proposal to use incremental distribution chain markups for the LCC analysis.*
Item 7-4	*The Department seeks comment on other sources of relevant data that could be used to characterize markups for the commercial refrigeration industry.*

8 LIFE-CYCLE COST AND PAYBACK PERIOD ANALYSIS

8.1 Overview

The effects of new energy conservation standards on equipment result in changes in operating expenses—usually a decrease—and changes in purchase price—usually an increase. In the past, the Department has analyzed the net effect of new standards on consumers by evaluating the net LCC using the cost-efficiency relationship derived in the engineering analysis, as well as the energy costs derived from the energy use and end-use load characterization analysis. Inputs to the LCC calculation include the installed cost to the consumer (purchase price plus installation cost), operating expenses (energy expenses and maintenance costs), the lifetime of the appliance, and a discount rate.

The installed and operating costs of equipment typically change in response to new standards (installed cost typically increases while operating cost typically decreases). Thus, there is a specific time in the life of higher-than-baseline efficiency equipment when the net operating cost benefit (in dollars) from the time of purchase is equal to the incremental first cost of purchasing the higher efficiency equipment. The length of time required for equipment to reach this cost-equivalence point is known as the payback period.

For the ANOPR, the Department will conduct the LCC and payback period analysis using typical values to reflect the conditions in the field for equipment life, equipment retail price, national or regional energy costs, energy consumption, and discount rates. If the Department determines that there is significant variability in any of the above inputs, it will conduct sensitivity analyses to determine how high and low estimates for each of the inputs affect the LCC and payback period. For any sensitivity analyses it conducts, the Department will account for correlations that may exist between inputs (e.g., there may be a correlation between energy usage and energy prices). The life-cycle cost subgroup analysis will be conducted for the NOPR and will include an assessment of impacts on subgroups of consumers.

For commercial refrigeration equipment, it will be necessary to determine several values for the LCC estimation, including retail prices; electricity prices; discount rate; maintenance, service and installation costs; and equipment lifetimes. The following sections discuss the methodologies the Department plans to use in determining these values.

8.2 Energy Prices

The Department will review EIA's energy price data for commercial refrigeration equipment as a means of establishing electricity and natural gas prices. The Department's inclination is to rely on regional average energy price data for the commercial sector. The Department will use

projections of these energy prices for commercial consumers to estimate future energy prices in its life-cycle cost and payback period analysis. The Department will use EIA's *Annual Energy Outlook* (*AEO*) as the default source of projections for future energy prices.

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

8.3 LCC Discount Rates

The calculation of consumer LCCs requires the use of an appropriate discount rate. For commercial refrigeration equipment, the Department plans to use the same approach it relied on for developing discount rates for commercial unitary air conditioners and distribution transformers. This approach involves deriving the discount rates for commercial consumers by estimating the cost of capital to companies that purchase commercial refrigeration equipment covered under this rulemaking. The Department commonly uses the cost of capital to estimate the present value of cash flows to be derived from a typical company project or investment. Most companies use both debt and equity capital to fund investments, so the cost of capital is the weighted-average cost to the firm of equity and debt financing. This corporate finance approach is referred to as the weighted-average cost of capital (WACC). Companies that purchase commercial refrigeration equipment may differ from those that purchase commercial unitary air conditioners or distribution transformers, which may result in different discount rates.

The Department will make the discount rates and associated calculations public at the time of the ANOPR publication. Stakeholders may comment on this issue during the ANOPR comment period.

Item 8-2	*The Department seeks comment on the proposed approaches for estimating discount rates for consumers using 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 should be considered in the evaluation of discount rates? In addition, do stakeholders feel government purchases of this equipment are large enough to require that they be included in the evaluation of discount rates?*

8.4 Maintenance, Repair, and Installation Costs

The Department will consider expected changes to maintenance, repair, and installation costs for the equipment covered in this rulemaking. Typically, small incremental changes in equipment efficiency incur no, or only very small, changes in repair and maintenance costs over baseline products. There is a greater probability that equipment with efficiencies that are significantly greater than the baseline will incur increased repair and maintenance costs since such equipment is more likely to incorporate technologies that are not widely available. The Department will

rely on input from manufacturers and other stakeholders in developing appropriate repair and maintenance costs if stakeholders feel such estimates are necessary.

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

Item 8-4	*The Department seeks feedback on whether it is correct to assume that changes in 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, the Department seeks comment on appropriate methodologies for assessing changes to each of these costs.*

8.5 Equipment Lifetimes

The Department will use information from various literature sources (e.g., *Appliance Magazine*, handbooks published by the American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE), etc.) and input from manufacturers and other stakeholders to establish average equipment lifetimes for use in the life-cycle cost and subsequent analyses.

Based on consideration of the comments received for the ANOPR, the Department will make necessary changes to the analyses. These changes will be reflected in the documentation of the NOPR.

Item 8-6	*The Department seeks comment on appropriate equipment lifetimes for the equipment covered in this rulemaking.*

9 SHIPMENTS ANALYSIS

Shipment forecasts are required to calculate the national impacts of standards on energy, NPV, and future manufacturer cash flows. The Department 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, the Department 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 the Department does not adopt new energy conservation standards for the equipment covered under this rulemaking. In determining the base case forecast, the Department will consider historical shipments, the mix of efficiencies sold in the absence of standards, and how that mix might change over time. For these purposes, the Department needs data on historical product shipments and the market shares of the different efficiency levels offered in each product class.

Appliance Magazine reports historical shipments for commercial refrigerated display cases as an overall product group. The United States Bureau of the Census (the Bureau) has also published limited statistics on the quantity and value of product shipments for those companies with shipments over $100,000 in both 1997 and 2002. While the Bureau data identifies several product classes separately, the data by product class are limited. Data for remote condensing and self-contained refrigeration products are provided separately. Additionally, the data provides the dollar-value of shipments rather than the actual shipment quantities in most cases.

The Department hopes to collect shipment data within each product class, as well as market-share efficiency data (i.e., data on the distribution of product shipments by efficiency) for each product class. The Department 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, the Department may use efficiency distributions based on available models as a proxy. The Department may also request separate shipment information for products sold with specific design features (e.g., ECM evaporator fan motors).

9.2 Accounting Methodology

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

The Department will also consider any other input provided by stakeholders.

Item 9-1	*The Department seeks information on representative saturation rates for each product class covered under this rulemaking, as well as industry-trend data regarding relative growth in each product class.*

9.3 Standards Impacts on Product Shipments

For each product, the Department will develop a set of shipment forecasts for the covered equipment for each set of standards analyzed. These standards case forecasts will be used to evaluate the impacts of standards on product 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 standards, forecasted shipments typically 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 product shipments relative to the base case.

The Department'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, the Department will consider modeling standards case shipments forecasts with scenarios (i.e., specified impacts to product 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 products and manufacturer tax credits that encourage the production of more-efficient products, also affect standards case forecasts. When such programs exist, the Department considers their impact on the forecast of both standards case and base case shipments.

Item 9-2	*As part of its preliminary manufacturer impact analysis, the Department will seek input from manufacturers on the potential impact of new energy conservation standards on product shipments. Other stakeholders are also welcome to provide input. The Department also requests input on any market-pull programs that currently exist to promote the adoption of more-efficient products.*

10 NATIONAL IMPACT ANALYSIS

Section 8 discusses methods for estimating the LCC savings and payback period for individual consumers. This section discusses the Department's assessment of the aggregate impacts at the national level. Measures of impact to be reported include the NPV of total consumer LCCs and national energy savings.

10.1 Inputs to Forecast

Analyzing national 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 8.1. Approaches to determining retail prices are described in section 7, while approaches to determining per unit net energy consumption impact are described in section 6.

10.2 Calculation of Energy Savings

The Department intends to calculate national energy consumption for each year beginning with the expected effective date of the standards. It will calculate national energy consumption by fuel type for the base case and each standard level analyzed. The Department plans to perform this calculation through the use of a spreadsheet model that effectively multiplies annual shipment forecasts by unit energy savings.

In response to comments by stakeholders who asked for a simple, transparent model, the Department has developed NES spreadsheet models for its standards rulemakings since 1996.

The Department expects the NES spreadsheet model to provide a credible, stand-alone forecast of national energy savings and NPV for commercial refrigeration equipment.

The Department has prepared NES spreadsheet models for other equipment[5] to forecast energy savings and to demonstrate how the growth in efficiency can be accounted for over time. Although these models are specific to each equipment type, their general structure can be applied to commercial refrigeration equipment.

Based on consideration of the comments DOE may receive on the ANOPR, DOE will make any necessary changes to the analysis. Those changes will be reflected in the documentation for the NOPR.

Item 10-1	*The Department seeks comment on its plan to develop NES spreadsheet models for estimating national impacts of amended energy conservation standards.*

10.3 Net Present Value

The Department 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 and average energy conservation forecasts described in section 9.1. The Department 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). The Department discounts these annual values to the present time and sums them to give an NPV.

Based on consideration of the comments received for the ANOPR, the Department will make any necessary changes to the analysis and candidate standard levels (CSLs). If major changes are required at this stage, the Department will give stakeholders an opportunity to review the revised analysis.

11 LIFE-CYCLE COST SUBGROUP ANALYSIS

This section describes how the Department analyzes consumer impacts by dividing consumers into subgroups and accounting for variations in key inputs to the life-cycle cost analysis. A consumer subgroup comprises a subset of the 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. The Department will work with stakeholders early in the rulemaking process to identify any subgroups for this consideration. However, it will not analyze the consumer subgroups until the NOPR stage of the analysis.

[5] For example, the NES model used in the Commercial Unitary Air Conditioners and Heat Pumps rulemaking is available for examination at:
http://www.eere.energy.gov/buildings/appliance_standards/commercial/docs/nes_cuac.xls

In comparing potential impacts on the different consumer subgroups, the Department 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, the Department 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 stakeholders.

The Department intends to consider the impact of any new standards on consumer subgroups.

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

12 MANUFACTURER IMPACT ANALYSIS

Recently, the Department announced changes to the manufacturer impact analysis format through a report issued to Congress on January 31, 2006 (as required by section 141 of EPACT 2005). This report, entitled "Energy Conservation Standards Activities," (Standards Activities) is available on the DOE website at: http://www.eere.energy.gov/buildings/appliance_standards/2006_schedule_setting.html.

Previously, the Department did not report any manufacturer impact analysis results during the ANOPR phase; however, under this new format, the Department will collect, evaluate, and report preliminary information and data in the ANOPR. (Standards Activities, page 48) Such preliminary information includes the anticipated conversion capital expenditures by efficiency level and the corresponding, anticipated impacts on jobs. The Department will solicit this information during the ANOPR engineering analysis manufacturer interviews.

The analysis of impacts on manufacturers is intended to provide the Department 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 these products. The Department will identify these effects through interviews with manufacturers and other stakeholders.

12.1 Sources of Information

Many of the analyses described earlier provide important information that the Department uses as inputs for the manufacturer impact analysis. 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), and shipments forecasts (section 9.1). The Department supplements this information with information gathered during manufacturer interviews. The interview process will play a key role in the manufacturer impact analysis, as it provides an opportunity for interested parties to express their views on important issues.

The Department will conduct detailed interviews with manufacturers to gain insight into the range of potential impacts of standards. During the interviews, the Department 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. The Department will schedule interviews well in advance to provide every opportunity for key individuals to be available. 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, the Department prefers an interactive interview process because it helps clarify responses and provides the opportunity for additional issues to be identified.

The Department 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, the Department will not make confidential information available in the public record. The Department will also ask participants to identify all information that they wish included in the public record, but that they do not want to have associated with their interview. The Department will incorporate this information into the public record, but will report it without attribution.

The Department will collate the completed interview questionnaires and prepare a summary of the major issues and outcomes. This summary will become part of the technical support document produced for this rulemaking.

Item 12-1 What procedures should the Department 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). The Department uses the GRIM to analyze the financial impacts of more stringent energy conservation standards on the industry that produces the products 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 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. The Department compares the results against base case projections that involve no new standards. The financial impact of new standards is then 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.

The Department will gather this information from two primary sources: the analyses conducted to this point, and interviews with manufacturers and other stakeholders. Information gathered from previous analyses will include financial parameters, manufacturing costs, price forecasts, and shipments forecasts. Interviews with manufacturers and other stakeholders 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 subgroup manufacturers. The Department 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, the Department would consider the impact on every firm individually. In highly concentrated industries, this may be possible. In industries having numerous participants, however, the Department will use the results of the market and technology assessment to group manufacturers into subgroups, as appropriate.

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

12.4 Competitive Impacts Assessment

EPCA directs the Department 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) added by section 136(h)(3) of EPACT 2005) 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) added by section 136(h)(3) of EPACT 2005) The Department will make a determined effort to gather firm-specific financial information and impacts. The Department will then report the aggregated impact of the standard on manufacturers. The competitive impacts assessment will focus on assessing the impacts to smaller, yet significant manufacturers. The Department will provide the Attorney General with a copy of the NOPR for consideration in his evaluation of the impact of standards on the lessening of competition. The Department will base the assessment on manufacturing cost data and on information collected from interviews with manufacturers. The manufacturer interviews will focus on gathering 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, the Department 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. The Department 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 the Department consider in the analysis of cumulative regulatory burden?

13 UTILITY IMPACT ANALYSIS

The utility impact analysis will include an analysis of both the electric and the gas utility industries. The Department is considering adapting the National Energy Modeling System (NEMS) produced by the EIA for this analysis. NEMS (EIA 2005) 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 for the purpose of preparing the Department's *Annual Energy Outlook* (*AEO*). In prior rulemakings, a variant of NEMS (currently termed NEMS-BT, BT referring to the DOE Building Technology Program) was developed to better address the specific impacts of an equipment efficiency standard.

The NEMS produces a widely recognized baseline energy forecast for the United States through the year 2030, and is available in the public domain. The typical NEMS outputs include forecasts of electricity sales, price, and avoided capacity. The Department plans on conducting 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.

Item 13-1 The Department seeks input from stakeholders on its proposed use of NEMS-BT to conduct the utility impact analysis.

14 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 the imposition of standards. The Department will evaluate direct employment impacts in the manufacturer impact analysis, as described in section 12. 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. The ImSET model was developed for the Department's Office of Planning, Budget, and Analysis, 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 The Department requests feedback on this approach to assessing employment impacts.

15 ENVIRONMENTAL ASSESSMENT

The primary environmental effects of energy conservation standards for the commercial refrigeration equipment covered under this rulemaking will be reduced emissions resulting from

reduced electrical energy consumption. The environmental impact analysis will track the impact of possible standards on three types of energy-related emissions: carbon dioxide (CO_2), oxides of nitrogen (NO_x), and sulfur dioxide (SO_2). The Department intends to base these calculations on the NEMS-BT modeling work proposed for the utility impact analysis. This approach has the advantage of examining the marginal impact of standards for the covered equipment on the utility generation mix and the subsequent environmental emissions.

Carbon emissions are tracked in NEMS-BT by a detailed module that produces robust results because of its broad coverage of all sectors and inclusion of interactive effects. NEMS-BT also includes a module for SO_2-allowance trading and delivers a forecast of SO_2-allowance prices. It is important to note, however, that simulation of SO_2 trading tends to imply that physical emissions effects will be zero. However, there is an SO_2 benefit from conservation in the form of a lower allowance price and, if big enough to be calculable by NEMS, this value can be reported. NEMS-BT also has an algorithm for estimating NO_x emissions from power generation.

Item 15-1 The Department requests feedback on this approach to assessing environmental factors.

16 REGULATORY IMPACT ANALYSIS

In the NOPR stage, the Department will prepare a regulatory impact analysis (RIA) pursuant to Executive Order (E.O.) 12866, "Regulatory Planning and Review," 58 FR 51735, October 4, 1993, which is subject to review under the Executive Order by the Office of Information and Regulatory Affairs (OIRA) at the Office of Management and Budget. The RIA will 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.

The Department 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. The Department intends to consider the likely effects of non-regulatory initiatives on product energy use, consumer utility, and LCCs. The Department will base its assessment on the actual impacts of any such initiatives to date, but also will consider information presented regarding the impacts that any existing initiative might have in the future.

Item 16-1 The Department is unaware of any current non-regulatory programs that specifically target the commercial refrigeration covered under this rulemaking. Are stakeholders aware of any such programs that should be examined as optional, non-regulatory approaches?

Item 16-2 Are there specific subgroups of end-users whom the Department should consider in its review of potential adverse impacts from standards developed under this rulemaking?