DEPARTMENT OF ENERGY

10 CFR Part 431

[Docket No. EERE–2010–BT–STD–0003]

RIN 1904–AC19

Energy Conservation Program: Energy Conservation Standards for Commercial Refrigeration Equipment

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

ACTION: Notice of proposed rulemaking and public meeting.

SUMMARY: The Energy Policy and Conservation Act of 1975 (EPCA), as amended, prescribes energy conservation standards for various consumer products and certain commercial and industrial equipment, including commercial refrigeration equipment (CRE). EPCA also requires the U.S. Department of Energy (DOE) to determine whether more-stringent, amended standards would be technologically feasible and economically justified, and would save a significant amount of energy. In this notice, DOE proposes amended energy conservation standards for commercial refrigeration equipment. The notice also announces a public meeting to receive comment on these proposed standards and associated analyses and results.

DATES: DOE will hold a public meeting on Thursday, October 3, 2013, from 9 a.m. to 4 p.m., in Washington, DC. The meeting will also be broadcast as a webinar. See section VII, ''Public Participation,'' for webinar registration information, participant instructions, and information about the capabilities available to webinar participants.

DOE will accept comments, data, and information regarding this notice of proposed rulemaking (NOPR) before and after the public meeting, but no later than November 12, 2013. See section VII, ''Public Participation,'' for details.

ADDRESSES: The public meeting will be held at the U.S. Department of Energy, Forrestal Building, Room 8E–089, 1000 Independence Avenue SW., Washington, DC 20585. To attend, please notify Ms. Brenda Edwards at (202) 586–2945. Persons can attend the public meeting via webinar. For more information, refer to section VII, Public Participation.

Any comments submitted must identify the NOPR for Energy Conservation Standards for Commercial Refrigeration Equipment and provide docket number EERE–2010–BT–STD–0003 and/or regulatory information number (RIN) 1904–AC19. Comments may be submitted using any of the following methods:

1. *Federal eRulemaking Portal: www.regulations.gov*. Follow the instructions for submitting comments.
2. *Email: CRE-2010-STD-0003@ee.doe.gov.* Include the docket number and/or RIN in the subject line of the message.
3. *Mail:* Ms. Brenda Edwards, U.S. Department of Energy, Building Technologies Program, Mailstop EE–2J, 1000 Independence Avenue SW., Washington, DC 20585–0121. If possible, please submit all items on a CD. It is not necessary to include printed copies.
4. *Hand Delivery/Courier:* Ms. Brenda Edwards, U.S. Department of Energy, Building Technologies Program, 950 L'Enfant Plaza SW., Suite 600, Washington, DC 20024. Telephone: (202) 586–2945. If possible, please submit all items on a CD, in which case it is not necessary to include printed copies.

Written comments regarding the burden-hour estimates or other aspects of the collection-of-information requirements contained in this proposed rule may be submitted to Office of Energy Efficiency and Renewable Energy through the methods listed above and by email to *Chad_S_Whiteman@omb.eop.gov*.

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

Docket: The docket, which includes **Federal Register** notices, public meeting attendee lists and transcripts, comments, and other supporting documents/materials, is available for review at regulations.gov. All documents in the docket are listed in the regulations.gov index. However, some documents listed in the index, such as those containing information that is exempt from public disclosure, may not be publicly available.

A link to the docket Web page can be found at: *http://www.regulations.gov/#!docketDetail;D=EERE-2010-BT-STD-0003*. This Web page will contain a link to the docket for this notice on the regulations.gov site. The regulations.gov Web page will contain simple instructions on how to access all documents, including public comments, in the docket. See section VII for further information on how to submit comments through *www.regulations.gov*.

For further information on how to submit a comment, review other public comments and the docket, or participate in the public meeting, contact Ms. Brenda Edwards at (202) 586–2945 or by email: *Brenda.Edwards@ee.doe.gov*.

FOR FURTHER INFORMATION CONTACT: Mr. Charles Llenza, U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, Building Technologies Program, EE–2J, 1000 Independence Avenue SW., Washington, DC 20585–0121. Telephone: (202) 586–2192. Email: *commercial_refrigeration_equipment@EE.Doe.Gov*.

Ms. Jennifer Tiedeman, U.S. Department of Energy, Office of the General Counsel, GC–71, 1000 Independence Avenue SW., Washington, DC 20585–0121. Telephone: (202) 287–6111. Email: *Jennifer.Tiedeman@hq.doe.gov*.

SUPPLEMENTARY INFORMATION:

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I. Summary of the Proposed Rule

Title III, Part C of the Energy Policy and Conservation Act of 1975 (EPCA), Public Law 94–163 (42 U.S.C. 6311–6317, as codified), added by Public Law 95–619, Title IV, section 441(a), established the Energy Conservation Program for Certain Industrial Equipment, a program covering certain industrial equipment, which includes the commercial refrigeration equipment that is the focus of this notice.[1] [2] EPCA specifies that any new or amended energy conservation standard that DOE prescribes for the equipment covered shall be designed to achieve the maximum improvement in energy efficiency that the Secretary of Energy (Secretary) determines is technologically feasible and economically justified. (42 U.S.C. 6295(o)(2)(A) and 6316(e)(1)) Furthermore, EPCA mandates that the new or amended standard must result in significant conservation of energy. (42 U.S.C. 6295(o)(3)(B) and 6316(e)(1)) In accordance with these and other statutory criteria discussed in this

[1] For editorial reasons, upon codification in the U.S. Code, Part C was re-designated Part A–1.

[2] All references to EPCA in this document refer to the statute as amended by the American Energy Manufacturing Technical Corrections Act (AEMTCA), Public Law 112–210 (Dec. 18, 2012).

notice, DOE proposes to adopt amended energy conservation standards for commercial refrigeration equipment. The proposed standards, which consist of maximum daily energy consumption (MDEC) values as a function of either refrigerated volume or total display area (TDA), are shown in Table I.1. DOE proposes that the standards proposed in this NOPR, if adopted, would apply to all equipment listed in Table I.1 that is manufactured in, or imported into, the United States on or after 3 years following the publication date of the final rule. (42 U.S.C. 6313(c)(6)(C)) For the NOPR analysis, DOE assumed a publication date in 2014 for this final rule and a compliance date in 2017 for the amended standards established by the final rule.

TABLE I.1—PROPOSED ENERGY CONSERVATION STANDARDS FOR COMMERCIAL REFRIGERATION EQUIPMENT

[Assumes compliance beginning in 2017]

Equipment class *	Proposed standard level ** †
VCT.RC.L	0.43 × TDA + 2.03
VOP.RC.M	0.61 × TDA + 3.03
SVO.RC.M	0.63 × TDA + 2.41
HZO.RC.L	0.57 × TDA + 6.88
HZO.RC.M	0.35 × TDA + 2.88
VCT.RC.M	0.08 × TDA + 0.72
VOP.RC.L	2.11 × TDA + 6.36
SOC.RC.M	0.39 × TDA + 0.08
VOP.SC.M	1.51 × TDA + 4.09
SVO.SC.M	1.5 × TDA + 3.99
HZO.SC.L	1.92 × TDA + 7.08
HZO.SC.M	0.75 × TDA + 5.44
HCT.SC.I	0.49 × TDA + 0.37
VCT.SC.I	0.52 × TDA + 2.56
VCS.SC.I	0.35 × V + 0.81
VCT.SC.M	0.04 × V + 1.07
VCT.SC.L	0.22 × V + 1.21
VCS.SC.M	0.03 × V + 0.53
VCS.SC.L	0.13 × V + 0.43
HCT.SC.M	0.02 × V + 0.51
HCT.SC.L	0.11 × V + 0.6
HCS.SC.M	0.02 × V + 0.37
HCS.SC.L	0.12 × V + 0.42
PD.SC.M	0.03 × V + 0.83
SOC.SC.M	0.32 × TDA + 0.53
VOP.RC.I	2.68 × TDA + 8.08
SVO.RC.L	2.11 × TDA + 6.36
SVO.RC.I	2.68 × TDA + 8.08
HZO.RC.I	0.72 × TDA + 8.74
VOP.SC.L	3.79 × TDA + 10.26
VOP.SC.I	4.81 × TDA + 13.03
SVO.SC.L	3.77 × TDA + 10.01
SVO.SC.I	4.79 × TDA + 12.72
HZO.SC.I	2.44 × TDA + 9.0
SOC.RC.L	0.83 × TDA + 0.18
SOC.RC.I	0.97 × TDA + 0.21
SOC.SC.I	1.35 × TDA + 0.29
VCT.RC.I	0.51 × TDA + 2.37
HCT.RC.M	0.14 × TDA + 0.11
HCT.RC.L	0.3 × TDA + 0.23
HCT.RC.I	0.35 × TDA + 0.27
VCS.RC.M	0.1 × V + 0.24
VCS.RC.L	0.21 × V + 0.5

TABLE I.1—PROPOSED ENERGY CONSERVATION STANDARDS FOR COMMERCIAL REFRIGERATION EQUIPMENT—Continued

[Assumes compliance beginning in 2017]

Equipment class *	Proposed standard level ** †
VCS.RC.I	0.25 × V + 0.58
HCS.SC.I	0.35 × V + 0.81
HCS.RC.M	0.1 × V + 0.24
HCS.RC.L	0.21 × V + 0.5
HCS.RC.I	0.25 × V + 0.58
SOC.SC.L	0.67 × TDA + 1.12

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

** "TDA" is the total display area of the case, as measured in the Air-Conditioning, Heating, and Refrigeration Institute (AHRI) Standard 1200–2010, appendix D.

† "V" is the volume of the case, as measured in American National Standards Institute (ANSI)/Association of Home Appliance Manufacturers (AHAM) Standard HRF–1–2004.

A. Benefits and Costs to Customers

Table I.2 presents DOE's evaluation of the economic impacts of the proposed standards on customers of commercial refrigeration equipment, as measured by the average life-cycle cost (LCC) savings [3] and the median payback period (PBP).[4] The average LCC savings are positive for all equipment classes under the standard proposed by DOE in this notice. At TSL 4, the percentage of customers who experience net benefits or no impacts ranges from 59 to 100 percent, and customers experiencing a net cost range from 0 to 41 percent. Chapter 11 presents the LCC subgroup analysis on groups of customers that may be disproportionately affected by the proposed standard.

TABLE I.2—IMPACTS OF PROPOSED STANDARDS ON CUSTOMERS OF COMMERCIAL REFRIGERATION EQUIPMENT

Equipment class *	Average LCC savings 2012$	Median PBP years
VOP.RC.M	$1,493.72	3.91
VOP.RC.L	1,129.51	2.22
VOP.SC.M	691.27	4.39
VCT.RC.M	1,108.13	2.70
VCT.RC.L	797.91	1.64
VCT.SC.M	641.05	2.54
VCT.SC.L	1,342.84	0.96
VCT.SC.I	431.88	1.97
VCS.SC.M	131.80	1.75
VCS.SC.L	220.83	1.15
VCS.SC.I	152.69	2.42
SVO.RC.M	1,008.46	4.50
SVO.SC.M	491.99	4.75
SOC.RC.M	494.51	4.41
HZO.RC.M **	0.00	NA
HZO.RC.L **	0.00	NA
HZO.SC.M	28.78	6.40
HZO.SC.L **	0.00	NA
HCT.SC.M	253.60	3.08
HCT.SC.L	368.92	1.47
HCT.SC.I	42.48	4.28
HCS.SC.M	8.68	4.28
HCS.SC.L	80.72	2.57
PD.SC.M	310.43	2.27
SOC.SC.M	739.75	2.99

* Values have been shown only for primary equipment classes, which are equipment classes that have significant volume of shipments and, therefore, were directly analyzed. See chapter 5 of the NOPR TSD, Engineering Analysis, for a detailed discussion of primary and secondary equipment classes.

** For equipment classes HZO.RC.M, HZO.RC.L, and HZO.SC.L, no efficiency levels above the baseline were found to be economically justifiable. Therefore, the proposed standards for these equipment classes are the same as the current standards. As a result, LCC savings for these equipment classes are shown as zero. The PBP values are indeterminate and are shown as "NA."

B. Impact on Manufacturers

The industry net present value (INPV) is the sum of the discounted cash flows to the industry from the base year (2013) through the end of the analysis period (2046). Using a real discount rate of 10 percent,[5] DOE estimates that the INPV for manufacturers of commercial refrigeration equipment is $1,162.0 million in 2012$. Under the proposed standards, DOE expects the industry net present value to decrease by 3.95

[3] Life-cycle cost (LCC) of commercial refrigeration equipment is the cost to customers of owning and operating the equipment over the entire life of the equipment. Life-cycle cost savings are the reductions in the life-cycle costs due to amended energy conservation standards when compared to the life-cycle costs of the equipment in the absence of amended energy conservation standards. Further discussion of the LCC analysis can be found in Chapter 8 of the TSD.

[4] Payback period (PBP) refers to the amount of time (in years) it takes customers to recover the increased installed cost of equipment associated with new or amended standards through savings in operating costs. Further discussion of the PBP can be found in Chapter 8 of the TSD.

[5] This is the rate used to discount future cash flows in the Manufacturer Impact Analysis. A discount rate of 10% was calculated based on SEC filings and feedback from manufacturer interviews about the current cost of capital in the industry. For more information, refer to Chapter 12 of the NOPR TSD.

percent to 7.97 percent. Total industry conversion costs are expected to total $87.5 million.

C. National Benefits

DOE's analyses indicate that the proposed standards would save a significant amount of energy. The lifetime savings for commercial refrigeration equipment purchased in the 30-year period that begins in the year of the compliance with amended standards (2017–2046) amount to 1.001 quadrillion British thermal units (quads). The average annual energy savings over the life of commercial refrigeration equipment purchased in 2017 through 2046 is 0.04 quads.[6]

The cumulative national net present value (NPV) of total customer costs and savings of the proposed standards for commercial refrigeration equipment in 2012$ ranges from $1.606 billion (at a 7-percent discount rate) to $4.067 billion (at a 3-percent discount rate). This NPV expresses the estimated total value to customers of future operating cost savings minus the estimated increased installed costs for equipment purchased in 2017–2046, discounted to 2013.

The proposed standards are expected to have significant environmental benefits. The energy savings would result in cumulative greenhouse gas (GHG) emission reductions of 54.88 million metric tons (MMt)[7] of carbon dioxide (CO_2), 265.9 thousand tons of methane, 1.1 thousand tons of nitrous oxide, 70.1 thousand tons of sulfur dioxide (SO_2), 81.1 thousand tons of NO_X and 0.1 tons of mercury (Hg).[8][9]

The value of the CO_2 reductions is calculated using a range of values per metric ton of CO_2 (otherwise known as the Social Cost of Carbon, or SCC) developed by a recent Federal interagency process. The derivation of the SCC values is discussed in section IV.O. DOE estimates that the net present monetary value of the CO_2 emissions reduction would be between $0.31 and $4.55 billion. DOE also estimates the present monetary value of the NO_X emissions reduction would be between $8.8 and $90.7 million at a 7-percent discount rate, and between $19.1 and $196.2 million at a 3-percent discount rate.[10]

Table I.3 summarizes the national economic costs and benefits expected to result from the proposed standards for commercial refrigeration equipment.

TABLE I.3—SUMMARY OF NATIONAL ECONOMIC BENEFITS AND COSTS OF PROPOSED COMMERCIAL REFRIGERATION EQUIPMENT ENERGY CONSERVATION STANDARDS

Category	Present value million 2012$	Discount rate (percent)
Benefits		
Operating Cost Savings	2,695	7
	6,034	3
CO_2 Reduction Monetized Value (at $12.9/Metric Ton) *	308	5
CO_2 Reduction Monetized Value (at $40.8/Metric Ton) *	1,504	3
CO_2 Reduction Monetized Value (at $62.2/Metric Ton) *	2,452	2.5
CO_2 Reduction Monetized Value (at $117.0/Metric Ton) *	4,552	3
NO_X Reduction Monetized Value (at $2639/Ton) **	50	7
	108	3
Total Benefits †	4,249	7
	7,646	3
Costs		
Incremental Installed Costs	1,089	7
	1,967	3
Net Benefits		
Including CO_2 and NO_X Reduction Monetized Value	3,160	7
	5,679	3

* The interagency group selected four sets of SCC values for use in regulatory analyses. Three sets of values are based on the average SCC from the integrated assessment models, at discount rates of 2.5, 3, and 5 percent. The fourth set, which represents the 95th percentile SCC estimate across all three models at a 3-percent discount rate, is included to represent higher-than-expected impacts from temperature change further out in the tails of the SCC distribution. The values in parentheses represent the SCC in 2015. The SCC time series incorporate an escalation factor.

** The value represents the average of the low and high NO_X values used in DOE's analysis.

† Total Benefits for both the 3% and 7% cases are derived using the CO_2 reduction monetized value series corresponding to average SCC with 3-percent discount rate.

The benefits and costs of today's proposed standards, for commercial refrigeration equipment sold in 2017–2046, can also be expressed in terms of annualized values. The annualized monetary values are the sum of (1) the annualized national economic value of the benefits from the customer operation of equipment that meets the proposed standards (consisting primarily of operating cost savings from using less energy, minus increases in equipment

[6] Total U.S. commercial sector energy (source energy) used for refrigeration in 2010 was 1.21 quads. Source: U.S. Department of Energy—Office of Energy Efficiency and Renewable Energy. *Buildings Energy Data Book,* Table 3.1.4, 2010 Commercial Energy End-Use Splits, by Fuel Type (Quadrillion Btu). 2012. (Last accessed April 23, 2013.) *http://buildingsdatabook.eren.doe.gov/TableView.aspx?table=3.1.4.*

[7] A metric ton is equivalent to 1.1 U.S. short tons. Results for NO_X and Hg are presented in short tons.

[8] DOE calculated emissions reductions relative to the Annual Energy Outlook (AEO) 2013 Reference case, which generally represents current legislation and environmental regulations for which implementing regulations were available as of December 31, 2012.

[9] DOE also estimated CO_2 and CO_2 equivalent (CO_2eq) emissions that occur through 2030 (CO_2eq includes greenhouse gases such as CH_4 and N_2O). The estimated emissions reductions through 2030 are 16 million metric tons CO_2, 1,687 thousand tons CO_2eq for CH_4, and 72.27 thousand tons CO_2eq for N_2O.

[10] DOE is currently investigating valuation of avoided Hg and SO_2 emissions.

installed cost, which is another way of representing customer NPV); and (2) the annualized monetary value of the benefits of emission reductions, including CO_2 emission reductions.[11]

Although combining the values of operating savings and CO_2 emission reductions provides a useful perspective, two issues should be considered. First, the national operating savings are domestic U.S. customer monetary savings that occur as a result of market transactions, while the value of CO_2 reductions is based on a global value. Second, the assessments of operating cost savings and CO_2 savings are performed with different methods that use different time frames for analysis. The national operating cost savings is measured over the lifetimes of commercial refrigeration equipment shipped in 2017–2046. The SCC values, on the other hand, reflect the present value of some future climate-related impacts resulting from the emission of 1 ton of CO_2 in each year. These impacts continue well beyond 2100.

Table I.4 shows the annualized benefits and costs of the proposed standards. The results of the primary estimate are as follows. Table I.4 shows the primary, low net benefits, and high net benefits scenarios. The primary estimate is the estimate in which the operating cost savings were calculated using the *Annual Energy Outlook 2013 (AEO2013)* Reference Case forecast of future electricity prices. The other two estimates, low net benefits estimate and high net benefits estimate, are based on the low and high electricity price scenarios from the *AEO2013* forecast. At a 7-percent discount rate for benefits and costs, the cost in the primary estimate of the standards proposed in today's notice is $82 million per year in increased equipment costs. The annualized benefits are $203 million per year in reduced equipment operating costs, $75 million in CO_2 reductions (note that DOE used a 3-percent discount rate, along with the corresponding SCC series that uses a 3-percent discount rate, to calculate the monetized value of CO_2 emissions reductions), and $3.75 million in reduced NO_X emissions. In this case, the annualized net benefit amounts to $199 million. At a 3-percent discount rate for all benefits and costs, the cost in the primary estimate of the amended standards proposed in today's notice is $97 million per year in increased equipment costs. The benefits are $299 million per year in reduced operating costs, $75 million in CO_2 reductions, and $5.33 million in reduced NO_X emissions. In this case, the net benefit amounts to $281 million per year.

DOE also calculated the low net benefits and high net benefits estimates by calculating the operating cost savings and incremental installed costs at the *AEO2013* low economic growth case and high economic growth case scenarios, respectively. These scenarios do not change the monetized emissions reductions values. The net benefits and costs for low and high net benefits estimates were calculated in the same manner as the primary estimate by using the corresponding values of operating cost savings and incremental installed costs.

TABLE I.4—ANNUALIZED BENEFITS AND COSTS OF PROPOSED STANDARDS FOR COMMERCIAL REFRIGERATION EQUIPMENT

	Discount rate (percent)	Primary estimate * million 2012$	Low net benefits estimate * million 2012$	High net benefits estimate * million 2012$
Benefits				
Operating Cost Savings	7	203	197	212
	3	299	288	314
CO_2 Reduction Monetized Value (at $12.9/Metric Ton) **	5	19	19	19
CO_2 Reduction Monetized Value (at $40.8/Metric Ton) **	3	75	75	75
CO_2 Reduction Monetized Value (at $62.2/Metric Ton) **	2.5	114	114	114
CO_2 Reduction Monetized Value (at $117.0/Metric Ton) **	3	225	225	225
NO_X Reduction Monetized Value (at $2,639/Ton) **	7	3.75	3.75	3.75
	3	5.33	5.33	5.33
Total Benefits (Operating Cost Savings, CO_2 Reduction and NO_X Reduction) †	7	281	275	290
	3	379	368	394
Costs				
Total Incremental Installed Costs	7	82	84	80
	3	97	100	95
Net Benefits Less Costs				
Total Benefits Less Incremental Costs	7	199	191	210
	3	281	268	299

* This table presents the annualized costs and benefits associated with equipment shipped in 2017–2046. These results include benefits to consumers which accrue after 2046 from the products purchased in 2017–2046. The primary, low, and high estimates utilize forecasts of energy prices from the *AEO2013* Reference Case, Low Economic Growth Case, and High Economic Growth Case, respectively. In addition, incremental equipment costs reflect a medium decline rate for projected product price trends in the Primary Estimate, a low decline rate for projected equipment price trends in the Low Benefits Estimate, and a high decline rate for projected equipment price trends in the High Benefits Estimate. The methods used to derive projected price trends are explained in Appendix 10B.

[11] DOE used a two-step calculation process to convert the time-series of costs and benefits into annualized values. First, DOE calculated a present value in 2013, the year used for discounting the NPV of total consumer costs and savings, for the time-series of costs and benefits using discount rates of 3 and 7 percent for all costs and benefits except for the value of CO_2 reductions. For the latter, DOE used a range of discount rates, as shown in Table I.4. From the present value, DOE then calculated the fixed annual payment over a 30-year period (2017 through 2046) that yields the same present value. The fixed annual payment is the annualized value. Although DOE calculated annualized values, this does not imply that the time-series of cost and benefits from which the annualized values were determined is a steady stream of payments.

** The interagency group selected four sets of SCC values for use in regulatory analyses. Three sets of values are based on the average SCC from the three integrated assessment models, at discount rates of 2.5, 3, and 5 percent. The fourth set, which represents the 95th percentile SCC estimate across all three models at a 3-percent discount rate, is included to represent higher-than-expected impacts from temperature change further out in the tails of the SCC distribution. The values in parentheses represent the SCC in 2015. The SCC time series incorporate an escalation factor. The value for NO_X is the average of the low and high values used in DOE's analysis.

† Total Benefits for both the 3-percent and 7-percent cases are derived using the series corresponding to average SCC with 3-percent discount rate. In the rows labeled "7% plus CO_2 range" and "3% plus CO_2 range," the operating cost and NO_X benefits are calculated using the labeled discount rate, and those values are added to the full range of CO_2 values.

DOE has tentatively concluded that the proposed standards meet the requirements found in EPCA by representing maximum improvement in energy efficiency that is technologically feasible and economically justified, and would result in significant conservation of energy. (42 U.S.C. 6295 (o), 6316(e)) DOE further notes that technologies used to achieve these standard levels are already commercially available for the equipment classes covered by today's proposal. Based on the analyses described above, DOE has tentatively concluded that the benefits of the proposed standards to the Nation (energy savings, positive NPV of customer benefits, customer LCC savings, and emission reductions) would outweigh the burdens (loss of INPV for manufacturers and LCC increases for some customers).

DOE also considered more-stringent and less-stringent energy use levels as trial standard levels (TSLs), and is still considering them in this rulemaking. However, DOE has tentatively concluded that the potential burdens of the more-stringent energy use levels would outweigh the projected benefits. Based on consideration of the public comments DOE receives in response to this notice and related information collected and analyzed during the course of this rulemaking effort, DOE may adopt energy use levels presented in this notice that are either higher or lower than the proposed standards, or some combination of level(s) that incorporate the proposed standards in part.

II. Introduction

The following section briefly discusses the statutory authority underlying today's proposal, as well as some of the relevant historical background related to the establishment of standards for commercial refrigeration equipment.

A. Authority

Title III, Part C of EPCA, Public Law 94–163 (42 U.S.C. 6311–6317, as codified), added by Public Law 95–619, Title IV, section 441(a), established the Energy Conservation Program for Certain Industrial Equipment, a program covering certain industrial equipment, which includes the commercial refrigeration equipment that is the focus of this notice.[12] [13] EPCA prescribes energy conservation standards for commercial refrigeration equipment (42 U.S.C. 6313(c)(2)–(4)), and directs DOE to conduct rulemakings to establish new and amended standards for commercial refrigeration equipment. (42 U.S.C. 6313(c)(4)–(6)) (DOE notes that under 42 U.S.C. 6295(m) and 6316(e)(1) the agency must periodically review its already established energy conservation standards for covered equipment. Under this requirement, the next review that DOE would need to conduct must occur no later than 6 years from the issuance of a final rule establishing or amending a standard for covered equipment.)

Pursuant to EPCA, DOE's energy conservation program for covered equipment generally consists of four parts: (1) Testing; (2) labeling; (3) the establishment of Federal energy conservation standards; and (4) certification and enforcement procedures. For commercial refrigeration equipment, DOE is responsible for the entirety of this program. Subject to certain criteria and conditions, DOE is required to develop test procedures to measure the energy efficiency, energy use, or estimated annual operating cost of each type or class of covered equipment. (42 U.S.C. 6314) Manufacturers of covered equipment must use the prescribed DOE test procedure as the basis for certifying to DOE that their equipment complies with the applicable energy conservation standards adopted under EPCA and when making representations to the public regarding the energy use or efficiency of that equipment. (42 U.S.C. 6315(b), 6295(s), and 6316(e)(1)) Similarly, DOE must use these test procedures to determine whether that equipment complies with standards adopted pursuant to EPCA. The DOE test procedure for commercial refrigeration equipment currently appears at title 10 of the Code of Federal Regulations (CFR) part 431, subpart C.

DOE must follow specific statutory criteria for prescribing amended standards for covered equipment. As indicated above, any amended standard for covered equipment must be designed to achieve the maximum improvement in energy efficiency that is technologically feasible and economically justified. (42 U.S.C. 6295(o)(2)(A) and 6316(e)(1)) Furthermore, DOE may not adopt any standard that would not result in the significant conservation of energy. (42 U.S.C. 6295(o)(3) and 6316(e)(1)) DOE also may not prescribe a standard: (1) For certain equipment, including commercial refrigeration equipment, if no test procedure has been established for the product; or (2) if DOE determines by rule that the proposed standard is not technologically feasible or economically justified. (42 U.S.C. 6295(o)(3)(A)–(B) and 6316(e)(1)) In deciding whether a proposed standard is economically justified, DOE must determine whether the benefits of the standard exceed its burdens. (42 U.S.C. 6295(o)(2)(B)(i) and 6316(e)(1)) DOE must make this determination after receiving comments on the proposed standard, and by considering, to the greatest extent practicable, the following seven factors:

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

(42 U.S.C. 6295(o)(2)(B)(i)(I)–(VII) and 6316(e)(1))

[12] For editorial reasons, upon codification in the U.S. Code, Part C was re-designated Part A–1.

[13] All references to EPCA in this document refer to the statute as amended through the American Energy Manufacturing Technical Corrections Act (AEMTCA), Public Law 112–210 (Dec. 18, 2012).

EPCA, as codified, also contains what is known as an ''anti-backsliding'' provision, which prevents the Secretary from prescribing any amended standard that either increases the maximum allowable energy use or decreases the minimum required energy efficiency of covered equipment. (42 U.S.C. 6295(o)(1) and 6316(e)(1)) Also, the Secretary may not prescribe an amended or new standard if interested persons have established by a preponderance of the evidence that the standard is likely to result in the unavailability in the United States of any covered product type (or class) of performance characteristics (including reliability), features, sizes, capacities, and volumes that are substantially the same as those generally available in the United States. (42 U.S.C. 6295(o)(4) and 6316(e)(1))

Further, EPCA, as codified, establishes a rebuttable presumption that a standard is economically justified if the Secretary finds that the additional cost to the consumer of purchasing a product complying with an energy conservation standard level will be less than three times the value of the energy savings during the first year that the consumer will receive as a result of the standard, as calculated under the applicable test procedure. (*See* 42 U.S.C. 6295(o)(2)(B)(iii) and 6316(e)(1)) Section III.D.2 presents additional discussion about the rebuttable presumption payback period.

Additionally, 42 U.S.C. 6295(q)(1) and 6316(e)(1) specify requirements when promulgating a standard for a type or class of covered equipment that has two or more subcategories that may justify different standard levels. DOE must specify a different standard level than that which applies generally to such type or class of equipment for any group of covered products that has the same function or intended use if DOE determines that products within such group (A) consume a different kind of energy from that consumed by other covered equipment within such type (or class); or (B) have a capacity or other performance-related feature that other equipment within such type (or class) do not have and such feature justifies a higher or lower standard. (42 U.S.C. 6295(q)(1) and 6316(e)(1)) In determining whether a performance-related feature justifies a different standard for a group of equipment, DOE must consider such factors as the utility to the consumer of the feature and other factors DOE deems appropriate. *Id.* Any rule prescribing such a standard must include an explanation of the basis on which such higher or lower level was established. (42 U.S.C. 6295(q)(2) and 6316(e)(1))

Federal energy conservation requirements generally supersede State laws or regulations concerning energy conservation testing, labeling, and standards. (42 U.S.C. 6297(a)–(c) and 6316(e))

B. Background

1. Current Standards

The current energy conservation standards for commercial refrigeration equipment were established by two different legislative actions and one DOE final rule. EPCA, as amended by the Energy Policy Act of 2005 (EPACT 2005), established standards for self-contained commercial refrigerators and freezer with solid or transparent doors, self-contained commercial refrigerator-freezers with solid doors, and self-contained commercial refrigerators designed for pull-down applications. (42 U.S.C. 6313(c)(2)–(3)) On January 9, 2009, DOE published a final rule (January 2009 final rule) prescribing standards for commercial refrigeration equipment. 74 FR 1092. Specifically, this final rule completed the first standards rulemaking for commercial refrigeration equipment by establishing standards for equipment types specified in 42 U.S.C. 6313(c)(5), and for which EPCA did not prescribe standards in 42 U.S.C. 6313(c)(2)–(3). These types consisted of commercial ice-cream freezers; self-contained commercial refrigerators, commercial freezers, and commercial refrigerator-freezers without doors; and remote condensing commercial refrigerators, commercial freezers, and commercial refrigerator-freezers. More recently, the American Energy Manufacturing Technical Corrections Act (AEMTCA), Public Law 112–210 (Dec. 18, 2012), amended section 342(c) of EPCA to establish a new standard for self-contained service over counter medium temperature commercial refrigerators (this class is known as SOC.SC.M per DOE's equipment class nomenclature). (42 U.S.C. 6313(c)(4)) As a result, DOE's current energy conservation standards for commercial refrigeration equipment include the following: standards established by EPCA for commercial refrigeration equipment manufactured on or after January 1, 2010; standards established in the January 2009 final rule for commercial refrigeration equipment manufactured on or after January 1, 2012; and standards established by AEMTCA for SOC.SC.M equipment manufactured on or after January 1, 2012.

Table II.1 and Table II.2 present DOE's current energy conservation standards for commercial refrigeration equipment set by EPCA and the January 2009 final rule, respectively. The AEMTCA standard for SOC.SC.M equipment manufactured on or after January 1, 2012 is prescribed as 0.6 × TDA + 1.0. (42 U.S.C. 6313(c)(4)).

TABLE II.1—COMMERCIAL REFRIGERATION EQUIPMENT STANDARDS PRESCRIBED BY EPCA—COMPLIANCE REQUIRED BEGINNING ON JANUARY 1, 2010

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

* kilowatt-hours per day.

** Where ''V'' means the chilled or frozen compartment volume in cubic feet as defined in the Association of Home Appliance Manufacturers Standard HRF–1–1979. 10 CFR 431.66.

† Where ''AV'' means that adjusted volume in cubic feet measured in accordance with the Association of Home Appliance Manufacturers Standard HRF–1–1979. 10 CFR 431.66

TABLE II.2—COMMERCIAL REFRIGERATION EQUIPMENT STANDARDS ESTABLISHED IN THE JANUARY 2009 FINAL RULE—COMPLIANCE REQUIRED BEGINNING ON JANUARY 1, 2012

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

* Equipment class designations consist of a combination (in sequential order separated by periods) of: (1) an equipment family code (VOP = vertical open, SVO = semivertical open, HZO = horizontal open, VCT = vertical transparent doors, VCS = vertical solid doors, HCT = horizontal transparent doors, HCS = horizontal solid doors, or SOC = service over counter); (2) an operating mode code (RC = remote condensing or SC = self-contained); and (3) a rating temperature code (M = medium temperature (38 °F), L = low temperature (0 °F), or I = ice-cream temperature (-15 °F)). For example, ''VOP.RC.M'' refers to the ''vertical open, remote condensing, medium temperature'' equipment class.

** TDA is the total display area of the case, as measured in ANSI/Air-Conditioning and Refrigeration Institute (ARI) Standard 1200–2006, appendix D.

† V is the volume of the case, as measured in AHAM Standard HRF–1–2004.

2. History of Standards Rulemaking for Commercial Refrigeration Equipment

EPCA, as amended by EPACT 2005, prescribes energy conservation standards for certain self-contained commercial refrigeration equipment designed for holding temperatures [14] (*i.e.,* commercial refrigerators, freezers, and refrigerator-freezers with transparent and solid doors designed for holding temperature applications) and self-contained commercial refrigerators with transparent doors designed for pull-down temperature applications.[15] Compliance with these standards was required as of January 1, 2010. (42 U.S.C. 6313(c)(2)–(3)) DOE published a technical amendment final rule on October 18, 2005 codifying these standards into subpart C of part 431 under title 10 of the Code of Federal Regulations (CFR). 70 FR 60407.

In addition, EPCA requires DOE to set standards for additional commercial refrigeration equipment that is not covered by 42 U.S.C. 6313(c)(2)–(3), namely commercial ice-cream freezers; self-contained commercial refrigerators, freezers, and refrigerator-freezers without doors; and remote condensing commercial refrigerators, freezers, and refrigerator-freezers. (42 U.S.C. 6313(c)(5)) DOE published a final rule establishing these standards on January 9, 2009 (74 FR 1092), and manufacturers must comply with these standards starting on January 1, 2012. (42 U.S.C. 6313(c)(5)(A))

EPCA requires DOE to conduct a subsequent rulemaking to determine whether to amend the standards established under 42 U.S.C. 6313(c), which includes both the standards prescribed by EPACT 2005 and those prescribed by DOE in the January 2009 final rule. (42 U.S.C. 6313(c)(6)) If DOE decides as part of this ongoing rulemaking to amend the current standards, DOE must publish a final rule establishing any such amended standards by January 1, 2013. *Id.*

To satisfy this requirement, DOE initiated the current rulemaking on April 30, 2010 by publishing on its Web site its ''Rulemaking Framework for Commercial Refrigeration Equipment.'' (The Framework document is available at: *www1.eere.energy.gov/buildings/appliance_standards/commercial/pdfs/cre_framework_04-30-10.pdf.*) DOE also published a notice in the **Federal Register** announcing the availability of the Framework document, as well as a public meeting to discuss the document. The notice also solicited comment on the matters raised in the document. 75 FR 24824 (May 6, 2010). The Framework document described the procedural and analytical approaches that DOE anticipated using to evaluate energy conservation standards for commercial refrigeration equipment, and identified various issues to be resolved in the rulemaking.

DOE held the Framework public meeting on May 18, 2010, at which it: (1) Presented the contents of the Framework document; (2) described the analyses it planned to conduct during the rulemaking; (3) sought comments from interested parties on these subjects; and (4) in general, sought to inform interested parties about, and facilitate their involvement in, the rulemaking. Major issues discussed at the public meeting included: (1) the scope of coverage for the rulemaking; (2) potential updates to the test procedure and appropriate test metrics (being addressed in a concurrent rulemaking); (3) manufacturer and market information, including distribution channels; (4) equipment classes, baseline units,[16] and design options to improve efficiency; (5) life-cycle costs to customer, including installation, maintenance, and repair costs; and (6) any customer subgroups DOE should consider. At the meeting and during the comment period on the Framework document, DOE received many comments that helped it identify and resolve issues pertaining to commercial refrigeration equipment relevant to this rulemaking. These are discussed in subsequent sections of this notice.

DOE then gathered additional information and performed preliminary analyses to help review energy conservation standards for this equipment. This process culminated in DOE's notice of another public meeting to discuss and receive comments regarding the tools and methods DOE used in performing its preliminary analysis, as well as the analyses results. 76 FR 17573 (March 30, 2011) (the March 2011 notice). DOE also invited written comments on these subjects and announced the availability on its Web site of a preliminary analysis technical support document (preliminary analysis TSD). *Id.* (The preliminary analysis TSD is available at: *www.regulations.gov/#!documentDetail;D=EERE-2010-BT-STD-0003-0030.*) Finally, DOE sought comments concerning other relevant issues that could affect amended energy

[14] EPCA defines the term ''holding temperature application'' as a use of commercial refrigeration equipment other than a pull-down temperature application, except a blast chiller or freezer. (42 U.S.C. 6311(9)(B))

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

[16] Baseline units consist of units possessing features and levels of efficiency consistent with the least-efficient equipment currently available and widely sold on the market.

conservation standards for commercial refrigeration equipment, or that DOE should address in this NOPR. 76 FR 17575 (March 30, 2011).

The preliminary analysis TSD provided an overview of DOE's review of the standards for commercial refrigeration equipment, discussed the comments DOE received in response to the Framework document, and addressed issues including the scope of coverage of the rulemaking. The document also described the analytical framework that DOE used (and continues to use) in considering amended standards for commercial refrigeration equipment, including a description of the methodology, the analytical tools, and the relationships between the various analyses that are part of this rulemaking. Additionally, the preliminary analysis TSD presented in detail each analysis that DOE had performed for this equipment up to that point, including descriptions of inputs, sources, methodologies, and results. These analyses were as follows:

- A *market and technology assessment* addressed the scope of this rulemaking, identified existing and potential new equipment classes for commercial refrigeration equipment, characterized the markets for this equipment, and reviewed techniques and approaches for improving its efficiency;
- A *screening analysis* reviewed technology options to improve the efficiency of commercial refrigeration equipment, and weighed these options against DOE's four prescribed screening criteria;
- An *engineering analysis* estimated the manufacturer selling prices (MSPs) associated with more energy efficient commercial refrigeration equipment;
- An *energy use analysis* estimated the annual energy use of commercial refrigeration equipment;
- A *markups analysis* converted estimated MSPs derived from the engineering analysis to customer purchase prices;
- A *life-cycle cost analysis* calculated, for individual customers, the discounted savings in operating costs throughout the estimated average life of commercial refrigeration equipment, compared to any increase in installed costs likely to result directly from the imposition of a given standard;
- A *payback period analysis* estimated the amount of time it would take customers to recover the higher purchase price of more energy efficient equipment through lower operating costs;
- A *shipments analysis* estimated shipments of commercial refrigeration equipment over the time period examined in the analysis;
- A *national impact analysis* (NIA) assessed the national energy savings (NES), and the national NPV of total customer costs and savings, expected to result from specific, potential energy conservation standards for commercial refrigeration equipment; and
- A *preliminary manufacturer impact analysis* (MIA) took the initial steps in evaluating the potential effects on manufacturers of amended efficiency standards.

The public meeting announced in the March 2011 notice took place on April 19, 2011 (April 2011 preliminary analysis public meeting). At the April 2011 preliminary analysis public meeting, DOE presented the methodologies and results of the analyses set forth in the preliminary analysis TSD. Interested parties provided comments on the following issues: (1) Equipment classes; (2) technology options; (3) energy modeling; (4) installation, maintenance, and repair costs; (5) markups and distributions chains; (6) commercial refrigeration equipment shipments; and (7) test procedures. The comments received since publication of the March 2011 notice, including those received at the April 2011 preliminary analysis public meeting, have contributed to DOE's proposed resolution of the issues in this rulemaking as they pertain to commercial refrigeration equipment. This NOPR responds to the issues raised by the commenters.

In December 2012, AEMTCA established new standards for SOC.SC.M equipment with a compliance date of January 1, 2012. (42 U.S.C. 6313(c)(4)) The SOC.SC.M equipment had previously been classified under the category self-contained commercial refrigerators with transparent doors for which standards were established by EPACT 2005. (42 U.S.C. 6313(c)(2)) The standard established by AEMTCA for SOC.SC.M equipment reduces the stringency of the standard applicable to this equipment.

AEMTCA also directs DOE to determine, within three years of enactment of the new SOC.SC.M standard, whether this standard should be amended. (42 U.S.C. 6313(c)(4)(B)(i)) If DOE determines that the standard should be amended, then DOE must issue a final rule establishing an amended standard within this same three-year period. (42 U.S.C. 6313(c)(4)(B)(ii))

III. General Discussion

A. Test Procedures and Normalization Metrics

1. Test Procedures

On December 8, 2006, DOE published a final rule in which it adopted American National Standards Institute (ANSI)/Air-Conditioning and Refrigeration Institute (ARI) Standard 1200–2006, ''Performance Rating of Commercial Refrigerated Display Merchandisers and Storage Cabinets,'' as the DOE test procedure for this equipment. 71 FR 71340, 71369–70. ANSI/ARI Standard 1200–2006 requires performance tests to be conducted according to the American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) Standard 72–2005, ''Method of Testing Commercial Refrigerators and Freezers.'' The standard also contains rating temperature specifications of 38 °F (±2 °F) for commercial refrigerators and refrigerator compartments, 0 °F (±2 °F) for commercial freezers and freezer compartments, and −5 °F (±2 °F) for commercial ice-cream freezers. During the 2006 test procedure rulemaking, DOE determined that testing at a −15 °F (±2 °F) rating temperature was more representative of the actual energy consumption of commercial freezers specifically designed for ice-cream application. 71 FR 71357 (Dec. 8, 2006). Therefore, in the test procedure final rule, DOE adopted a −15 °F (±2 °F) rating temperature for commercial ice-cream freezers, rather than the −5 °F (±2 °F) prescribed in the ANSI/ARI Standard 1200–2006. In addition, DOE adopted ANSI/Association of Home Appliance Manufacturers (AHAM) Standard HRF–1–2004, ''Energy, Performance, and Capacity of Household Refrigerators, Refrigerator-Freezers, and Freezers,'' for determining compartment volumes for this equipment. 71 FR 71369–70 (Dec. 8, 2006).

On February 21, 2012, DOE published a test procedure final rule (2012 test procedure final rule) in which it adopted several amendments to the DOE test procedure. This included an amendment to incorporate by reference ANSI/Air-Conditioning, Heating, and Refrigeration Institute (AHRI) Standard 1200–2010, ''Performance Rating of Commercial Refrigerated Display Merchandisers and Storage Cabinets,'' as the DOE test procedure for this equipment. 77 FR 10292, 10314 (Feb. 21, 2012). The 2012 test procedure final rule also included an amendment to incorporate by reference the updated ANSI/AHAM Standard HRF–1–2008, ''Energy, Performance, and Capacity of Household Refrigerators, Refrigerator-Freezers, and Freezers,'' for determining compartment volumes for this equipment.

In addition, the 2012 test procedure final rule included several amendments designed to address certain energy efficiency features that were not accounted for by the previous DOE test procedure, including provisions for measuring the impact of night curtains [17] and lighting occupancy sensors and scheduled controls. 77 FR 10296–98 (Feb. 21, 2012). In the 2012 test procedure final rule, DOE also adopted amendments to allow testing of commercial refrigeration equipment at temperatures other than one of the three rating temperatures previously specified in the test procedure. Specifically, the 2012 test procedure final rule allows testing of commercial refrigeration equipment at its lowest application product temperature, for equipment that cannot be tested at the prescribed rating temperature. The 2012 test procedure final rule also allows manufacturers to test and certify equipment at the more-stringent temperatures and ambient conditions required by NSF for food safety testing. 77 FR 10305 (Feb. 21, 2012). (The NSF was founded in 1944 as the National Sanitation Foundation, and is now referred to simply as NSF.)

The test procedure amendments established in the 2012 test procedure final rule are required to be used in conjunction with any amended standards promulgated as a result of this energy conservation standard rulemaking. As such, use of the amended test procedure to show compliance with DOE energy conservation standards or make representations with respect to energy consumption of commercial refrigeration equipment is required on the compliance date of any revised energy conservation standards established as part of this rulemaking. 77 FR 10308 (Feb. 21, 2012).

DOE has initiated a test procedure rulemaking for commercial refrigeration equipment to address many issues raised by stakeholders since the publication of the 2012 test procedure final rule. This rulemaking will address the following issues:

- A number of new definitions related to commercial refrigeration equipment,
- A description of the proper configuration and use of energy management systems,
- Clarifications on the use of calculation methods, appropriate reporting requirements, and determination of the lowest application product temperature,
- Incorporation of Interpretations 1 through 5 to AHRI 1200–2010, and
- Updates and clarifications regarding the compliance dates of test procedure amendments adopted in the 2012 test procedure final rule by reorganizing the test procedure in two different appendices.

The issues that will be addressed in the test procedure rulemaking are consistent with the analysis in this NOPR.

2. Normalization Metrics

Both the January 2009 final rule and EPACT 2005 contain energy conservation standards for respective covered types of commercial refrigeration equipment, expressed in the form of equations developed as a function of unit size. This use of normalization metrics allows for a single standard-level equation developed for an equipment class to apply to a broad range of equipment sizes offered within that class by manufacturers. In the aforementioned commercial refrigeration equipment standards, the two normalization metrics used are refrigerated compartment volume, as determined using AHAM HRF–1–2004, and TDA, as determined using ANSI/ARI 1200–2006. In particular, the EPACT 2005 standards utilize volume as the normalization metric for all equipment types, with the exception of refrigerator-freezers with solid doors, for which it specifies adjusted volume. (42 U.S.C. 6313(c)(2)) The January 2009 final rule, meanwhile, utilized TDA as the normalization metric for all equipment with display capacity while specifying volume as the metric for solid-door (VCS and HCS) equipment. 74 FR 1093 (Jan. 9, 2009).

At the May 2010 Framework public meeting, interested parties raised several questions regarding the potential normalization metrics that could be used in amended standards. DOE also received stakeholder feedback pertaining to this issue following the publication of the Framework document. In the preliminary analysis, DOE suggested that it would consider retaining the normalization metrics in this rulemaking for the respective classes to which they were applied in EPCA (42 U.S.C. 6313(c)(2)–(3)) and the January 2009 final rule. 74 FR 1093 (Jan. 9, 2009). In chapter 2 of the preliminary analysis TSD, DOE presented its rationale for the continued use of TDA for equipment with display areas addressed in the January 2009 final rule and the continued use of volume as the metric for solid-door remote condensing equipment and ice-cream freezers, as well as for the equipment covered by EPACT 2005 standards. DOE did not receive any information or data while conducting the NOPR analyses that would alter this position, and thus DOE proposes continued use of the existing normalization metrics in today's notice.

B. Technological Feasibility

1. General

In each standards rulemaking, DOE conducts a screening analysis, which is based on information that the Department has gathered on all current technology options and prototype designs that could improve the efficiency of the products or equipment that are the subject of the rulemaking. As the first step in such analysis, DOE develops a list of design options for consideration, in consultation with manufacturers, design engineers, and other interested parties. DOE then determines which of these options for improving efficiency are technologically feasible. DOE considers a design option to be technologically feasible if it is used by the relevant industry or if a working prototype has been developed. Technologies incorporated in commercially available equipment or in working prototypes will be considered technologically feasible. 10 CFR 430, subpart C, appendix A, section 4(a)(4)(i) Although DOE considers technologies that are proprietary, it will not consider efficiency levels that can only be reached through the use of proprietary technologies (*i.e.,* a unique pathway), which could allow a single manufacturer to monopolize the market.

Once DOE has determined that particular design options are technologically feasible, it further evaluates each of these design options in light of the following additional screening criteria: (1) Practicability to manufacture, install, or service; (2) adverse impacts on product utility or availability; and (3) adverse impacts on health or safety. 10 CFR part 430, subpart C, appendix A, section 4(a)(4)(ii)–(iv) Chapter 4 of the NOPR TSD discusses the results of the screening analyses for commercial refrigeration equipment. Specifically, it presents the designs DOE considered, those it screened out, and those that are the bases for the TSLs considered in this rulemaking.

[17] Night curtains are devices made of an insulating material, typically insulated aluminum fabric, designed to be pulled down over the open front of the case to decrease infiltration and heat transfer into the case when the merchandizing establishment is closed.

2. Maximum Technologically Feasible Levels

When DOE proposes to adopt (or not adopt) an amended or new energy conservation standard for a type or class of covered equipment such as commercial refrigeration equipment, it determines the maximum improvement in energy efficiency that is technologically feasible for such equipment. (*See* 42 U.S.C. 6295(p)(1) and 6316(e)(1)) Accordingly, in the preliminary analysis, DOE determined the maximum technologically feasible (''max-tech'') improvements in energy efficiency for commercial refrigeration equipment in the engineering analysis using the design parameters that passed the screening analysis.

As indicated previously, whether efficiency levels exist or can be achieved in commonly used equipment is not relevant to whether they are considered max-tech levels. DOE considers technologies to be technologically feasible if they are incorporated in any currently available equipment or working prototypes. Hence, a max-tech level results from the combination of design options predicted to result in the highest efficiency level possible for an equipment class, with such design options consisting of technologies already incorporated in commercial equipment or working prototypes. DOE notes that it reevaluated the efficiency levels, including the max-tech levels, when it updated its results for this NOPR. See chapter 5 of the NOPR TSD for the results of the analyses, and a list of technologies included in max-tech equipment. Table III.1 shows the max-tech levels determined in the engineering analysis for commercial refrigeration equipment.

TABLE III.1—''MAX-TECH'' LEVELS FOR COMMERCIAL REFRIGERATION EQUIPMENT PRIMARY CLASSES

Equipment class	''Max-Tech'' level kWh/day
VCT.RC.L	0.41 × TDA + 1.93
VOP.RC.M	0.6 × TDA + 2.99
SVO.RC.M	0.62 × TDA + 2.38
HZO.RC.L	0.55 × TDA + 6.7
HZO.RC.M	0.34 × TDA + 2.83
VCT.RC.M	0.07 × TDA + 0.66
VOP.RC.L	2.07 × TDA + 6.26
SOC.RC.M	0.39 × TDA + 0.08
VOP.SC.M	1.5 × TDA + 4.06
SVO.SC.M	1.5 × TDA + 3.97
HZO.SC.L	1.91 × TDA + 7.03
HZO.SC.M	0.74 × TDA + 5.35
HCT.SC.I	0.36 × TDA + 0.28
VCT.SC.I	0.5 × TDA + 2.44
VCS.SC.I	0.33 × V + 0.76
VCT.SC.M	0.03 × V + 0.97
VCT.SC.L	0.21 × V + 1.16
VCS.SC.M	0.02 × V + 0.41
VCS.SC.L	0.11 × V + 0.38
HCT.SC.M	0.01 × V + 0.38
HCT.SC.L	0.08 × V + 0.45
HCS.SC.M	0.01 × V + 0.18
HCS.SC.L	0.07 × V + 0.24
PD.SC.M	0.03 × V + 0.72
SOC.SC.M	0.32 × TDA + 0.53

C. Energy Savings

1. Determination of Savings

For each TSL, DOE projected energy savings from the products that are the subjects of this rulemaking, purchased during the 30-year period that begins in the year of compliance with amended standards (2017–2046). The savings are measured over the entire lifetime of products purchased in the 30-year period.[18] DOE used the NIA model to estimate the NES for equipment purchased over the period 2017–2046. The model forecasts total energy use over the analysis period for each representative equipment class at efficiency levels set by each of the five considered TSLs. DOE then compares the energy use at each TSL to the base-case energy use to obtain the NES. The NIA model is described in section IV.I of this notice and in chapter 10 of the NOPR TSD.

DOE used its national impact analysis (NIA) spreadsheet model to estimate energy savings from amended standards for the products that are the subject of this rulemaking. The NIA spreadsheet model (described in section IV.I of this notice) calculates energy savings in site energy, which is the energy directly consumed by products at the locations where they are used. For electricity, DOE reports national energy savings in terms of the savings in the energy that is used to generate and transmit the site electricity. To calculate this quantity, DOE derives annual conversion factors from the model used to prepare the Energy Information Administration's (EIA) *Annual Energy Outlook* (*AEO*).

[18] In the past, DOE presented energy savings results for only the 30-year period that begins in the year of compliance. In the calculation of economic impacts, however, DOE considered operating cost savings measured over the entire lifetime of products purchased during the 30-year period. DOE has chosen to modify its presentation of national energy savings to be consistent with the approach used for its national economic analysis.

DOE has begun to also estimate full-fuel-cycle (FFC) energy savings. 76 FR 51282 (Aug. 18, 2011), as amended at 77 FR 49701 (August 17, 2012). The FFC metric includes the energy consumed in extracting, processing, and transporting primary fuels, and thus presents a more complete picture of the impacts of energy efficiency standards. DOE's approach is based on calculation of an FFC multiplier for each of the energy types used by covered products.

2. Significance of Savings

EPCA prohibits DOE from adopting a standard that would not result in significant additional energy savings. (42 U.S.C. 6295(o)(3)(B),(v) and 6316(e)(1)) While the term ''significant'' is not defined in EPCA, the U.S. Court of Appeals for the District of Columbia in *Natural Resources Defense Council* v. *Herrington,* 768 F.2d 1355, 1373 (D.C. Cir. 1985), indicated that Congress intended significant energy savings to be savings that were not ''genuinely trivial.'' The estimated energy savings in the 30-year analysis period for the TSLs considered in this rulemaking range from 0.236 to 1.278 quads (see section V.B.2 for additional details); therefore, DOE considers them significant within the meaning of section 325 of the Act.

D. Economic Justification

1. Specific Criteria

As discussed in section II.A, EPCA provides seven factors to be evaluated in determining whether a potential energy conservation standard is economically justified. (42 U.S.C. 6295(o)(2)(B)(i) and 6316(e)(1)) The following sections generally discuss how DOE is addressing each of those seven factors in this rulemaking. For further details and the results of DOE's analyses pertaining to economic justification, see sections IV and V of today's notice.

a. Economic Impact on Manufacturers and Commercial Customers

In determining the impacts of a potential new or amended energy conservation standard on manufacturers, DOE first determines its quantitative impacts using an annual cash flow approach. This includes both a short-term assessment (based on the cost and capital requirements associated with new or amended standards during the period between the announcement of a regulation and the compliance date of the regulation) and a long-term assessment (based on the costs and marginal impacts over the 30-year analysis period). The impacts analyzed include INPV (which values the industry based on expected future cash flows), cash flows by year, changes in revenue and income, and other measures of impact, as appropriate. Second, DOE analyzes and reports the potential impacts on different types of manufacturers, paying particular attention to impacts on small manufacturers. Third, DOE considers the impact of new or amended standards on domestic manufacturer employment and manufacturing capacity, as well as the potential for new or amended standards to result in plant closures and loss of capital investment. Finally, DOE takes into account cumulative impacts of other DOE regulations and non-DOE regulatory requirements on manufacturers.

For individual customers, measures of economic impact include the changes in LCC and the PBP associated with new or amended standards. The LCC, which is also separately specified as one of the seven factors to be considered in determining the economic justification for a new or amended standard (42 U.S.C. 6295(o)(2)(B)(i)(II), and 6316(e)(1)), is discussed in the following section. For customers in the aggregate, DOE also calculates the NPV from a national perspective of the economic impacts on customers over the analysis period used in a particular rulemaking. For a description of the methodology used for assessing the economic impact on customers, see sections IV.H and IV.I; for results, see sections V.B.1 and V.B.2 of this notice. Additionally, chapters 8 and 10 and the associated appendices of the NOPR TSD contain a detailed description of the methodology and discussion of the results. For a description of the methodology used to assess the economic impact on manufacturers, see section IV.K; for results, see section V.B.2 of this notice. Additionally, chapter 13 of the NOPR TSD contains a detailed description of the methodology and discussion of the results.

b. Life-Cycle Costs

The LCC is the sum of the purchase price of equipment (including the cost of its installation) and the operating costs (including energy and maintenance and repair costs) discounted over the lifetime of the equipment. The LCC savings for the considered efficiency levels are calculated relative to a base-case scenario, which reflects likely trends in the absence of new or amended standards. DOE carried out the LCC analysis for this rulemaking by analyzing the LCC impacts on those customers who purchase the equipment in the year in which compliance with the new standard is required. To account for uncertainty and variability in specific inputs, such as equipment lifetime and discount rate, DOE uses a range of values, each with its own probability of selection. In addition to identifying distribution of customer impacts, DOE evaluates the LCC impacts of potential standards on identifiable subgroups of customers who may be disproportionately affected by a new national standard. For the results of DOE's analyses related to the LCC, see section V.B.1 of this notice and chapter 8 of the NOPR TSD; for LCC impacts on identifiable subgroups, see section V.B.1 of this notice and chapter 11 of the NOPR TSD.

c. Energy Savings

While significant conservation of energy is a statutory requirement for imposing an energy conservation standard, EPCA also requires DOE, in determining the economic justification of a standard, to consider the total projected energy savings that are expected to result directly from the standard. (42 U.S.C. 6295(o)(2)(B)(i)(III) and 6316(e)(1)) DOE uses NIA spreadsheet results in its consideration of total projected savings. For the results of DOE's analyses related to the potential energy savings, see section VI.B.3 of this notice and chapter 10 of the NOPR TSD.

d. Lessening of Utility or Performance of Equipment

In establishing classes of equipment, and in evaluating design options and the impact of potential standard levels, DOE seeks to develop standards that would not lessen the utility or performance of the equipment under consideration. None of the TSLs presented in today's NOPR would reduce the utility or performance of the equipment considered in the rulemaking. (42 U.S.C. 6295(o)(2)(B)(i)(IV) and 6316(e)(1)) During the screening analysis, DOE eliminated from consideration any technology that would adversely impact customer utility. For the results of DOE's analyses related to the potential impact of amended standards on equipment utility and performance, see section IV.D of this notice and chapter 4 of the NOPR TSD.

e. Impact of Any Lessening of Competition

EPCA directs DOE to consider the impact of any lessening of competition, as determined in writing by the Attorney General, that is likely to result from the imposition of a standard. (42 U.S.C. 6295(o)(2)(B)(i)(V) Specifically, it directs the Attorney General to determine in writing the impact, if any, of any lessening of competition likely to result from a proposed standard and to transmit such determination to the Secretary, not later than 60 days after the publication of a proposed rule, together with an analysis of the nature and extent of such impact. (42 U.S.C. 6295(o)(2)B(ii) and 6316(e)(1)) For the results of DOE's analysis related to lessening of competition, see section V.B.5 of this notice.

f. Need of the Nation To Conserve Energy

Another factor that DOE must consider in determining whether a new or amended standard is economically justified is the need for national energy and water conservation. (42 U.S.C. 6295(o)(2)(B)(i)(VI) and 6316(e)(1)) The energy savings from new or amended standards are likely to provide improvements to the security and reliability of the Nation's energy system. Reductions in the demand for electricity may also result in reduced costs for maintaining the reliability of the Nation's electricity system. DOE conducts a utility impact analysis to estimate how new or amended standards may affect the Nation's needed power generation capacity.

Energy savings from amended standards for commercial refrigeration equipment are also likely to result in environmental benefits in the form of reduced emissions of air pollutants and GHGs associated with energy production (*i.e.,* from power plants). For a discussion of the results of the analyses relating to the potential environmental benefits of the amended standards, see sections IV.N, IV.O and V.B.6 of this notice. DOE reports the expected environmental effects from the proposed standards, as well as from each TSL it considered for commercial refrigeration equipment, in the emissions analysis contained in chapter 13 of the NOPR TSD. DOE also reports estimates of the economic value of emissions reductions resulting from the considered TSLs in chapter 14 of the NOPR TSD.

g. Other Factors

EPCA allows the Secretary, in determining whether a new or amended standard is economically justified, to consider any other factors that the Secretary deems to be relevant. (42 U.S.C. 6295(o)(2)(B)(i)(VII) and 6316(e)(1)) In developing the TSLs set forth in this notice, DOE has also considered the comments submitted by interested parties. For the results of

DOE's analyses related to other factors, see section V.B.7 of this notice.

2. Rebuttable Presumption

As set forth in 42 U.S.C. 6295(o)(2)(B)(iii) and 6316(e)(1), EPCA provides for a rebuttable presumption that an energy conservation standard is economically justified if the additional cost to the customer of equipment that meets the new or amended standard level is less than three times the value of the first-year energy (and, as applicable, water) savings resulting from the standard, as calculated under the applicable DOE test procedure. DOE's LCC and PBP analyses generate values that calculate the PBP for customers of potential new and amended energy conservation standards. These analyses include, but are not limited to, the 3-year PBP contemplated under the rebuttable presumption test. However, DOE routinely conducts a full economic analysis that considers the full range of impacts to the customer, manufacturer, Nation, and environment, as required under 42 U.S.C. 6295(o)(2)(B)(i) and 6316(e)(1). The results of these analyses serve as the basis for DOE to evaluate the economic justification for a potential standard level definitively (thereby supporting or rebutting the results of any preliminary determination of economic justification). The rebuttable presumption payback calculation is discussed in section IV.H.12 of this notice and chapter 8 of the NOPR TSD.

IV. Methodology and Discussion of Comments

A. General Rulemaking Issues

During the April 2011 preliminary analysis public meeting and in subsequent written comments, stakeholders provided input regarding general issues pertinent to the rulemaking, such as issues of scope of coverage and DOE's authority in setting standards. These issues are discussed in this section.

1. Statutory Authority

In the preliminary analysis, DOE stated its position that EPCA prevents the setting of both energy performance standards and prescriptive design requirements (see chapter 2 of the preliminary analysis TSD [19]). DOE also stated its intent to amend the energy performance standards for commercial refrigeration equipment, and not to set prescriptive design requirements at this time (see chapter 2 of the preliminary analysis TSD). In a written comment, Earthjustice opined that DOE misread EPCA in suggesting that DOE does not have authority to establish design requirements for commercial refrigeration equipment. More specifically, Earthjustice asserted that DOE's interpretation of 42 U.S.C. 6311(18) ignores that EPCA uses the plural form in compelling this rulemaking to amend energy conservation ''standards.'' Further, Earthjustice stated, even if DOE were only authorized to promulgate a single standard or single design requirement in any one rulemaking, nothing in EPCA indicates that prior establishment of performance standards would foreclose the issuance of design requirements in a subsequent rulemaking, provided that those design requirements achieved the maximum technologically feasible and economically justified energy savings. (Earthjustice, No. 35 at pp. 4–5) [20]

EPCA defines the phrase ''energy conservation standard'' as a performance standard that prescribes a minimum level of energy efficiency or a maximum quantity of energy use for a product or as a design requirement for a product. (42 U.S.C. 6311(18)(A)–(B)) Therefore, based on a clear reading of EPCA, DOE must use either a performance standard or a design (prescriptive) requirement in prescribing energy conservation standards. It has been DOE's longstanding interpretation that the term ''standard'' means either a performance standard or a design requirement, and that the plural term ''standards'' refers to the setting of a collective group of standards across all covered equipment or product classes. Thus, it is not DOE's interpretation of EPCA that the statute's use of the plural term ''standards,'' in referring to a collective group of equipment classes, grants DOE the authority to set both prescriptive and performance standards for a given class within that group. In the case of commercial refrigeration equipment, all of the equipment that is the subject of this rulemaking is currently covered either by a statutorily mandated performance standard or by a performance standard set by DOE in the January 2009 final rule. (42 U.S.C. 6313(c)(1)–(4)); 74 FR 1093 (Jan. 9, 2009). In this rulemaking, DOE is considering amendments to these performance standards for commercial refrigeration equipment, and is therefore not considering design requirements at this time.

2. January 2009 Final Rule Equipment

At the April 2011 preliminary analysis public meeting, AHRI stated that in 2005 when the legislation that was to become EPACT 2005 was drafted, the drafters' intent was not for DOE to start a rulemaking on remote cases in 2010. According to AHRI, the drafters' intent was that DOE start the rulemaking on self-contained units. AHRI pointed out that manufacturers would have to redesign products (those covered by the 2009 DOE final rule) twice in a 4-year period, first to meet the 2009 DOE standards in 2012, and then again to meet the 2013 standards in 2016. AHRI asked DOE to take that into account, a situation AHRI described as unprecedented. (AHRI, Public Meeting Transcript, No. 31 at pp. 204–05) AHRI elaborated on this situation in its written comment, expressing its belief that it is illogical that DOE decided to analyze equipment types for which standards exist, but with which manufacturers are not yet required to comply. AHRI stated that the intent of Congress was never to require DOE to start a rulemaking on this equipment, and questioned how DOE could possibly assess whether amended standards are appropriate before the January 2009 final rule standards reach the stage where manufacturers must comply. AHRI urged DOE to focus on self-contained refrigerators and freezers with doors in this rulemaking. (AHRI, No. 43 at pp. 1–2)

Similarly, Zero Zone expressed disappointment with the fact that the current rulemaking was initiated before the standards compliance date of January 1, 2012 specified in the January 2009 final rule. Zero Zone went on to state that waiting until after this compliance date to initiate a rulemaking would have allowed DOE to determine the accuracy of its models and the impacts on industry. (Zero Zone, No. 37 at p. 1)

The EPACT 2005 amendments to EPCA require DOE to conduct a rulemaking to determine whether to amend the standards for commercial refrigeration equipment established under 42 U.S.C. 6313(c), which covers both the standards prescribed by EPACT

[19] U.S. Department of Energy—Office of Energy Efficiency and Renewable Energy. Preliminary Technical Support Document (TSD): Energy Conservation Program for Certain Commercial and Industrial Equipment: Commercial Refrigeration Equipment. Chapter 2. Analytical Framework, Comments from Interested Parties, and DOE Responses. March 2011. Washington, DC *www.regulations.gov/#!documentDetail;D=EERE-2010-BT-STD-0003-0030.*

[20] A notation in this form provides a reference for information that is in the docket of DOE's rulemaking to develop energy conservation standards for commercial refrigeration equipment (Docket No. EERE–2010–BT–STD–0003), which is maintained at *www.regulations.gov.* This notation indicates that the statement preceding the reference is document number 35 in the docket for the commercial refrigeration equipment energy conservation standards rulemaking, and appears at pages 4–5 of that document.

2005 and the standards set by DOE in the January 2009 final rule. (42 U.S.C. 6313(c)(6)) If DOE determines that these standards should be amended, DOE must publish a final rule establishing such amended standards by January 1, 2013. *Id*. Regarding AHRI's comment, DOE is thus compelled by statute to conduct this rulemaking with a scope of coverage including the equipment specified in both EPACT 2005 and in the January 2009 final rule. In response to Zero Zone's comments concerning the burden imposed by amended standards, DOE has considered manufacturer impacts in the MIA, as required by 42 U.S.C. 6295(o)(2)(B)(i)(I) and 6316(e)(1). DOE has also used its manufacturer interviews as a forum to discuss and receive feedback on the inputs to and accuracy of its models.

3. Normalization Metrics

In chapter 2 of the preliminary analysis TSD, DOE stated its proposal to retain the current normalization metrics for all equipment classes and requested comment from interested parties. Traulsen agreed with DOE's tentative plan to use cabinet volume as the normalization metric for ''appropriate'' equipment, but noted that there are other (unspecified) design factors that need to be considered. (Traulsen, No. 45 at p. 2) Zero Zone stated that evaluation of the normalization metrics should take place after the January 2009 final rule compliance date. (Zero Zone, No. 37 at p. 4)

During the NOPR analyses, DOE took into account stakeholder input when reviewing normalization metrics for covered equipment. DOE agrees with Traulsen that volume is the appropriate normalization metric for most self-contained equipment classes. With respect to the comment by Zero Zone, the timing of this proceeding made it difficult for significant amounts of data on sales and other factors to be acquired after the January 2009 final rule compliance date of January 1, 2012. DOE took into account information regarding the size and composition of the commercial refrigeration equipment market obtained through manufacturer interviews, market research publications, and other sources during the NOPR stage.

4. Treatment of Blast Chillers, Thawing Cabinets, Prep Tables, Salad Bars, and Buffet Tables

In its written comment, Traulsen expressed concern that DOE may inadvertently include equipment such as prep tables, blast chillers, and thawing cabinets in standards it develops. (Traulsen, No. 45 at p. 1) During the ongoing rulemaking, DOE also received several inquiries from interested parties regarding the coverage, under current or amended energy conservation standards, of salad bars, buffet tables, and other refrigerated holding and serving equipment.

EPCA, in its definition of ''commercial refrigerator, freezer, and refrigerator-freezer,'' states that such equipment must display or store merchandise or other perishable materials horizontally, vertically, or semi-vertically, and must be designed for pull-down temperature applications or holding temperature applications, among other factors. (42 U.S.C. 6311(9)(A)) Moreover, 42 U.S.C. 6311(9) defines ''holding temperature application'' as specifically omitting blast chillers or freezers, and specifies that ''pull-down temperature application'' refers solely to equipment designed to cool 12 ounce beverage cans from 90 to 38 °F in 12 hours or less. Thus, blast chillers and thawing cabinets do not meet the relevant statutory definition, and will not be addressed in this rulemaking.

With regard to prep tables with open bins or trays, salad bars, and buffet tables, DOE does not currently have energy conservation standards that cover this equipment. DOE notes that some of this equipment is designed for the temporary placement of food during preparation or service, rather than storage or retailing, and may operate very differently from the commercial refrigeration equipment considered in this rulemaking. Moreover, DOE's current test procedure does not include provisions for testing this type of equipment. For example, some types of foodservice equipment (such as salad bars, buffet tables, and prep tables) do not have doors, drawers, or openings typical of conventional commercial refrigeration equipment. While DOE has the authority to set standards for other types of commercial refrigeration equipment (42 U.S.C. 6313(c)(5)(B)), this rulemaking is not currently considering standards for equipment types other than those covered by DOE's existing standards. 10 CFR 431.66

5. Dedicated Remote Condensing Units

Several stakeholders inquired whether equipment consisting of a refrigerated case served by a single, dedicated remote condensing unit that serves only that unit would be covered under DOE's proposed standards. True Manufacturing (True) stated that smaller units are more likely to have such a condensing unit, and that continuous cases[21] are almost exclusively rack condensing systems[22] due to the energy savings gained in the long term by rejecting heat outside of the building. (True, Public Meeting Transcript, No. 31 at pp. 268–69) Southern Store Fixtures stated that it is very difficult for the company to predict whether a given case that it builds will ultimately be connected to an individual condensing unit or to a compressor rack. (Southern Store Fixtures, Public Meeting Transcript, No. 31 at p. 268) Zero Zone commented that 20 to 40 percent of the units it sells are served by dedicated condensing units, and that the remainder are served by racks, noting that businesses such as convenience stores and dollar stores use dedicated condensing units in the interest of simplicity. (Zero Zone, Public Meeting Transcript, No. 31 at p. 269) In its written comment, Earthjustice referenced Zero Zone's statement that 20 to 40 percent of remote condensing commercial refrigeration equipment is served by dedicated remote condensing units, and stated that because there is a significant market share for such equipment, DOE should explore standards that address the performance of such units. (Earthjustice, No. 35 at p. 4)

DOE understands that some stakeholders are concerned that shipments of equipment utilizing dedicated remote condensing units may comprise a nontrivial portion of the market. However, the DOE test procedure does not contain a methodology for testing such condensing units. DOE anticipates working with the industry in the future to develop testing methodologies that can be used in future commercial refrigeration equipment rulemakings. For this current rulemaking, display cases connected to dedicated remote condensers will be treated like any other piece of remote condensing equipment under the DOE test procedure, with the energy of the remote condensing unit calculated as specified in AHRI 1200 and added to the measured energy consumption of the display case. As there is no industry-accepted method of test for dedicated remote condensers, DOE proposes to continue to treat

[21] In most supermarket and large food retail settings, multiple display cases from a manufacturer are attached together into a single continuous lineup without internal partitions; these are referred to as ''continuous cases.''

[22] Rack condensing systems utilize a ''rack'' of multiple compressors and a condenser that serves to deliver liquid refrigerant to a number of different pieces of equipment served by the single rack. For example, most supermarkets have one or more compressor racks to serve their display cases, walk-in coolers and freezers, and other equipment.

equipment utilizing this condensing unit configuration in the same manner as all other display cases connected to remote condensers.

Also, as Southern Store Fixtures noted, it is often difficult or impossible for the display case manufacturer to know ahead of time whether a given case will be attached to a dedicated remote condensing unit or a remote condensing rack by an end user. In some cases, the dedicated condensing unit is produced by a separate manufacturer and purchased independently. As Zero Zone stated, the majority of remote condensing cases are still sold to be connected to a remote condensing rack system that serves multiple pieces of equipment. Thus, DOE believes that comparing remote condensing cases based on the calculated performance of a typical remote condensing rack, in the manner prescribed by AHRI 1200, is a consistent way to compare performance of remote condensing display cases.

In chapter 2 of the preliminary analysis TSD, DOE discussed the potential of addressing coverage of remote condensers in a separate future rulemaking. DOE believes that, should any such action take place in the future, such a proceeding would be the appropriate venue in which to investigate dedicated remote condensers.

6. Small Units

Traulsen stated that it believes that smaller units are effectively prohibited under current DOE regulations, and that it recognizes that legislative change is the proper avenue for resolution of this issue. (Traulsen, No. 45 at p. 5)

DOE understands manufacturer concerns regarding the performance of small units, and took steps to account for them in its analyses. In its engineering analysis, DOE selected specifications for units that it found to be representative of typical, high sales volume models for each of the equipment classes directly analyzed. These selections were based on market and industry research, and the representative unit specifications were presented to manufacturers for their feedback and input during manufacturer interviews. The representative units were then used as one analysis point in developing the standard-level equations for their respective classes. DOE also developed ''offset factors'' that form the second analysis point used in developing the linear equations that represent the equipment standards. The purpose of the offset factor is to account for energy consumption end effects inherent in equipment of all sizes so that certain groups of units, including small units, would not be disadvantaged by the standard-level equations. To understand how the offset accounts for size effects, consider the energy consumption of a single lighting fixture—a feature common to all sizes of VCT display cases. The development of offset factors resulted in energy allowances at zero case volume or TDA, thus preventing even the smallest cases from being disadvantaged by the standards. The procedure that DOE used to develop the offset factors implicitly assumes that small units are relatively less efficient than larger units, particularly in the case of the smallest-sized equipment. Therefore, DOE believes that its analysis adequately accounts for smaller units. A detailed discussion of offset factors can be found in chapter 5 of the NOPR TSD.

7. Consideration of Impact of Amended Standards

Traulsen stated that there are many niches of commercial refrigeration equipment that are essential to manufacturers and customers, and that setting overly aggressive standards may lead to inadvertent equipment design obsolescence. Traulsen thus urged DOE to take a conservative approach when setting mandatory standards. (Traulsen, No. 45 at p. 1)

DOE performed an MIA, as required by 42 U.S.C. 6295(o)(2)(B)(i)(I) and 6316(e)(1), in which it assessed both the qualitative issues of concern to manufacturers and the quantitative potential impacts to the commercial refrigeration equipment industry. These impacts were weighed and taken into consideration during the selection of the proposed standard level in an effort to minimize adverse impacts on the industry. DOE also notes it considers the design configurations offered in the commercial refrigeration equipment market in its analysis and selection of equipment classes. As required by EPCA, DOE does not set standards that eliminate equipment designs that deliver unique utility or features for consumers. (42 U.S.C. 6295(o)(4) and 6316(e)(1))

8. CO_2 Cascade Systems

Hussmann stated that, in California, Title 24 [23] allows the use of CO_2 cascade systems,[24] and that compliance with both Title 24 and amended DOE standards could make development of a CO_2 cascade system difficult. (Hussmann, Public Meeting Transcript, No. 31 at p. 153) True stated that there is no DOE test procedure for cascade systems, and that there has been no consideration of cascade systems in the standards-setting process. (True, Public Meeting Transcript, No. 31 at p. 154)

DOE agrees with True that secondary coolant systems, including CO_2 cascade systems, are not being addressed in this rulemaking, partially due to the lack of an industry-accepted method of test for this type of equipment. DOE articulated its rationale in the preliminary analysis TSD chapter 2 and maintains the position in this notice.

9. Coverage of Existing Cases Undergoing Refurbishments or Retrofits

During the NOPR analysis period, DOE received a stakeholder inquiry as to whether the Department's energy conservation standards apply only to new equipment manufactured or imported after the compliance date, or to existing equipment undergoing retrofits and refurbishments as well.

DOE wishes to clarify that energy conservation standards apply only to new equipment, and not to previously installed equipment undergoing retrofits or refurbishments. As DOE stated in its Certification, Compliance and Enforcement final rule published on March 7, 2011, manufacturers and private labelers must certify to DOE that any covered equipment meets the applicable standard before distributing that equipment into U.S. commerce. DOE's authority covers newly manufactured equipment and does not extend to rebuilt and refurbished equipment. 76 FR 12422, 12426 and 12437 (March 7, 2011).

10. Components Shipped as After-Market Additions

DOE has received inquiries regarding open commercial refrigerated display cases that may be shipped with doors to be installed in the field. Stakeholders have sought guidance on whether equipment that is produced and shipped in this manner would be subject to the standards applicable to an open case or subject to the standards applicable to a closed case.

DOE's response to the issue of components shipped as after-market additions will be addressed in the on-going test procedure rulemaking.

11. Definition of Hybrid Equipment

During the NOPR analysis period, DOE received a comment regarding the definition of hybrid equipment.

[23] ''Title 24'' refers to Title 24, part 6 of the California Code of Regulations, and includes California's energy efficiency standards for residential and nonresidential buildings. This is available at: *www.energy.ca.gov/title24/*.

[24] A cascade system is a type of secondary-loop refrigeration cycle that uses a higher-temperature refrigerant to condense the secondary refrigerant, in this case carbon dioxide, which is then used to cool the refrigerated space.

Specifically, the stakeholder inquired about the proper definition of commercial hybrid refrigerator-freezer and the applicable standards.

DOE's response to the issue of hybrid equipment will be addressed in the on-going test procedure rulemaking.

12. Coverage of Commercial Refrigeration Equipment With Drawers

DOE has received several comments from interested parties regarding the coverage of commercial refrigeration equipment units with drawers. Specifically, interested parties inquired if commercial refrigeration equipment units with drawers were covered under the existing and proposed energy conservation standards for commercial refrigeration equipment and, so, (1) which equipment families they belong to; and (2) what the test procedure requirements are for these units.

DOE's response to the issue of commercial refrigeration equipment with drawers will be addressed in the on-going test procedure rulemaking.

B. Test Procedures

DOE received several comments that pertain only to the test procedure rulemaking. DOE responded to these and similar comments in the 2012 test procedure final rule. 77 FR 10298, 10300, and 10307 (Feb. 21, 2012). Specifically, DOE received comments from multiple interested parties that many cases are installed with remote lighting controls that are operated at the aisle or store level (Southern Store Fixtures, Public Meeting Transcript, No. 31 at pp. 190–91, 194; Zero Zone, Public Meeting Transcript, No. 31 at p. 196; California Investor Owned Utilities, No. 42 at p. 4) and, according to the Northwest Energy Efficiency Alliance (NEEA), that cases wired uniquely to receive a remote energy management system should receive credit in the DOE test procedure. (NEEA, Public Meeting Transcript, No. 31 at p. 195) DOE also received comments from interested parties that an accepted test method for secondary coolant systems, especially those with two-phase flow, had not been developed and validated. (True, Public Meeting Transcript, No. 31 at pp. 162–64; Southern Store Fixtures, Public Meeting Transcript, No. 31 at pp. 164–65; AHRI, Public Meeting Transcript, No. 31 at pp. 165–66) Because these comments pertain only to the test procedure for commercial refrigeration equipment and not the potential standards or analysis discussed in this rulemaking, DOE addressed these comments in the 2012 test procedure final rule and has not addressed them further here.

NEEA stated that DOE's efforts to conduct a robust standards analysis are hindered by DOE's failure to resolve some test procedure issues and the fact that test procedure limitations have resulted in the removal of some technologies from consideration. Among these issues, according to NEEA, are the inability of the test procedure to measure savings from anti-sweat heater controls and the screening out of variable-speed and variable-capacity components based on the perceived limitations of the test procedure. (NEEA, No. 36 at p. 1)

DOE recognizes stakeholders' desire that the DOE test procedure better measure the performance of variable-speed and variable-capacity devices. However, in the 2012 test procedure final rule, DOE stated that testing of part-load technologies would significantly increase the burden on manufacturers to test and certify equipment and is not justified given the minimal efficiency gains achieved by this equipment. 77 FR 10308 (Feb. 21, 2012). As such, DOE maintained that the fluctuations in refrigeration load experienced by equipment undergoing the DOE test procedure are sufficiently representative of average use, and that the establishment of additional test requirements would impose an undue burden on manufacturers. When evaluating amended energy conservation standards, DOE bases its engineering analysis on the energy efficiency of a unit as tested by the DOE test procedure. DOE has assessed the potential energy savings associated with technologies as tested under the test procedure established in DOE's 2012 test procedure final rule and considered technologies based on the factors prescribed by EPCA. (42 U.S.C. 6295(o)(2)(B)(i) and 6316(e)(1))

C. Market and Technology Assessment

When beginning an energy conservation standards rulemaking, DOE develops information that provides an overall picture of the market for the equipment concerned, including the purpose of the equipment, the industry structure, and market characteristics. This activity includes both quantitative and qualitative assessments based primarily on publicly available information (*e.g.,* manufacturer specification sheets, industry publications) and data submitted by manufacturers, trade associations, and other stakeholders. The subjects addressed in the market and technology assessment for this rulemaking include: (1) Quantities and types of equipment sold and offered for sale; (2) retail market trends; (3) equipment covered by the rulemaking; (4) equipment classes; (5) manufacturers; (6) regulatory requirements and non-regulatory programs (such as rebate programs and tax credits); and (7) technologies that could improve the energy efficiency of the equipment under examination. DOE researched manufacturers of commercial refrigeration equipment and made a particular effort to identify and characterize small business manufacturers. See chapter 3 of the NOPR TSD for further discussion of the market and technology assessment.

1. Equipment Classes

In evaluating and establishing energy conservation standards, DOE generally divides covered equipment into classes by the type of energy used, or by capacity or other performance-related feature that justifies a different standard for equipment having such a feature. (42 U.S.C. 6295(q) and 6316(e)(1)) In deciding whether a feature justifies a different standard, DOE must consider factors such as the utility of the feature to users. *Id.* DOE normally establishes different energy conservation standards for different equipment classes based on these criteria.

Commercial refrigeration equipment can be divided into various equipment classes categorized by specific physical and design characteristics. These characteristics impact equipment efficiency, determine the kind of merchandise that the equipment can be used to display, and affect how the customer can access that merchandise. Key physical and design characteristics of commercial refrigeration equipment are the operating temperature, the presence or absence of doors (*i.e.,* closed cases or open cases), the type of doors used (transparent or solid), the angle of the door or air curtain [25] (horizontal, semivertical, or vertical), and the type of condensing unit (remote condensing or self-contained). The following list shows the key characteristics of commercial refrigeration equipment that DOE developed as part of the January 2009 final rule (74 FR 1099–1100 (Jan. 9, 2009)), and used during the Framework and preliminary analysis for this rulemaking:

1. Operating Temperature

- Medium temperature (38 °F, refrigerators)

[25] An air curtain is a continuously moving stream of air, driven by fans, which exits on one side of the opening in an open refrigerated case and re-enters on the other side via an intake grille. The function of the air curtain is to cover the opening in the case with this sheet of air, which minimizes the infiltration of warmer ambient air into the refrigerated space.

- Low temperature (0 °F, freezers)
- Ice-cream temperature (−15 °F, ice-cream freezers)

2. Door Type

- Equipment with transparent doors
- Equipment with solid doors
- Equipment without doors

3. Orientation (air-curtain or door angle)

- Horizontal
- Semivertical
- Vertical

4. Type of Condensing Unit

- Remote condensing
- Self-contained

Additionally, because EPCA specifically sets a separate standard for refrigerators with a self-contained condensing unit designed for pull-down temperature applications and transparent doors, DOE plans to create a separate equipment class for this equipment. (42 U.S.C. 6313(c)(3)) DOE included this equipment in the form of a separate family with a single class (PD.SC.M) for the preliminary analysis. A total of 49 equipment classes were created, and these are listed in chapter 3 of the NOPR TSD using the nomenclature developed in the January 2009 final rule. 74 FR 1100 (Jan. 9, 2009).

During the April 2011 preliminary analysis public meeting and in subsequent written comments, a number of stakeholders addressed issues related to proposed equipment classes and the inclusion of certain types of equipment in the analysis. These topics are discussed in this section.

a. Equipment Classification

Several stakeholders commented on the general equipment classification structure used by DOE in the preliminary analysis. Traulsen stated that, with respect to the currently defined classes of equipment, there are subcategories DOE failed to specify, including upright units (1-, 2-, and 3-section; reach-in; pass-through; roll-in; and roll-through) and undercounter units (categorized by length in inches). (Traulsen, No. 45 at p. 1) On the other hand, Zero Zone approved of DOE's proposed equipment classes, as presented in the preliminary analysis TSD. (Zero Zone, No. 37 at p. 4) AHRI stated that the equipment class nomenclature developed by DOE in the January 2009 final rule was appropriate. (AHRI, No. 43 at p. 2)

In response to Traulsen's comment, DOE recognizes that there are subcategories of equipment within certain equipment families and classes, each with varying geometries. However, DOE believes that the equipment classes it has developed and modeled are broad enough to account for the variety of equipment incorporated within each of them, including the unit types described in Traulsen's comment. In performing its engineering analysis, DOE selected representative unit sizes and feature sets for modeling so as to best represent a typical unit for each given class. Regarding the comments from Zero Zone and AHRI, DOE has retained the equipment classes and nomenclature adopted in the January 2009 final rule (74 FR 1100 (Jan. 9, 2009)) and used in the Framework document and preliminary analysis for this NOPR.

b. Application Temperature Equipment

DOE received feedback on the subject of application temperature equipment [26] at the April 2011 preliminary analysis public meeting and in written comments. NEEA stated that the difference between DOE rating temperatures and application temperatures can be significant, and commented that allowing manufacturers to demonstrate that equipment meets a standard defined by rating temperature by testing at (presumably higher) application temperatures would equate to a very lenient standard for such equipment. (NEEA, Public Meeting Transcript, No. 31 at pp. 26–27) NEEA added that, for such equipment, the difference between ambient conditions and internal conditions would be much lower than for equipment maintaining a temperature of 38 °F, and that daily energy use for this equipment would be lower as well. Thus, while NEEA agreed that cabinets should be tested at the lowest temperature they can achieve, NEEA stated that, if the standard for such cabinets is set equal to the level of energy use of cabinets designed to hold 38 °F, that equipment may be much less efficient than what could be cost-effectively possible were separate standards set for the equipment. (NEEA, No. 36 at p. 2) NEEA further asked why DOE was not proposing to set separate standards for application temperature equipment. (NEEA, Public Meeting Transcript, No. 31 at pp. 26–27) NEEA stated that, while DOE has dismissed concerns regarding application temperature equipment because it is roughly 2 percent of the market, NEEA has heard from manufacturers that it is a growing market segment and added that 2 percent is, in its opinion, a nontrivial portion of the market. (NEEA, No. 36 at pp. 1–2)

Moreover, NEEA asserted that DOE failed to acknowledge the differences between high-temperature equipment (*e.g.,* floral cases) and ice storage cabinets, and suggested two new equipment classes for these products: One for equipment with cabinet temperature greater than 40 °F and one for ice storage cabinets that can operate outdoors and are designed to hold temperatures between 20 and 30 °F. (NEEA, No. 36 at p. 2; NEEA, Public Meeting Transcript, No. 31 at pp. 26–27) NEEA further opined that ice storage cabinets in particular are often used in environments not well represented by the test procedure conditions, namely outdoor environments. NEEA added that to allow the test procedure to not represent the operating conditions of this equipment would violate 42 U.S.C. 6295(2). (NEEA, No. 36 at pp. 1–2)

True stated that, during the test procedure public meeting, interested parties suggested that the lowest application temperature should include ice storage and be in the mid-twenties. (True, Public Meeting Transcript, No. 31 at p. 177) Traulsen commented that it did not have an issue with testing equipment at internal temperatures that are higher than the rating temperatures, such as 50 °F or 10 °F. However, Traulsen expressed concern regarding equipment that is designed to run at internal temperatures that are lower than the rating temperature, or ambient temperatures that are higher than the test ambient temperature. Specifically, Traulsen stated that this equipment inherently uses more energy at the design conditions (often very high ambient temperatures and relative humidities) and may also use more energy at the designated rating conditions (the temperature and relative humidity values specified by ASHRAE 72–2005) as well. Traulsen provided the examples of a piece of equipment designed to hold ice cream at −40 °F and a unit designed for 105 °F ambient conditions. (Traulsen, No. 45 at p. 2)

In the 2012 test procedure final rule, DOE adopted provisions that allow for the testing of commercial refrigeration equipment that cannot operate at its prescribed rating temperature at the ''lowest application product temperature.'' DOE defined ''lowest application product temperature'' as ''the integrated average temperature closest to the specified rating temperature for a given piece of equipment achievable and repeatable, such that the integrated average temperature of a given unit is within ±2 °F of the reported lowest application

[26] Application temperature equipment is equipment that is designed to operate at temperatures distinctly different from the DOE rating temperatures of 38 °F, 0 °F, and −15 °F. Examples include wine chillers and candy cases, which operate in the range of 45 to 60 °F.

product temperature for that basic model.'' DOE also applied this provision to all refrigerators, freezers, and ice-cream freezers. 77 FR 10302 (Feb. 21, 2012).

DOE maintains that units tested at the lowest application product temperature will still be required to meet the applicable energy conservation standard based on their equipment class. The required standard level will not change based on the different internal temperature at which a particular unit is tested. While DOE understands that this requirement makes it easier for a small number of units (that cannot be tested at the prescribed rating temperatures) to meet the current standards, DOE does not believe that establishing separate equipment categories for these niche types of equipment would be justified because the energy savings achievable with such standards would be relatively small. In response to NEEA's suggestion that ice chests designed to operate outdoors be tested at alternate ambient conditions, DOE notes that its test procedure prescribes only one ambient condition. DOE believes this ambient condition is adequately representative of the operating conditions for the majority of commercial refrigeration equipment. Additionally, DOE has seen no evidence that a unit designed to perform at stricter conditions than the DOE test procedure (*i.e.,* higher ambient temperature and/or humidity) would have difficulty meeting a standard at the conditions prescribed in the test procedure.

In response to NEEA's assertion that application temperature equipment is a growing commercial refrigeration equipment market segment, DOE has no data to substantiate the assertion. DOE has not collected shipments data indicating that such a trend exists, nor have manufacturer interviews indicated that this is the case. Application temperature equipment represents a niche equipment market, and this equipment has been in existence for a long time (*e.g.,* candy cases, wine cases, floral cases). DOE has no evidence indicating that this market segment will grow disproportionately to other equipment types.

DOE also agrees with Traulsen that testing these units at a higher integrated average temperature does not necessarily mean that the unit will use less energy. The variability in energy use and the impact of variation in integrated average temperature will vary based on case type, geometry, and configuration. This variation would make setting a consistent standard for high-temperature or intermediate-temperature equipment impractical, because any value chosen would not be representative of all cases.

c. Open Cases

At the April 2011 preliminary analysis public meeting and in written comments, numerous stakeholders revisited the issue of DOE's proposed decision to retain separate standards for open and closed cases. Earthjustice first raised the issue, inquiring about the evidence behind DOE's assertion that open cases provide distinct utility with respect to features such as unobstructed view and access to product, as well as simplified stocking, cleaning, and maintenance. Earthjustice continued by stating that it wished to renew its request that DOE continue grouping open and doored cases together, adding that any determination of utility is required to be based on substantial evidence. (Earthjustice, Public Meeting Transcript, No. 31 at pp. 23, 25) AHRI responded that the distinction between the two types of cases was made in the language of EPACT 2005, which was developed through negotiations among AHRI and other parties, including advocacy groups. (AHRI, Public Meeting Transcript, No. 31 at pp. 24–25) Southern Store Fixtures added that open and doored cases are two distinct types of equipment with different applications, and that they cannot be combined into a single category. Southern Store Fixtures also stated that substantial analysis and evidence would have to be provided in order to show that there would be no product loss or sales loss as a result of moving from open to doored cases. (Southern Store Fixtures, Public Meeting Transcript, No. 31 at pp. 28–29)

In further discussion at the public meeting, Earthjustice stated that it had submitted to DOE a study conducted by ASHRAE,[27] as well as a Swedish study, to support Earthjustice's assertion that product sales are unaffected by the presence of door on cases. (Earthjustice, Public Meeting Transcript, No. 31 at p. 29) However, Southern Store Fixtures stated that it would dispute the ASHRAE study regarding open cases, and that it would articulate its argument later. (Southern Store Fixtures, Public Meeting Transcript, No. 31 at pp. 29–30) Additionally, the Swedish study was retracted from submission due to copyright issues.

Stakeholders also provided comments regarding the subject of metrics of utility. Pacific Gas and Electric (PG&E) stated that, in its opinion, sales would be the most obvious metric, along with the ability to keep product at the desired temperature. However, PG&E asked that DOE elaborate on how it would quantify what constitutes utility. (PG&E, Public Meeting Transcript, No. 31 at pp. 30–31) The California Investor Owned Utilities (CA IOUs) included a similar request in its written comment, asking that DOE clarify what it specifically considers as criteria to justify unique utility. CA IOUs also asked that DOE continue to assess options that would enable open cases to consume amounts of energy similar to those used by equivalent closed cases. (CA IOUs, No. 42 at p. 5) Zero Zone, continuing on the subject of utility, stated that, in its opinion, there may have been utility differences between open and doored cases at one time, but since that time it believed the market had changed and this difference no longer exists. As a result, Zero Zone supported the comments suggesting that DOE combine the open and doored display case classes. (Zero Zone, Public Meeting Transcript, No. 31 at p. 32)

The Appliance Standards Awareness Project (ASAP), while not commenting specifically on equipment utility, stated that it believed the issue of open versus closed cases is very important from an NES perspective, as the preliminary analysis documents showed that open cases consume two to three times as much energy as comparable doored cases. (ASAP, Public Meeting Transcript, No. 31 at p. 32) CA IOUs agreed with DOE's assessment that open, low-temperature vertical and semivertical cases represent small portions of the market. Further, it pointed out that the California Energy Commission (CEC) is proposing to require doors on all upright, low-temperature cases at the State level. (CA IOUs, No. 42 at p. 5)

During the preliminary analysis comment period, Earthjustice submitted a detailed comment outlining its position on the issue of open cases. Earthjustice expressed its belief that separate standards for open cases are neither warranted nor required by EPCA, as well as its opinion that such cases provide no capacity or performance features justifying separate standards, once again referencing the previously submitted ASHRAE and Swedish studies. Implicitly in response to statements made by AHRI at the public meeting, Earthjustice added that EPACT 2005's codification of standards for equipment with doors does not require DOE to maintain separate

[27] Fricke, B.A., and B.R. Becker. *Comparison of Vertical Display Cases: Energy and Productivity Impacts of Glass Doors Versus Open Vertical Display Cases.* December 2009. American Society of Heating, Refrigerating and Air-Conditioning Engineers, Atlanta, GA. Report No. RP–1402. *http://rp.ashrae.biz/researchproject.php?rp_id=580*

classes for equipment without doors. (Earthjustice, No. 35 at p.1) Earthjustice expressed the belief that DOE's intention to adhere to its previous stance that the presence or absence of doors on cases affects case utility ignores the evidence that has been presented in the form of the aforementioned ASHRAE and Swedish sales studies, and that EPCA requires DOE's factual conclusions to be supported by substantial evidence which, according to Earthjustice, DOE has not provided. (Earthjustice, No. 35 at p. 2)

Earthjustice reiterated its disagreement with DOE's assertion in the preliminary analysis that open cases provide utility in the form of ''unobstructed view of and access to product,'' citing the two sales studies that it believed to conclude otherwise. Earthjustice also disagreed with DOE's statement that open cases simplify stocking, cleaning, and maintenance, questioning how the need to prop a door open would impede stocking a case. On the contrary, Earthjustice asserted, the presence of doors would reduce warm air infiltration and the opportunities for items to fall out of the case onto the store floor, thereby reducing stocking burdens and losses due to products damaged during stocking. Furthermore, Earthjustice stated that DOE has not suggested shorter life cycles for equipment with doors, something it believes would be a logical outcome were the presence of doors to impair cleaning and maintenance operations. (Earthjustice, No. 35 at p. 2)

Earthjustice then presented a legal argument, stating that, in maintaining that 42 U.S.C. 6295(o) prevents the merging of equipment classes for equipment with and without doors, DOE has misconstrued the statutory authority for whether separate classes are required. Earthjustice asserted that DOE has, in its preliminary analysis TSD, attempted to shift the evidentiary burden onto the stakeholders who support equivalent standards for the two equipment types. Earthjustice commented that, in dismissing the findings of the ASHRAE study, DOE has violated the plain language of EPCA, which requires that a preponderance of the evidence must support the position that open cases provide a unique feature in order for DOE to conclude that separate equipment classes are required. (Earthjustice, No. 35 at pp. 2–3)

Earthjustice suggested that, should DOE decide not to merge classes for open and closed cases, DOE should adopt standards reflecting the overlapping applications for the equipment. Earthjustice stated that because equipment with doors is economically advantageous on an LCC basis, encouraging a shift to equipment with doors will increase the monetary savings from this rulemaking. (Earthjustice, No. 35 at p. 3) By adopting highly cost-effective standards for equipment with doors as well as standards that would result in LCC increases for open cases, Earthjustice suggested, DOE could encourage consumers to purchase cases with transparent doors. Earthjustice stated that DOE has taken a market-transforming approach in the past. Specifically, Earthjustice referenced the small electric motors rulemaking (75 FR 10874 (March 9, 2010)), in which DOE maintained standards for two types of general purpose single-phase motors but tailored those standards to encourage the market to shift to one of those types. (Earthjustice, No. 35 at p. 3) Similarly, Earthjustice added, in the rulemaking for commercial clothes washers (75 FR 1122 (Jan. 8, 2010)), DOE adopted standards set at the max-tech level for top-loading washers, but less aggressive standards for front-loading washers, partially to encourage the growth of front-loader market share. In conclusion, Earthjustice suggested that DOE adopt the max-tech level for equipment without doors and a more economically advantageous standard for equipment with doors, thus encouraging the market to shift to doored cases. (Earthjustice, No. 35 at pp. 3–4)

DOE understands the concern of some stakeholders regarding the issue of open cases. While some stakeholders have reiterated their previous positions on this topic, DOE does not believe that any new data has been presented since the Framework document public meeting (May 2010) that would warrant a change in DOE's stance as outlined in chapter 2 of the preliminary analysis TSD. DOE maintains that to set standards discouraging users from purchasing open cases would violate its statutory charge to preserve the availability of features and performance characteristics currently on the market. While Earthjustice again cited the ASHRAE study and the Swedish study comparing sales from open and closed cases, DOE still maintains its position from the preliminary analysis. After having reviewed the ASHRAE study, DOE believes that because the data were collected only under very specific conditions in a controlled environment and with a limited range of merchandise types, the data are insufficient to drive a conclusion applicable across the broad wide range of open case applications and end uses. As one example, DOE points out that neither study includes fresh produce and packaged meat products in the analysis of impact on product sales, and that these are types of merchandise that manufacturers have mentioned as benefiting from the use of open cases.

Regarding the questions about the definition of utility raised by Earthjustice and PG&E, EPCA states that, in setting or amending standards, the Secretary must consider, among other factors, any lessening of the utility or performance of the covered products likely from the imposition of the standard. (42 U.S.C. 6295(o)(2)(B)(i)(IV) and 6316(e)(1)) EPCA further states that the Secretary may not prescribe an amended or new standard under this section if the Secretary finds (and publishes such finding) that interested persons have established by a preponderance of the evidence that the standard is likely to result in the unavailability in the United States in any covered product type (or class) of performance characteristics (including reliability), features, sizes, capacities, and volumes that are substantially the same as those generally available in the United States at the time of the Secretary's finding. (42 U.S.C. 6295(o)(4) and 6316(e)(1))

Thus, while the term ''utility'' is not specifically defined in EPCA, it is used in conjunction with the term ''performance''; the statute further prohibits DOE from setting standards that result in the unavailability of performance characteristics or features from the U.S. market. In this case, DOE has determined that customer access to product is a distinct performance characteristic or feature in the case of commercial refrigeration equipment and believes, based on its research and discussions with experts and members of industry, that open cases provide more convenient access to products than do closed cases, as well as providing other measures of utility, such as ease of stocking and cleaning.

In response to the comment by Earthjustice that DOE violated the plain language of EPCA, which requires that a preponderance of the evidence must support the position that open cases provide a unique feature in order to conclude that separate equipment classes are required, DOE refers to the language found at 42 U.S.C. 6295(o)(4) and 6316(e)(1). This language states that the Secretary may not issue a standard if interested persons have established by a preponderance of the evidence that the standard is likely to result in the unavailability in the United States of any covered product type (or class) of performance characteristics (including reliability), or features currently available. One statement suggesting that the elimination of open cases would have this effect was presented at the April 2011 preliminary analysis public meeting, when Southern Store Fixtures explicitly stated that open and doored cases are two different equipment types, adding that ''substantial analysis and evidence would have to be provided'' to ensure that there would be no detriment to performance by combining the classes. (Southern Store Fixtures, Public Meeting Transcript, No. 31 at pp. 28–29) DOE has agreed with this stance in its past and current proceedings, as evidenced by the retention of separate equipment types for open and closed cases in its analyses. At the commercial refrigeration equipment test procedure NOPR public meeting, Coca-Cola, a major purchaser of display cases, cited internal studies concluding that the presence of doors on displays near registers can decrease sales by 35 to 50 percent. (Docket No. EERE–2010–BT–TP–0034, Coca-Cola, No. 19 at p. 90) These study results stand in contrast to the assertion by Earthjustice that the two sales studies it provided show that open cases do not provide utility in the form of unobstructed view of and access to product. The conflict between the sets of data suggests that, while both conclusions may be correct in the specific contexts of the respective studies, in some applications the presence of doors on cases can adversely affect visibility and access to product. Therefore, elimination of open cases from the market would equate to the unavailability of this performance characteristic, in direct violation of (42 U.S.C. 6295(o)(2)(B)(i)(IV) and 6316(e)(1)).

In its manufacturer interviews, DOE spoke with several manufacturers who provided anecdotal data regarding the utility of open cases. They pointed to increased sales due to ''impulse buys,'' stating that users of open cases reported generating higher revenues out of those cases. Manufacturers also stated that open cases allow for vastly easier stocking of high-margin items including produce and meat. The ease of stocking these items is particularly important to retailers, because open cases are stocked continuously while shoppers are in the store, making simultaneous, unobstructed access to the case by both the employee and customer an important utility issue. Manufacturers reaffirmed during these interviews that unobstructed view of and access to product, as well as simplified stocking, as previously referenced by DOE, were significant attributes of open cases. Furthermore, the manufacturers pointed to better accommodation of non-standard-sized merchandise within these cases. The information that DOE has gathered regarding market perceptions at conferences and other venues has indicated that many grocery store managers and operators strongly prefer open cases to closed cases, as they perceive that product visibility from a distance is a very strong factor in sales. Engineers for large chain grocery stores have stated that their efforts to convert even part of the grocery store equipment from open cases to closed cases, during store remodeling, have been met with opposition from store managers due to their perception that open cases lead to higher sales compared to closed cases. This finding is in contrast to the statement by Zero Zone that utility differences between open and doored cases no longer exist. The statement by Zero Zone also conflicts with the internal study data quoted by Coca-Cola, in which that company noted a significant loss in sales due to the presence of doors on display cases in certain settings. As the result of a collective review of the data obtained through its public meetings, manufacturer interviews, and conferences, DOE believes that its position of setting separate standards for open and closed cases is reasonable and based on the distinct performance characteristics of each class, as shown by a preponderance of the evidence presented. DOE notes that manufacturers did not cite differences in maintenance and cleaning between open and closed cases, but DOE believes the other utility and performance factors cited, including ease of access to the product, increased visibility, and ease of use during operations and maintenance, are sufficient to warrant maintenance of two separate equipment classes.

DOE understands AHRI's statement that the distinction between case types was made in the EPACT 2005 language, which set standards for closed cases and required DOE to set standards for open cases (42 U.S.C. 6313(c)), and Earthjustice's response that the codification of separate standards does not require DOE to maintain different classes. However, DOE is restricted by EPCA from prescribing energy conservation standards in any manner that would lessen utility to the customer or result in the unavailability of performance characteristics or features currently on the market. (42 U.S.C. 6295(o)(2)(B)(IV), 6295(o)(4), and 6316(e)(1)) Therefore, DOE continues to consider open and doored cases to be two distinct equipment types due to the evident performance and feature differences between them.

DOE acknowledges ASAP's statement that open cases have been shown to consume more energy than doored cases and CA IOU's assertion that open, low-temperature cases comprise a small market share. However, independent of these factors, as stated above, DOE is forbidden by EPCA from setting standards that would result in the unavailability on the market of the performance characteristics and features that open cases exhibit. (42 U.S.C. 6295(o)(4) and 6316(e)(1)) Therefore, DOE, through its analyses, sought to develop separate proposed standard levels for open and closed cases that would result in the maximum economically justified and technologically feasible energy savings for the respective equipment.

Regarding Earthjustice's assertion that DOE failed to suggest shorter life cycles for commercial refrigeration equipment with doors, DOE points out that the replacement of doors is one of the factors contributing to repair costs (see chapter 8 of the NOPR TSD). Damage to doors does not necessarily shorten the life of the equipment itself.

With respect to Earthjustice's suggestion that DOE force a market shift from open to closed cases by adopting cost-effective standards for doored cases but less economically attractive standards for open cases, DOE is compelled by EPCA to examine the economic and technical justification of all equipment under the same criteria and with the same rigor. (42 U.S.C. 6295(o) and 6316(e)(1)) In other words, DOE must independently determine the maximum technologically feasible and economically justified standard level for each equipment class. Therefore, DOE examined all TSLs equally using the same quantitative metrics, such as LCC and national NPV, and selected a proposed standard level using these criteria. In response to the suggestion that DOE adopt a market-transforming approach in which it would intentionally shift market share toward doored cases, DOE believes that to do so would violate the EPCA provision barring DOE from setting standards that result in the lessening of utility or unavailability of performance characteristics. (42 U.S.C. 6295(o)(4) and 6316(e)(1)) Because DOE has determined that open cases present a unique set of performance characteristics and features to the market, to set standards eliminating their manufacture and sale would violate 42 U.S.C. 6295(o)(4) and 6316(e)(1). DOE notes that in the rulemakings for small electric motors and commercial clothes washers that Earthjustice cited, DOE was careful to set standards such that they would not result in the unavailability of features or performance characteristics. For example, the commercial clothes washers final rule, published by DOE on January 8, 2010, states that the amended efficiency levels can be met by either top- or front-loading designs. In fact, the clothes washers final rule notes that there were vertical-axis top-loading and horizontal-axis frontloading washers on the market at the time that already met the higher standard. Thus, DOE concluded, consumers would have the same range of clothes washer options, including features valued by consumers such as door placement, capacity, water temperature, and adjustable load sizes. 75 FR 1122, 1133–34 (Jan. 8, 2010). In the case of commercial refrigeration equipment, DOE believes that separate equipment classes are necessary to preserve the unique features provided by open refrigerated display cases, established by interested parties as discussed above. DOE does not believe it would be possible to combine standards classes or arbitrarily set more aggressive standards for open cases without violating EPCA provisions regarding utility/product availability. (42 U.S.C. 6295(o)(2)(B) and 6316(e)(1)) As a result, DOE has maintained the position regarding utility of open cases that it asserted in the January 2009 final rule and in its preliminary analysis and framework document. 74 FR 1099 (Jan. 9, 2009).

DOE understands that there are other options available in the market to reduce the energy consumption of open cases, such as retrofitting doors to open cases, and that DOE's energy conservation standards may not be the only factor related to improving the energy efficiency of open cases. DOE believes that, in general, management staff of grocery stores is well aware of high energy costs because energy costs consistently figure as one of the top five issues in the Food Marketing Institute (FMI) Worry Index,[28] which is obtained through surveys of the food retailers regarding the most important issues in their businesses that cause them to ''worry.'' Some stores have retrofitted their open cases with transparent doors to achieve substantial savings in energy costs. DOE also recognizes that the market for retrofitting open, multi-deck display cases with transparent doors is steadily increasing. In addition, features such as night curtains and more-efficient air curtains are also available in the market to reduce the energy consumption of open cases.

In its NOPR analyses, DOE modeled open and closed display cases separately, and has included separate proposed standards for the two types of equipment in this notice.

d. Service Over Counter Equipment

AHRI voiced concerns about self-contained service over counter (SOC) equipment,[29] stating that DOE incorrectly determined that SOC equipment was covered by EPACT 2005 and that this error resulted in an overly stringent standard being applied to the equipment. (AHRI, No. 43 at p. 2) AHRI commented that it, working with other stakeholders, had proposed legislative language that defines SOC equipment and establishes minimum standards for that equipment, which is included in the Implementation of National Consensus Appliance Agreements Act of 2011, S. 398, 112th Cong. (2011). AHRI asked that DOE adopt the definition of SOC equipment that AHRI had proposed in that legislation, and also asked DOE to use TDA as a normalization metric for this equipment. (AHRI, No. 43 at p. 2)

With respect to the statement by AHRI that DOE has incorrectly determined that SOC equipment is within the scope of coverage of EPACT 2005, DOE disagrees, having determined that SOC.SC.M equipment meets the statutory definition of a self-contained commercial refrigerator with transparent doors in 42 U.S.C. 6311(9)(A). EPCA does not specify equipment subsets such as SOC equipment beyond defining the terms ''commercial refrigerator,'' ''freezer,'' and ''refrigerator-freezer'' and ''self-contained condensing unit,'' among other definitions related to this equipment. (42 U.S.C. 6311(9)) In December 2009, DOE's Office of Hearings and Appeals (OHA) responded to an application for exception relief from a manufacturer of SOC equipment. This manufacturer argued that it was entitled to relief because its SOC units could not meet the EPACT 2005 standards for self-contained equipment with doors. OHA responded that DOE did not have jurisdiction to consider such exceptions for equipment covered by the statutorily mandated standards. (Case No. TEE–0066, Dec. 29, 2009)

During the preliminary engineering analysis for this rulemaking, DOE confirmed that the EPACT 2005 standards for SOC.SC.M (42 U.S.C. 6313(c)(2)) could not be achieved at even the max-tech level (see chapter 2, section 2.2.1.5, of the preliminary analysis TSD). Therefore, DOE agrees with AHRI's comment that the standard set by EPACT 2005 was too stringent for equipment belonging to equipment class SOC.SC.M. Consequently, DOE had excluded SOC.SC.M equipment from the preliminary analysis.[30]

In December 2012, during the NOPR analysis for this rulemaking, the American Energy Manufacturing Technical Corrections Act (AEMTCA), Public Law 112–210 (Dec. 18, 2012) amended EPCA to establish new standards for self-contained service over counter medium temperature commercial refrigerators. (42 U.S.C. 6313(c)(4)) The amendment reduces the stringency of the standard applicable to this equipment. AEMTCA prescribed the standard for SOC.SC.M equipment manufactured on or after January 1, 2012 as $0.6 \times TDA + 1.0$, expressed in kilowatt hours per day. (42 U.S.C. 6313(c)(4)(A))

AEMTCA also amended EPCA to direct DOE to determine, within 3 years of enactment of the new standard for SOC.SC.M, whether the standard should be amended. (42 U.S.C. 6313(c)(4)(B)(1) If DOE determines that the standard should be amended, then DOE must issue a final rule establishing an amended standard within this same 3-year period. (42 U.S.C. 6313(c)(4)(B))

DOE conducted the analysis for this determination of whether to amend the standard for equipment class SOC.SC.M as part of this NOPR analysis. The analysis was carried out in a manner similar to that of all the other equipment classes being analyzed as part of the current rulemaking. DOE used the standard established by AEMTCA as the baseline efficiency level for equipment class SOC.SC.M.[31] The results of the analysis indicated that if an amendment to the AEMTCA standard for equipment

[28] FMI Research. *The Food Retailing Industry Speaks 2011.* 2011. Food Marketing Institute, Arlington, VA.

[29] ''Service over counter'' means equipment with sliding or hinged doors in the back intended for use by sales personnel for loading and retrieving items for sale, and fixed, sliding or hinged transparent panels in the front for displaying merchandise. The equipment has a height no greater than 66 inches and is intended to serve as a counter for transactions between sales personnel and customers.

[30] DOE had also excluded SOC.SC.L, a low-shipments-volume equipment class, from the preliminary analysis as well, as it too is covered under standards prescribed by EPACT 2005 for freezers with transparent doors found at 10 CFR 431.66(b). Due to its similarity in design, construction, and performance to SOC.SC.M equipment, DOE presumed that it too would not be able to meet the standards set by EPACT 2005 for self-contained equipment with transparent doors.

[31] This approach is similar to that adopted for all the other equipment classes, as explained in section IV.H.1.

class SOC.SC.M, based on same criteria established for all the other equipment classes of the current rulemaking,[32] would represent a reduction in energy consumption of roughly 30 percent as compared to the AEMTCA standard. Based on this result, DOE has proposed an amended standard for equipment class SOC.SC.M in this NOPR (see section I and section V.A.2).

In response to AHRI's request that DOE use TDA as a normalization metric for this equipment, the January 2009 final rule standards for remote condensing SOC equipment were expressed using TDA as a normalization metric. 74 FR 1093 (Jan. 9, 2009). As AHRI suggested, DOE proposes in this NOPR to continue to use TDA as the normalization metric for SOC equipment.

DOE is also proposing to adopt a new definition of the ''service over counter'' equipment family, which is included in this notice. DOE based its proposed definition on the definition of self-contained service-over-counter refrigerators (SOC.SC.M) found in Paragraph (1) of section 4 of AEMTCA. (42 U.S.C. 6313(c)(1)(C)) However, DOE proposes to adopt a broader definition of SOC equipment that DOE believes is applicable to all of the equipment classes that belong to the SOC equipment family, not just the single SOC.SC.M equipment class described by the AEMTCA language. The proposed definition can be found in section 0 of this NOPR.

2. Technology Assessment

As part of the market and technology assessment performed for the NOPR analysis, DOE developed a comprehensive list of technologies that would be expected to improve the energy efficiency of commercial refrigeration equipment. Chapter 3 of the NOPR TSD contains a detailed description of each technology that DOE identified. Although DOE identified a complete list of technologies that improve efficiency, DOE only considered in its analysis technologies that would impact the efficiency rating of equipment as tested under the DOE test procedure. Therefore, DOE excluded several technologies from the analysis during the technology assessment because they do not improve the rated efficiency of equipment as measured under the specified test procedure. Technologies that DOE determined impact the rated efficiency were carried through to the screening analysis and are discussed in section IV.D.

a. Technologies Applicable to All Equipment

In the preliminary analysis market and technology assessment, DOE listed the following technologies that would be expected to improve the efficiency of all equipment: higher efficiency lighting, higher efficiency lighting ballasts, remote lighting ballast location, higher efficiency expansion valves, higher efficiency evaporator fan motors, variable-speed evaporator fan motors and evaporator fan motor controllers, higher efficiency evaporator fan blades, increased evaporator surface area, low-pressure differential evaporators, increased case insulation or improvements, defrost mechanisms, defrost cycle controls, vacuum insulated panels, and occupancy sensors for lighting controls. Not all of these technologies were considered in the preliminary engineering analysis; some were screened out or removed from consideration on technical grounds, as described in chapters 3 and 4 of the NOPR TSD. After the publication of the preliminary analysis, DOE received numerous stakeholder comments regarding these technologies, discussed below.

Lighting Technologies

In response to DOE's request for comment, Southern Store Fixtures questioned DOE's specification for light-emitting diode (LED) lighting because it appeared that LEDs had a lower efficacy in terms of lumens per watt compared to T8 fluorescent lighting (the standard baseline lighting technology) in DOE's model. (Southern Store Fixtures, Public Meeting Transcript, No. 31 at pp. 59–60) Zero Zone observed that while fluorescent lighting is a mature technology, LED lighting is constantly evolving. (Zero Zone, Public Meeting Transcript, No. 31 at p. 63) Additionally, Southern Store Fixtures suggested that the efficiency of the driver powering the LEDs be explicitly considered, as it is a key aspect of lighting energy consumption. (Southern Store Fixtures, Public Meeting Transcript, No. 31 at p. 62) True noted that light output from LEDs is highly directional, and the additional heat load from the LEDs increases the load on the compressor, which is less efficient than the lighting system. (True, Public Meeting Transcript, No. 31 at pp. 60–61)

Regarding the comment by Southern Store Fixtures, the output of LED light fixtures used in commercial refrigeration equipment is indeed lower in terms of lumens per watt when compared to T8 fluorescent bulbs. However, for commercial refrigerated display applications, the advantage of LED lighting lies in the directionality of its light output. While T8 lighting produces greater output in lumens, much of that light is directed toward the ambient space rather than the merchandise to be illuminated, and thus is wasted from a product merchandising perspective. LED lighting, on the other hand, is very directional, and the light can be aimed directly at the product on display. This difference allows for more conservative sizing of LED fixtures and, as a result, overall power consumption is lower compared to T8 fluorescent lamps.

DOE agrees with the comment by Zero Zone that LED lighting is an evolving technology. As a result, DOE has taken efforts to update its LED fixture cost estimates throughout the rulemaking process, gathering the most current data available from publicly available sources as well as from manufacturer interviews. Regarding Southern Store Fixtures' concern about driver power, this power consumption is considered in the engineering model and is incorporated into the calculation of calculated daily energy consumption (CDEC). Similarly, with respect to True's comment, the impact of lighting on case heat load, and thus compressor power consumption, is accounted for in the engineering model through the use of a multiplier to estimate the fraction of light produced that is retained inside the case as heat.

Lighting Controls

In addition to discussing lighting, stakeholders also commented on the location of lighting controls. Southern Store Fixtures observed that certain operators use central energy management systems to control the display case lighting, and asked if this approach would be considered instead of just the placement of occupancy sensors in individual display cases. The company added that when customers ask them to supply a case to be controlled by a central energy management system, the lights in the display cases must be wired separately from the other energy-consuming components. (Southern Store Fixtures, Public Meeting Transcript, No. 31 at pp. 190–91, 194) Further, Southern Store Fixtures pointed out that CEC is considering these central lighting systems in its proceedings. (Southern Store Fixtures, Public Meeting Transcript, No. 31 at p. 197) Zero Zone stated that it typically wires cases with a separate lighting circuit to allow for

[32] The criteria for trial standard level selection can be found in section V.A.1, and discussion concerning the selection of the proposed standard level can be found in section V.C.

independent lighting control, while NEEA stated that if a case is wired differently to interface with centralized controls, it should be treated identically to a self-contained set of controls. (Zero Zone, Public Meeting Transcript, No. 31 at p. 196; NEEA, Public Meeting Transcript, No. 31 at p. 195) CA IOUs supported the manufacturer assertion made during the April 2011 preliminary analysis public meeting that it is possible to distinguish between cases designed for remote energy controls and those that are not. (CA IOUs, No. 42 at p. 4) For this reason, the CA IOUs suggested that DOE develop a calculation to measure energy savings due to the use of such remote systems in the test procedure. (CA IOUs, No. 42 at p. 4)

DOE acknowledges that there are several ways to implement lighting controls (*e.g.,* individual case controls, controls for a case lineup, storewide energy management systems), and that allowing certain systems to be included in calculating energy consumption may set a precedent for how DOE defines the boundaries of covered equipment and what technologies are allocated energy savings for a piece of equipment in the test procedure. For example, cases set up to accept remote control systems have a dedicated circuit for lights so that the lights can be controlled separately from the rest of the case. However, this lighting circuit configuration does not inherently save energy and must be paired with an expensive energy management control system, which is sold separately from the piece of commercial refrigeration equipment, is produced by different manufacturers, and is not integral to the commercial refrigeration equipment. In addition, the existence of an energy management system does not necessarily mean it will be used with commercial refrigeration equipment; for example, energy management systems are used in many stores and offices to control room lighting and temperature set points.

DOE acknowledges that remote lighting controls do save energy and may be the more commonly used technology to dim or turn off lights. However, energy consumption for a piece of commercial refrigeration equipment must be determined using the DOE test procedure to measure the energy consumption of a representative unit, as shipped to customers. Because the remote energy management system is not part of the piece of commercial refrigeration equipment as shipped from the manufacturer, but rather is a separate piece of equipment supplied by a separate manufacturer, remote energy management controls will not be considered as an energy conservation feature in this commercial refrigeration equipment rulemaking.

Part-Load Technologies

Stakeholders also submitted comments on the subject of part-load and variable-capacity technologies. These are technologies that allow the performance of the system components to be varied in response to changes in the load placed on them, such as changes due to varying ambient conditions or product loading. PG&E requested that DOE clarify its stance on part-load technologies, suggesting that there was a disparity between the NOPR DOE published on November 24, 2010, which proposed amendments to DOE's test procedures for commercial refrigeration equipment (November 2010 test procedure NOPR (75 FR 71596 (Nov. 24, 2010)) and the screening analysis presented in chapter 2 of the preliminary analysis TSD. Specifically, in the November 2010 test procedure NOPR, DOE stated that the proposed test procedure, which relied on AHRI Standard 1200 and ASHRAE Standard 72,[33] is able to capture the energy-saving effects of some part-load technologies. (76 FR 71601 (Nov. 24, 2010)). Conversely, in the screening analysis in chapter 2 of the preliminary analysis TSD, DOE removed some technologies from the analysis and stated that their effects could not be measured by the steady-state test procedure. PG&E asked DOE to clarify its stance and asked that, if DOE determines that the effects of these technologies can be measured, to include them in the screening and engineering analyses. PG&E later reiterated its desire that DOE be consistent in its approach toward technologies that maintain energy savings at variable ambient conditions or variable load. (PG&E, Public Meeting Transcript, No. 31 at pp. 51–52, 178)

Similarly, CA IOUs noted a perceived disparity between DOE's statement in the preliminary analysis TSD chapter 2, where DOE stated that it ''believes that the energy saving potential of these technologies is already captured to some degree in the current test procedure,'' and chapter 4, where DOE stated that ''[t]echnologies that reduce energy use only under transient conditions, such as fluctuations in ambient temperature and humidity, periods of product loading, and frequent door openings, will not affect the measured CDEC. Therefore, DOE removed from consideration these technologies that do not affect or do not reduce CDEC during the tests.'' CA IOUs requested clarification of DOE's rationale for eliminating those technologies from consideration, and also requested that DOE include in its engineering analysis all technologies that can be measured in part by the test procedure, notably those that save energy at variable load or under fluctuating ambient conditions. (CA IOUs, No. 42 at p. 2) NEEA expressed its opinion that DOE had not yet adequately justified its lack of initiative in examining part-load technologies. (NEEA, No. 36 at p. 4)

Stakeholders questioned the ability of the DOE test procedure to reflect the performance of part-load technologies. In a written comment submitted jointly, ASAP and the Natural Resources Defense Council (NRDC) encouraged DOE to consider technologies that improve efficiency under part-load conditions in the engineering analysis, stating that DOE referenced in its test procedure NOPR the fact that units tested using ASHRAE 72, namely those with doors, experience variation in load due to the door opening requirements of the test. ASAP and NRDC mentioned that there is clearly a variation in refrigeration load during the test for this equipment, due to the door opening requirement. ASAP and NRDC added that, in its proposed test procedure, DOE also referred to transient load variation effects (76 FR 71601 (Nov. 24, 2010)). ASAP and NRDC stated that, if single-speed compressors cycle on and off during the test, there is likely opportunity for variable-speed compressors to reduce energy consumption by increasing the operating effectiveness of heat exchangers and reducing cycling losses. (ASAP and NRDC, No. 34 at pp. 1–2)

Interested parties also commented that it is important to distinguish between steady-state and full-load modes of operation, since equipment experiencing relatively constant loads is not necessarily operating at full load. ASAP and NRDC stated that if the compressor is cycling, this indicates that the equipment is operating at part load. ASAP and NRDC continued, stating that if a commercial refrigerator or freezer did operate at full load during a test, then it would not be able to maintain the necessary case temperature under the more extreme conditions that it would likely encounter in the field, posing a risk to food safety. Therefore, ASAP and NRDC stated, it is likely that manufacturers design equipment to meet a higher load than that experienced during a test, and that

[33] ANSI/ASHRAE Standard 72–2005. ''Method of Testing Commercial Refrigerators and Freezers.'' 2005. American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Inc. Atlanta, GA.

technologies that improve part-load performance could reduce energy consumption for both open and doored cases. (ASAP and NRDC, No. 34 at p. 2) NEEA expressed a similar viewpoint, commenting that the door opening provision in ASHRAE 72 leads to load variation and that, even for open cases, it is unlikely that the refrigeration system is operating at full capacity during the test period, as this would make the system unable to meet load requirements and guarantee food safety under more extreme environmental conditions. (NEEA, No. 36 at p. 4) NEEA stated that, unless a refrigeration system is sized exactly for its operating load, and that load remains constant, there is good reason to examine part-load system performance. NEEA added that, since most refrigeration systems must perform under a variety of conditions, they will operate cyclically, leaving room for more-efficient operation during times of lower load. NEEA urged DOE to explore the use of variable-speed and variable-capacity components. (NEEA, No. 36 at p. 4)

DOE received comments regarding the treatment and modeling of specific part-load technologies. ASAP stated that, in its proposed energy conservation standards for residential refrigerators (75 FR 59470 (Sept. 27, 2010)), DOE had included variable-speed compressors as a design option, and that the residential refrigerators test procedure was also a steady-state test. ASAP asked why variable-speed compressors were considered for residential refrigerators but not for commercial refrigeration equipment. (ASAP, Public Meeting Transcript, No. 31 at p. 54) NEEA commented that variable-speed condenser fans and condenser fan motor controllers could enable improved part-load performance, and that screening them out due to test procedure limitations is shortsighted. (NEEA, No. 36 at p. 3) NEEA added that high-efficiency expansion valves are becoming much more prevalent in refrigeration systems, and that they should be included in the analysis. NEEA stated that savings associated with high-efficiency expansion valves may arise in conjunction with other technologies installed as part of a part-load package and that, while these energy savings may be small, this should be proven by analysis. (NEEA, No. 36 at p. 3) CA IOUs requested clarification on how variable-speed compressors and modulating capacity compressors[34] are covered in this rulemaking. CA IOUs stated that such compressor technologies did not appear to have been screened out or listed as an option, and appeared to have been included in the engineering analysis TSD chapter under the section discussing higher efficiency compressors. (CA IOUs, No. 42 at p. 2) Finally, ASAP and NRDC stated that the model used in the engineering analysis should be able to capture the potential benefits of technologies that improve part-load performance and that, if this is not the case, DOE should consider a different methodology. (ASAP and NRDC, No. 34 at p. 3)

After receiving these stakeholder comments, DOE reviewed its position on part-load and variable-capacity technologies, as articulated in chapter 2 of the preliminary analysis and test procedure NOPR publications (75 FR 71601 (Nov. 24, 2010)). DOE agrees there was a disparity between the preliminary analysis, in which DOE reiterated its position from the January 2009 final rule that part-load technologies could not be captured by the steady-state ASHRAE 72 method of test,[35] and the test procedure NOPR, in which DOE stated that the door opening and night curtain testing portions of the test would in fact create part-load conditions. 75 FR 71601 (Nov. 24, 2010). DOE believes that the position presented in the test procedure NOPR is accurate, as the variation in operating conditions introduced by door openings and the use of night curtains could create an opportunity for part-load technologies to produce quantifiable energy impacts. DOE revised its position after reviewing the test procedure established in the 2012 test procedure final rule (77 FR 10292 (Feb. 21, 2012)) and the energy consumption profile of equipment observed during testing conducted using the DOE test procedure. DOE believes the confusion arose due to the way in which the industry refers to the ASHRAE 72 method of test. As mentioned above, part load technologies allow a piece of commercial refrigeration equipment to respond to changes in refrigeration load that occur due to changes in ambient conditions or internal loads on the case. The ASHRAE 72 method of test prescribes a single fixed set of ambient conditions, so no major changes in refrigeration load are intentionally introduced through changes in ambient condition. Thus, the ASHRAE 72 method of test is often referred to as steady-state. However, as stated in the November 2010 test procedure NOPR, commercial refrigeration equipment tested using ASHRAE 72 experiences variation in refrigeration load due to door openings, drawing of the night curtain, and inherent compressor cycling that occur during the test. 77 FR 10308 (Feb. 21, 2012). Realizing this, DOE has revised its position and agrees with ASAP, NRDC, and NEEA that the nature of the ASHRAE 72 method of test, while conducted at fixed ambient operating conditions, is not strictly thermodynamically steady-state, as evidenced by compressor cycling and minor fluctuations in internal temperatures throughout the duration of the test. DOE also agrees with these stakeholders that the presence of compressor cycling demonstrates that commercial refrigeration units generally do not operate at full load during the test. From its discussions with manufacturers, DOE understands that most equipment can operate at temperatures lower than the equipment's given DOE rating temperature, and thus performance at the test procedure conditions would likely not constitute full-capacity operation.

In response to the stakeholder suggestions that DOE include specific part-load technologies in the NOPR analyses, DOE investigated the technologies referenced by these commenters. DOE researched the state of part-load and variable-capacity technologies such as fan motor controllers and variable-speed compressors through available manufacturer and component supplier literature, as well as through its discussions with manufacturers during interviews. DOE found that that many of these part-load technologies had not yet been developed for the commercial refrigeration equipment industry to the extent that they could be adopted by manufacturers in the near future. For example, while variable-speed compressors are indeed, as some stakeholders mentioned, prevalent in residential refrigeration applications, their availability for commercial application is very limited and is not applicable to many equipment types. Some technologies were also removed

[34] Variable-speed compressors are able to control the rate at which they operate in order to tailor their performance to varying conditions and thus reduce compressor cycling. Modulating capacity compressors, most commonly found in larger sizes used in compressor racks, allow for the volume of fluid being compressed by the moving pistons (and thus the throughput of the compressor) to be changed in response to load variations.

[35] U.S. Department of Energy–Office of Energy Efficiency and Renewable Energy. Preliminary Technical Support Document (TSD): Energy Conservation Program for Certain Commercial and Industrial Equipment: Commercial Refrigeration Equipment. Chapter 5, Engineering Analysis. March 2011. Washington, DC. *www.regulations.gov/#!documentDetail;D=EERE-2010-BT-STD-0003-0030.*

for functional purposes or because of concerns over food safety performance. Others were removed from consideration because they would not have measurable impacts under the test procedure. Therefore, while DOE did not screen out or preclude the analysis of part-load technologies, DOE did not utilize any of these technologies explicitly as design options in its engineering analysis. For further discussion of DOE's examination of these technologies, see chapters 3 through 5 of the NOPR TSD.

DOE reiterates that the design options that it has chosen for this particular analysis, and the design paths used in modeling the proposed standard levels, do not constitute a prescriptive design requirement. In other words, DOE does not claim that the combinations of design options presented in the engineering analysis form unique paths for achieving higher energy efficiency. Manufacturers are free to utilize any design features available to them in order to develop compliant units, provided that those units meet all the requirements for testing under the DOE test procedure and other applicable regulations. Thus, should manufacturers develop part-load features that produce quantifiable reductions in energy consumption under the DOE test procedure, they are not prohibited from taking advantage of those features, even if particular technologies were not modeled in the analysis for this rulemaking.

b. Technologies Relevant Only to Equipment With Doors

In chapter 3 of the preliminary analysis TSD, DOE mentioned three technologies that could apply only to doored equipment: anti-fog films, anti-sweat heater controllers, and high-performance doors. Not all of these technologies were considered in the preliminary engineering analysis, as some were screened out or removed from consideration on technical grounds. The following sections discuss stakeholder comments regarding these technologies.

Anti-Fog Films

Zero Zone stated that research by Southern California Edison indicated that anti-fog films do not allow for the reduction of anti-sweat heat. (Zero Zone, Public Meeting Transcript, No. 31 at p. 47)

DOE reviewed the available literature regarding anti-fog films, and understands that these films alone do not necessarily eliminate the need for anti-sweat heaters under many conditions, including high ambient humidity, as they cannot prevent condensation from forming on the outside of the case. This shortcoming of anti-fog films can present a major problem for customers. Discussions with manufacturers have led DOE to believe that alternative improvements in door construction provide the capacity to reduce anti-sweat heat without the drawbacks mentioned here. Because of these issues, DOE did not consider anti-fog films on transparent doors as a design option. For further discussion of this subject, see chapter 5 of the NOPR TSD.

Anti-Sweat Heater Controllers

During the April 2011 preliminary analysis public meeting, Zero Zone stated that anti-sweat controllers have the potential to save energy because the controllers would allow heaters to be designed with extra capacity for more humid climates. (Zero Zone, Public Meeting Transcript, No. 31 at p. 53) NEEA, ASAP, and NRDC all suggested DOE investigate Zero Zone's comment further, while the CA IOUs noted it may be possible to include a calculation method to address the benefit of these controllers. (NEEA, No. 36 at p. 3; ASAP and NRDC, No. 34 at p. 2; CA IOUs, No. 42 at pp. 2–4)

DOE raised the subject of anti-sweat heater controllers during its manufacturer interviews for this NOPR. Several manufacturers agreed that, within the context of the test procedure, anti-sweat heater controllers will effectively keep the power to anti-sweat heaters at the levels necessary for the test conditions. While anti-sweat controllers could also modulate the anti-sweat power further in the field to account for more or less extreme ambient conditions, a system equipped with anti-sweat heater controllers will not likely exhibit significantly different performance at test procedure conditions than will a unit with anti-sweat heaters tuned for constant 75 °F, 55 percent relative humidity conditions. Therefore, DOE did not consider anti-sweat heater controllers in the engineering analysis, as modeling these devices within the context of the test procedure would not yield appreciable energy savings over anti-sweat heaters that are properly sized for the test procedure ambient conditions. DOE notes that manufacturers that produce cases with anti-sweat heater controls for higher temperature and humidity environments may use anti-sweat heater controllers in the test procedure, however.

High-Performance Doors

Zero Zone also commented on high-performance doors, stating that when they were incentivized in California, retail stores used more energy because they had to set their air conditioning to a lower set point to avoid condensation. Zero Zone added that high-performance doors also sweat under conditions that are less favorable than the ASHRAE test conditions, and that DOE should evaluate technologies intended to be used for performance under actual conditions, not just under ASHRAE 72 test procedure conditions. Zero Zone stated that DOE should remove high-performance doors from the analysis. (Zero Zone, No. 37 at pp. 1 and 3)

During the NOPR engineering analysis, DOE reviewed its data for all design options, including high-performance doors. Transparent door performance was discussed at manufacturer interviews during the preliminary analysis and NOPR stages of the rulemaking, and the glass door designs considered in the engineering analysis are based on door models currently available on the market. The performance of these door designs was analyzed using Lawrence Berkeley National Laboratory's (LBNL's) WINDOW 5 software [36] in conjunction with the analyses for DOE's ongoing energy conservation standards rule for walk-in coolers and freezers, an equipment type in which the same models of glass display doors are often employed. While it is true that extreme conditions could adversely impact glass door performance, as mentioned by Zero Zone, the performance of the equipment for this analysis was based on the standardized ASHRAE 72 test conditions of 75°F and 55 percent relative humidity, ambient conditions that have been accepted by industry, the ASHRAE working group, and DOE as being generally representative of the environments typically encountered by commercial refrigeration equipment.

DOE believes that high-performance doors, such as those offered on the market by several door manufacturers and analyzed in this rulemaking, have the potential to save significant amounts of energy for transparent-door cases. Based on its market research and discussions with manufacturers, DOE has concluded that high-performance doors meet all the criteria for inclusion in its analysis, and has thus considered them as a design option in the engineering analysis.

[36] LBNL's WINDOW 5 software is a program designed for modeling the performance of windows, doors, and other fenestration devices.

c. Technologies Applicable Only to Equipment Without Doors

In chapter 3 of the preliminary analysis TSD, DOE mentioned two technologies, air-curtain design and night curtains, that could potentially be used to improve the efficiency of commercial refrigeration equipment without doors. Air curtain design was not considered in the preliminary engineering analysis, as it was screened out and removed from consideration because, according to the information available to DOE, advanced air curtain designs are still in research and development stages and are not yet available for use in the manufacture of commercial refrigeration equipment. The following sections address stakeholder comments regarding technologies applicable to equipment without doors.

Night Curtains

At the April 2011 preliminary analysis public meeting and in written comments, DOE received numerous comments from stakeholders regarding night curtains and their use in equipment without doors. CA IOUs agreed with DOE's decision to include night curtains in the analysis, but pointed out that such energy savings are only significant if the night curtains are properly deployed, and encouraged DOE to review and update its assumptions. (CA IOUs, No. 42 at pp. 4–5) Zero Zone also commented on the potential of night curtains to conserve energy, and stated that this technology should not be included in this rulemaking because there is no reasonable way to estimate how it will actually be used and because it cannot be used in 24-hour stores. (Zero Zone, No. 37 at p. 4) Southern Store Fixtures agreed with respect to these operational challenges, and also pointed out that CEC did not consider night curtains due to long PBPs, labor costs, and questions about the reliability of energy savings. (Southern Store Fixtures, No. 38 at p. 1; Southern Store Fixtures, Public Meeting Transcript, No. 31 at p. 42)

Southern Store Fixtures expressed concern that the use of night curtains on open cases could create design and operational challenges, potentially resulting in an inefficient case with product temperature issues and the potential for noncompliance with food safety regulations. (Southern Store Fixtures, No. 38 at p. 1) Southern Store Fixtures also noted that major design changes will be needed for cases with night curtains. Specifically, the evaporator coil and expansion devices currently used in open cases will be significantly oversized for use with night curtains; the number of fans needed and airflow characteristics will change; and lighting and temperature controls will need to be altered in converting a standard open case to accommodate night curtains. Cases with night curtains would also, Southern Store Fixtures stated, require duplication of controls to be able to operate with and without the curtains. (Southern Store Fixtures, No. 38 at p. 1) In summary, Southern Store Fixtures asserted that these issues would require a redesign of an open case for compatibility with night curtains and that, when considering the potential energy savings associated with the use of a night curtain, DOE should include the cost of performing such a redesign in its analysis. (Southern Store Fixtures, No. 38 at p. 1)

During the public meeting, Zero Zone observed that doored and open cases have a similar energy profile, and therefore, night curtains could be used as a design option for doored equipment as well. (Zero Zone, Public Meeting Transcript, No. 31 at pp. 40–41)

DOE acknowledges that the use of night curtains may not be consistent in the field. However, DOE's test procedures and energy conservation standards cannot control for equipment application and actual end use. Night curtains are an available technology for reducing energy consumption in commercial refrigeration equipment and DOE believes that including night curtains in its test procedure and energy conservation standards would allow manufacturers to take credit for the energy savings associated with this technology. In the 2012 test procedure final rule, DOE assumed 6 hours as the time period that night curtains would be implemented. 77 FR 10310 (Feb. 21, 2012). DOE believes that 6 hours conservatively represents the amount of time a night curtain would be drawn in a typical, non-24-hour store, when accounting for stocking and the fact that not all night curtains can be deployed at once. In addition, 6 hours is consistent with field data and studies that DOE has identified.[37 38 39]

[37] Southern California Edison, Refrigeration and Technology and Test Center, Energy Efficiency Division. *Effects of the Low Emissivity Shields on Performance and Power Use of a Refrigerated Display Case.* August 1997. Irwindale, CA. *www.econofrost.com/acrobat/sce_report_long.pdf.*

[38] Faramarzi, R. and Woodworth-Szieper, M. Effects of Low-E Shields on the Performance and Power Use of a Refrigerated Display Case. *ASHRAE Transactions.* 1999. 105(1).

[39] Portland Energy Conservation, Inc. *Query of Database of GrocerySmart Data.* Portland, OR. Received October 18, 2011. Last viewed July 23, 2011.

With respect to Zero Zone's concern regarding the use of night curtains in 24-hour stores, DOE is not mandating the use of night curtains, but is simply accounting for them as one available energy efficiency technology. In addition, DOE notes that night curtains may be used in 24-hour stores during periods of low customer traffic. DOE further acknowledges that accounting for the energy savings associated with night curtains on open cases would, by definition, result in the setting of a more-stringent standard for open cases. DOE believes such a standard may encourage migration to the use of more-efficient doored cases for those cases used in contexts where the distinct utility of an open case is not required, while preserving the availability of open cases.

Regarding Southern Store Fixtures' comment about the cost-effectiveness of night curtains, DOE points out that the LCC analysis and NIA conducted by DOE are specifically aimed at assessing the cost-effectiveness of all the design options used to achieve greater energy efficiency.

DOE acknowledges Southern Store Fixtures' concerns regarding the costs associated with the need for equipment redesign due to presence of night curtains. After discussions with multiple manufacturers, DOE did not incorporate additional material costs and redesign costs associated with a secondary set of controls because most manufacturers do not implement this design according to information that DOE has obtained through market research and manufacturer interviews. DOE recognizes that individual manufacturers may select different design options and incur different conversion costs than those modeled by DOE. However, DOE attempts in its analysis to represent the choices most likely to be selected by the industry.

Southern Store Fixtures also commented that use of night curtains on open cases could create design and operational challenges that would result in inefficient cases with product temperature issues and the potential for noncompliance with food safety regulations. (Southern Store Fixtures, No. 38 at p. 1) DOE acknowledges that, as with any new technology, implementation of night curtains on open cases may require slight adjustments to equipment design to ensure the case operates efficiently and effectively. During manufacturer interviews for the MIA, data was collected by manufacturer (under confidentiality agreements) and, in aggregate, DOE's resulting conclusion was that night curtains would not result in the challenges discussed by Southern Store Fixtures. The prevalence of night curtains as retrofit options supports this conclusion as well. Thus, DOE believes that modifications can be made that allow open cases to be used with night curtains to achieve energy savings and improve temperature control, and has accounted for the cost to achieve these modifications in the MIA.

In response to Zero Zone's comment regarding the use of night curtains on doored cases, it is DOE's understanding that night curtains can be applied to all types of open cases (*i.e.,* vertical, semivertical, and horizontal), and that night curtains are most effective and commonly used on open cases rather than doored cases. DOE was not able to identify any public data regarding the use or potential for energy savings of night curtains on doored cases. Lacking a sound technical basis for including night curtains on doored cases in its analysis, DOE is hesitant to expand the definition of night curtain, as established in the 2012 test procedure final rule (77 FR 10296 (Feb. 21, 2012)), to explicitly include doored cases at this time. On January 6, 2011, DOE held a public meeting to discuss amendments to the DOE test procedure for commercial refrigeration equipment proposed in a NOPR DOE published on November 24, 2010. 75 FR 71596. At that January 2011 test procedure NOPR public meeting, True stated that it had seen night curtains implemented on doored cases and that this does save a minimal amount of energy, but that these minor savings did not justify consideration of night curtains in the DOE test procedure. (Docket No. EERE–BT–2010–TP–0034, True, Public Meeting Transcript, No. 19 at pp. 146–47) DOE agrees with True and believes that use of night curtains on doored cases will not significantly impact the daily energy consumption of the display case. Therefore, DOE did not incorporate the use of night curtains on cases with doors in the 2012 test procedure final rule. 77 FR 10297 (Feb. 21, 2012). Because night curtains on doored cases cannot be accounted for in the DOE test procedure, they are not included as a design option in the energy conservation standards analyses.

Strip Curtains

While not providing specific comments on the included technologies, Earthjustice questioned DOE's grounds for not considering strip curtains[40] in the analysis, stating that the criteria for considering design options in the analysis should be whether a technology is technologically feasible, economically justified, and reduces energy consumption, not whether it is currently used by manufacturers. (Earthjustice, Public Meeting Transcript, No. 31 at p. 36) Earthjustice stated that DOE should include strip curtains as a design option because these devices can be installed by equipment purchasers, and this illustrates the ease and practicality of their use. (Earthjustice, No. 35 at p. 4) True stated that manufacturers do not install strip curtains at the factory because customers can often receive a secondary rebate for installing strip curtains at the point of end use. (True, Public Meeting Transcript, No. 31 at p. 40)

While DOE understands that some end users purchase and install strip curtains on some open refrigerated display cases, DOE has no information as to the prevalence of use of these accessories. DOE has concerns that incorporating strip curtains into its analyses, and thus potentially into an amended standard, could impose restrictions similar to requiring the use of doors. Doing so would compromise one of the major utility factors of an open case. Namely, manufacturers have reported to DOE that the major utility of an open case is enhanced product visibility to the customer and easy access to product. Installation of a strip curtain would, by definition, inhibit both of these functions. Moreover, on technical grounds, strip curtains could potentially interfere with the operation of the existing air curtain in cases in which the air curtain is less than vertical. Thus, in response to the comment by Earthjustice, the latter issue described above is one of technical feasibility, while the former concern, reduction of utility, could make the consideration of strip curtains inconsistent with the requirements of EPCA. (42 U.S.C. 6295(o)(4) and 6316(e)(1)) While some end users may decide to install strip curtains on their own accord for their specific applications, DOE does not intend to explore their use as applicable to entire equipment classes.

d. Self-Contained Equipment Technologies

In chapter 3 of the preliminary analysis, DOE listed several technologies that are applicable only to the self-contained equipment classes. One of the technologies mentioned in the preliminary market and technology assessment, but not considered for analysis as a design option, was liquid suction heat exchangers (LSHXs).[41] NEEA commented that it did not see a reason for excluding LSHXs from the analysis for systems in which they are likely to be used, and that DOE should include them to the extent that the test procedure can be structured to capture their savings. (NEEA, No. 36 at p. 3) Southern Store Fixtures suggested that DOE investigate why CEC decided not to consider LSHXs because of potential refrigerant leaks. (Southern Store Fixtures, Public Meeting Transcript, No. 31 at p. 44)

During the NOPR stage of this rulemaking, DOE further investigated the subject of LSHXs as applicable to commercial refrigeration equipment. The information obtained by DOE indicated that LSHX performance depends on the specific design of a given system, as well as other factors, including refrigerant type, operating temperature, and ambient conditions. These factors all combine to determine whether an LSHX will reduce the energy consumption of a given system; in some systems, the use of an LSHX will actually increase energy consumption by introducing a greater pressure drop within the refrigeration circuit. DOE also heard comments from parties during manufacturer interviews and conferences concerning potential reliability and leakage issues such as those mentioned by Southern Store Fixtures. Because LSHXs may not improve efficiency in all systems and may experience reliability issues, DOE did not include LSHXs in its analysis. For more discussion of LSHXs, see chapter 3 of the NOPR TSD.

D. Screening Analysis

DOE uses four screening criteria to determine which design options are suitable for further consideration in a standards rulemaking. Namely, design options will be removed from consideration if they are not technologically feasible; are not practicable to manufacture, install, or service; have adverse impacts on product utility or product availability; or have adverse impacts on health or

[40] Strip curtains consist of a series of strips of transparent, flexible material (usually plastic) that hang down and cover the opening of a case without doors. This creates a physical barrier that reduces ambient air infiltration into the case while still allowing customers and employees to access the product contained inside.

[41] A liquid suction heat exchanger is a device intended to further cool the flow of liquid refrigerant entering the expansion valve from the condenser using the flow of gaseous refrigerant leaving the evaporator. The exchanger provides sub-cooling for the entering liquid by super-heating the exiting suction vapor. Hotter suction vapor is less susceptible to heat gains in the return piping to the compressor.

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

In written comments submitted following the April 2011 preliminary analysis public meeting, Zero Zone stated that DOE was correct in screening out a number of technologies, as any technology needs to be thoroughly researched and proven reliable before inclusion for consideration in a standards rulemaking. Zero Zone cited demand defrost as an example of an unproven technology that, if its use were encouraged by an energy conservation standard, would produce poor results in the field. (Zero Zone, No. 37 at p. 1) DOE agrees with Zero Zone's comment, as it is compelled by the screening criteria to ensure that any technology considered is feasible to implement; practicable to manufacture, install, and service; does not adversely impact utility or availability; and would not lead to adverse impacts on health or safety.

Based on all available information, DOE has concluded that: (1) All of the efficiency levels discussed in today's notice are technologically feasible; (2) equipment at these efficiency levels could be manufactured, installed, and serviced on a scale needed to serve the relevant markets; (3) these efficiency levels would not force manufacturers to use technologies that would adversely affect product utility or availability; and (4) these efficiency levels would not adversely affect consumer health or safety. Thus, the efficiency levels that DOE analyzed and discusses in this notice are all achievable through technology options that were ''screened in'' during the screening analysis.

E. Engineering Analysis

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

As discussed in the Framework document and preliminary analysis, DOE conducted the engineering analyses for this rulemaking using a design-option approach for commercial refrigeration equipment. The decision to use this approach was made due to several factors, including the wide variety of equipment analyzed, the lack of numerous levels of equipment efficiency currently available in the market, and the prevalence of relatively easily implementable energy-saving technologies applicable to this equipment. More specifically, DOE identified design options for analysis and used a combination of industry research and teardown-based cost modeling to determine manufacturing costs, then employed numerical modeling to determine the energy consumption for each combination of design options employed in increased equipment efficiency. DOE selected a set of 24 high-shipment classes, referred to as ''primary'' classes, to analyze directly in the engineering analysis. Additional details of the engineering analysis are available in chapter 5 of the NOPR TSD.

1. Representative Equipment for Analysis

a. Representative Unit Selection

In performing its engineering analysis, DOE selected representative units for each primary equipment class to serve as analysis points in the development of cost-efficiency curves. In selecting these units, DOE researched the offerings of major manufacturers to select models that were generally representative of the typical offerings produced within the given equipment class. Unit sizes, configurations, and features were based on high-shipment-volume designs prevalent in the market. Using this data, a set of specifications was developed defining a representative unit for each primary equipment class. These specifications include geometric dimensions, quantities of components (such as fans), operating temperatures, and other case features that are necessary to calculate energy consumption. Modifications to the units modeled were made as needed to ensure that those units were representative of typical models from industry, rather than a specific unit offered by one manufacturer. This process created a representative unit for each equipment class with typical characteristics for physical parameters (*e.g.,* volume, TDA), and minimum performance of energy-consuming components (*e.g.,* fans, lighting).

In its written comment following the preliminary analysis, Traulsen stated that DOE's choice of representative unit sizes for self-contained commercial refrigeration equipment with doors was generally suitable, but added that factors such as cabinet sizes, door quantities, and door types contribute significantly to overall equipment performance. Traulsen cautioned that a failure to factor these variables into the analysis could lead to unintended obsolescence of models with these features. (Traulsen, No. 45 at p. 2) DOE agrees with Traulsen that there are numerous design factors that can influence the performance of commercial refrigeration equipment. In selecting representative units for analysis, DOE sought unit sizes and configurations that generally represented the most commonly sold equipment on the market. The geometric features DOE considered included unit volume, height, length and width, number of doors, and door orientation. DOE avoided considering any features or unit configurations that could skew the analysis away from sound representation of the majority of units produced within a chosen equipment class. As a result, DOE believes that its analysis and resulting proposed standards are applicable and extensible to the range of covered equipment in each class. In response to Traulsen's concern, DOE wishes to point out that it is compelled by statute to avoid the elimination of features or utility currently present in equipment on the market, and that the obsolescence of specific unique equipment types would be included in this provision. (42 U.S.C. 6295(o)(2)(B)(IV), 6295(o)(4), and 6316(e)(1))

b. Baseline Models

DOE created a set of baseline design specifications for each equipment class analyzed directly in the engineering model. Each set of representative baseline unit specifications, when combined with the lowest technological level of each design option applicable to the given equipment class, defines the energy consumption and cost of the lowest efficiency equipment analyzed for that class. DOE established baseline specifications by reviewing available manufacturer data for equipment manufactured at the time of the analysis, and by selecting components and design features that were representative of the most basic models being manufactured at the time of the analysis. Chapter 5 of the NOPR TSD sets forth the specifications that DOE chose for each equipment class and discusses baseline models in greater detail.

One complexity involved in developing an engineering baseline was due to the timing of the analysis, which was conducted in 2010 and 2011. Because the analysis was performed in proximity to the January 2009 final rule compliance date of January 1, 2012 (74 FR 1092 (Jan. 9, 2009)), and the compliance date for the standards established in EPCA of January 1, 2010 (42 U.S.C. 6313(c)(2)–(3)), it was difficult for DOE to establish a market baseline reflecting compliance with any specific set of standards. In particular, the equipment covered by the January 2009 final rule was not required to comply with amended standards until after the preliminary and NOPR analyses had been performed. As a result, DOE retained the engineering baseline and associated technologies used in its January 2009 final rule engineering analysis and expanded them to accommodate the new equipment classes covered by the standards initially established by EPCA. (42 U.S.C. 6313(c)(2)–(3)) DOE then added technologies to this baseline to develop its cost-efficiency curves. As a result, some of the engineering results represent units that are below the standard levels for equipment currently on the market and subject to the DOE's existing standards. 10 CFR 431.66 However, in its LCC and other downstream analyses, DOE accounted for this fact by utilizing a standards baseline as the minimum efficiency level examined, thereby truncating the engineering design option levels so that the lowest efficiency point analyzed corresponded to the current standard level with which that particular piece of equipment would have to comply. The exact procedure is described in section IV.H.1, and additional details are provided in chapter 8 of NOPR TSD.

2. Design Options

After conducting the screening analysis and removing from consideration technologies that did not warrant inclusion on technical grounds, DOE included the remaining technologies as design options in the energy consumption model for its NOPR engineering analysis:

- Higher efficiency lighting and occupancy sensors for VOP, SVO, and SOC equipment families (horizontal fixtures);
- Higher efficiency lighting and occupancy sensors for VCT and PD equipment families (vertical fixtures);
- Improved evaporator coil design;
- Higher efficiency evaporator fan motors;
- Improved case insulation;
- Improved doors for VCT equipment family, low temperature and ice-cream temperature (hinged);
- Improved doors for VCT and PD equipment families, medium temperature (hinged);
- Improved doors for HCT equipment family, low temperature and ice-cream temperature (sliding);
- Improved doors for HCT equipment family, medium temperature (sliding);
- Improved doors for SOC equipment family, medium temperature (sliding);
- Improved condenser coil design (for self-contained equipment only);
- Higher efficiency condenser fan motors (for self-contained equipment only);
- Higher efficiency compressors (for self-contained equipment only); and
- Night curtains (equipment without doors only).

3. Refrigerants

For the preliminary analysis, DOE considered two refrigerants, hydrofluorocarbons (HFCs) R–134a and R–404a, because these are the industry-standard choices for use in the vast majority of commercial refrigeration equipment covered by this rulemaking. This selection was consistent with the modeling performed in the January 2009 final rule, which was based on industry research and stakeholder feedback at that time. After the publication of the preliminary analysis, DOE received several comments on potential future issues relating to refrigerants for this equipment. Emerson noted that possible future EPA actions could prohibit certain refrigerants, which would reduce equipment efficiency, and suggested that if EPA is going to use total emissions as the basis for Significant New Alternatives Policy (SNAP) [42] regulations, then energy efficiency must also be considered by the EPA when making those determinations. However, Emerson conceded that the discussion of potential action by EPA was speculative at this point. (Emerson, Public Meeting Transcript, No. 31 at pp. 48, 157–58) Similarly, True observed that EPA proposals could result in the banning of R134a and R404a, and that while there are replacements for R134a, it would be difficult to replace R404a. (True, Public Meeting Transcript, No. 31 at p. 154) However, AHRI remarked that it believed that EPA was only considering NRDC's petition for removal of R134a [43] from the list of acceptable substitutes under the SNAP program in the context of automotive air-conditioning applications, and that EPA is not currently seeking to restrict the use of R134a in the commercial refrigeration industry. (AHRI, Public Meeting Transcript, No. 31 at pp. 155–56) True also pointed out that the removal of HFCs from remote condensing equipment would likely necessitate a total system design and a shift toward cascade equipment. (True, Public Meeting Transcript, No. 31 at pp. 152–53) However, True stated that 90 percent of its market is for self-contained equipment, and that 85 percent of its products could be converted to alternative refrigerants with minimal cost increases and efficiency losses. (True, Public Meeting Transcript, No. 31 at p. 155)

Commenters also provided information regarding the performance and regulatory status of specific alternative refrigerants. True noted that it had tested a large amount of isobutene and propane-driven equipment, which exhibited an efficiency gain of 7 to 11 percent in smaller equipment. True stated that the use of these alternative refrigerants was not overly cost burdensome because of the recent increase in the cost of HFC refrigerants, but that they could not be used on larger equipment because of SNAP regulations involving refrigerant charge levels. (True, Public Meeting Transcript, No. 31 at pp. 151–52, 155) However, True added, the need to address flammability concerns in the interest of safety could result in significant cost increases for certain components. True further stated that the EPA SNAP program's discussion of allowing 150-gram charges of propane as a refrigerant in self-contained commercial applications would not be a factor that could prevent use of these refrigerants, and that propane is not currently excluded from use by most building codes. (True, Public Meeting Transcript, No. 31 at p. 152, 159) Emerson asked whether building codes could be changed to allow for numerous 150-gram charges within a supermarket. (Emerson, Public Meeting Transcript, No. 31 at p. 158) Coca-Cola mentioned that it had

[42] SNAP is EPA's program to evaluate and regulate substitutes for the ozone-depleting chemicals that are being phased out under the stratospheric ozone protection provisions of the Clean Air Act. For more information, please see: *www.epa.gov/ozone/snap/*.

[43] In May 2010, the Natural Resources Defense Council petitioned the EPA to remove HFC–134a from the list of acceptable substitutes under the SNAP program. In February 2011, the EPA concluded that NRDC's petition was complete with respect to the end use of motor vehicle air conditioners, and expressed its intent to begin a rulemaking on the topic. For more information, please see: *www.epa.gov/ozone/downloads/NRDC_petition_responses.pdf*.

selected transcritical[44] CO_2 as an alternative for applications in the United States, but could not provide efficiency data. (Coca-Cola, Public Meeting Transcript, No. 31 at p. 157) NEEA noted that Daikin Industries, Ltd., the world's largest central air conditioner manufacturer, was progressing toward using only non-halogen refrigerants in its products. (NEEA, Public Meeting Transcript, No. 31 at p. 161) AHRI encouraged DOE to not assume constant refrigerant prices over the analysis period it considers because legislation has been introduced that could result in the unavailability of HFC refrigerants and lead to significant price increases. (AHRI, No. 43 at p. 3)

In its written comments, NEEA provided an alternative viewpoint, stating that it did not believe refrigerant issues are significant for this rulemaking. This is because, according to NEEA, refrigerant issues (referring to past phase-outs of CFCs, HCFCs, and other refrigerant types used in the past) have been known for almost 20 years. Historically, these issues have included the phase-outs of chlorofluorocarbons (CFCs) and HFCs in accordance with the Montreal Protocol.[45] Manufacturers have contended with these issues over time, and understand the design changes needed to adapt to new refrigerants. NEEA added that shifts to different refrigerants will have to be made regardless of the course that any one rulemaking takes. Further, NEEA pointed to the statements by several manufacturers that a reduction of system efficiency due to implementation of new refrigerants should not be assumed. NEEA agreed with these manufacturers and suggested that it is likely that these parties will resolve refrigerant issues in a way that will not compromise efficiency and that will not be cost-prohibitive. In conclusion, NEEA stated that refrigerant issues are not new and that the outcome of the standards-setting process is not likely to affect how manufacturers resolve these issues. (NEEA, No. 36 at pp. 6–7)

While future regulations may cap or eliminate the use of the currently prevalent refrigerants, and proposed legislation, such as the American Clean Energy and Security Act of 2009,[46] has included HFC phase-downs, DOE does not speculate on the impact of proposed legislation in current rulemaking analyses. Additionally, as mentioned above, many low global warming potential (GWP) refrigerants, such as CO_2 and propane, are being introduced to the market, and use of these new refrigerants may influence the cost and efficiency of equipment. However, DOE is not in a position to predict future trends of the refrigerants market or the performance of alternative refrigerants, and any analysis conducted at this time would be speculative. Consequently, DOE is not considering the potential effects of alternative refrigerants or current or future legislation on refrigerants within the scope of this rulemaking. Instead, DOE will continue to model equipment as currently designed for the U.S. market, utilizing the most common HFC refrigerants, R–134A and R–404A, accepted and broadly used by the industry. To the extent that there has been experience within the industry, domestically or internationally, with the use of alternative low-GWP refrigerants, DOE requests any available information, specifically cost and efficiency information relating to use of alternative refrigerants. DOE acknowledges that there are government-wide efforts to reduce emissions of HFCs, and such actions are being pursued both through international diplomacy as well as domestic actions. DOE, in concert with other relevant agencies, will continue to work with industry and other stakeholders to identify safer and more sustainable alternatives to HFCs while evaluating energy efficiency standards for this equipment.

4. Cost Assessment Methodology

During the preliminary analysis, DOE developed costs for the core case structure of the representative units it modeled, based on cost estimates performed in the analysis for the January 2009 final rule. For more information, see chapter 5 of the preliminary analysis TSD, pp. 5–3 to 5–8. DOE also developed costs for the design option levels implemented, based on publicly available information and price quotes provided during manufacturer interviews. These costs were combined in the engineering cost model based on the specifications of a given modeled unit in order to yield manufacturer production cost (MPC) estimates for each representative unit at each configuration modeled. At the preliminary analysis rulemaking stage, DOE's component cost estimates were based on data developed from manufacturer interviews, estimates from the January 2009 final rule, and publicly available cost information. During the NOPR analysis, DOE augmented this information with data from physical teardowns of commercial refrigeration equipment currently on the market.

During the development of the engineering analysis for this NOPR, DOE interviewed manufacturers to gain insight into the commercial refrigeration industry, and to request feedback on the engineering analysis methodology, data, and assumptions that DOE used. Based on the information gathered from these interviews, along with the information obtained through a teardown analysis and public comments, DOE refined the engineering cost model. Next, DOE derived manufacturer markups using publicly available commercial refrigeration industry financial data, in conjunction with manufacturer feedback. The markups were used to convert the MPCs into MSPs. Further discussion of the comments received and the analytical methodology used is presented in the following subsections. For additional detail, see chapter 5 of the NOPR TSD.

a. Teardown Analysis

In the preliminary analysis TSD, DOE expressed its intent to update its core case cost estimates, which were at that time developed based on estimates from the January 2009 final rule, through performing physical teardowns of selected units. These core case costs consist of the costs to manufacture the structural members, insulation, shelving, wiring, etc., but not the costs associated with the components that could directly affect energy consumption, which were considered collectively as design options and served as one of many inputs to the engineering cost model. DOE first selected representative units for physical teardown based on available offerings from the catalogs of major manufacturers. DOE selected units that had sizes and feature sets similar to those of the representative units modeled in the engineering analytical model. DOE selected units for teardown representing each of the proposed equipment families, with the exception of the HZO family.[47] The units were

[44] A transcritical system is one in which the refrigerant changes phase during the course of the refrigeration cycle.

[45] The Montreal Protocol on Substances that Deplete the Ozone Layer is an international treaty that was designed to protect the ozone layer by phasing out many ozone depleting substances.

[46] Colloquially known as the Waxman-Markey Bill, this legislation (H.R. 2454) would have established an emissions cap and trade system in the United States. It was passed by the House of Representatives in June 2009, but was tabled by the Senate. For more information, please see *http://thomas.loc.gov/cgi-bin/bdquery/z?d111:H.R.2454:*.

[47] The reason why no HZO units were torn down was that the HZO family is the least complex of the equipment classes with respect to its construction. DOE felt that there was no additional data which could be gained from teardown of this equipment

Continued

then disassembled into their base components, and DOE estimated the materials, processes, and labor required for the manufacture of each individual component. This process is referred to as a ''physical teardown.'' Using the data gathered from the physical teardowns, DOE characterized each component according to its weight, dimensions, material, quantity, and the manufacturing processes used to fabricate and assemble it. These component data were then entered into a spreadsheet and organized by system and subsystem levels to produce a comprehensive bill of materials (BOM) for each unit analyzed through the physical teardown process.

The physical teardowns allowed DOE to identify the technologies, designs, and manufacturing techniques that manufacturers incorporated into the equipment that DOE analyzed. The result of each teardown was a structured BOM, incorporating all materials, components, and fasteners, classified as either raw materials or purchased parts and assemblies, and characterizing the materials and components by weight, manufacturing processes used, dimensions, material, and quantity. The BOMs from the teardown analysis were then modified, and the results used as one of the inputs to the cost model to calculate the MPC for each representative unit modeled. The MPCs resulting from the teardowns were then used to develop an industry average MPC for each equipment class analyzed. See chapter 5 of the NOPR TSD for more details on the teardown analysis.

b. Cost Model

The cost model for this rulemaking was divided into two parts. The first of these was a standalone core case cost model, based on physical teardowns, that was used for developing the core case costs for the 24 directly analyzed equipment classes. This cost model is a spreadsheet that converts the materials and components in the BOMs from the teardowns units into MPC dollar values based on the price of materials, average labor rates associated with manufacturing and assembling, and the cost of overhead and depreciation, as determined based on manufacturer interviews and DOE expertise. To convert the information in the BOMs to dollar values, DOE collected information on labor rates, tooling costs, raw material prices, and other factors. For purchased parts, the cost model estimates the purchase price based on volume-variable price quotations and detailed discussions with manufacturers and component suppliers. For fabricated parts, the prices of raw metal materials (*e.g.,* tube, sheet metal) are estimated based on 5-year averages calculated from cost estimates obtained from sources including the *American Metal Market* and manufacturer interviews. The cost of transforming the intermediate materials into finished parts is estimated based on current industry pricing.

The function of the cost model described above is solely to convert the results of the physical teardown analysis into core case costs. To achieve this, components immaterial to the core case cost (lighting, compressors, fans, etc.) were removed from the BOMs, leaving the cost model to generate values for the core case costs for each of the teardown points. Then, these teardown-based core case BOMs were used to develop a ''parameterized'' computational cost model, which allows a user to virtually manipulate case parameters such as height, length, insulation thickness, and number of doors by inputting different numerical values for these features to produce new cost estimates. For example, a user could start with the teardown data for a two-door case and expand the model of the case computationally to produce a cost estimate for a three-door case by changing the parameter representing the number of doors. This parameterized model, coupled with the design specifications chosen for each representative unit modeled in the engineering analysis, was used to develop core case MPC cost estimates for each of the 24 directly analyzed representative units. These values served as one of several inputs to the engineering cost model.

The engineering analytical model, as implemented by DOE in a Microsoft Excel spreadsheet, also incorporated the engineering cost model, the second cost modeling tool used in this analysis. In the engineering cost model, core case costs developed based on physical teardowns were one input, and costs of the additional components required for a complete piece of equipment (design options) were another input. The two inputs were added together to arrive at an overall MPC value for each equipment class. Based on the configuration of the system at a given design option level, the appropriate design option costs were added to the core case cost to reflect the cost of the entire system. Costs for design options were calculated based on price quotes from publicly available sources and discussions with commercial refrigeration equipment manufacturers. Chapter 5 of the NOPR TSD describes DOE's cost model and definitions, assumptions, data sources, and estimates.

Some stakeholders expressed concern with the potential variability in prices that served as inputs to the cost model. NEEA suggested that using a forecast of materials futures market pricing might be a better approach than using a historical average, and Hill Phoenix questioned whether the 2009 cost model had been updated, as its cost structure had significantly increased since that time. (NEEA, Public Meeting Transcript, No. 31 at pp. 85–86; Hill Phoenix, Public Meeting Transcript, No. 31 at p. 84) Southern Store Fixtures agreed with Hill Phoenix, and noted that it would be advisable to use 2011 costs for equipment that complies with the January 2009 final rule, instead of a current market baseline. (Southern Store Fixtures, Public Meeting Transcript, No. 31 at pp. 86–87)

Regarding the comments from Hill Phoenix and Southern Store Fixtures, DOE has updated all of its cost modeling information. This information includes component costs, which were based on public-source data and estimates provided during manufacturer interviews, and core case costs, which were developed based on DOE's teardown analysis performed during the NOPR stage of the rulemaking. In response to Southern Store Fixtures' comment that DOE should use 2011 costs in its analyses for equipment that complies with the January 2009 final rule, DOE believes that materials prices depend on broader market conditions and are unlikely to be influenced by equipment that complies with the January 2009 final rule. DOE calculates the materials cost based on price information gathered from the market, and uses a methodology based on the Bureau of Labor Statistics (BLS) Producer Price Indices to account for fluctuations in materials prices and processing costs. Regarding NEEA's suggestion that using a forecast of materials futures market pricing might be preferable to using an historical average, DOE believes that such price forecasting is speculative, and therefore DOE has continued to use actual prices and averages thereof as the basis for its analyses.

c. Manufacturer Production Cost

Once the cost estimates for all the components of each representative unit, including the core case cost and design option costs, were finalized, DOE totaled the costs in the engineering cost model to calculate the MPC. DOE estimated the MPC at each efficiency

which would not have already been captured by the teardowns of other units.

level considered for each directly analyzed equipment class, from the baseline through the max-tech. After incorporating all of the assumptions into the cost model, DOE calculated the percentages attributable to each element of total production cost (*i.e.,* materials, labor, depreciation, and overhead). DOE used these production cost percentages in the MIA (see section IV.K). DOE revised the cost model assumptions used for the preliminary analysis based on teardown analysis, updated pricing, and additional manufacturer feedback, which resulted in refined MPCs and production cost percentages. DOE calculated the average equipment cost percentages by equipment class. Chapter 5 of the NOPR TSD presents DOE's estimates of the MPCs for this rulemaking, along with the different percentages attributable to each element of the production costs that comprise the total MPC.

d. Cost-Efficiency Relationship

The result of the engineering analysis is a cost-efficiency relationship. DOE created a separate relationship for each input capacity associated with each commercial refrigeration equipment class examined for this NOPR. DOE also created 24 cost-efficiency curves, representing the cost-efficiency relationship for each commercial refrigeration equipment class.

To develop cost-efficiency relationships for commercial refrigeration equipment, DOE examined the cost differential to move from one design option to the next for manufacturers. DOE used the results of teardowns to develop core case costs for the equipment classes modeled, and added those results to costs for design options developed from publicly available pricing information and manufacturer interviews. Additional details on how DOE developed the cost-efficiency relationships and related results are available in the chapter 5 of the NOPR TSD. Chapter 5 of the NOPR TSD also presents these cost-efficiency curves in the form of energy efficiency versus MPC. After the publication of the preliminary analysis, several stakeholders provided input and feedback regarding DOE's cost estimates, specifically regarding insulation costs, LED lighting costs, and DOE's methodology for estimating manufacturer overhead in its cost model. The following sections address these stakeholder comments and concerns.

Insulation Cost Specifications

Several stakeholders submitted comments regarding DOE's estimated costs and specifications for insulation. Traulsen observed that DOE's estimates for the number of foaming fixtures [48] present in a manufacturing facility and units per year are high if they are meant to represent the production of a base model by an average manufacturer. (Traulsen, No. 45 at p. 4) Zero Zone noted that the material costs for increasing foamed-in-place panels are not trivial, and that its foam cost associated with adding a half inch of insulation to a five-door case is approximately $25. (Zero Zone, No. 37 at p. 3) Zero Zone also commented that the engineering costs modeled by DOE do not include any redesign costs that are incurred as wall thickness changes, and that foamed-in-place sheet metal panels are an integral part of the structural design of cases. However, Zero Zone expressed concern that the ability of vacuum insulated panels to perform as structural members has not been verified and should be validated before vacuum insulated panels are included in the analysis. (Zero Zone, No. 37 at p. 3) Zero Zone concluded by stating that increased foam panel thickness should be dropped from the analysis because DOE had not collected sufficient, accurate cost information regarding this design option. (Zero Zone, No. 37 at p. 3)

DOE considered these comments in revising its implementation of improved insulation during the NOPR analyses. Regarding Traulsen's statement, DOE based its estimates of costs and specifications on discussions with manufacturers and site visits of manufacturing facilities and, while DOE understands the variability in manufacturing practices and equipment utilization that exists across manufacturers and product line offerings, DOE believes those estimates are sound. DOE took into account the comment from Zero Zone regarding additional foam costs and, in response, accounted for the differential cost of additional foam due to changes in wall thickness in its engineering analysis for the NOPR. However, regarding Zero Zone's assertion that redesign costs are not accounted for in the engineering analysis, the engineering model does include an estimate of engineering cost to account for the design efforts that must be incurred in developing a case with higher wall thickness. DOE has also discussed the implementation of vacuum insulated panels with manufacturers, cross-referenced its data with other rulemaking analyses in which vacuum insulated panels were used, and revised its data accordingly. As a result, DOE believes that its estimates and assumptions for improved insulation are valid, and has retained those design options for the NOPR.

Light-Emitting Diode Cost Specifications

Stakeholders also provided feedback on pricing and performance related to DOE's LED specifications in the engineering model. ASAP and NRDC stated that DOE should not assume LED prices remain constant because LEDs are an emerging technology and will likely experience a dramatic price decline in the near future. The comment cited DOE's 2011 Solid-State Lighting Research and Development (R&D) Multi-Year Program Plan (MYPP),[49] which projects that, between 2010 and 2015, prices of some LEDs will decrease by 85 percent, while LED lighting will experience a significant increase in efficacy during the same period. (ASAP and NRDC, No. 34 at p. 3) These stakeholders added that it is important for DOE to capture cost decreases not only during the analysis period (2017–2046), but prior to the proposed 2017 compliance date for the amended standards considered in this rulemaking as well, stating that a price estimate for 2017 will be needed for the LCC calculations to be accurate. ASAP and NRDC stated that, according to the DOE solid-state lighting documents referenced, if today's LED prices are held constant through the 2017 compliance date, the result will be a misrepresentation in the LCC of the value of potential LED energy savings; as a result, ASAP and NRDC urged DOE to develop cost estimates reflecting this price decline. (ASAP and NRDC, No. 34 at p. 3) NEEA referenced the DOE 2011 MYPP as well, and agreed that it believed that DOE is grossly overestimating the future cost of LED lighting. (NEEA, No. 36 at pp. 3–4)

DOE agrees with these stakeholders that forecasts of the LED lighting industry, including those performed by DOE, suggest that LED lighting is an emerging technology that will continue to experience significant price decreases in coming years. For this reason, to capture the anticipated cost reduction in LED fixtures in the analyses for this

[48] Foaming fixtures are pieces of equipment consisting of molds to guide the injection of foamed-in-place insulation so that that the foam takes a desired shape once hardened.

[49] The DOE Solid-State Lighting Research and Development Multi-Year Program Plan outlines DOE's research goals and planned methodologies with respect to the advancement of solid-state lighting technologies in the United States. The complete document is available at: *http://apps1.eere.energy.gov/buildings/publications/pdfs/ssl/ssl_mypp2011_web.pdf.*

rulemaking, DOE incorporated price projections from its Solid-State Lighting Program into its MPC values for the primary equipment classes. The price projections for LED case lighting were developed from projections developed for the DOE Solid-State Lighting Program 2012 report, *Energy Savings Potential of Solid-State Lighting in General Illumination Applications 2010 to 2030* (''the energy savings report'').[50] In the appendix of this report, price projections from 2010 to 2030 were provided in ($/klm) for LED lamps and LED luminaires. DOE analyzed the models used in the Solid-State Lighting Program work and determined that the LED luminaire projection would serve as an appropriate proxy for a cost projection to apply to refrigerated case LEDs.

The price projections presented in the Solid-State Lighting Program's energy savings report are based on the DOE's 2011 MYPP. The MYPP is developed based on input from manufacturers, researchers, and other industry experts. This input is collected by the DOE at annual roundtable meetings and conferences. The projections are based on expectations dependent on the continued investment into solid-state lighting by the DOE.

DOE incorporated the price projection trends from the energy savings report into its engineering analysis by using the data to develop a curve of decreasing LED prices normalized to a base year. That base year corresponded to the year when LED price data was collected for the NOPR analyses of this rulemaking from catalogs, manufacturer interviews, and other sources. DOE started with this commercial refrigeration equipment-specific LED cost data and then applied the anticipated trend from the energy savings report to forecast the projected cost of LED fixtures for commercial refrigeration equipment at the time of compliance with the proposed rule (2017). These 2017 cost figures were incorporated into the engineering analysis as comprising the LED cost portions of the MPCs for the primary equipment classes. Table IV.1 shows the normalized LED price deflators used in this NOPR analysis.

TABLE IV.1—LED PRICE DEFLATORS USED IN THE NOPR ANALYSIS

Year	Normalized to 2013	Normalized to 2017	Year	Normalized to 2013	Normalized to 2017
2010	2.998	5.652	2021	0.361	0.681
2011	1.799	3.392	2022	0.335	0.631
2012	1.285	2.423	2023	0.312	0.588
2013	1.000	1.885	2024	0.292	0.550
2014	0.819	1.543	2025	0.274	0.517
2015	0.693	1.306	2026	0.259	0.488
2016	0.601	1.133	2027	0.245	0.462
2017	0.530	1.000	2028	0.232	0.438
2018	0.475	0.895	2029	0.221	0.417
2019	0.430	0.810	2030	0.211	0.398
2020	0.393	0.740	2031–2046 *	0.211	0.398

* DOE did not have data available to project prices beyond 2030. Therefore, for the NOPR analysis, it was assumed that the LED prices stay constant after 2030.

The LCC analysis (section IV.H) was carried out with the engineering numbers that account for the 2017 prices of LED luminaires. The reduction in price of LED luminaires from 2018 through 2030 was taken into account in the NIA (section IV.I). The cost reductions were calculated for each year from 2018 through 2030 and subtracted from the equipment costs in the NIA. The reduction in lighting maintenance costs[51] due to reduction in LED prices for equipment installed in 2018 to 2030 were also calculated and appropriately deducted from the lighting maintenance costs.

Manufacturer Overhead Costs

NEEA commented that, in the DOE rulemaking on distribution transformers, manufacturers had stated that they do not apply overhead to material costs, but to labor costs only, and that the application of overhead to both of these cost components can have a major impact on MPCs, depending on how much of the product cost is attributed to each component. (NEEA, Public Meeting Transcript, No. 31 at pp. 70–71) In another comment, NEEA elaborated on this statement, adding that during the distribution transformers public meeting, manufacturers stated that they do not apply factory overhead rates to the cost of materials, but only to labor. NEEA went on to suggest that DOE use this methodology to the extent applicable to commercial refrigeration equipment, and adjust its cost estimation methods to take this approach into account. (NEEA, No. 36 at pp. 4–5)

In DOE's cost model for commercial refrigeration equipment, the following three overhead components are dependent on labor or materials: utilities, property tax, and insurance. The cost of utilities is a function of equipment costs only (no labor included) and is calculated using a ratio derived in the past from U.S. Securities and Exchange Commission (SEC) 10–K forms for appliance manufacturers.[52] The ratios for property tax and insurance costs are also based on past 10–K form analysis, but are dependent on overall unit costs (*i.e.,* cost of goods sold). Altogether, these three components represent only about 3 percent of the total cost of a unit, so whether they are based on labor and materials or on labor only, they are unlikely to have a significant effect on MPCs, especially on an incremental cost basis. DOE welcomes suggestions on how to improve its methodology and hopes that stakeholders can provide DOE with documentation for improved insurance, property tax, and utility calculations. In particular, DOE would welcome nationwide data on property tax rates based on property, plant, and

[50] Navigant Consulting, Inc., *Energy Savings Potential for Solid-State Lighting in General Illumination Applications.* 2012. Prepared for the U.S. Department of Energy—Office of Energy Efficiency and Renewable Energy Building Technologies Office, Washington, DC.

[51] Discussion related to lighting maintenance costs for commercial refrigeration equipment can be found in section IV.H.3, and a more detailed explanation can be found in chapter 8 of the NOPR TSD.

[52] A searchable directory of SEC filings is available at: *www.sec.gov/edgar/searchedgar/companysearch.html.*

equipment valuations; average power consumption for conditioned as well as unconditioned factory spaces; and insurance rates and how they are applied.

For the distribution transformers energy conservation standards rulemaking, DOE did not apply overhead rates to labor—overhead was only applied to direct material production costs. For more details on material and labor inputs for distribution transformers, see chapter 5 of the TSD for the distribution transformers preliminary analysis (*www1.eere.energy.gov/buildings/appliance_standards/commercial/pdfs/transformer_preanalysis_ch5.pdf*). Furthermore, due to the different industries in which distribution transformer and commercial refrigeration manufacturers operate, the same cost model may not necessarily be applicable to both.

e. Manufacturer Markup

To account for manufacturers' non-production costs and profit margin, DOE applies a non-production cost multiplier (the manufacturer markup) to the full MPC. The resulting MSP is the price at which the manufacturer can recover all production and non-production costs and earn a profit. To meet new or amended energy conservation standards, manufacturers often introduce design changes to their product lines that result in increased MPCs. Depending on the competitive environment for this equipment, some or all of the increased production costs may be passed from manufacturers to retailers and eventually to customers in the form of higher purchase prices. The MSP should be high enough to recover the full cost of the equipment (*i.e.,* full production and non-production costs) and yield a profit. The manufacturer markup has an important bearing on profitability. A high markup under a standards scenario suggests manufacturers can readily pass along the increased variable costs and some of the capital and equipment conversion costs (one-time expenditures) to customers. A low markup suggests that manufacturers will not be able to recover as much of the necessary investment in plant and equipment.

To calculate the manufacturer markups, DOE used 10–K reports submitted to the SEC by the six publicly owned commercial refrigeration equipment companies in the United States. (SEC 10–K reports can be found using the search database available at *www.sec.gov/edgar/searchedgar/webusers.htm.*) The financial figures necessary for calculating the manufacturer markup are net sales, costs of sales, and gross profit. DOE averaged the financial figures spanning the years from 2004 to 2010 [53] to calculate the markups. For commercial refrigeration equipment, to calculate the average gross profit margin for the periods analyzed for each firm, DOE summed the gross profit earned during all of the aforementioned years and then divided the result by the sum of the net sales for those years. DOE presented the calculated markups to manufacturers during the manufacturer interviews for the NOPR (see section IV.E.4.g). DOE considered manufacturer feedback to supplement the calculated markup, and refined the markup to better reflect the commercial refrigeration market. DOE developed the manufacturer markup by weighting the feedback from manufacturers on a market share basis because manufacturers with larger market shares more significantly affect the market average. DOE used a constant markup to reflect the MSPs of both the baseline equipment and higher efficiency equipment. DOE used this approach because amended standards may transform high-efficiency equipment, which currently is considered to be premium equipment, into baseline equipment. See chapter 5 of the NOPR TSD for more details about the manufacturer markup calculation.

f. Shipping Costs

The final component of the MSP after the MPC and manufacturer markup is the shipping cost associated with moving the equipment from the factory to the first point on the distribution chain. During interviews, manufacturers stated that the specific party (manufacturer or buyer) that incurs that cost for a given shipment may vary based on the terms of the sale, the type of account, the manufacturer's own business practices, and other factors. However, for consistency, DOE includes shipping costs as a component of MSP. In calculating the shipping costs for use in its analysis, DOE first gathered estimates of the cost to ship a full trailer of manufactured equipment an average distance in the United States, generally representative of the distance from a typical manufacturing facility to the first point on the distribution chain. DOE then used representative unit sizes to calculate a volume for each unit. Along with the dimensions of a shipping trailer and a loading factor to account for inefficiencies in packing, DOE used this cost and volume information to develop an average shipping cost for each equipment class directly analyzed.

[53] Typically, DOE uses the data for the 5 years preceding the year of analysis. However, in this case additional data were available up to 2004. Hence, data from 2004 to 2010 were used for these calculations.

g. Manufacturer Interviews

Throughout the rulemaking process, DOE has sought and continues to seek feedback and insight from interested parties that would improve the information used in its analyses. DOE interviewed manufacturers as a part of the NOPR MIA (see section IV.K). During the interviews, DOE sought feedback on all aspects of its analyses for commercial refrigeration equipment. For the engineering analysis, DOE discussed the analytical assumptions and estimates, cost model, and cost-efficiency curves with manufacturers. DOE considered all of the information learned from manufacturers when refining the cost model and assumptions. However, DOE incorporated equipment and manufacturing process figures into the analysis as averages to avoid disclosing sensitive information about individual manufacturers' equipment or manufacturing processes. More details about the manufacturer interviews are contained in chapter 12 of the NOPR TSD.

5. Energy Consumption Model

The energy consumption model is the second key analytical model used in constructing cost-efficiency curves. This model estimates the daily energy consumption, calculated using the DOE test procedure, of commercial refrigeration equipment in kilowatt-hours at various performance levels using a design-option approach. In this methodology, a unit is initially modeled at a baseline level of performance, and higher-efficiency technologies, referred to as design options, are then implemented and modeled to produce incrementally more-efficient equipment designs. The model is specific to the types of equipment covered under this rulemaking, but is sufficiently generalized to model the energy consumption of all covered equipment classes. DOE developed the energy consumption model as a Microsoft Excel spreadsheet.

For a given equipment class, the model estimates the daily energy consumption for the baseline, as well as the energy consumption of subsequent levels of performance above the baseline. The model calculates each performance level separately. For the baseline level, a corresponding cost is calculated using the cost model, which is described in section IV.E.4.b. For each level above the baseline, the changes in system cost due to the implementation of various design options are used to recalculate the cost. Collectively, the data from the energy consumption model are paired with the cost model data to produce points on cost-efficiency curves corresponding to specific equipment configurations. After the publication of the preliminary analysis, DOE received numerous stakeholder comments regarding the methodology and results of the energy consumption model.

a. Energy Consumption Model Results

Zero Zone noted that, while the overall modeling approach is appropriate, the results for the VCT.RC.M class are, in its opinion, too restrictive. (Zero Zone, No. 37 at p. 1) Similarly, Traulsen believed that DOE's numbers were slightly high for the VCT.SC.L equipment class, and that the incremental energy change may have been overstated, while the cost was understated, for technologies such as LED lighting, high-performance doors, and vacuum insulated panels. (Traulsen, No. 45 at p. 4)

In its analyses for the NOPR stage of this rulemaking, DOE reviewed its inputs to the engineering cost model and energy consumption model. This included reviewing publicly available data from sources such as manufacturer specification sheets and catalogs, as well as incorporating information drawn from stakeholder comments and manufacturer interviews conducted as part of the MIA process. The process included discussion and investigation of specific design options, such as the aforementioned LED lighting and vacuum insulated panels. DOE has taken efforts to incorporate all available information into its models to produce the most accurate results possible. In response to the comments by Zero Zone and Traulsen regarding energy consumption and cost results for the VCT.RC.M and VCT.SC.L classes, respectively, DOE has reviewed and updated its methodologies during the NOPR analyses to account for the latest information available, and is confident that its current results best reflect this information.

b. Anti-Sweat Heater Power

Traulsen suggested that DOE investigate whether the anti-sweat power consumed by the VCT.SC.L and VCT.SC.I equipment classes can truly be zero when high-performance doors are used, and suggested that DOE review its data. Traulsen added that it believed that, even with these door types, anti-sweat heaters are often still found on the cabinet body, especially in low-temperature equipment, which is prone to condensation due to conduction. (Traulsen, No. 45 at pp. 6–7)

In DOE's preliminary engineering analysis, anti-sweat heater power values were assigned for each of the transparent door configurations based on available data from manufacturer specification sheets and data obtained during manufacturer interviews. For medium-temperature doors, both commercial refrigeration equipment manufacturer and door manufacturer literature indicated that truly energy-free door designs with no anti-sweat heat are available on the market. This finding was confirmed through discussions with commercial refrigeration equipment manufacturers. However, for low- and ice-cream temperature doors, DOE has found that, as Traulsen stated, anti-sweat heat is still required, at a minimum, on the door frame. Table 5.6.9 of the preliminary analysis TSD chapter 5 lists anti-sweat heater powers of 165 and 80 watts for standard and high-performance doors, respectively, at low and ice-cream temperatures. These values are consistent with those that DOE has found through its research, and were retained in the NOPR analysis.

c. Evaporator Fan Motor Power

Zero Zone observed that, while DOE's assumptions regarding motor efficiency are valid, the evaporator fan specifications used by DOE for freezers of 6 rated watts per fan were flawed because freezer fans are generally higher in wattage (*i.e.,* 9 or 12 watts) to increase airflow and decrease frost formation. (Zero Zone, No. 37 at p. 2)

After receiving the comment by Zero Zone, DOE further researched evaporator fan motor power values through manufacturer catalogs and discussed the subject in manufacturer interviews during the NOPR stage of the rulemaking. The data yielded by this effort showed that remote condensing freezer cases do utilize evaporator fan motors with rated shaft powers generally closer to 9 watts. As a result, DOE updated the design specifications for those representative units in its engineering model to more accurately reflect the standard design of those units.

d. Condenser Energy Consumption

Southern Store Fixtures stated that the energy usage of the condenser is missing from the energy consumption model diagram contained in chapter 5 of the preliminary analysis TSD (Figure 5.6.1).

Regarding the comment by Southern Store Fixtures, Figure 5.6.1 of the preliminary analysis TSD chapter 5 does include a representation of the condenser fan motor energy consumption under the category of component energy consumption. The energy usage attributed to the condenser fan, found in self-contained units, is accounted for in the energy consumption model by the compressor duty cycle. For remote condensing units, the condenser fan energy consumption is not explicitly calculated; instead, remote case compressor energy consumption is calculated based on the energy efficiency ratio values given in AHRI 1200.

e. Evaporator Coil Design

Zero Zone expressed concerns about DOE's assumptions regarding evaporator coils, and noted that reduced fin spacing [54] will result in coils that do not function well in the field due to excessive frost loading. (Zero Zone, No. 37 at p. 2) Zero Zone also observed that the improved evaporator coil described in the preliminary analysis TSD for the VCT.RC.M and VCT.RC.L equipment classes would raise evaporator temperatures to the same level as the discharge air temperature, which is not feasible. (Zero Zone, No. 37 at pp. 2–3) Additionally, Zero Zone recommended that DOE conduct performance testing before assuming that high-performance coils will work in all situations because, Zero Zone asserted, DOE failed to address issues with superheat control for these advanced coils, namely that as the evaporating temperature becomes closer to the return air temperature, the ability of the expansion valve to maintain a stable superheat is decreased. (Zero Zone, No. 37 at p. 3)

With respect to Zero Zone's comment on reduction of fin spacing, DOE confirmed during manufacturer interviews that excessive frost loading becomes a concern once fin spacing is reduced below certain thresholds. As a result, DOE sought to ensure that its coil models reflected coil geometries that are suitable for production and field use without incurring such negative secondary effects as increased frost buildup. With respect to Zero Zone's second comment involving the evaporator coil temperatures, the referenced statement in the preliminary analysis TSD was intended to be a single example, and was incorrectly presented as applying to all equipment classes. The engineering model never utilized evaporator temperatures that

[54] Fin spacing, or fin pitch, refers to the distance between the flat fins that are oriented transverse to the direction of airflow across a fin-and-tube heat exchanger.

were physically infeasible or impossible to attain.

During its NOPR analyses, DOE performed independent modeling of evaporator and condenser coils based on physical teardowns of coils available on the market, coupled with numerical modeling of the coil performance. Design parameters were varied from the baseline, and the heat transfer performance of the coils was iteratively analyzed to yield higher efficiency coil designs. Cost modeling was utilized to produce cost estimates for the baseline and high-performance coil designs. This analysis served as the basis for the coil cost and performance values input into the engineering model. While DOE was unable to perform physical testing of its high-performance coil designs, as those designs were solely analytically derived and not constructed as prototypes, DOE controlled the parameters of its analysis to retain the required conditions for proper system performance. DOE believes that this analysis addresses the concerns presented by Zero Zone in its comments. For more details on the coil modeling process, see chapter 5 of the NOPR TSD.

F. Markups Analysis

DOE applies multipliers called ''markups'' to the MSP to calculate the customer purchase price of the analyzed equipment. These markups are in addition to the manufacturer markup (discussed in section IV.E.4.e) and are intended to reflect the cost and profit margins associated with the distribution and sales of the equipment. DOE identified three major distribution channels for commercial refrigeration equipment, and markup values were calculated for each distribution channel based on industry financial data. The overall markup values were then calculated by weighted-averaging the individual markups with market share values of the distribution channels. See chapter 6 of the NOPR TSD for more details on DOE's methodology for markups analysis.

DOE received a number of comments regarding markups after the publication of the preliminary analysis.

1. Baseline and Incremental Markups

Traulsen stated that, in its experience, the initial markup on equipment will be consistent with production costs, and that the incremental markups will increase with higher levels of product efficiency due to product differentiation. (Traulsen, No. 45 at p. 4) However, Traulsen also stated that it did not believe that wholesalers differentiate markups based on the technologies inherently present in this equipment and that, in its experience, wholesalers/resellers will use traditional markup rates regardless of equipment's energy efficiency. (Traulsen, No. 45 at p. 7)

In general, DOE has found that markup values vary over a wide range according to general economic outlook, manufacturer brand value, inventory levels, manufacturer rebates to distributors based on sales volume, newer versions of the same equipment model introduced into the market by the manufacturers, and availability of cheaper or more technologically advanced alternatives. Based on market data, DOE divided distributor costs into: (1) Direct cost of equipment sales; (2) labor expenses; (3) occupancy expenses; (4) other operating expenses (such as depreciation, advertising, and insurance); and (5) profit. DOE assumed that, for higher efficiency equipment only, the ''other operating costs'' and ''profit'' scale with MSP, while the remaining costs scale the same way as does the MSP of baseline equipment. In other words, the remaining costs stay constant irrespective of equipment efficiency level. Incremental markups were applied as multipliers only to the MSP increments (of higher efficiency equipment compared to baseline) and not to the entire MSP. This assumption is in line with Traulsen's first comment. Further, while DOE's use of separate values for baseline and incremental markup rates will lead to higher marked-up values for equipment at higher efficiency levels, the rate of markup will be same for all higher efficiency levels, which is consistent with Traulsen's second comment.

2. Distribution Channel Market Shares

True stated that national chains are a major part of the glass-doored, self-contained equipment market. True stated that it serves these via national accounts, adding that the market shares of the national accounts channel and the distributor channel that were used for the preliminary analysis of this rulemaking should be reversed. (True, Public Meeting Transcript, No. 31 at p. 80) NEEA agreed with True, stating that DOE had more or less reversed the market shares of the distribution channels for glass door and open self-contained equipment. NEEA also agreed with other commenters who stated that DOE's market channel fractions applied more to specialty and solid-door self-contained equipment. (NEEA, No. 36 at p. 5) Southern Store Fixtures added that it sells many remote condensing units directly to the end users, and that it also sells many self-contained units directly to supermarket and convenience store chains without using an intermediary. (Southern Store Fixtures, Public Meeting Transcript, No. 31 at pp. 80–81) Traulsen commented that it believed that DOE's distribution channel data were reasonably accurate, within plus or minus 10 percent. (Traulsen, No. 45 at p. 3)

DOE agrees with comments from True, NEEA, and Southern Store Fixtures regarding market shares for self-contained display cases. Consequently, DOE made the distribution channel market shares for all display cases (VOP, SVO, HZO, VCT, HCT, SOC, and PD), irrespective of self-contained or remote condensing configuration, equal to that of the remote condensing equipment market shares that were proposed in the preliminary analysis TSD. DOE kept the market shares of VCS and HCS equipment families same as the self-contained equipment market shares proposed in the preliminary analysis TSD. The distribution channel market shares used for this NOPR are shown in Table IV.2. Chapter 6 and appendix 6A of the NOPR TSD provide complete details of the methodology and data used in the estimation of the markups.

TABLE IV.2—DISTRIBUTION CHANNEL MARKET SHARES

Equipment family	National account channel (percent)	Wholesaler channel (percent)	Contractor channel (percent)
VOP, SVO, HZO, VCT, HCT, SOC, and PD	70	15	15
VCS and HCS	30	60	10

G. Energy Use Analysis

Several stakeholders commented on DOE's methodology for investigating secondary impacts of efficiency improvement, as described in the preliminary analysis. Southern Store Fixtures agreed with DOE's conclusion that efficiency improvements in self-contained equipment do not have a noticeable impact on building heating and cooling loads. Southern Store Fixtures further stated that a kitchen area, with limited space and limited equipment, differs from larger settings such as supermarkets, which contain a large quantity of self-contained equipment. Southern Store Fixtures asked whether the impact of large numbers of self-contained units on the heating and cooling loads of buildings had been investigated. (Southern Store Fixtures, Public Meeting Transcript, No. 31 at pp. 93–94)

Other stakeholders, however, had questions regarding DOE's methods. NRDC asked why only self-contained units were reviewed for secondary impacts, and whether any rack-based units had been reviewed. (NRDC, Public Meeting Transcript, No. 31 at p. 100) NEEA stated that the placement of multiple cases in a supermarket will affect heating, ventilation, and air-conditioning (HVAC) loads, and suggested that DOE reexamine the subject by modeling the performance of commercial refrigeration equipment in a business type other than a restaurant, such as a grocery store. NEEA added that restaurants typically have high ventilation loads, and opined that, in a space such as a supermarket, where the refrigeration loads approximate the ventilation loads, DOE's results are inaccurate. NEEA added that mechanical engineers use DOE–2 [55] to model secondary impacts. (NEEA, Public Meeting Transcript, No. 31 at pp. 98–100)

NEEA continued, stating that self-contained equipment, because it is not perfectly efficient, will emit more heat into its surroundings than it absorbs, which could be of benefit in the heating season but which is definitely a detriment in the cooling season. While the magnitude of these effects will depend on the equipment's geographic location, NEEA expressed its belief that DOE should not ignore this issue. NEEA added that DOE should quantify the contributions to space cooling and heating loads being generated by self-contained equipment so that stakeholders can make an informed judgment as to their significance. (NEEA, No. 36 at p. 5)

In response to NRDC's comment regarding modeling rack-based units, DOE points to the January 2009 final rule analysis that presents an extensive energy use analysis for remote condensing equipment and self-contained equipment without doors. The analysis was carried out by simulating display cases in supermarkets using the DOE–2.2 software package. Details of this analysis can be found in chapter 7 of the January 2009 final rule TSD (*www1.eere.energy.gov/buildings/appliance_standards/commercial/pdfs/chp_7_cre_energy_final.pdf*). Based on this energy use analysis, DOE concluded that the overall impact of the considered design options had only a minor differential impact on the overall HVAC energy consumption of supermarkets. Further, DOE concluded that the energy consumption model used in the engineering analysis simulated the energy consumption of the various equipment classes with adequate accuracy, and therefore DOE used the estimates from the engineering analysis for the LCC and subsequent analyses.

For the current rulemaking, DOE received comments during the May 2010 Framework document public meeting regarding the proportionally larger share of self-contained equipment examined in this rulemaking compared to that examined in the January 2009 final rule, and the impact of this equipment on building HVAC loads. DOE evaluated the impact of self-contained equipment through whole-building simulations with a VCT.SC.L freezer in restaurant buildings using the whole-building energy use simulation tool EnergyPlus, which is the primary software tool supported by DOE's Building Technologies Program for energy use analysis of buildings. Through these simulations, DOE found that the differential impact of efficiency improvements in VCT.SC.L equipment on the HVAC loads of restaurant buildings was negligible. Since VCT.SC.L energy consumption is one of the highest among the major self-contained equipment classes, DOE concluded that the incremental impact of efficiency improvements in all self-contained refrigerators and freezers on HVAC loads of restaurant buildings is negligible. While it is true, as stated in NEEA's comment, that restaurant building models have higher ventilation loads than other building models, DOE decided, as a matter of policy, that it would not assess the secondary impacts of amended standards such as the impacts of improved equipment efficiency on building HVAC loads. Therefore, DOE did not pursue this matter any further in its NOPR analysis.

In response to NEEA's comment regarding the equipment's heat emitted by self-contained equipment and the geographic location of these units, DOE points to chapter 7 of the preliminary analysis TSD for complete details of the analysis. The whole-building simulations conducted for the preliminary analysis were carried out in 15 different climates zones, representing all the major climate zones in the United States, with an appropriate weighting factor applied to each climate zone. Further, the analysis was carried out over 1 full year (365 days). The results of the preliminary energy use analysis were obtained by averaging the energy consumption of the equipment over 1 full year and over all the major climate zones in the United States.

DOE understands that the presence of many self-contained refrigeration units may have a considerable impact on the HVAC loads of a business establishment, as stated by Southern Store Fixtures. However, DOE reiterates that the objective of its analysis is to assess only the differential impact of equipment efficiency improvements, and not to assess the impact of total heat output by a self-contained unit. Moreover, DOE's energy use analysis is concerned with the impact of only one unit of commercial refrigeration equipment. As stated above, DOE found that the differential impact of equipment efficiency improvements to a VCT.SC.L freezer on the building HVAC loads was negligible.

As a matter of policy, DOE has determined that it will not carry out studies to determine the impact of efficiency improvements to equipment on building HVAC loads in appliance and commercial equipment standards rulemakings.

H. Life-Cycle Cost Analysis

DOE conducts LCC analysis to evaluate the economic impacts of potential amended energy conservation standards on individual commercial customers—that is, buyers of the equipment. LCC is defined as the total customer cost over the life of the equipment, and consists of purchase price, installation costs, and operating costs (maintenance, repair, and energy costs). DOE discounts future operating costs to the time of purchase and sums them over the expected lifetime of the piece of equipment. PBP is defined as

[55] DOE–2 is a widely used and accepted freeware building energy analysis program that can predict the energy use and cost for different types of buildings. DOE–2 uses a description of the building layout, construction, usage, conditioning systems and utility rates provided by the user, along with weather data, to perform an hourly simulation of the building and to estimate utility bills.

the estimated amount of time it takes customers to recover the higher installed costs of more-efficient equipment through savings in operating costs. DOE calculates the PBP by dividing the increase in installed costs by the average savings in annual operating costs.

As part of the engineering analysis, design option levels were ordered based on increasing efficiency (i.e., decreasing energy consumption) and increasing MSP. For the LCC analysis, DOE chose a maximum of eight levels, henceforth referred to as ''efficiency levels,'' from the list of engineering design option levels. For equipment classes for which fewer than eight design option levels were defined in the engineering analysis, all design option levels were used. However, for equipment classes where more than eight design option levels were defined, DOE selected specific levels to analyze in the following manner:

1. The lowest and highest energy consumption levels provided in the engineering analysis were preserved.

2. If the difference in reported energy consumptions and reported manufacturer price between sequential levels was minimal, only the higher efficiency level was selected.

3. If the energy consumption savings benefit between efficiency levels relative to the increased cost was very similar across multiple sequential levels, an intermediate level was not selected as an efficiency level.

The first efficiency level (Level 1) in each equipment class is the least efficient and the least expensive equipment in that class. The higher efficiency levels (Level 2 and higher) exhibit progressive increases in efficiency and cost from Level 1. The highest efficiency level in each equipment class corresponds to the max-tech level. DOE treats the efficiency levels as ''candidate standard levels,'' as each higher efficiency level represents a potential new standard level.

The installed cost of equipment to a customer is the sum of the equipment purchase price and installation costs. The purchase price includes MPC, to which a manufacturer markup and outbound freight cost are applied to obtain the MSP. This value is calculated as part of the engineering analysis (chapter 5 of the NOPR TSD). DOE then applies additional markups to the equipment to account for the markups associated with the distribution channels for the particular type of equipment (chapter 6 of the NOPR TSD). Installation costs varied by State, depending on the prevailing labor rates.

Operating costs for commercial refrigeration equipment are the sum of maintenance costs, repair costs, and energy costs. These costs are incurred over the life of the equipment and therefore are discounted to the base year (2017, which is the compliance date of any amended standards that are established as part of this rulemaking). The sum of the installed cost and the operating cost, discounted to reflect the present value, is termed the life-cycle cost or LCC.

Generally, customers incur higher installed costs when they purchase higher efficiency equipment, and these cost increments will be partially or wholly offset by savings in the operating costs over the lifetime of the equipment. Usually, the savings in operating costs are due to savings in energy costs because higher efficiency equipment uses less energy over the lifetime of the equipment. Often, the LCC of higher efficiency equipment is less than lower efficiency equipment. LCC savings are calculated for each efficiency level of each equipment class.

The PBP of higher efficiency equipment is obtained by dividing the increase in the installed cost by the decrease in annual operating cost. In addition to energy costs (calculated using the electricity price forecast for the first year), the annual operating cost includes annualized maintenance and repair costs. PBP is calculated for each efficiency level of each equipment class.

Apart from MSP, installation costs, and maintenance and repair costs, other important inputs for the LCC analysis are markups and sales tax, equipment energy consumption, electricity prices and future price trends, expected equipment lifetime, and discount rates.

Many inputs for the LCC analysis are estimated from the best available data in the market, and in some cases the inputs are generally accepted values within the industry. In general, each input value has a range of values associated with it. While single representative values for each input may yield an output that is the most probable value for that output, such an analysis does not provide the general range of values that can be attributed to a particular output value. Therefore, DOE carried out the LCC analysis in the form of Monte Carlo simulations,[56] in which certain inputs were expressed as a range of values and probability distributions to account for the ranges of values that may be typically associated with the respective input values. The results, or outputs, of the LCC analysis are presented in the form of mean and median LCC savings; percentages of customers experiencing net savings, net cost and no impact in LCC; and median PBP. For each equipment class, 10,000 Monte Carlo simulations were carried out. The simulations were conducted using Microsoft Excel and Crystal Ball, a commercially available Excel add-in used to carry out Monte Carlo simulations.

LCC savings and PBP are calculated by comparing the installed costs and LCC values of standards-case scenarios against those of base-case scenarios. The base-case scenario is the scenario in which equipment is assumed to be purchased by customers in the absence of the proposed energy conservation standards. Standards-case scenarios are scenarios in which equipment is assumed to be purchased by customers after the amended energy conservation standards, determined as part of the current rulemaking, go into effect. The number of standards-case scenarios for an equipment class is equal to one less than the total number of efficiency levels in that equipment class, since each efficiency level above Efficiency Level 1 represents a potential amended standard. Usually, the equipment available in the market will have a distribution of efficiencies. Therefore, for both base-case and standards-case scenarios, in the LCC analysis, DOE assumed a distribution of efficiencies in the market, and the distribution was assumed to be spread across all efficiency levels in the LCC analysis (see NOPR TSD chapter 10).

Recognizing that each building that uses commercial refrigeration equipment is unique, DOE analyzed variability in the LCC and PBP results by performing the LCC and PBP calculations for seven types of businesses: (1) Supermarkets; (2) wholesaler/multi-line retail stores, such as ''big-box stores,'' ''warehouses,'' and ''supercenters''; (3) convenience and small specialty stores, such as meat markets and wine, beer, and liquor stores; (4) convenience stores associated with gasoline stations; (5) full-service restaurants; (6) limited service restaurants; and (7) other foodservice businesses, such as caterers and cafeterias. Different types of businesses

[56] Monte Carlo simulation is, generally, a computerized mathematical technique that allows for computation of the outputs from a mathematical model based on multiple simulations using different input values. The input values are varied based on the uncertainties inherent to those inputs. The combination of the input values of different inputs is carried out in a random fashion to simulate the different probable input combinations. The outputs of the Monte Carlo simulations reflect the various outputs that are possible due to the variations in the inputs.

face different energy prices and also exhibit differing discount rates that they apply to purchase decisions.

Expected equipment lifetime is another input whose value varies over a range. Therefore, DOE assumed a distribution of equipment lifetimes that are defined by Weibull survival functions.[57]

Another important factor influencing the LCC analysis is the State in which the commercial refrigeration equipment is installed. Inputs that vary based on this factor include energy prices and sales tax. At the national level, the spreadsheets explicitly modeled variability in the inputs for electricity price and markups, using probability distributions based on the relative shipments of units to different States and business types.

Detailed descriptions of the methodology used for the LCC analysis, along with a discussion of inputs and results, are presented in chapter 8 and appendices 8A and 8B of the NOPR TSD.

1. Effect of Current Standards

DOE notes that, beginning January 1, 2012, manufacturers were required to comply with the standards set by the January 2009 final rule.[58] 74 FR 1092 (Jan. 9, 2009). DOE concludes that the efficiency level of the equipment on the market increased during this time. The engineering analysis for this NOPR was first developed in 2011, and therefore the engineering design option levels include efficiency levels of equipment available in the market in 2011. This means that the engineering efficiency levels were built up starting from levels which are below the standards set by the January 2009 final rule. These levels were included for analytical purposes, solely to represent the manner in which manufacturers may have achieved compliance with the January 2009 final rule standard levels, and were not considered in the development of proposed standard levels. The LCC analysis and NIA assume the first year for the analyses as 2017. As noted above, the market in 2017 will be different from that in 2011 in terms of efficiency distribution of the equipment, mainly due to the effect of the standards established by the January 2009 final rule. Therefore, the market baseline (from the year 2011) used as the starting point for the engineering analysis is not the same as the market baseline in 2017, when any amended standards prescribed by the current rulemaking are scheduled to go into effect.

To estimate the state of the market baseline level in 2017, DOE introduced a baseline level termed the ''standards baseline.'' The energy consumption of the standards baseline level of an equipment class is equal to the standard prescribed by the January 2009 final rule for that equipment class. 74 FR 1093 (Jan. 9, 2009). The design option levels that are less efficient than the standards baseline were disregarded, and the more-efficient design option levels were carried forward for downstream analyses. A detailed description of this procedure is presented with the aid of an example in chapter 8 of NOPR TSD.

At the April 2011 preliminary analysis public meeting, AHRI asked whether DOE intended to update the LCC analysis once the standards set in the January 2009 final rule became effective in order to change the baseline. (AHRI, Public Meeting Transcript, No. 31 at pp. 99–100)

The engineering analysis for this NOPR was first developed in 2011, and updated with new information as it became available up to the time of this publication. However, DOE continued to use in its engineering baseline characteristics reflecting the construction of equipment prior to required compliance with the standards set by the January 2009 final rule. As a result, some of the engineering efficiency levels reflect levels which do not correspond to equipment performance currently permitted on the market after January 1, 2012. These levels, however, are solely used to reflect the manner in which DOE believes manufacturers could have attained the 2009 final rule standard levels through implementation of design options, and were not used in the downstream analysis for the purposes of calculating standard levels proposed in this NOPR.

Consistent with the methodology described above and explained in detail in Chapter 8 of the NOPR TSD, DOE developed a ''standards baseline'' for use as the starting point for its downstream (LCC and PBP, NIA, etc.) analyses. This standards baseline corresponds to the lowest efficiency level which would be compliant with current (January 2009 final rule) standards. From there, higher efficiency levels were studied as the basis for developing potential standard levels as proposed in today's NOPR. In response to AHRI's comment, DOE used updated inputs to the baseline in order to reflect the compliance date of the January 2009 final rule standards having passed. This includes updates to the non-standards case efficiency distribution and other inputs to the downstream analyses. These inputs were updated based on the most recent available information for use in conducting the analysis described in today's NOPR.

2. Equipment Cost

To calculate customer equipment costs, DOE multiplied the MSPs developed in the engineering analysis by the distribution channel markups, described in section IV.F. DOE applied baseline markups to baseline MSPs, and incremental markups to the MSP increments associated with higher efficiency levels.

3. Installation, Maintenance, and Repair Costs

Installation cost includes labor, overhead, and any miscellaneous materials and parts needed to install the equipment. The installation costs may vary from one equipment class to another, but they do not vary with efficiency levels within an equipment class. Costs that do not vary with efficiency levels do not impact the LCC, PBP, or NIA results. DOE retained the nationally representative installation cost values from the January 2009 final rule of $2,000 for all remote condensing equipment and $750 for all self-contained equipment, and simply escalated the values from 2007$ to 2012$, resulting in 2012 installation costs of $2,299 and $862, respectively.

True stated that the average glass-doored merchandiser is moved and installed twice in its lifetime, and that self-contained, solid-doored units, which are used in commercial kitchens, are moved and installed in different locations at least three times, on average, during their lifetimes. Therefore, True suggested that DOE double or triple its estimated installation cost. (True, Public Meeting Transcript, No, 31 at p. 110)

Based on the design options for higher efficiency levels, DOE determined that installation costs do not vary by efficiency levels within a given equipment class. Costs that do not vary with efficiency levels do not impact the LCC, PBP, or NIA results. Because doubling or tripling of installation costs would not impact the net results, DOE did not alter the installation costs for the NOPR analyses based on True's comment.

[57] Weibull survival function is a continuous probability distribution function that is used to approximate the distribution of equipment lifetimes of commercial refrigeration equipment.

[58] DOE extended the compliance date for manufacturers to submit certification reports tor commercial refrigeration equipment until December 31, 2013. 77 FR 76825 (Dec. 31, 2012). DOE emphasizes, however, that the testing and sampling requirements for commercial refrigeration equipment are unchanged by this extension.

Maintenance costs are associated with maintaining the operation of the equipment. DOE split the maintenance costs into regular maintenance costs and lighting maintenance costs. Regular maintenance activities, which include cleaning evaporator and condenser coils, drain pans, fans, and intake screens; inspecting door gaskets and seals; lubricating hinges; and checking starter panel, control, and defrost system operation, were considered to be equivalent for equipment at all efficiency levels. Lighting maintenance costs are the costs incurred to replace display case lighting at regular intervals in a preventative fashion. Because lights and lighting configuration change with efficiency levels, lighting maintenance costs vary with efficiency levels. As stated in section IV.E.4.d, for efficiency levels that incorporate LED lights as a design option, the reduction in LED costs beyond 2017 were taken into account when calculating the lighting maintenance costs.

Repair cost is the cost to the customer of replacing or repairing failed components. DOE calculated repair costs based on the typical failure rate of refrigeration system components, original equipment manufacturer (OEM) cost of the components, and an assumed markup value to account for labor cost.

a. Maintenance and Repair Costs by Efficiency Level

Traulsen commented that it agreed with DOE that installation and maintenance costs would be flat across all efficiency levels. (Traulsen, No. 45 at p. 4) AHRI, however, disagreed with DOE's assumption that repair and maintenance costs would not vary with efficiency. AHRI stated that the industry's experience has been that higher efficiency equipment is more expensive to repair and maintain since it uses more sophisticated components. AHRI also added that, if repair and maintenance cost data are not available by efficiency level, DOE should correlate repair and maintenance cost with equipment cost. (AHRI, No. 43 at p. 3)

DOE does not believe that any design option used in the higher efficiency equipment considered in this rulemaking would lead to higher costs for regular maintenance activities. Repair costs and lighting maintenance costs, on the other hand, have been modeled to be proportional to the OEM cost of the components and, consequently, are higher for higher efficiency equipment. DOE requested information from stakeholders regarding maintenance and repair costs specifically related to any of the design options used for this rulemaking, but did not receive any such information. Therefore, DOE retained its approach of using flat costs for regular maintenance, and costs proportional to OEM cost for repair costs and lighting maintenance costs.

Southern Store Fixtures questioned whether DOE would examine the economic impact of night curtains and lighting occupancy sensors on equipment cost and operating cost. (Southern Store Fixtures, Public Meeting Transcript, No. 31 at pp. 185–86) CA IOUs stated that labor costs related to night curtain deployment can be significant. CA IOUs urged DOE to review and update its assumptions involving night curtains. (CA IOUs, No. 42 at p. 5)

Equipment costs, which include costs of night curtains and lighting occupancy sensors, were covered in the engineering analysis used to obtain the MSP (see section IV.E). Based on discussions with specialists in display case retrofits who are familiar with lighting occupancy sensor installation and setup, DOE concluded that lighting occupancy sensors do not increase maintenance costs of commercial refrigeration equipment. With respect to repair or replacement costs, DOE determined that the manufacturing processes used today produce highly reliable products, making the failure of occupancy sensors relatively rare. Typically, according to the available data, lighting occupancy sensors last nearly 15 years, which is longer than the average lifetime of commercial refrigeration equipment. Therefore, DOE did not include lighting occupancy sensor repair or replacement costs in the LCC analysis.

DOE believes that the night curtains currently available in the market are designed for easy deployment and retraction. In most instances, it takes less than 15 seconds per refrigerated display case to deploy or retract a night curtain. DOE believes that deployment and retraction of night curtains can be easily assimilated into the activities associated with store closing or opening operations, and will not amount to an added expense. Therefore, DOE did not add labor costs for night curtain deployment and retraction to the LCC analysis or NIA.

b. Maintenance and Repair Cost Annualization

Stakeholders provided feedback on DOE's methodology in annualizing the costs of equipment maintenance and repair. ASAP stated that annualizing lighting maintenance costs results in a present value that is greater than it would be if DOE were to model lighting replacement costs in the years in which they actually were incurred. (ASAP, Public Meeting Transcript, No. 31 at p. 104) NEEA agreed that DOE should try to characterize maintenance costs as accurately as possible, modeling truly annual costs on an annual basis, and other costs as they occur (*i.e.,* as capital equipment costs). NEEA added that it is not appropriate to annualize all costs because, while some costs are truly annual or biannual, others are periodic maintenance investments and should be treated as such. NEEA referenced the fluorescent lamp ballast rulemaking (Docket No. EE–2007–BT–STD–0016), in which DOE accounted for lamp replacement costs in the years in which they occurred, and urged DOE to adopt a similar methodology in this rulemaking. (NEEA, Public Meeting Transcript, No. 31 at p. 105, No. 36 at pp. 5–6) ASAP and NRDC echoed this stance in their jointly submitted written comment, stating that, while it is reasonable to annualize costs that are indeed incurred annually or biannually, annualizing costs that only occur in certain years could distort the LCC output, resulting in a higher present value of annualized costs. ASAP and NRDC also referenced the fluorescent ballast rulemaking, and suggested that DOE account for costs similarly in this rulemaking's analyses. (ASAP and NRDC, No. 34 at p. 4) Southern Store Fixtures, however, offered a dissenting opinion, adding that it is a common practice in supermarkets to have lighting contracts under which a maintenance worker changes the lights on a scheduled basis, whether they are broken or not, making lighting costs indeed annual. (Southern Store Fixtures, Public Meeting Transcript, No. 31 at p. 107)

DOE has determined that, if the costs of known items occurring at predictable intervals are appropriately discounted when annualized, there will be no impact on LCC and NIA results, regardless of whether or not the costs are annualized. Additionally, in the commercial refrigeration equipment analyses, repairs and replacements have been modeled as a combination of known, expected items, plus others modeled simply as a fraction of failed components that are expected to be replaced during equipment lifetime. Such a characterization of maintenance and repair costs does not lend itself to specification of a particular time, during the equipment lifetime, when such repairs are likely to occur. Further, the PBP by its very definition cannot be calculated unless the costs are annualized. Finally, if multiple explicit repair and maintenance line items were tracked individually in the NIA model, the size and complexity of the computer model would grow exponentially without a commensurate improvement in value. Therefore, DOE has retained its conventional approach of annualizing the maintenance and repair costs.

c. Maintenance Cost Estimates

At the April 2011 preliminary analysis public meeting, Coca-Cola stated that its largest maintenance cost is condenser cleaning, which is much more expensive than lighting maintenance. (Coca-Cola, Public Meeting Transcript, No. 31 at p. 109) NEEA commented that, in the case of actual maintenance costs, it agreed with Coca-Cola's assertion that $35 per year, the maintenance cost presented by DOE in its preliminary analysis, is too low based on its intuition regarding the cost of labor and travel to maintain equipment. (NEEA, No. 36 at p. 6)

DOE obtained its annualized maintenance costs for commercial refrigeration equipment from RS Means Facilities Maintenance and Repair Cost Data.[59] RS Means data provide estimates of the person-hours, labor rates, and materials required to maintain commercial refrigeration equipment. While it could be true that an amount of $35 per year does not reflect travel and other overhead charges, DOE believes that the value reflects the cost incurred for labor if the maintenance were to be performed by in-house personnel of the business establishment. In any case, the actual amount allocated to the regular maintenance costs has no effect on the LCC analysis or the NIA because maintenance costs do not vary based on efficiency levels in any equipment class. DOE believes the higher efficiency design options selected for this rulemaking do not result in changes to the regular maintenance costs of the commercial refrigeration equipment. Therefore, DOE believes that a value of $35 is reasonably representative of the regular maintenance costs for self-contained equipment.

d. Refrigerant Costs

Southern Store Fixtures stated that DOE should include refrigerant recharge costs in its maintenance cost estimates, because EPA and DOE have accepted that there is an 18-percent refrigerant leakage rate annually, or at least regularly, for rack systems. (Southern Store Fixtures, Public Meeting Transcript, No. 31 at p. 108)

Costs incurred due to refrigerant leakage do not vary with equipment efficiency levels. Therefore, these costs will not affect the LCC analysis or NIA results. DOE did not take these costs into account for the NOPR analysis.

e. Repair Costs

Traulsen stated that repair costs would increase commensurate with the purchase price of the components to be repaired. This increase, Traulsen added, would be consistent with the increase in manufacturing cost due to the implementation of a technology. (Traulsen, No. 45 at p. 4)

DOE modeled repair costs as directly proportional to the OEM cost of the failed components. This approach yields higher repair costs for higher efficiency equipment and is consistent with Traulsen's comment.

Zero Zone stated that it suspected the average lifetime of an LED light is less than 5 years, and that the cost to replace one will be higher than estimated. This, Zero Zone added, is because LEDs continue to evolve and older models are discontinued, meaning that replacement of failed LEDs will require a complete relamping to maintain consistent product appearance. (Zero Zone, No. 37 at p. 4)

All major manufacturers of LED lighting solutions for refrigerated display cases state that the maintenance-free lifetime for LED lights is 50,000 hours, and some of the retailers offer a 5-year warranty. DOE did not find any basis for doubting the assumption of a 50,000-hour lifetime for LED lights in refrigerated display cases. Recognizing that replacement of LED strip lighting in refrigerated display cases involves higher labor costs compared to the simple lamp replacement process of fluorescent tube lights, DOE applied a retrofit factor (multiplier) of 1.4 to the LED lamp cost to account for relamping of LED lights in display cases. The results presented in the preliminary analysis used the retrofit factor of 1.4, and DOE used the same factor for its NOPR analysis.

4. Annual Energy Consumption

Annual energy consumption of commercial refrigeration equipment is obtained from engineering analysis (chapter 5 of the NOPR TSD).

5. Energy Prices

DOE calculated average commercial electricity prices using the U.S. Energy Information Administration's (EIA's) Form EIA–826, ''Database Monthly Electric Utility Sales and Revenue Data.''[60] DOE calculated an average national commercial price by (1) estimating an average commercial price for each utility company by dividing the commercial revenues by commercial sales; and (2) weighting each utility by the number of commercial customers it served in that region, across the nation.

6. Energy Price Projections

To estimate energy prices in future years for the preliminary analysis TSD, DOE multiplied the average regional energy prices described above by the forecast of annual average commercial energy price indices developed in the Reference Case from *AEO2013*.[61] *AEO2013* forecasted prices through 2040. To estimate the price trends after 2040, DOE assumed the same average annual rate of change in prices as from 2031 to 2040.

7. Equipment Lifetime

DOE defines lifetime as the age at which a commercial refrigeration equipment unit is retired from service. DOE based expected equipment lifetime on discussions with industry experts, and concluded that a typical lifetime of 10 years is appropriate for most commercial refrigeration equipment in large grocery/multi-line stores and restaurants. Industry experts believe that operators of small food retail stores, on the other hand, tend to use display cases longer. DOE used 15 years as the average equipment lifetime for display cases used in such retail stores. DOE reflects the uncertainty of equipment lifetimes in the LCC analysis for both equipment markets as probability distributions, as discussed in section 8.2.3.5 of the TSD.

Traulsen stated that 10 years is an acceptable estimate for the lifetime of self-contained equipment, and that it is not uncommon for some applications to have a 20-year lifetime. However, Traulsen added that smaller units subject to more frequent human interaction, such as undercounter units, would likely have shorter lifetimes, such as 7 years. Traulsen also stated that price point could indicate potential lifetime. (Traulsen, Public Meeting Transcript, No. 31 at p. 4) AHRI commented that properly installed and maintained equipment typically has a much longer lifetime than the actual

[59] RS Means Company, Inc. *Means Costworks 2010: Facility, Maintenance and Repair Cost Data.* 2010. Kingston, MA.

[60] U.S. Energy Information Administration. *EIA–826 Sales and Revenue Spreadsheets.* (Last accessed May 16, 2012). *www.eia.doe.gov/cneaf/electricity/page/eia826.html*

[61] The spreadsheet tool that DOE used to conduct the LCC and PBP analyses allows users to select price forecasts from either *AEO*'s High Economic Growth or Low Economic Growth Cases. Users can thereby estimate the sensitivity of the LCC and PBP results to different energy price forecasts.

period of time the end use customers retain it, and that this is entirely dependent on the specific business models of and competitive demands on different users. However, AHRI added that the 10-year lifetime used by DOE is an appropriate average value. (AHRI, No. 43 at p. 3) NEEA concurred, stating that it generally agreed with the inputs to the Crystal Ball simulations that DOE used. In particular, NEEA stated that it was comfortable with the assumed equipment lifetimes and distributions thereof, and that, while much of the equipment does indeed last longer, at that point the equipment becomes used equipment and is not directly applicable to the rulemaking except for purposes of estimating shipments. (NEEA, No. 36 at p. 6)

DOE appreciates the comments previously submitted and welcomes further input on the equipment lifetimes for the LCC analysis and NIA.

8. Discount Rates

In calculating the LCC, DOE applies discount rates to estimate the present value of future operating costs to the customers for commercial refrigeration equipment. The discount rate is the rate at which future expenditures are discounted to establish their present value to the customer.[62] DOE derived the discount rates for the commercial refrigeration equipment analysis by estimating the cost of capital for a large number of companies similar to those that could purchase commercial refrigeration equipment and then sampling them to characterize the effect of a distribution of potential customer discount rates. The cost of capital is commonly used to estimate the present value of cash flows to be derived from a typical company project or investment. Most companies use both debt and equity capital to fund investments, so their cost of capital is the weighted average of the cost to the company of equity and debt financing.

DOE estimated the cost of equity financing by using the Capital Asset Pricing Model (CAPM).[63] The CAPM, among the most widely used models to estimate the cost of equity financing, assumes that the cost of equity is proportional to the amount of systematic risk associated with a company. The cost of equity financing tends to be high when a company faces a large degree of systematic risk, and it tends to be low when the company faces a small degree of systematic risk.

9. Compliance Date of Standards

EPCA prescribes that DOE must review and determine whether to amend performance-based standards for commercial refrigeration equipment by January 1, 2013. (42 U.S.C. 6313(c)(6)(A)) In addition, EPCA requires that any amended standards established in this rulemaking must apply to equipment that is manufactured on or after 3 years after the final rule is published in the **Federal Register** unless DOE determines, by rule, that a 3-year period is inadequate, in which case DOE may extend the compliance date for that standard by an additional 2 years. (42 U.S.C. 6313(c)(6)(C)) Based on these criteria, DOE reasoned due to the cumulative regulatory burden of the recently implemented 2009 CRE final rule and of the upcoming walk-in cooler and freezer rule, which both affect the same industry that the most likely compliance date for standards set by this rulemaking would be in 2017. Therefore, DOE calculated the LCC and PBP for commercial refrigeration equipment under the assumption that compliant equipment would be purchased in 2017. DOE seeks comment on whether it should extend the compliance date as authorized, and, if so, by how long.

10. Base-Case and Standards-Case Efficiency Distributions

To accurately estimate the share of affected customers who would likely be impacted by a standard at a particular efficiency level, DOE's LCC analysis considers the projected distribution of efficiencies of equipment that customers purchase under the base case (that is, the case without new or amended energy efficiency standards). DOE refers to this distribution of equipment efficiencies as a base-case efficiency distribution.

DOE's methodology to estimate market shares of each efficiency level within each equipment class is a cost-based method consistent with the approaches that were used in the EIA's National Energy Modeling System (NEMS)[64] and in the Canadian Integrated Modeling System (CIMS)[65] [66] for estimating efficiency choices within each equipment class. DOE then extrapolated future scenarios of the equipment efficiency for the base case and amended standards cases using the same cost-based method. The difference in equipment efficiency between the base case and amended standards case was the basis for determining the reduction in unit energy consumption resulting from amended standards.

Traulsen commented that it believed that DOE's estimates of shipment-weighted market share are skewed toward the higher performance levels. Traulsen added that it believed that DOE has overestimated the value that end users place on energy efficiency. (Traulsen, No. 45 at p. 7)

DOE recognizes Traulsen's concern, but at this time has no data to more accurately define the market shares by efficiency level within each equipment class. No data on shipments by efficiency level of either self-contained or remote condensing equipment classes are known to DOE or were provided by industry or other stakeholders. Currently, there is also no extensive database of available efficiency levels by model that could be used to provide a proxy for efficiency levels for shipped equipment, an approach that has been used in rulemakings for other products when efficiency data on shipped products was lacking. The methodology used for this analysis was identical to that used in the January 2009 final rule analysis. See chapter 10 of the TSD for the January 2009 final rule, available at: *www1.eere.energy.gov/buildings/appliance_standards/commercial/pdfs/chp_10_cre_shipmts_final.pdf*. If the model overstates the share of shipments at higher efficiency levels in the base case scenario, it results in analysis erring on the side of lower NES and NPV values.

11. Inputs to Payback Period Analysis

Payback period is the amount of time it takes the customer to recover the higher purchase cost of more energy efficient equipment as a result of lower operating costs. Numerically, the PBP is the ratio of the increase in purchase cost to the decrease in annual operating expenditures. This type of calculation is known as a ''simple'' PBP because it does not take into account changes in operating cost over time or the time

[62] The LCC analysis estimates the economic impact on the individual customer from that customer's own economic perspective in the year of purchase and therefore needs to reflect that individual's own perceived cost of capital. By way of contrast DOE's analysis of national impact requires a societal discount rate. These rates used in that analysis are 7 percent and 3 percent, as required by OMB Circular A–4, September 17, 2003.

[63] Harris, R.S. *Applying the Capital Asset Pricing Model.* UVA–F–1456. Available at SSRN: *http://ssrn.com/abstract=909893.*

[64] U.S. Energy Information Administration. National Energy Modeling System Commercial Model (2004 Version). 2004. Washington, DC.

[65] The CIMS Model was originally known as the Canadian Integrated Modeling System, but as the model is now being applied to other countries, the acronym is now used as its proper name.

[66] Energy Research Group/M.K. Jaccard & Associates. *Integration of GHG Emission Reduction Options using CIMS.* 2000. Vancouver, B.C. *www.emrg.sfu.ca/media/publications/Reports%20for%20Natural%20Resources%20Canada/Rollup.pdf*

value of money; that is, the calculation is done at an effective discount rate of zero percent. PBPs are expressed in years. PBPs greater than the life of the equipment mean that the increased total installed cost of the more-efficient equipment is not recovered in reduced operating costs over the life of the equipment.

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

12. Rebuttable-Presumption Payback Period

Sections 325(o)(2)(B)(iii) and 345(e)(1)(A) of EPCA, (42 U.S.C. 6295(o)(2)(B)(iii) and 42 U.S.C. 6316(e)(1)(A)), establish a rebuttable presumption applicable to commercial refrigeration equipment. The rebuttable presumption states that a new or amended standard is economically justified if the Secretary finds that the additional cost to the consumer of purchasing a product complying with an energy conservation standard level will be less than three times the value of the energy savings during the first year that the consumer will receive as a result of the standard, as calculated under the applicable test procedure. This rebuttable presumption test is an alternative way of establishing economic justification.

To evaluate the rebuttable presumption, DOE estimated the additional cost of purchasing more-efficient, standards-compliant equipment, and compared this cost to the value of the energy saved during the first year of operation of the equipment. DOE interprets that the increased cost of purchasing standards-compliant equipment includes the cost of installing the equipment for use by the purchaser. DOE calculated the rebuttable presumption payback period (RPBP), or the ratio of the value of the increased installed price above the baseline efficiency level to the first year's energy cost savings. When the RPBP is less than 3 years, the rebuttable presumption is satisfied; when the RPBP is equal to or more than 3 years, the rebuttable presumption is not satisfied. Note that this PBP calculation does not include other components of the annual operating cost of the equipment (*i.e.,* maintenance costs and repair costs).

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

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

The NIA assesses the NES and the NPV of total customer costs and savings that would be expected as a result of amended energy conservation standards. The NES and NPV are analyzed at specific efficiency levels for each equipment class of commercial refrigeration equipment. DOE calculates the NES and NPV based on projections of annual equipment shipments, along with the annual energy consumption and total installed cost data from the LCC analysis. For the NOPR analysis, DOE forecasted the energy savings, operating cost savings, equipment costs, and NPV of customer benefits for equipment sold from 2017 through 2046—the year in which the last standards-compliant equipment is shipped during the 30-year analysis period.

DOE evaluates the impacts of the amended standards by comparing base-case projections with standards-case projections. The base-case projections characterize energy use and customer costs for each equipment class in the absence of any amended energy conservation standards. DOE compares these projections with projections characterizing the market for each equipment class if DOE were to adopt an amended standard at specific energy efficiency levels for that equipment class. For the standards cases, DOE considered a ''roll-up'' scenario, in which DOE assumed that equipment efficiencies that do not meet the standard level under consideration would ''roll-up'' to meet the amended standard level, and those already above the proposed standard level would remain unaffected.

DOE uses a Microsoft Excel spreadsheet model to calculate the energy savings and the national customer costs and savings from each TSL. The NOPR TSD and other documentation that DOE provides during the rulemaking help explain the models and how to use them, and interested parties can review DOE's analyses by interacting with these spreadsheets. The NIA spreadsheet model uses average values as inputs (as opposed to probability distributions of key input parameters from a set of possible values).

For the current analysis, the NIA used projections of energy prices and commercial building starts from the *AEO2013* Reference Case. In addition, DOE analyzed scenarios that used inputs from the *AEO2013* Low Economic Growth and High Economic Growth Cases. These cases have lower and higher energy price trends, respectively, compared to the Reference Case. NIA results based on these cases are presented in chapter 10 of the NOPR TSD.

A detailed description of the procedure to calculate NES and NPV, and inputs for this analysis are provided in chapter 10 of the NOPR TSD.

1. Shipments

Complete historical shipments data for commercial refrigeration equipment could not be obtained from a single source; therefore, DOE used data from multiple sources to estimate historical shipments. The major sources were 2005 shipments data provided by ARI as part of its comments submitted in response to the January 2009 final rule Framework document, ARI 2005 Report (Docket No. EERE–2006–BT–STD–0126, ARI, No. 7, Exhibit B at p. 1); *Commercial Refrigeration Equipment to 2014* by Freedonia Group, Inc.[67]; *2008 Size and Shape of Industry* by the North American Association of Food Equipment Manufacturers;[68] and *Energy Savings Potential and R&D Opportunities for Commercial Refrigeration* prepared by Navigant Consulting, Inc. for DOE.[69] Exact shipments numbers and assumptions have been withheld because some of the sources cited above are not public documents and are available only for purchase.

Historical linear feet of shipped units depicts the annual amount of commercial refrigeration equipment capacity shipped, and is an alternative way to express shipments data. DOE determined the linear feet shipped for any given year by multiplying each unit shipped by its associated average length, and then summing all the linear footage

[67] Freedonia Group, Inc. *Commercial Refrigeration Equipment to 2014.* 2010. Cleveland, OH. Study 2261. *www.freedoniagroup.com/Commercial-Refrigeration-Equipment.html*

[68] North American Association of Food Equipment Manufacturers. *2008 Size and Shape of Industry.* 2008. Chicago, IL.

[69] Navigant Consulting, Inc. *Energy Savings Potential and R&D Opportunities for Commercial Refrigeration.* 2009. Prepared by Navigant Consulting, Inc. for the U.S. Department of Energy, Washington, DC.

values. Table IV.3 presents the representative equipment class lengths used for the conversion of per-unit shipments to linear footage within each equipment class.

TABLE IV.3—EQUIPMENT LINEAR DIMENSIONS ASSUMED FOR SHIPMENTS ANALYSIS

Equipment class	Assumed length ft	Basis
VOP.RC.M	10	Average of 8 ft and 12 ft, manufacturer interviews.
VOP.RC.L	10	Average of 8 ft and 12 ft, manufacturer interviews.
VOP.SC.M	4	Baseline equipment used for engineering analysis.
SVO.RC.M	10	Average of 8 ft and 12 ft, manufacturer interviews.
SVO.SC.M	4	Baseline equipment used for engineering analysis.
HZO.RC.M	10	Average of 8 ft and 12 ft, manufacturer interviews.
HZO.RC.L	10	Average of 8 ft and 12 ft, manufacturer interviews.
HZO.SC.M	4	Baseline equipment used for engineering analysis.
HZO.SC.L	4	Baseline equipment used for engineering analysis.
VCT.RC.M	10	Average of 3-door and 5-door (30 in. per door), manufacturer interviews.
VCT.RC.L	10	Average of 3-door and 5-door (3 in. per door), manufacturer interviews.
VCT.SC.M	4	Engineering estimate.*
VCT.SC.L	3.5	Average of 1-door and 2-door freezer.
VCT.SC.I	5	Baseline equipment used for engineering analysis.
VCS.SC.M	4	Engineering estimate.*
VCS.SC.L	3.5	Average of 1-door and 2-door freezer.
VCS.SC.I	5	Baseline equipment used for engineering analysis.
HCT.SC.M	3	Engineering estimate.*
HCT.SC.L	3	Engineering estimate.*
HCT.SC.I	3.4	Baseline equipment used for engineering analysis.
HCS.SC.M	4	Engineering estimate.*
HCS.SC.L	5	Engineering estimate.*
SOC.RC.M	8	Average of 4 ft, 8 ft, 12 ft, all common equipment lengths.
PD.SC.M	2.5	Baseline equipment used for engineering analysis.
SOC.SC.M	5	Engineering estimate.*

* For equipment classes that exhibit a wide range of equipment lengths in the market, DOE assumed a value for equipment length based on its best engineering judgment.

DOE converted the estimated 2009 shipments data in each equipment class to percentages of total shipped linear feet of commercial refrigeration equipment for use in the shipments model. This established the commercial refrigeration equipment market share attributed to each equipment class. DOE calculated the percentage of shipped linear footage by dividing the linear footage shipped for each equipment class by the overall linear footage shipped for all commercial refrigeration equipment covered in this rulemaking.

Table IV.4 summarizes DOE's estimated division of historical annual shipments into new and replacement categories by building type. The distributions shown in Table IV.4 result from several discrete steps. First, equipment types were identified by the type of business they generally serve. For example, vertical open cases with remote compressors are associated with large grocers and multi-line retail stores. Remote condensing equipment is generally associated with retail stores that sell high volumes of perishable goods, while self-contained units are associated with foodservice and convenience or small food sales stores. When there was no strong association between the building type and equipment class, equipment was distributed across broader classes. Second, a ratio of new versus replacement equipment was developed based on commercial floor space estimates (floor space estimates are discussed below). Using the expected useful life of commercial refrigeration equipment and commercial floor space stock, additions, and retirements, ratios were developed of new versus replacement stock for use in this analysis. Using these and related factors (*e.g.,* the division of foodservice into the three building types—limited service restaurants, full-service restaurants, and other), DOE distributed commercial refrigeration equipment shipments among building types and new versus replacement shipments, as shown in Table IV.4.

TABLE IV.4—ESTIMATED DISTRIBUTION OF 2009 LINEAR FEET OF COMMERCIAL REFRIGERATION EQUIPMENT SHIPMENTS AMONG NEW VS. REPLACEMENT EQUIPMENT

Building type	Replacement (percent)	New (percent)	Total (percent)
Large Grocery/Multi-Line Retail	30.5	8.6	39.1
Small Grocery/Convenience	14.6	4.1	18.7
Limited Service Restaurants	9.4	3.3	12.7
Full Service Restaurants	9.8	3.4	13.2
Other	12.1	4.2	16.3
Total	76.4	23.6	100.0

Table IV.5 shows the forecasted square footage of new construction used to scale annual new commercial refrigeration equipment shipments. As the data in Table IV.5 show, forecasted square footage additions to the building stocks vary from year to year, with the first few years of the analyzed period exhibiting lower levels of growth due to predicted lingering impacts of the U.S. economic recession. The forecasted commercial refrigeration equipment shipments therefore show some variability as well, tracking the forecasted square footage floor space additions. The growth rates over the last 10 years of the *AEO2013* forecast (2031 through 2040) were used to extend the *AEO* forecast out until the year 2046 to develop the full 30-year forecast needed for the NIA.

TABLE IV.5—*AEO2013* FORECAST OF NEW FOOD SALES AND FOODSERVICE SQUARE FOOTAGE

Year	New construction million ft²	
	Foodservice	Food sales
2009	47.715	34.070
2012	31.455	22.149
2017	49.076	34.496
2020	47.617	33.447
2025	47.522	33.416
2030	53.630	37.836
2035	55.536	39.107
2040	55.814	39.243
Annual Growth Factor, 2031–2040	2.41%	2.27%

Source: U.S. Energy Information Administration, *Annual Energy Outlook 2013.*

DOE then estimated the annual linear footage shipped for each of the 24 primary equipment classes. The shipments analysis relies on the 24 primary equipment classes to represent the commercial refrigeration equipment market. Table IV.6 shows the fraction of the linear footage shipped by each of these 24 equipment classes.

TABLE IV.6—PERCENT OF SHIPPED LINEAR FEET OF COMMERCIAL REFRIGERATION EQUIPMENT

Equipment class	Percentage of linear feet shipped*
VOP.RC.M	11.59
VOP.RC.L	0.61
VOP.SC.M	0.82
SVO.RC.M	9.30
SVO.SC.M	1.23
HZO.RC.M	1.43
HZO.RC.L	4.49
HZO.SC.M	0.11
HZO.SC.L	0.22
VCT.RC.M	0.87
VCT.RC.L	12.11
VCT.SC.M	5.46
VCT.SC.L	0.27
VCT.SC.I	0.30
VCS.SC.M	22.11
VCS.SC.L	11.25
VCS.SC.I	0.07
HCT.SC.M	0.07
HCT.SC.L	0.43
HCT.SC.I	0.48
HCS.SC.M	5.01
HCS.SC.L	0.65
SOC.RC.M	2.34
PD.SC.M	8.58
SOC.SC.M	0.17

* The percentages in this column do not sum to 100 percent because shipments of secondary equipment classes and certain other equipment classes that were not analyzed in this rulemaking were not included.

The amount of new and existing commercial floor space is the main driver for commercial refrigeration equipment shipments, and is appropriately one of the basic inputs into the shipments model. The model divides commercial space into two components: space from new construction floor space and space from existing floor space.

DOE took the projected floor space construction after the year 2009 from the NEMS projection underlying *AEO2013*.[70] DOE extracted annual estimates of new floor space additions from an *AEO2013* data file (kdbout) for the period from 2009 through 2040. As stated earlier, the last 10 years of the *AEO* forecast were used to develop growth rates used to extend the forecast to 2046.

Detailed description of the procedure to calculate future shipments is presented in chapter 9 of NOPR TSD.

[70] U.S. Energy Information Administration. *Annual Energy Outlook 2013.* Washington, DC. DOE/EIA–0383(2013).

Comments related to shipment analysis received during the April 2011 preliminary analysis public meeting are listed below, along with DOE's responses to the comments.

a. VOP.RC.L Shipments

At the April 2011 preliminary analysis public meeting, Southern Store Fixtures stated that vertical open freezers represent far less than the figure of 1.9 percent of the commercial refrigeration equipment shipments that DOE included in the preliminary analysis TSD. (Southern Store Fixtures, Public Meeting Transcript, No. 31 at p. 123) In a written comment, NEEA referenced this statement by Southern Store Fixtures, urging DOE to ensure the accuracy of its shipments data for the VOP.RC.L equipment class, but stating that it generally agreed with DOE's shipments analysis. (NEEA, No. 36 at p. 6)

Shipments estimates for VOP.RC.L were not explicitly stated in the ARI 2005 Report. DOE assumed that these shipments numbers were likely grouped with those of VOP.RC.M. For the preliminary analysis, DOE allocated a portion of VOP.RC.M shipments to the VOP.RC.L equipment class. In response to the comments from Southern Store Fixtures and based on new evidence, DOE reduced the portion of VOP.RC.M shipments (obtained from the ARI 2005 Report) that it allocated to the VOP.RC.L equipment class.

b. Shipments by End User Type

Southern Store Fixtures stated that the shipments estimates presented in the preliminary analysis for new equipment for large supermarkets and smaller markets did not appear to reflect the assumption of 10- and 15-year equipment lifetimes. Specifically, Southern Store Fixtures pointed out that the replacement shipment numbers were much higher than the new shipments in the small grocery store segment. Southern Store Fixtures pointed out that because the equipment life in small grocery stores is 15 years, compared to 10 years in large grocery stores, the ratio of replacement shipments to new shipments for small grocery stores should be smaller than the same ratio for large grocery stores. (Southern Store Fixtures, Public Meeting Transcript, No. 31 at p. 124)

Small grocery stores and convenience stores house many self-contained units. In many stores, self-contained units comprise most of the refrigeration load, when the refrigeration from walk-in cold rooms is discounted (as it does not belong in the commercial refrigeration equipment rulemaking). In the current rulemaking, all self-contained units are assumed to have an average lifetime of 10 years. Therefore, the ratio of replacement shipments to new shipments in small grocery stores and convenience stores is dictated largely by the 10-year lifetime of self-contained units, and is relatively less impacted by the 15-year lifetime of remote condensing display cases, which form a much smaller share of the commercial refrigeration equipment found in small grocery and convenience stores. DOE believes that this factor explains the apparent discrepancy highlighted in the comment by Southern Store Fixtures.

Traulsen expressed the belief that DOE's values for projected shipments for the foodservice building type, as well as its projected shipments by equipment class, were low. (Traulsen, No. 45 at p. 4)

DOE calculated future shipments based on forecasted square footage of new construction, obtained from the *AEO* forecast and historical shipments data. The ratio of floor space occupied by commercial refrigeration equipment to the total commercial floor space is much smaller in foodservice buildings than in food sales buildings such as grocery stores. Further, DOE converted the historical shipment numbers from number of units into number of linear feet by multiplying the number of units by the average linear feet of equipment. Commercial refrigeration equipment used in the foodservice industry is overwhelmingly dominated by self-contained equipment, which, on an average, has a shorter length compared to the remote condensing equipment found in grocery stores. A combination of these factors results in the shipments numbers (in linear feet) to foodservice buildings being much lower than shipments numbers to food sales buildings. However, in terms of number of units shipped, the proportion of shipments to foodservice buildings is much higher as compared to shipments to food sales buildings.

c. Shipments Forecasts

Traulsen commented that overly aggressive performance standards are likely to add costs that will be passed along to the customer, resulting in stunted market growth and retention of less-efficient units. Traulsen estimated that equipment prices have increased 1–2 percent based on variable manufacturing cost increases alone as a result of the need to comply with the standards set by EPACT 2005. (Traulsen, No. 45 at p. 6)

DOE does not have detailed information on the historical shipments data of various types of commercial refrigeration equipment by equipment classes. As described in earlier in this section, DOE extracted shipments data from certain publications and estimated the shipments by equipment class. The ARI 2005 report only contains shipments data for the year 2005. With the available shipments data for commercial refrigeration equipment, its difficult to determine the impact of price increases on future shipments.

Regarding display cases, which are predominantly used in supermarkets and grocery stores, DOE believes that replacement of display cases is largely performed during store remodeling, and that the major driving factor behind remodeling is the need to improve aesthetics. Decisions regarding store remodeling are influenced by many factors, including overall future economic outlook and availability of capital, and DOE believes that equipment price increases do not figure as the major factor. DOE recognizes that, on the other hand, foodservice establishments may be more sensitive to equipment prices. The equipment that is predominantly used in this sector is composed of refrigerators and freezers with solid doors. The MSP increases related to the higher efficiency refrigerators and freezers were estimated as part of the engineering analysis, and were found to be 6 to 8 percent of the baseline MSPs. The effect of amended DOE standards could be that foodservice establishments extend the life of their existing equipment. DOE expects that this effect will result in a slight dip in shipments only in the early years after amended standards go into effect because the old equipment will have to be replaced eventually. The effect of such a dip will not have a significant impact on the NIA, which is carried out over a 30-year period. Extending the life of the existing equipment may also result in higher maintenance and repair costs that may offset part or all of the apparent customer savings.

DOE welcomes stakeholder input in this regard, as the information currently available to DOE is not sufficient to determine the impact of price increases on future shipments of commercial refrigeration equipment.

2. Forecasted Efficiency in the Base Case and Standards Cases

The method for estimating the market share distribution of efficiency levels is presented in section IV.H.9, and a detailed description can be found in chapter 11 of the NOPR TSD. To estimate efficiency trends in the standards cases, DOE uses a ''roll-up'' scenario in its standards rulemakings. Under the roll-up scenario, DOE assumes that equipment efficiencies in the base case that do not meet the standard level under consideration would ''roll up'' to meet the new standard level, and equipment efficiencies above the standard level under consideration would be unaffected. Table IV.7 shows the shipment-weighted market shares by efficiency level in the base-case scenario.

TABLE IV.7—SHIPMENT-WEIGHTED MARKET SHARES BY EFFICIENCY LEVEL, BASE CASE

Equipment class	Shipment-weighted market shares by efficiency level * **							
	Level 1 (percent)	Level 2 (percent)	Level 3 (percent)	Level 4 (percent)	Level 5 (percent)	Level 6 (percent)	Level 7 (percent)	Level 8 (percent)
VOP.RC.M	24.3	24.0	23.4	13.4	12.8	2.0	NA	NA
VOP.RC.L	26.0	26.1	23.2	22.4	2.2	NA	NA	NA
VOP.SC.M	19.1	19.0	18.8	18.1	11.3	10.7	3.1	NA

TABLE IV.7—SHIPMENT-WEIGHTED MARKET SHARES BY EFFICIENCY LEVEL, BASE CASE—Continued

Equipment class	Shipment-weighted market shares by efficiency level * **							
	Level 1 (percent)	Level 2 (percent)	Level 3 (percent)	Level 4 (percent)	Level 5 (percent)	Level 6 (percent)	Level 7 (percent)	Level 8 (percent)
VCT.RC.M	18.8	18.8	15.9	15.5	14.8	14.5	1.7	NA
VCT.RC.L	19.5	20.4	20.0	19.4	19.0	1.8	NA	NA
VCT.SC.M	16.7	17.4	15.5	13.0	12.6	11.7	11.5	1.7
VCT.SC.L	10.5	13.3	16.4	16.2	14.4	14.2	13.1	2.0
VCT.SC.I	16.4	18.1	17.8	15.9	15.5	14.8	1.5	NA
VCS.SC.M	13.1	14.9	15.0	15.0	14.6	14.0	12.6	0.8
VCS.SC.L	12.1	15.1	15.3	15.4	14.3	13.9	13.3	0.6
VCS.SC.I	16.7	16.8	17.4	17.0	16.0	15.4	0.7	NA
SVO.RC.M	24.5	24.5	22.2	13.2	12.6	3.0	NA	NA
SVO.SC.M	19.5	19.5	18.5	18.0	10.8	10.1	3.7	NA
SOC.RC.M	17.7	17.8	17.8	14.5	14.1	12.7	5.4	NA
HZO.RC.M	78.4	21.6	NA	NA	NA	NA	NA	NA
HZO.RC.L	86.2	13.8	NA	NA	NA	NA	NA	NA
HZO.SC.M	25.4	25.4	25.0	21.9	2.4	NA	NA	NA
HZO.SC.L	71.8	28.2	NA	NA	NA	NA	NA	NA
HCT.SC.M	14.8	15.4	15.6	15.7	13.4	12.8	11.0	1.4
HCT.SC.L	12.3	13.3	13.6	15.8	15.6	15.0	13.2	1.2
HCT.SC.I	25.6	25.8	25.1	22.3	1.1	NA	NA	NA
HCS.SC.M	17.2	17.5	17.2	16.8	15.9	13.3	2.1	NA
HCS.SC.L	17.2	17.5	17.2	16.8	16.6	14.5	1.5	NA
PD.SC.M	14.0	17.2	16.1	15.8	15.3	11.0	9.7	1.0
SOC.SC.M	14.7	15.1	15.1	15.0	12.5	12.1	11.0	4.6

* ''NA'' means that no market share was calculated for this efficiency level. For example, the VOP.RC.M equipment class only had six possible efficiency levels, so no market share was allotted to Efficiency Levels 7 and 8.
** Shares may not add to 100 percent exactly due to rounding.

3. National Energy Savings

For each year in the forecast period, DOE calculates the NES for each potential standard level by multiplying the stock of equipment affected by the energy conservation standards by the estimated per-unit annual energy savings. DOE typically considers the impact of a rebound effect, introduced in the energy use analysis, in its calculation of NES for a given product. A rebound effect occurs when users operate higher efficiency equipment more frequently and/or for longer durations, thus offsetting estimated energy savings. However, DOE used a rebound factor of 1, or no effect, for commercial refrigeration equipment because it is operates 24 hours a day, and therefore there is no potential for a rebound effect.

Major inputs to the calculation of NES are annual unit energy consumption, shipments, equipment stock, a site-to-source conversion factor, and a full fuel cycle factor.

The annual unit energy consumption is the site energy consumed by a commercial refrigeration unit in a given year. Because the equipment classes analyzed represent equipment sold across a range of sizes, DOE's ''unit'' in the NES is actually expressed as a linear foot of equipment in an equipment class, and not an individual unit of commercial refrigeration equipment of a specific size. DOE determined annual forecasted shipment-weighted average equipment efficiencies that, in turn, enabled determination of shipment-weighted annual energy consumption values.

The commercial refrigeration equipment stock in a given year is the total linear footage of commercial refrigeration equipment shipped from earlier years (up to 15 years, depending on the type of equipment) that is in use in that year. The NES spreadsheet model keeps track of the total linear footage of commercial refrigeration units shipped each year. For purposes of the NES and NPV analyses conducted for the NOPR, DOE assumed that, based on 15-year and 10-year average equipment lifetimes, approximately 6.67 and 10 percent, respectively, of the existing commercial refrigeration units are retired in each year. DOE assumes that, for units shipped in 2046, any units remaining at the end of 2060 will be replaced.

DOE has historically presented NES in terms of primary energy savings. In response to the recommendations of a committee on ''Point-of-Use and Full-Fuel-Cycle Measurement Approaches to Energy Efficiency Standards'' appointed by the National Academy of Science, DOE announced its intention to use full-fuel-cycle (FFC) measures of energy use and greenhouse gas and other emissions in the national impact analyses and emissions analyses included in future energy conservation standards rulemakings. 76 FR 51281 (August 18, 2011) While DOE stated in that notice that it intended to use the Greenhouse Gases, Regulated Emissions, and Energy Use in Transportation (GREET) model to conduct the analysis, it also said it would review alternative methods, including the use of NEMS. After evaluating both models and the approaches discussed in the August 18, 2011 notice, DOE published a statement of amended policy in the **Federal Register** in which DOE explained its determination that NEMS is a more appropriate tool for its FFC analysis and its intention to use NEMS for that purpose. 77 FR 49701 (August 17, 2012). DOE received one comment, which was supportive of the use of NEMS for DOE's FFC analysis.[71]

The approach used for today's NOPR, and the FFC multipliers that were applied, are described in appendix 10D of the NOPR TSD. NES results are presented in both primary and FFC savings in section V.B.3.a.

4. Net Present Value of Customer Benefit

The inputs for determining the NPV of the total costs and benefits experienced by customers of the commercial refrigeration equipment are: (1) total annual installed cost; (2) total

[71] Docket ID: EERE–2010–BT–NOA–0028, comment by Kirk Lundblade.

annual savings in operating costs; and (3) a discount factor. DOE calculated net national customer savings for each year as the difference between the base-case scenario and standards-case scenarios in terms of installation and operating costs. DOE calculated operating cost savings over the life of each piece of equipment shipped in the forecast period.

DOE multiplied monetary values in future years by the discount factor to determine the present value of costs and savings. DOE estimated national impacts using both a 3-percent and a 7-percent real discount rate as the average real rate of return on private investment in the U.S. economy. These discount rates are used in accordance with the Office of Management and Budget (OMB) guidance to Federal agencies on the development of regulatory analysis (OMB Circular A–4, September 17, 2003), and section E, ''Identifying and Measuring Benefits and Costs,'' therein. DOE defined the present year as 2013 for the NOPR analysis. The 7-percent real value is an estimate of the average before-tax rate of return to private capital in the U.S. economy. The 3-percent real value represents the ''societal rate of time preference,'' which is the rate at which society discounts future consumption flows to their present.

5. Benefits From Effects of Amended Standards on Energy Prices

The reduction in electricity consumption associated with amended standards for commercial refrigeration equipment could reduce the electricity prices charged to customers in all sectors of the economy, and thereby reduce electricity expenditures. In chapter 2 of the preliminary analysis TSD, DOE explained that, because the power industry is a complex mix of fuel and equipment suppliers, electricity producers, and distributors, it did not plan to estimate the value of potentially reduced electricity costs for all customers associated with new or amended standards for refrigeration products.

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

J. Customer Subgroup Analysis

In analyzing the potential impact of new or amended standards on commercial customers, DOE evaluates the impact on identifiable groups (*i.e.,* subgroups) of customers, such as different types of businesses that may be disproportionately affected. Based on data from the 2007 U.S. Economic Census and size standards set by the U.S. Small Business Administration (SBA), DOE determined that a majority of convenience stores and restaurants fall under the definition of small businesses (see chapter 11 of NOPR TSD for details). Small businesses typically face higher cost of capital. In general, the lower the cost of electricity and higher the cost of capital, the more likely it is that an entity would be disadvantaged by the requirement to purchase higher efficiency equipment. Table IV.8 and Table IV.9 present average commercial electricity prices by business type and discount rates by building types, respectively.

Comparing the small grocery and convenience store category to the convenience store with gas station category, both face the same cost of capital, but convenience stores with gas stations generally incur lower electricity prices. Therefore, convenience stores with gas stations were chosen for LCC subgroup analysis in the food-retail segment.

In the foodservice segment, limited service restaurants and full-service restaurants have similar electricity price and discount rates, with limited service restaurants paying slightly lower electricity rates and full-service restaurants facing a slightly higher cost of capital. DOE chose to study full-service restaurants for the LCC subgroup analysis in the foodservice segment because a higher percentage of full-service restaurants tend to be operated by independent small business concerns, as compared to a majority of fast-food restaurants which are owned by or affiliated with national restaurant chains.

DOE estimated the impact on the identified customer subgroups using the LCC spreadsheet model. The standard LCC analysis (described in section IV.H) includes various types of businesses that use commercial refrigeration equipment. For the LCC subgroup analysis, it was assumed that the subgroups analyzed do not have access to national commercial refrigeration equipment purchasing accounts and, consequently, face a higher distribution channel markup. Further, electricity rates and discount rates differ among these subgroups. Details of the data used for LCC subgroup analysis and results are presented in chapter 11 of the NOPR TSD.

TABLE IV.8—DERIVED AVERAGE COMMERCIAL ELECTRICITY PRICE BY BUSINESS TYPE

Business type	Electricity price cents/kWh	Ratio of electricity price to average price for all commercial buildings
Grocery store/food market	0.07222	0.910
Convenience store *	0.08583	1.082
Convenience store with gas station	0.07722	0.973
Multi-line retail **	0.07262	0.915
Limited service restaurant	0.07962	1.003
Full service restaurant	0.08467	1.067
Other foodservice	0.07664	0.966
All commercial buildings	0.07936	1.000

Source: Commercial Buildings Energy Consumption Survey 2003.

* This group is assumed to include convenience stores without gas stations, specialty stores (such as meat markets), and beer, wine, and liquor stores.
** This group is assumed to include mainly large multi-line retailers and supercenters that sell both grocery and non-grocery items.

TABLE IV.9—DERIVATION OF REAL DISCOUNT RATES BY BUILDING TYPE

Building type description	Major chain		Local or non-chain		Governmental		Discount rate (percent)	No. Obs.†
	WACC* (percent)	Percent of stock	Small frm premium** (percent)	Percent of stock	Muni bond rate (percent)	Percent of stock		
Large Grocery	4.16	100	0.0	0	0	0	4.16	18
Small Grocery & Convenience	4.20	50	1.9	50	0	0	5.19	5
Gas Station With Convenience Store	4.20	50	1.9	50	0	0	5.19	NA
Multi-Line Retail	4.33	100	0.0	0	0	0	4.33	6
Restaurant—Limited Service	5.29	50	1.9	50	0	0	6.29	21
Restaurant—Full Service	5.61	50	1.9	50	0	0	6.62	24
Restaurant—Other Foodservice	5.61	25	1.9	25	2.34	50	4.48	NA

Source: Pacific Northwest National Laboratory (PNNL) Weighted Average Cost of Capital (WACC) calculations applied to firms sampled from the Damodaran Online web site (*http://pages.stern.nyu.edu/~adamodar/New_Home_Page/papers.html*). Assumptions for weighting factors for convenience and foodservice reflect lack of reliable data sources. The estimate of inflation used to translate nominal rates to real rates is based on a 40-year (1971–2010) average gross domestic product deflator (3.832 percent).
* WACC stands for weighted-average cost of capital. See chapter 8 of the NOPR TSD for additional details.
** Small Firm Premium refers to higher premium paid by smaller firms that face higher risks of loss of invested capital. Source: Small Business Administration data on loans between $10,000 and $99,000 compared to AAA Corporate Rates. *http://www.sba.gov/advocacy/7540/6282.* Data compiled 6/20/2013.
† "NA" means no Damodaran observations available.

K. Manufacturer Impact Analysis

1. Overview

DOE performed an MIA to estimate the financial impact of amended energy conservation standards on manufacturers of commercial refrigeration equipment and to calculate the impact of such standards on employment and manufacturing capacity. The MIA has both quantitative and qualitative aspects. The quantitative part of the MIA primarily relies on the Government Regulatory Impact Model (GRIM), an industry cash-flow model with inputs specific to this rulemaking. The key GRIM inputs are data on the industry cost structure, product costs, shipments, and assumptions about markups and conversion expenditures. The key output is the INPV. Different sets of markup scenarios will produce different results. The qualitative part of the MIA addresses factors such as equipment characteristics, impacts on particular subgroups of manufacturers, and important market and product trends. The complete MIA is outlined in chapter 12 of the NOPR TSD.

DOE conducted the MIA for this rulemaking in three phases. In Phase 1 of the MIA, DOE prepared a profile of the commercial refrigeration equipment industry that includes a top-down cost analysis of manufacturers used to derive preliminary financial inputs for the GRIM (*e.g.,* sales general and administration (SG&A) expenses; research and development (R&D) expenses; and tax rates). DOE used public sources of information, including company SEC 10–K filings, corporate annual reports, the U.S. Census Bureau's Economic Census, and Hoover's reports.

In Phase 2 of the MIA, DOE prepared an industry cash-flow analysis to quantify the impacts of an amended energy conservation standard. In general, more-stringent energy conservation standards can affect manufacturer cash flow in three distinct ways: (1) by creating a need for increased investment; (2) by raising production costs per unit; and (3) by altering revenue due to higher per-unit prices and possible changes in sales volumes.

In Phase 3 of the MIA, DOE conducted structured, detailed interviews with a representative cross-section of manufacturers. During these interviews, DOE discussed engineering, manufacturing, procurement, and financial topics to validate assumptions used in the GRIM and to identify key issues or concerns. See section IV.K.4 for a description of the key issues manufacturers raised during the interviews.

Additionally, in Phase 3, DOE evaluated subgroups of manufacturers that may be disproportionately impacted by amended standards, or that may not be accurately represented by the average cost assumptions used to develop the industry cash-flow analysis. For example, small manufacturers, niche players, or manufacturers exhibiting a cost structure that largely differs from the industry average could be more negatively affected.

DOE identified one subgroup, small manufacturers, for separate impact analyses. DOE applied the small business size standards published by the SBA to determine whether a company is considered a small business. 65 FR 30836, 30848 (May 15, 2000), as amended at 65 FR 53533, 53544 (Sept. 5, 2000) and codified at 13 CFR part 121. To be categorized as a small business under North American Industry Classification System (NAICS) 333415, ''Air-Conditioning and Warm Air Heating Equipment and Commercial and Industrial Refrigeration Equipment Manufacturing,'' a commercial refrigeration manufacturer and its affiliates may employ a maximum of 750 employees. The 750-employee threshold includes all employees in a business's parent company and any other subsidiaries. Based on this classification, DOE identified at least 32 commercial refrigeration equipment manufacturers that qualify as small businesses. The commercial refrigeration equipment small manufacturer subgroup is discussed in chapter 12 of the NOPR TSD and in section VI.B.1 of this notice.

2. Government Regulatory Impact Model

DOE uses the GRIM to quantify the changes in the commercial refrigeration equipment industry cash flow due to amended standards that result in a higher or lower industry value. The GRIM analysis uses a standard, annual cash-flow analysis that incorporates manufacturer costs, markups, shipments, and industry financial information as inputs, and models changes in costs, investments, and manufacturer margins that would result from new and amended energy conservation standards. The GRIM spreadsheet uses the inputs to arrive at a series of annual cash flows, beginning with the base year of the analysis, 2013 in this case, and continuing to 2046. DOE calculated INPVs by summing the stream of annual discounted cash flows during this period. For commercial refrigeration equipment manufacturers, DOE used a real discount rate of 10 percent. DOE's discount rate estimate was derived from industry financials and then modified according to feedback during manufacturer interviews.

The GRIM calculates cash flows using standard accounting principles and compares changes in INPV between a base case and various TSLs (the standards cases). The difference in INPV between the base case and a standards case represents the financial impact of the amended standard on manufacturers. As discussed previously, DOE collected the information on the critical GRIM inputs from a number of sources, including publicly available data and interviews with a number of manufacturers (described in the next section). The GRIM results are shown in section V.B.2.a. Additional details about the GRIM can be found in chapter 12 of the NOPR TSD.

a. Government Regulatory Impact Model Key Inputs

Manufacturer Production Costs

Manufacturing a higher efficiency product is typically more expensive than manufacturing a baseline product due to the use of more complex components, which are more costly than baseline components. The changes in the MPCs of the analyzed products can affect the revenues, gross margins, and cash flow of the industry, making these product cost data key GRIM inputs for DOE's analysis.

In the MIA, DOE used the MPCs for each considered efficiency level calculated in the engineering analysis, as described in section IV.C and further detailed in chapter 5 of the NOPR TSD. In addition, DOE used information from its teardown analysis, described in section IV.E.4.a, to disaggregate the MPCs into material, labor, and overhead costs. To calculate the MPCs for equipment above the baseline, DOE added incremental material, labor, overhead costs from the engineering cost-efficiency curves to the baseline MPCs. These cost breakdowns and equipment markups were validated with manufacturers during manufacturer interviews.

Base-Case Shipments Forecast

The GRIM estimates manufacturer revenues based on total unit shipment forecasts and the distribution of these values by efficiency level. Changes in sales volumes and efficiency mix over time can significantly affect manufacturer finances. For this analysis, the GRIM uses the NIA's annual shipment forecasts derived from the shipments analysis from 2013, the base year, to 2046, the end of the analysis period. See chapter 9 of the NOPR TSD for additional details.

Product and Capital Conversion Costs

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

To evaluate the level of capital conversion expenditures manufacturers would likely incur to comply with amended energy conservation standards, DOE used manufacturer interviews to gather data on the level of capital investment required at each efficiency level. DOE validated manufacturer comments through estimates of capital expenditure requirements derived from the product teardown analysis and engineering model described in section IV.E.4.

DOE assessed the equipment conversion costs at each level by integrating data from quantitative and qualitative sources. DOE considered feedback regarding the potential costs of each efficiency level from multiple manufacturers to determine conversion costs such as R&D expenditures and certification costs. Manufacturer data were aggregated to better reflect the industry as a whole and to protect confidential information.

In general, DOE assumes that all conversion-related investments occur between the year of publication of the final rule and the year by which manufacturers must comply with an amended standard. The investment figures used in the GRIM can be found in section V.B.2.a of this notice. For additional information on the estimated product conversion and capital conversion costs, see chapter 12 of the NOPR TSD.

b. Government Regulatory Impact Model Scenarios

Markup Scenarios

As discussed above, MSPs include direct manufacturing production costs (*i.e.,* labor, material, and overhead estimated in DOE's MPCs) and all non-production costs (*i.e.,* SG&A, R&D, and interest), along with profit. To calculate the MSPs in the GRIM, DOE applied markups to the MPCs estimated in the engineering analysis and then added in the cost of shipping. Modifying these markups in the standards case yields different sets of impacts on manufacturers. For the MIA, DOE modeled two standards-case markup scenarios to represent the uncertainty regarding the potential impacts on prices and profitability for manufacturers following the implementation of amended energy conservation standards: (1) A preservation of gross margin percentage markup scenario; and (2) a preservation of operating profit markup scenario. These scenarios lead to different markups values that, when applied to the inputted MPCs, result in varying revenue and cash flow impacts.

Under the preservation of gross margin percentage scenario, DOE applied a single uniform ''gross margin percentage'' markup across all efficiency levels. As production costs increase with efficiency, this scenario implies that the absolute dollar markup will increase as well. Based on publicly available financial information for manufacturers of commercial refrigeration equipment and comments from manufacturer interviews, DOE assumed the non-production cost markup—which includes SG&A expenses, R&D expenses, interest, and profit—to be 1.42. Because this markup scenario assumes that manufacturers would be able to maintain their gross margin percentage markups as production costs increase in response to an amended energy conservation standard, the scenario represents a high bound to industry profitability under an amended energy conservation standard.

In the preservation of operating profit scenario, manufacturer markups are set so that operating profit 1 year after the compliance date of the amended energy conservation standard is the same as in the base case. Under this scenario, as the cost of production and the cost of sales go up, manufacturers are generally required to reduce their markups to a level that maintains base-case operating profit. The implicit assumption behind this markup scenario is that the industry can only maintain its operating profit in absolute dollars after compliance with the amended standard is required. Therefore, operating margin in percentage terms is squeezed (reduced) between the base case and standards case. DOE adjusted the manufacturer markups in the GRIM at each TSL to yield approximately the same earnings before interest and taxes in the standards case in the year after the compliance date of the amended standards as in the base case. This markup scenario represents a low bound to industry profitability under an amended energy conservation standard.

3. Discussion of Comments

During the April 2011 preliminary analysis public meeting, interested parties commented on the assumptions and results of the preliminary analysis TSD. Oral and written comments addressed several topics, including testing and certification, cumulative regulatory burden, small manufacturers, and manufacturer markups.

a. Testing and Certification

At the public meeting and in written comments, several stakeholders expressed concern to DOE regarding the potential burden of testing.

Traulsen stated that certification, compliance, and enforcement (CC&E) is its most significant cost item in terms of internal resources in the form of time and direct expenses. Traulsen further explained that, with respect to the manufacturer impacts, the three most important topics are CC&E, testing burden, and compliance with other (unspecified) certifications. (Traulsen, No. 45 at pp. 4–5) NEEA expressed the opinion that the most significant issue associated with manufacturer impacts is testing and compliance for a wide array of equipment offerings, especially given the large number of variations on single models. AHRI also stated that the CC&E requirements put in place by DOE have the potential to bankrupt the industry due to the excessive number of tests required. (AHRI, No. 43 at p. 3) True added that it believed there are economies of scale in testing commercial refrigeration equipment units. (True, Public Meeting Transcript, No. 31 at p. 151) True also stated that the testing and regulatory burden, including tooling, fixturing, and setup costs imposed on small production runs is an issue for large manufacturers as well as small manufacturers. (True, Public Meeting Transcript, No. 31 at pp. 206, 210) NEEA expressed agreement with manufacturers that testing each variation would create a significant potential burden, especially on small manufacturers. (NEEA, No. 36 at p. 7) In addition, Southern Store Fixtures stated that it would be difficult to produce information to estimate the compliance testing burden on manufacturers, as the certification and compliance requirements had not yet been finalized. (Southern Store Fixtures, Public Meeting Transcript, No. 31 at pp. 149–50) Southern Store Fixtures added that it is impossible to determine potential impacts of testing and certification on manufacturers until the definition of a basic model is clarified. (Southern Store Fixtures, No. 38 at p. 1)

DOE recognizes industry concerns regarding CC&E testing requirements. Although CC&E costs are not directly analyzed in the GRIM because they do not vary with different standard levels, the CC&E burden is identified as a key issue and as a cumulative regulatory burden in the MIA. DOE intends to address these manufacturer concerns in ongoing CC&E rulemakings. Moreover, DOE is currently considering alternative efficiency determination methods (AEDMs) for commercial refrigeration equipment and issued a notice of proposed rulemaking on Alternative Efficiency Determination Methods and Alternative Rating Methods in May 2012. 77 FR 32038 (May 31, 2012). AEDMs are computer modeling tools used to establish a model's efficiency rating in lieu of testing. More information about the AEDM rulemaking can be found at: *www1.eere.energy.gov/buildings/appliance_standards/certification_enforcement.html*.

While the GRIM does not account for DOE certification costs, it does account for industry certification (*i.e.,* Underwriters Laboratories (UL) and NSF testing) and research and development costs in its analysis of product conversion costs, which are associated with a change in standards. The change in INPV, the primary output of the GRIM, reflects the possible increase in industry certification costs and is considered by DOE when proposing a standard.

b. Cumulative Regulatory Burden

Numerous stakeholders commented on the cumulative regulatory burden tied to DOE efficiency standards. Some stakeholders expressed concern regarding potential conflicts with other certification programs. Traulsen stated that the redundancy of testing required by other Federal programs (such as EPA ENERGY STAR®),[72] potentially involves conflicting criteria, increases cost, and that cross-references to databases with inconsistent tests, classes, and enforcement requirements adds further complications. Traulsen estimated that the financial burden associated with meeting both DOE and EPA ENERGY STAR requirements has been greater than 0.5 percent of revenue, and that it would be beneficial to reconcile the differences between DOE and EPA standards. (Traulsen, No. 45 at pp. 5–6) NEEA stated that the burden of certifications and associated testing is inherent in the manufacturing industry, and that this burden should have little to do with the current standards rulemaking. However, NEEA added, any steps that can be taken to harmonize test methods and procedures between certifications should be taken. (NEEA, No. 36 at p. 7)

DOE realizes that the cumulative effect of multiple regulations on an industry may significantly increase the burden faced by manufacturers that need to comply with regulations and certification programs from different organizations and levels of government. However, DOE notes that certain standards, such as ENERGY STAR, are optional for manufacturers.

AHRI stated that there are several legislative and regulatory activities that could significantly burden manufacturers of commercial refrigeration equipment, including the DOE CC&E program and the upcoming amended energy conservation standards for walk-in coolers and freezers. AHRI also added that climate change bills could have a significant negative impact on the availability and price of HFC refrigerants. (AHRI, No. 43 at p. 4)

DOE estimates the present value of the total benefits over the analysis period (2010–2040) of the EPACT 2005 standards for CRE to be $2.3 billion and the costs to be $0.32 billion, in 2012 dollars and using a discount rate of 7 percent. DOE estimates the present

[72] ENERGY STAR is a joint program of EPA and DOE that helps the Nation save money and protect the environment through energy efficient products and practices. More information can be found at: *www.energystar.gov*.

value of total benefits over the analysis period (2012–2042) of the DOE 2009 standards for CRE to be $3.97 billion and the costs to be $1.52 billion, in 2012 dollars and using a 7 percent discount rate. Additionally, in the energy conservation standard NOPR for walk-in coolers and freezers, DOE estimates the net present value of the total benefits over the analysis period (2017–2046) to be $21.6 billion and the costs to be $3.7 billion, in 2012% and using a discount rate of 7 percent.

DOE takes into account the cumulative cost of multiple Federal regulations on manufacturers, including CC&E, in the cumulative regulatory burden (CRB) section of its analysis. The CRB can be found in section V.B.2.e of this document. The CRB review also recognizes the additional burden faced by manufacturers that produce both commercial refrigeration equipment and walk-in coolers and freezers.

AHRI also stated that California is currently working on new regulations as part of Title 24 that will likely establish new prescriptive requirements on commercial refrigeration equipment beginning in 2013. AHRI added that other States on the West Coast are following California's lead and are likely to implement similar regulations in the near future. AHRI suggested that DOE account for these developments in its analysis. (AHRI, No. 43 at p. 4) Finally, AHRI commented that several States have enacted their own climate change legislation, including regulations established by the California Air Resources Board (CARB) to limit GHGs and reduce the usage of high GWP refrigerants such as HFCs. AHRI stated that CARB will implement these regulations in 2011. (AHRI, No. 43 at p. 4)

According to the California Code of Regulations, title 24, part 6, any appliance for which there is a California standard established may be installed only if the manufacturer has certified to the CEC, as specified in those regulations, that the appliance complies with the applicable standard for that appliance. California's appliance efficiency regulations require that the MDEC (in kilowatt-hours) for commercial refrigerators manufactured on or after January 1, 2010 does not exceed the following:

- Refrigerators with solid doors: 0.10V + 2.04
- Refrigerators with transparent doors: 0.12V + 3.34
- Freezers with solid doors: 0.40V + 1.38
- Freezers with transparent doors: 0.75V + 4.10
- Refrigerator/freezers with solid doors: the greater of 0.27AV–0.71 or 0.70
- Refrigerators with self-condensing unit designed for pull-down temperature applications: 0.126V + 3.51

Since these standards are identical to the ones prescribed in EPACT 2005 and the efficiency levels set by the current rulemaking will either exceed or be equivalent to the EPACT 2005 levels, DOE does not expect the Title 24 regulations to create a cumulative regulatory burden on manufacturers. California also has started a rulemaking proceeding to adopt changes to the building energy efficiency standards contained in the California Code of Regulations, title 24, part 6, but the CEC is currently in the pre-rulemaking stage and any new standards will not be published until 2013. DOE has not evaluated the impacts of the 2013 rule because any analysis would be speculative in the absence of final regulations.

CARB is currently limiting the in-State use of high-GWP refrigerants in non-residential refrigeration systems through its Refrigerant Management Program, effective January 1, 2011.[73] According to this new regulation, facilities with refrigeration systems that have a refrigerant capacity exceeding 50 pounds must repair leaks within 14 days of detection, maintain on-site records of all leak repairs, and keep receipts of all refrigerant purchases. The regulation applies to any person or company that installs, services, or disposes of appliances with high-GWP refrigerants. Refrigeration systems with a refrigerant capacity exceeding 50 pounds typically belong to food retail operations with remote condensing racks that store refrigerant serving multiple commercial refrigeration equipment units within a business. However, commercial refrigeration equipment units in food retail establishments are usually installed and serviced by refrigeration contractors, not manufacturers. As a result, although these CARB regulations apply to refrigeration technicians and owners of facilities with refrigeration systems, they are unlikely to represent a regulatory burden for commercial refrigeration manufacturers.

The cumulative regulatory burden on manufacturers of commercial refrigeration equipment is discussed in further detail in chapter 12 of the NOPR TSD.

[73] California Air Resources Board. *Refrigerant Management Program Final Regulation*. 2011. (Last accessed March 16, 2012.) *www.arb.ca.gov/cc/reftrack/reftrackrule.html*.

c. Small Manufacturers

During the April 2011 preliminary analysis public meeting, Southern Store Fixtures stated that the impact of research, development, and testing is greater on smaller manufacturers because, while they may have the same number of models in their product lines as do larger manufacturers, they produce fewer units of each model. (Southern Store Fixtures, Public Meeting Transcript, No. 31 at p. 150) Similarly, Zero Zone stated that amended standards have large impacts on small companies. For example, Zero Zone uses foamed-in-place urethane panels. If it were to become necessary to use thicker foam, Zero Zone stated, the company could face capital conversion expenditures of roughly $250,000. (Zero Zone, Public Meeting Transcript, No. 31 at p. 199)

DOE agrees that amended standards may have disproportionate impacts on smaller manufacturers. As a result, the DOE conducts a small business analysis to assess those impacts, the results of which are set forth in section VI.B of this notice.

Stakeholders also commented on DOE's classification of small manufacturers. NEEA suggested that DOE review its characterizations of small and large manufacturers, as it believed there to be disparities between the listed company sizes and market shares in DOE's classifications. (NEEA, Public Meeting Transcript, No. 31 at p. 160) Emerson stated that manufacturers' sizes should be characterized by their operations in the market. According to Emerson, some manufacturers are part of larger companies, but the fact that they are owned by larger companies does not change the potential for impacts on their employment levels or risk of going out of business. (Emerson, Public Meeting Transcript, No. 31 at p. 207)

DOE requested feedback regarding the accuracy of its list of small businesses during its interviews with manufacturers. Since the publication of the preliminary analysis TSD, DOE has revised the list based on responses received from manufacturers. Furthermore, DOE understands that manufacturers that are owned by large parent companies may not be protected from the potential impacts of amended standards. However, in its analysis of small businesses, DOE also takes into account that manufacturers that belong to large parent companies are more likely to have better access to capital and engineering resources than manufacturers that have no parent company or have parent companies with a total size of less than 750 employees.

A detailed discussion of the impact of the proposed standards on small manufacturers can be found in chapter 12 of the NOPR TSD.

d. Manufacturer Markup

Southern Store Fixtures expressed concern that research and development was considered part of the manufacturer markup. The company also asked whether sales, marketing, and engineering costs were included in this markup as well, and suggested that all of these expenses should be considered indirect costs instead. (Southern Store Fixtures, Public Meeting Transcript, No. 31 at pp. 71–72)

DOE incorporates all non-production costs, including sales, marketing, and R&D, in its manufacturer markup. Although manufacturers' accounting practices may vary, DOE uses this standard model to approximate the cost structure of the commercial refrigeration industry as a whole. A detailed explanation of the manufacturer markup can be found in section V.B.2 of this notice and in chapter 5 of the NOPR TSD.

4. Manufacturer Interviews

DOE interviewed manufacturers representing over 90 percent of food retail sales and over 60 percent of foodservice sales. These interviews were in addition to those DOE conducted as part of the engineering analysis. The information gathered during these interviews enabled DOE to tailor the GRIM to reflect the unique financial characteristics of the commercial refrigeration industry. All interviews provided information that DOE used to evaluate the impacts of potential amended energy conservation standards on manufacturer cash flows, manufacturing capacities, and employment levels.

During the manufacturer interviews, DOE asked manufacturers to describe their major concerns about this rulemaking. The following sections describe the most significant issues identified by manufacturers. DOE has also included additional concerns in chapter 12 of the NOPR TSD.

a. Enforcement

Interviewed manufacturers expressed concern about the enforcement of an amended energy efficiency standard for commercial refrigeration equipment. Manufacturers believe that insufficient enforcement will lead to market distortions, as companies that make the necessary investments to meet amended standards and compliance requirements would be at a distinct pricing disadvantage to unscrupulous competitors that do not fully comply. The manufacturers requested that DOE take the enforcement action necessary to maintain a level playing field and to eliminate non-compliant products from the market.

b. Certification and Compliance Costs

Nearly all manufacturers expressed concern over CC&E costs. In particular, confusion over the definition of ''basic model'' and the implementation of AEDMs is making it difficult for some manufacturers to anticipate their total testing needs and total testing costs.

Manufacturers are concerned that CC&E requirements for commercial refrigeration equipment do not take into account the customized nature of the commercial refrigeration equipment industry. Manufacturers stated that their industry has a high level of end-user specification and low production volumes compared to other industries, such as residential refrigeration. As a result, the strictest interpretations of the CC&E requirements could lead to hundreds of thousands of tests per company. Additional clarification of how basic models and AEDMs apply to the commercial refrigeration equipment industry would help manufacturers understand the testing investments that will be necessary. DOE is aware of the current confusion and continues to work with industry to improve the CC&E process and AEDM rules to address these concerns.

c. Disproportionate Impact on Small Businesses

Manufacturers noted that small businesses will be disproportionately impacted by certification and compliance requirements compared to larger businesses. One manufacturer indicated that small and large manufacturers of the same equipment tend to have similar numbers of basic models, but large manufacturers offer a broader suite of products based on those basic models and have higher sales. Therefore, the manufacturer expressed concern that small manufacturers will be at a disadvantage because they will need to spread both industry certification and conversion costs over a smaller number of shipments.

Also, small manufacturers indicated they have fewer resources with which to manage CC&E requirements. As a result, they will be forced to focus on compliance rather than on innovation. Small manufacturers believe that their large competitors will have greater resources to continue innovating while meeting amended energy conservation standards.

d. Potential Loss of Product Utility and Decrease in Food Safety

Manufacturers expressed concern about the potential impact of amended energy conservation standards on product performance. Specifically, manufacturers serving the foodservice industry were concerned about negative impacts on food safety, while manufacturers serving the food retail industry were concerned about negative impacts on merchandising design.

One manufacturer of commercial refrigeration equipment for the foodservice industry summarized the challenge of amended energy conservation standards as ''the design trade-off between product price, energy efficiency, and food safety.'' In the foodservice industry, refrigeration equipment must maintain safe food temperatures despite frequent door openings in challenging environments, such as kitchens with high temperatures and high humidity. The infiltration of warm, moist air places an additional burden on the refrigeration equipment and increases energy usage. Manufacturers expressed concern that more-efficient equipment would have trouble maintaining food safety in extreme, but not uncommon, conditions.

Manufacturers in the food retail market design their equipment to optimally present merchandise. Some manufacturers were concerned that amended energy conservation standards would limit their ability to tailor their commercial refrigeration equipment for specific merchandise. Specifically, manufacturers noted that the highly directional light from LED bulbs provides poor light for display case applications where the product is presented in multiple layers, such as prepared food display cases. Additionally, manufacturers noted that higher efficiency designs generally have less airflow (due to reduced fan power consumption). They stated that this reduction in airflow could result in less desirable presentation of meats and in increased icing on products. In general, more-efficient standards limit manufacturer options for optimizing the presentation features of products. Food retail customers such as supermarkets make purchasing decisions based on the various presentation features of commercial refrigeration equipment offered by different manufacturers.

L. Employment Impact Analysis

Employment impacts are one of the factors that DOE considers in selecting an efficiency standard. Employment impacts include direct and indirect impacts. Direct employment impacts are any changes that affect employment of commercial refrigeration equipment manufacturers, their suppliers, and related service firms. Indirect impacts are those changes in employment in the larger economy that occur because of the shift in expenditures and capital investment caused by the purchase and operation of more-efficient commercial refrigeration equipment. Direct employment impacts are analyzed as part of the MIA. Indirect impacts are assessed as part of the employment impact analysis.

Indirect employment impacts from amended commercial refrigeration equipment standards consist of the net jobs created or eliminated in the national economy, other than in the manufacturing sector being regulated, as a consequence of (1) reduced spending by end users on electricity; (2) reduced spending on new energy supply by the utility industry; (3) increased spending on the purchase price of new commercial refrigeration equipment; and (4) the effects of those three factors throughout the Nation's economy. DOE expects the net monetary savings from amended standards to stimulate other forms of economic activity. DOE also expects these shifts in spending and economic activity to affect the demand for labor.

In developing this analysis in the NOPR, DOE estimated indirect national employment impacts using an input/output model of the U.S. economy, called ImSET (Impact of Sector Energy Technologies), developed by DOE's Building Technologies Program. ImSET is an economic analysis model that characterizes the interconnections among 188 sectors of the economy as national input/output structural matrices, using data from the U.S. Department of Commerce's 1997 Benchmark U.S. input/output table.[74] The ImSET model estimates changes in employment, industry output, and wage income in the overall U.S. economy resulting from changes in expenditures in various sectors of the economy. DOE estimated changes in expenditures using the NIA model. ImSET then estimated the net national indirect employment impacts that amended commercial refrigeration equipment efficiency standards could have on employment by sector.

For more details on the employment impact analysis and its results, see chapter 16 of the NOPR TSD and section 0 of this notice.

M. Utility Impact Analysis

The utility impact analysis estimates several important effects on the utility industry of the adoption of new or amended standards. For this analysis, DOE used the NEMS–BT model to generate forecasts of electricity consumption, electricity generation by plant type, and electric generating capacity by plant type, that would result from each considered TSL. DOE obtained the energy savings inputs associated with efficiency improvements to considered products from the NIA. DOE conducts the utility impact analysis as a scenario that departs from the latest *AEO* Reference Case. In the analysis for today's rule, the estimated impacts of standards are the differences between values forecasted by NEMS–BT and the values in the *AEO2013* Reference Case. For more details on the utility impact analysis, see chapter 15 of the NOPR TSD.

N. Emissions Analysis

In the emissions analysis, DOE estimated the reduction in power sector emissions of CO_2, NO_X, sulfur dioxide (SO_2) and Hg from amended energy conservation standards for commercial refrigeration equipment. In addition, DOE estimates emissions impacts in production activities (extracting, processing, and transporting fuels) that provide the energy inputs to power plants. These are referred to as ''upstream'' emissions. Together, these emissions account for the full-fuel-cycle (FFC). In accordance with DOE's FFC Statement of Policy (76 FR 51282 (Aug. 18, 2011)) 77 FR 49701 (August 17, 2012), the FFC analysis includes impacts on emissions of methane (CH_4) and nitrous oxide (N_2O), both of which are recognized as greenhouse gases.

DOE conducted the emissions analysis using emissions factors that were derived from data in EIA's *Annual Energy Outlook 2013* (*AEO 2013*), supplemented by data from other sources. DOE developed separate emissions factors for power sector emissions and upstream emissions. The method that DOE used to derive emissions factors is described in chapter 13 of the NOPR TSD.

EIA prepares the *Annual Energy Outlook* using the National Energy Modeling System (NEMS). Each annual version of NEMS incorporates the projected impacts of existing air quality regulations on emissions. *AEO 2013* generally represents current legislation and environmental regulations, including recent government actions, for which implementing regulations were available as of December 31, 2012.

SO_2 emissions from affected electric generating units (EGUs) are subject to nationwide and regional emissions cap-and-trade programs. Title IV of the Clean Air Act sets an annual emissions cap on SO_2 for affected EGUs in the 48 contiguous States (42 U.S.C. 7651 *et seq.*) and the District of Columbia (DC). SO_2 emissions from 28 eastern States and DC were also limited under the Clean Air Interstate Rule (CAIR; 70 FR 25162 (May 12, 2005)), which created an allowance-based trading program. CAIR was remanded to the U.S. Environmental Protection Agency (EPA) by the U.S. Court of Appeals for the District of Columbia but it remained in effect. See *North Carolina* v. *EPA,* 550 F.3d 1176 (D.C. Cir. 2008); *North Carolina* v. *EPA,* 531 F.3d 896 (D.C. Cir. 2008). On July 6, 2011, EPA issued a replacement for CAIR, the Cross-State Air Pollution Rule (CSAPR). 76 FR 48208 (Aug. 8, 2011). On August 21, 2012, the DC Circuit issued a decision to vacate CSAPR. See *EME Homer City Generation, LP* v. *EPA,* 696 F.3d 7, 38 (D.C. Cir. 2012). The court ordered EPA to continue administering CAIR. The *AEO 2013* emissions factors used for today's NOPR assume that CAIR remains a binding regulation through 2040.[75]

The attainment of emissions caps is typically flexible among EGUs and is enforced through the use of emissions allowances and tradable permits. Under existing EPA regulations, any excess SO_2 emissions allowances resulting from the lower electricity demand caused by the adoption of a new or amended efficiency standard could be used to permit offsetting increases in SO_2 emissions by any regulated EGU. In past rulemakings, DOE recognized that there was uncertainty about the effects of efficiency standards on SO_2 emissions covered by the existing cap-and-trade system, but it concluded that negligible reductions in power sector SO_2 emissions would occur as a result of standards.

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[74] U.S. Department of Commerce, Bureau of Economic Analysis. *Benchmark Input-Output Accounts.* 1997. U.S. Government Printing Office: Washington, DC.

[75] On December 30, 2011, the DC Circuit stayed the new rules while a panel of judges reviews them, and told EPA to continue administering CAIR. See EME *Homer City Generation, LP* v. *EPA,* Order, No. 11–1302, Slip Op. at *2 (D.C. Cir. Dec. 30, 2011). On August 21, 2012, the DC Circuit issued a decision to vacate CSAPR. See *EME Homer City Generation, LP* v. *EPA,* No. 11–1302, 2012 WL 3570721 at *24 (D.C. Cir. Aug. 21, 2012). The court again ordered EPA to continue administering CAIR. *AEO2012* had been finalized prior to both these decisions, however. DOE understands that CAIR and CSAPR are similar with respect to their effect on emissions impacts of energy efficiency standards.

Beginning in 2015, however, SO_2 emissions will fall as a result of the Mercury and Air Toxics Standards (MATS) for power plants, which were announced by EPA on December 21, 2011. 77 FR 9304 (Feb. 16, 2012). In the final MATS rule, EPA established a standard for hydrogen chloride as a surrogate for acid gas hazardous air pollutants (HAP), and also established a standard for SO_2 (a non-HAP acid gas) as an alternative equivalent surrogate standard for acid gas HAP. The same controls are used to reduce HAP and non-HAP acid gas; thus, SO_2 emissions will be reduced as a result of the control technologies installed on coal-fired power plants to comply with the MATS requirements for acid gas. *AEO2013* assumes that, in order to continue operating, coal plants must have either flue gas desulfurization or dry sorbent injection systems installed by 2015. Both technologies, which are used to reduce acid gas emissions, also reduce SO_2 emissions. Under the MATS, NEMS shows a reduction in SO_2 emissions when electricity demand decreases (*e.g.,* as a result of energy efficiency standards). Emissions will be far below the cap that would be established by CAIR, so it is unlikely that excess SO_2 emissions allowances resulting from the lower electricity demand would be needed or used to permit offsetting increases in SO_2 emissions by any regulated EGU. Therefore, DOE believes that efficiency standards will reduce SO_2 emissions in 2015 and beyond.

CAIR established a cap on NO_X emissions in 28 eastern States and the District of Columbia. Energy conservation standards are expected to have little effect on NO_X emissions in those States covered by CAIR because excess NO_X emissions allowances resulting from the lower electricity demand could be used to permit offsetting increases in NO_X emissions. However, standards would be expected to reduce NO_X emissions in the States not affected by the caps, so DOE estimated NO_X emissions reductions from the standards considered in today's NOPR for these States.

The MATS limit mercury emissions from power plants, but they do not include emissions caps and, as such, DOE's energy conservation standards would likely reduce Hg emissions. DOE estimated mercury emissions factors based on *AEO2013,* which incorporates the MATS.

After the preliminary analysis, two stakeholders provided comments pertinent to the emissions analysis. NRDC stated that, given that supermarket rack-based commercial refrigeration equipment units have leakage rates of 15 to 30 percent and use HFC refrigerants with GWPs in the range of 2,000 to 3,400, direct emissions can be as large as the indirect emissions due to energy use. NRDC added that DOE or EPA should review emissions due to leakage. (NRDC, Public Meeting Transcript, No. 31 at p. 173) CA IOUs stated that refrigerant emissions and leakage may have a significant GWP, and suggested that DOE include in its environmental impact analysis estimates of changes in refrigerant emissions, and their effects on total GHG emissions and GWP. CA IOUs pointed to the CEC analysis as a potential starting point for DOE to use in including refrigerants in the environmental impact analysis. (CA IOUs, No. 42 at p. 6)

DOE appreciates the comments by stakeholders regarding the emissions analysis of refrigerants. DOE's emission analysis adheres to the guidance and methodologies that has been outlined in this section.

DOE also adds that the design options used for efficiency improvement of commercial refrigeration equipment in this rulemaking are not expected to impact refrigerant leakage rates. Consequently, the proposed standards would not affect refrigerant emissions. If stakeholders believe that the proposed standards would lead to an increase or a decrease in refrigerant emissions, then supporting arguments may be submitted for DOE's consideration during the NOPR public meeting or comment period.

O. Monetizing Carbon Dioxide and Other Emissions Impacts

As part of the development of the proposed standards in this NOPR, DOE considered the estimated monetary benefits from the reduced emissions of CO_2 and NO_X that are expected to result from each of the TSLs considered. In order to make this calculation analogous to the calculation of the NPV of customer benefit, DOE considered the reduced emissions expected to result over the lifetime of equipment shipped in the forecast period for each TSL. This section summarizes the basis for the monetary values used for each of these emissions and presents the values considered in this NOPR.

For today's NOPR, DOE is relying on a set of values for the SCC that was developed by a Federal interagency process. The basis for these values is summarized below, and a more detailed description of the methodologies used is provided as an appendix to chapter 14 of the NOPR TSD.

1. Social Cost of Carbon

The SCC is an estimate of the monetized damages associated with an incremental increase in carbon emissions in a given year. It is intended to include (but is not limited to) changes in net agricultural productivity, human health, property damages from increased flood risk, and the value of ecosystem services. Estimates of the SCC are provided in dollars per metric ton of carbon dioxide. A domestic SCC value is meant to reflect the value of damages in the United States resulting from a unit change in carbon dioxide emissions, while a global SCC value is meant to reflect the value of damages worldwide.

Under section 1(b) of Executive Order 12866, agencies must, to the extent permitted by law, ''assess both the costs and the benefits of the intended regulation and, recognizing that some costs and benefits are difficult to quantify, propose or adopt a regulation only upon a reasoned determination that the benefits of the intended regulation justify its costs.'' The purpose of the SCC estimates presented here is to allow agencies to incorporate the monetized social benefits of reducing CO_2 emissions into cost-benefit analyses of regulatory actions that have small, or ''marginal,'' impacts on cumulative global emissions. The estimates are presented with an acknowledgement of the many uncertainties involved and with a clear understanding that they should be updated over time to reflect increasing knowledge of the science and economics of climate impacts.

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

a. Monetizing Carbon Dioxide Emissions

When attempting to assess the incremental economic impacts of carbon dioxide emissions, the analyst faces a number of serious challenges. A report from the National Research Council [76]

[76] National Research Council. *Hidden Costs of Energy: Unpriced Consequences of Energy*

points out that any assessment will suffer from uncertainty, speculation, and lack of information about (1) future emissions of GHGs; (2) the effects of past and future emissions on the climate system, (3) the impact of changes in climate on the physical and biological environment, and (4) the translation of these environmental impacts into economic damages. As a result, any effort to quantify and monetize the harms associated with climate change will raise serious questions of science, economics, and ethics and should be viewed as provisional.

Despite the serious limits of both quantification and monetization, SCC estimates can be useful in estimating the social benefits of reducing CO_2 emissions. Most Federal regulatory actions can be expected to have marginal impacts on global emissions. For such policies, the agency can estimate the benefits from reduced (or costs from increased) emissions in any future year by multiplying the change in emissions in that year by the SCC value appropriate for that year. The net present value of the benefits can then be calculated by multiplying each of these future benefits by an appropriate discount factor and summing across all affected years. This approach assumes that the marginal damages from increased emissions are constant for small departures from the baseline emissions path, an approximation that is reasonable for policies that have effects on emissions that are small relative to cumulative global CO_2 emissions. For policies that have a large (non-marginal) impact on global cumulative emissions, there is a separate question of whether the SCC is an appropriate tool for calculating the benefits of reduced emissions. This concern is not applicable to this notice, however.

It is important to emphasize that the interagency process is committed to updating these estimates as the science and economic understanding of climate change and its impacts on society improves over time. In the meantime, the interagency group will continue to explore the issues raised by this analysis and consider public comments as part of the ongoing interagency process.

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

Economic analyses for Federal regulations have used a wide range of values to estimate the benefits associated with reducing CO_2 emissions. The model year 2011 Corporate Average Fuel Economy final rule, the U.S. Department of Transportation (DOT) used both a ''domestic'' SCC value of $2 per metric ton of CO_2 and a ''global'' SCC value of $33 per metric ton of CO_2 for 2007 emission reductions (in 2007$), increasing both values at 2.4 percent per year. DOT also included a sensitivity analysis at $80 per metric ton of CO_2.[77] A 2008 regulation proposed by DOT assumed a domestic SCC value of $7 per metric ton of CO_2 (in 2006$) for 2011 emission reductions (with a range of $0–$14 for sensitivity analysis), also increasing at 2.4 percent per year.[78] [79] A regulation for packaged terminal air conditioners and packaged terminal heat pumps finalized by DOE in 2008 used a domestic SCC range of $0 to $20 per metric ton CO_2 for 2007 emission reductions (in 2007$). 73 FR 58772, 58814 (Oct. 7, 2008) In addition, EPA's 2008 Advance Notice of Proposed Rulemaking on Regulating Greenhouse Gas Emissions Under the Clean Air Act identified what it described as ''very preliminary'' SCC estimates subject to revision. 73 FR 44354 (July 30, 2008). EPA's global mean values were $68 and $40 per metric ton CO_2 for discount rates of approximately 2 percent and 3 percent, respectively (in 2006$ for 2007 emissions).

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

c. Current Approach and Key Assumptions

Since the release of the interim values, the interagency group reconvened on a regular basis to generate improved SCC estimates. Specially, the group considered public comments and further explored the technical literature in relevant fields. The interagency group relied on three integrated assessment models commonly used to estimate the SCC: the FUND, DICE, and PAGE models. These models are frequently cited in the peer-reviewed literature and were used in the last assessment of the Intergovernmental Panel on Climate Change. Each model was given equal weight in the SCC values that were developed.

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

The interagency group selected four sets of SCC values for use in regulatory analyses. Three sets of values are based on the average SCC from the three IAMs, at discount rates of 2.5, 3, and 5 percent. The fourth set, which represents the 95th percentile SCC estimate across all three models at a 3-percent discount rate, was included to represent higher than expected impacts from temperature change further out in the tails of the

Production and Use. 2009. National Academies Press: Washington, DC.

[77] See *Average Fuel Economy Standards Passenger Cars and Light Trucks Model Year 2011,* 74 FR 14196 (March 30, 2009) (Final Rule); Final Environmental Impact Statement Corporate Average Fuel Economy Standards, Passenger Cars and Light Trucks, Model Years 2011–2015 at 3–90 (Oct. 2008) (Available at: *www.nhtsa.gov/fuel-economy*).

[78] See *Average/fuel Economy Standards, Passenger Cars and Light Trucks, Model Years 2011–2015*, 73 FR 24352 (May 2, 1008) (Proposed Rule); Draft Environmental Impact Statement Corporate Average Fuel Economy Standards, Passenger Cars and Light Trucks, Model Years 2011–2015 at 3-58 (June 2008) (Available at *www.nhtsa.gov/fuel-economy*).

[79] See *Average/fuel Economy Standards, Passenger Cars and Light Trucks, Model Years 2011–2015*, 73 FR 24352 (May 2, 1008) (Proposed Rule); Draft Environmental Impact Statement Corporate Average Fuel Economy Standards, Passenger Cars and Light Trucks, Model Years 2011–2015 at 3-58 (June 2008) (Available at *www.nhtsa.gov/fuel-economy*).

SCC distribution. The values grow in real terms over time. Additionally, the interagency group determined that a range of values from 7 percent to 23 percent should be used to adjust the global SCC to calculate domestic effects,[80] although preference is given to consideration of the global benefits of reducing CO_2 emissions. Table IV.10 presents the values in the 2010 interagency group report,[81] which is reproduced in appendix 14A of the NOPR TSD.

TABLE IV.10—ANNUAL SCC VALUES FROM 2010 INTERAGENCY REPORT, 2010–2050

[In 2007 dollars per metric ton]

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

The SCC values used for today's notice were generated using the most recent versions of the three integrated assessment models that have been published in the peer-reviewed literature.[82] Table IV.11 shows the updated sets of SCC estimates in 5-year increments from 2010 to 2050. The full set of annual SCC estimates between 2010 and 2050 is reported in appendix 14A of the TSD. The central value that emerges is the average SCC across models at the 3 percent discount rate. However, for purposes of capturing the uncertainties involved in regulatory impact analysis, the interagency group emphasizes the importance of including all four sets of SCC values.

TABLE IV.11—ANNUAL SCC VALUES FROM 2013 INTERAGENCY REPORT, 2010–2050

[in 2007 dollars per metric ton]

Year	Discount rate			
	5%	3%	2.5%	3%
	Average	Average	Average	95th Percentile
2010	11	33	52	90
2015	12	38	58	109
2020	12	43	65	129
2025	14	48	70	144
2030	16	52	76	159
2035	19	57	81	176
2040	21	62	87	192
2045	24	66	92	206
2050	27	71	98	221

It is important to recognize that a number of key uncertainties remain, and that current SCC estimates should be treated as provisional and revisable since they will evolve with improved scientific and economic understanding. The interagency group also recognizes that the existing models are imperfect and incomplete. The 2009 National Research Council report mentioned above points out that there is tension between the goal of producing quantified estimates of the economic damages from an incremental ton of carbon and the limits of existing efforts to model these effects. There are a number of concerns and problems that should be addressed by the research community, including research programs housed in many of the Federal agencies participating in the interagency process to estimate the SCC. The interagency group intends to periodically review and reconsider those estimates to reflect increasing knowledge of the science and economics of climate impacts, as well as improvements in modeling.

The interagency group intends to periodically review and reconsider those estimates to reflect increasing knowledge of the science and economics of climate impacts, as well as improvements in modeling.

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

[81] *Social Cost of Carbon for Regulatory Impact Analysis Under Executive Order 12866.* Interagency Working Group on Social Cost of Carbon, United States Government, February 2010. *www.whitehouse.gov/sites/default/files/omb/inforeg/for-agencies/Social-Cost-of-Carbon-for-RIA.pdf.*

[82] *Technical Update of the Social Cost of Carbon for Regulatory Impact Analysis Under Executive Order 12866.* Interagency Working Group on Social Cost of Carbon, United States Government. May 2013. *http://www.whitehouse.gov/sites/default/files/omb/inforeg/social_cost_of_carbon_for_ria_2013_update.pdf*

In summary, in considering the potential global benefits resulting from reduced CO_2 emissions, DOE used the values from the 2013 interagency report adjusted to 2012$ using the GDP price deflator. For each of the four sets of SCC values, the values for emissions in 2015 were $12.9, $40.8, $62.2, and $117 per metric ton avoided [83] (values expressed in 2012$). DOE derived values after 2050 using the relevant growth rates for the 2040–2050 period in the interagency update.

DOE multiplied the CO_2 emissions reduction estimated for each year by the SCC value for that year in each of the four cases. To calculate a present value of the stream of monetary values, DOE discounted the values in each of the four cases using the specific discount rate that had been used to obtain the SCC values in each case.

2. Valuation of Other Emissions Reductions

DOE investigated the potential monetary benefit of reduced NO_X emissions from the potential standards it considered. As noted above, DOE has taken into account how new or amended energy conservation standards would reduce NO_X emissions in those 22 States not affected by emissions caps. DOE estimated the monetized value of NO_X emissions reductions resulting from each of the TSLs considered for today's NOPR based on estimates found in the relevant scientific literature. Available estimates suggest a very wide range of monetary values per ton of NO_X from stationary sources, ranging from $468 to $4,809 per ton in 2012$).[84] In accordance with OMB guidance, [85] DOE calculated a range of monetary benefits using each of the economic values for NO_X and real discount rates of 3 percent and 7 percent.

DOE is evaluating appropriate monetization of avoided SO_2 and Hg emissions in energy conservation standards rulemakings. It has not included monetization in the current analysis

P. Regulatory Impact Analysis

DOE prepared a regulatory impact analysis (RIA) for this rulemaking, which is described in chapter 16 of the NOPR TSD. The RIA is subject to review by OIRA in the OMB. The RIA consists of (1) a statement of the problem addressed by this regulation and the mandate for Government action; (2) a description and analysis of policy alternatives to this regulation; (3) a qualitative review of the potential impacts of the alternatives; and (4) the national economic impacts of the proposed standard.

The RIA assesses the effects of feasible policy alternatives to amended commercial refrigeration equipment standards and provides a comparison of the impacts of the alternatives. DOE evaluated the alternatives in terms of their ability to achieve significant energy savings at reasonable cost, and compared them to the effectiveness of the proposed rule.

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

- No new regulatory action
- commercial customer tax credits
- commercial customer rebates
- voluntary energy efficiency targets
- bulk government purchases
- early replacement

DOE qualitatively evaluated each alternative's ability to achieve significant energy savings at reasonable cost and compared it to the effectiveness of the proposed rule. DOE assumed that each alternative policy would induce commercial customers to voluntarily purchase at least some higher efficiency equipment at any of the TSLs. In contrast to a standard at one of the TSLs, the adoption rate of the alternative non-regulatory policy cases may not be 100 percent, which would result in lower energy savings than a standard. The following paragraphs discuss each policy alternative. (See chapter 17 of the NOPR TSD for further details.)

No new regulatory action: The case in which no regulatory action is taken for commercial refrigeration equipment constitutes the base case (or no action) scenario. By definition, no new regulatory action yields zero energy savings and an NPV of zero dollars.

Commercial customer tax credits: Customer tax credits are considered a viable non-regulatory market transformation program. From a customer perspective, the most important difference between rebate and tax credit programs is that a rebate can be obtained quickly, whereas receipt of tax credits is delayed until income taxes are filed or a tax refund is provided by the Internal Revenue Service (IRS). From a societal perspective, tax credits (like rebates) do not change the installed cost of the equipment, but rather transfer a portion of the cost from the customer to taxpayers as a whole. DOE, therefore, assumed that equipment costs in the customer tax credits scenario were identical to the NIA base case. The change in the NES and NPV is a result of the change in the efficiency distributions that results from lowering the prices of higher efficiency equipment.

Commercial customer rebates: Customer rebates cover a portion of the difference in incremental product price between products meeting baseline efficacy levels and those meeting higher efficacy levels, resulting in a higher percentage of customers purchasing more-efficacious models and decreased aggregated energy use compared to the base case. Although the rebate program reduces the total installed cost to the customer, it is financed by tax revenues. Therefore, from a societal perspective, the installed cost at any efficiency level does *not* change with the rebate program; rather, part of the cost is transferred from the customer to taxpayers as a whole. Consequently, DOE assumed that equipment costs in the rebates scenario were identical to the NIA base case. The change in the NES and NPV is a result of the change in the efficiency distributions that results as a consequence of lowering the prices of higher efficiency equipment.

Voluntary energy efficiency targets: While it is possible that voluntary programs for equipment would be effective, DOE lacks a quantitative basis to determine how effective such a program might be. As noted previously, broader economic and social considerations are in play than simple economic return to the equipment purchaser. DOE lacks the data necessary to quantitatively project the degree to which voluntary programs for more expensive, higher efficiency equipment would modify the market.

Bulk government purchases and early replacement incentive programs: DOE also considered, but did not analyze, the potential of bulk government purchases and early replacement incentive programs as alternatives to the proposed standards. Bulk government purchases would have a very limited impact on improving the overall market efficiency of commercial refrigeration equipment because they would be a negligible part of the total equipment sold in the market. In the case of replacement incentives, several policy options exist to promote early replacement, including a direct national program of customer incentives, incentives paid to utilities to promote an early replacement program,

[83] The interagency report presents SCC values through 2050. DOE derived values after 2050 using the 3-percent per year escalation rate used by the interagency group.

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

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

market promotions through equipment manufacturers, and replacement of government-owned equipment. In considering early replacements, DOE estimates that the energy savings realized through a one-time early replacement of existing stock equipment does not result in energy savings commensurate to the cost to administer the program. Consequently, DOE did not analyze this option in detail.

V. Analytical Results

A. Trial Standard Levels

1. Trial Standard Level Formulation Process and Criteria

DOE selected between five and eight efficiency levels for all but three equipment classes for the LCC analysis and NIA; the three exceptions were the HZO.RC.M, HZO.RC.L, and HZO.SC.L equipment classes, which had only two efficiency levels each, including the baseline efficiency levels.[86] For all equipment classes, the first efficiency level is the baseline efficiency level. Based on the results of the LCC analysis and NIA, DOE selected five TSLs above the baseline level for each equipment class for the NOPR stage of this rulemaking. TSL 5 was selected at the max-tech level for all equipment classes. TSL 4 was chosen so as to group the efficiency levels with the highest energy savings combined with a positive customer NPV at a 7-percent discount rate. ''Customer NPV'' is the NPV of future savings obtained from the NIA. It provides a measure of the benefits only to the customers of the commercial refrigeration equipment, and does not account for the net benefits to the Nation. The net benefits to the Nation also include monetized values of emissions reductions in addition to the customer NPV. TSL 3 was chosen to represent the group of efficiency levels with the highest customer NPV at a 7-percent discount rate. While the selection of TSL 4 and TSL 3 were based on customer NPV, the proposed standard levels were selected on the basis of net social benefits. TSL 2 and TSL 1 were selected to provide intermediate efficiency levels that fill the gap between the baseline efficiency level and TSL 3. For the HZO.RC.M, HZO.RC.L, and HZO.SC.L equipment classes, there is only one efficiency level above baseline. While TSL 5 was associated with the max-tech level for these three equipment classes, TSLs 1 through 4 did not have corresponding efficiency levels that satisfied TSL formulation criteria. Therefore, the baseline efficiency level was assigned to TSL 1 through TSL 4 for each of these three equipment classes. Table V.1 shows the mapping between TSLs and efficiency levels.

TABLE V.1—MAPPING BETWEEN TSLS AND EFFICIENCY LEVELS

Equipment class	Baseline	Intermediate level*	Intermediate level**	Max NPV***	Max eff. lvl with pos-NPV†	Max-tech
		TSL 1	TSL 2	TSL 3	TSL 4	TSL 5
VOP.RC.M	Level 1	Level 2	Level 3	Level 4	Level 5	Level 6.
VOP.RC.L	Level 1	Level 2	Level 3	Level 4	Level 4	Level 5.
VOP.SC.M	Level 1	Level 3	Level 4	Level 5	Level 6	Level 7.
VCT.RC.M	Level 1	Level 2	Level 3	Level 4	Level 6	Level 7.
VCT.RC.L	Level 1	Level 3	Level 4	Level 5	Level 5	Level 6.
VCT.SC.M	Level 1	Level 2	Level 3	Level 4	Level 7	Level 8.
VCT.SC.L	Level 1	Level 3	Level 4	Level 5	Level 7	Level 8.
VCT.SC.I	Level 1	Level 3	Level 5	Level 6	Level 6	Level 7.
VCS.SC.M	Level 1	Level 3	Level 5	Level 7	Level 7	Level 8.
VCS.SC.L	Level 1	Level 3	Level 5	Level 6	Level 7	Level 8.
VCS.SC.I	Level 1	Level 3	Level 5	Level 6	Level 6	Level 7.
SVO.RC.M	Level 1	Level 2	Level 3	Level 4	Level 5	Level 6.
SVO.SC.M	Level 1	Level 3	Level 4	Level 5	Level 6	Level 7.
SOC.RC.M	Level 1	Level 2	Level 3	Level 4	Level 6	Level 7.
HZO.RC.M†	Level 1	Level 1	Level 1	Level 1	Level 1	Level 2.
HZO.RC.L†	Level 1	Level 1	Level 1	Level 1	Level 1	Level 2.
HZO.SC.M	Level 1	Level 2	Level 2	Level 3	Level 4	Level 5.
HZO.SC.L†	Level 1	Level 1	Level 1	Level 1	Level 1	Level 2.
HCT.SC.M	Level 1	Level 3	Level 5	Level 6	Level 7	Level 8.
HCT.SC.L	Level 1	Level 3	Level 4	Level 5	Level 7	Level 8.
HCT.SC.I	Level 1	Level 2	Level 3	Level 4	Level 4	Level 5.
HCS.SC.M	Level 1	Level 2	Level 3	Level 4	Level 5	Level 7.
HCS.SC.L	Level 1	Level 4	Level 5	Level 6	Level 6	Level 7.
PD.SC.M	Level 1	Level 2	Level 2	Level 3	Level 7	Level 8.
SOC.SC.M	Level 1	Level 3	Level 4	Level 5	Level 7	Level 8.

''Level'' stands for ''Efficiency Level.''

* TSL 1 was generally chosen as one level below TSL 2, but in some cases an even lower efficiency level was chosen if the Level immediately below TSL 2 had an NPV value that was close to the NPV value of TSL 2.

** TSL 2 was generally chosen as one level below TSL 3, but in some cases an even lower efficiency level was chosen if the Level immediately below TSL 3 had an NPV value that was close to the NPV value of TSL 3.

*** Efficiency level that has the highest NPV at a 7-percent discount rate.

† Highest efficiency level with a positive NPV at a 7-percent discount rate.

‡ TSLs 1 through 4 for equipment classes HZO.RC.M, HZO.RC.L, and HZO.SC.L do not satisfy the criteria for the corresponding TSL selection. See explanation in section V.A.1. TSLs 1 through 4 were assigned to the baseline efficiency level for all three equipment classes.

[86] As explained in section IV.H.1, the baseline efficiency levels for equipment classes HZO.RC.M, HZO. RC.L and HZO.SC.L were set by their respective standards baseline values. The latest amended standards for these equipment classes were specified by the January 2009 final rule. DOE could identify only one design option (vacuum insulated panels) that could increase the efficiency of these equipment classes above the standards baseline. Therefore, apart from the baseline efficiency levels (standard baseline levels), there was only one additional efficiency level for each of these three equipment classes.

2. Trial Standard Level Equations

Because of the equipment size variation within each equipment class and the use of daily energy consumption as the efficiency metric, DOE developed a methodology to express efficiency standards in terms of a normalizing metric. DOE used two normalizing metrics that were used for all equipment classes: (1) Volume (V) and (2) TDA. The use of these two normalization metrics allows for the development of the standard in the form of a linear equation that can be used to represent the entire range of equipment sizes within a given equipment class. DOE retained the respective normalization metric (TDA or volume) previously used in the EPACT 2005 or the January 2009 final rule standards for each covered equipment class. (42 U.S.C. 6313(c)(2)–(3)); 74 FR 1093 (Jan. 9, 2009). Additionally, in its January 2009 final rule, DOE developed offset factors as a method to adjust the energy efficiency requirements for smaller equipment in each equipment class analyzed. These offset factors, which form the y-intercept on a plot of each standard level equation (representing a fictitious case of zero volume or zero TDA), accounted for certain components of the refrigeration load (such as conduction end effects) that remain constant even when equipment sizes vary. These constant loads affect smaller cases disproportionately. The offset factors were intended to approximate these constant loads and provide a fixed end point in an equation that describes the relationship between energy consumption and the corresponding normalization metric. 74 FR 1,118–19 (Jan. 9, 2009). The standard level equations prescribed by EPACT 2005 also contained similar fixed parts not multiplied by the volume metric and which correspond to these offset factors. (42 U.S.C. 6313(c)(2)) In this NOPR, DOE modified the January 2009 final rule (74 FR 1,118–19 (Jan. 9, 2009)) and EPACT 2005 offset factors at each TSL to reflect the proportional changes in energy consumption for each equipment class, as modeled in the engineering analysis. See chapter 5 of the NOPR TSD for further details and discussion of offset factors.

For the equipment classes covered under this rulemaking, the standards equation at each TSL is proposed in the form of MDEC (in kilowatt-hours per day), normalized by a volume (V) or TDA metric, with an offset factor added to that value. These equations take the form:

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

or

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

For equipment classes directly analyzed in the engineering analysis, offset factor *B* was calculated for each class (see chapter 5 of the NOPR TSD for discussion of offset factors). The slope, *A,* was derived based on the offset factor, *B,* and the CDEC of the representative unit modeled in the engineering analysis for that equipment class is presented in Table V.2. The standards equations may be used to prescribe the MDEC for equipment of different sizes within the same equipment class. Chapter 9 of the NOPR TSD explains the methodology used for selecting TSLs and developing the coefficients shown in Table V.3.

TABLE V.2—CDEC VALUES BY TSL FOR REPRESENTATIVE UNITS ANALYZED IN THE ENGINEERING ANALYSIS FOR EACH PRIMARY EQUIPMENT CLASS

Equipment class	CDEC Values by TSL kWh/day				
	TSL 1	TSL 2	TSL 3	TSL 4	TSL 5
VOP.RC.M	46.84	44.33	35.71	35.51	35.06
VOP.RC.L	106.22	101.03	100.51	100.51	98.87
VOP.SC.M	30.03	29.60	26.70	26.62	26.46
VCT.RC.M	15.56	8.10	6.26	5.97	5.49
VCT.RC.L	31.13	30.58	30.29	30.29	28.85
VCT.SC.M	7.56	4.08	3.24	2.97	2.68
VCT.SC.L	13.48	13.30	12.44	12.09	11.57
VCT.SC.I	17.45	16.36	16.14	16.14	15.37
VCS.SC.M	2.36	2.17	1.81	1.81	1.39
VCS.SC.L	7.26	6.75	6.66	6.56	5.71
VCS.SC.I	18.24	17.79	17.64	17.64	16.53
SVO.RC.M	36.11	33.85	27.71	27.57	27.26
SVO.SC.M	25.74	25.36	23.29	23.24	23.12
SOC.RC.M	25.62	24.97	20.43	20.15	19.93
HZO.RC.M	14.43	14.43	14.43	14.43	14.17
HZO.RC.L	33.10	33.10	33.10	33.10	32.22
HZO.SC.M	14.76	14.76	14.60	14.49	14.26
HZO.SC.L	30.12	30.12	30.12	30.12	29.91
HCT.SC.M	1.87	0.84	0.75	0.67	0.49
HCT.SC.L	4.11	1.77	1.70	1.57	1.18
HCT.SC.I	3.22	3.07	2.86	2.86	2.13
HCS.SC.M	0.65	0.60	0.56	0.50	0.25
HCS.SC.L	1.61	1.46	1.27	1.27	0.74
PD.SC.M	3.90	3.90	2.23	1.64	1.42
SOC.SC.M	27.04	26.80	22.02	21.70	21.41

TABLE V.3—EQUATIONS REPRESENTING THE STANDARDS AT EACH TSL FOR ALL PRIMARY EQUIPMENT CLASSES

Equipment class	Trial standard levels for primary equipment classes analyzed					
	Baseline	TSL 1	TSL 2	TSL 3	TSL 4	TSL 5
VCT.RC.L	0.56 × TDA + 2.61	0.45 × TDA + 2.08	0.44 × TDA + 2.05	0.43 × TDA + 2.03	0.43 × TDA + 2.03	0.41 × TDA + 1.93
VOP.RC.M	0.82 × TDA + 4.07	0.8 × TDA + 3.99	0.76 × TDA + 3.78	0.61 × TDA + 3.04	0.61 × TDA + 3.03	0.6 × TDA + 2.99

TABLE V.3—EQUATIONS REPRESENTING THE STANDARDS AT EACH TSL FOR ALL PRIMARY EQUIPMENT CLASSES—Continued

Equipment class	Trial standard levels for primary equipment classes analyzed					
	Baseline	TSL 1	TSL 2	TSL 3	TSL 4	TSL 5
SVO.RC.M	0.83 × TDA + 3.18	0.82 × TDA + 3.16	0.77 × TDA + 2.96	0.63 × TDA + 2.42	0.63 × TDA + 2.41	0.62 × TDA + 2.38
HZO.RC.L	0.57 × TDA + 6.88	0.57 × TDA + 6.88	0.57 × TDA + 6.88	0.57 × TDA + 6.88	0.57 × TDA + 6.88	0.55 × TDA + 6.7
HZO.RC.M	0.35 × TDA + 2.88	0.35 × TDA + 2.88	0.35 × TDA + 2.88	0.35 × TDA + 2.88	0.35 × TDA + 2.88	0.34 × TDA + 2.83
VCT.RC.M	0.22 × TDA + 1.95	0.21 × TDA + 1.87	0.11 × TDA + 0.97	0.08 × TDA + 0.75	0.08 × TDA + 0.72	0.07 × TDA + 0.66
VOP.RC.L	2.27 × TDA + 6.85	2.23 × TDA + 6.72	2.12 × TDA + 6.39	2.11 × TDA + 6.36	2.11 × TDA + 6.36	2.07 × TDA + 6.26
SOC.RC.M	0.51 × TDA + 0.11	0.5 × TDA + 0.11	0.49 × TDA + 0.11	0.4 × TDA + 0.09	0.39 × TDA + 0.08	0.39 × TDA + 0.08
VOP.SC.M	1.74 × TDA + 4.71	1.7 × TDA + 4.61	1.68 × TDA + 4.54	1.51 × TDA + 4.1	1.51 × TDA + 4.09	1.5 × TDA + 4.06
SVO.SC.M	1.73 × TDA + 4.59	1.67 × TDA + 4.42	1.64 × TDA + 4.35	1.51 × TDA + 4.	1.5 × TDA + 3.99	1.5 × TDA + 3.97
HZO.SC.L	1.92 × TDA + 7.08	1.92 × TDA + 7.08	1.92 × TDA + 7.08	1.92 × TDA + 7.08	1.92 × TDA + 7.08	1.91 × TDA + 7.03
HZO.SC.M	0.77 × TDA + 5.55	0.77 × TDA + 5.54	0.77 × TDA + 5.54	0.76 × TDA + 5.48	0.75 × TDA + 5.44	0.74 × TDA + 5.35
HCT.SC.I	0.56 × TDA + 0.43	0.55 × TDA + 0.42	0.52 × TDA + 0.4	0.49 × TDA + 0.37	0.49 × TDA + 0.37	0.36 × TDA + 0.28
VCT.SC.I	0.67 × TDA + 3.29	0.56 × TDA + 2.77	0.53 × TDA + 2.6	0.52 × TDA + 2.56	0.52 × TDA + 2.56	0.5 × TDA + 2.44
VCS.SC.I	0.38 × V + 0.88	0.36 × V + 0.84	0.35 × V + 0.82	0.35 × V + 0.81	0.35 × V + 0.81	0.33 × V + 0.76
VCT.SC.M	0.12 × V + 3.34	0.1 × V + 2.74	0.05 × V + 1.48	0.04 × V + 1.17	0.04 × V + 1.07	0.03 × V + 0.97
VCT.SC.L	0.53 × V + 2.92	0.25 × V + 1.35	0.24 × V + 1.33	0.23 × V + 1.25	0.22 × V + 1.21	0.21 × V + 1.16
VCS.SC.M	0.06 × V + 1.31	0.03 × V + 0.69	0.03 × V + 0.64	0.03 × V + 0.53	0.03 × V + 0.53	0.02 × V + 0.41
VCS.SC.L	0.21 × V + 0.72	0.14 × V + 0.48	0.13 × V + 0.44	0.13 × V + 0.44	0.13 × V + 0.43	0.11 × V + 0.38
HCT.SC.M	0.06 × V + 1.73	0.05 × V + 1.42	0.02 × V + 0.63	0.02 × V + 0.57	0.02 × V + 0.51	0.01 × V + 0.38
HCT.SC.L	0.36 × V + 1.98	0.29 × V + 1.57	0.12 × V + 0.68	0.12 × V + 0.65	0.11 × V + 0.6	0.08 × V + 0.45
HCS.SC.M	0.03 × V + 0.54	0.02 × V + 0.49	0.02 × V + 0.45	0.02 × V + 0.41	0.02 × V + 0.37	0.01 × V + 0.18
HCS.SC.L	0.2 × V + 0.69	0.15 × V + 0.53	0.14 × V + 0.48	0.12 × V + 0.42	0.12 × V + 0.42	0.07 × V + 0.24
PD.SC.M	0.13 × V + 3.51	0.07 × V + 1.98	0.07 × V + 1.98	0.04 × V + 1.13	0.03 × V + 0.83	0.03 × V + 0.72
SOC.SC.M	0.6 × TDA + 1.0	0.4 × TDA + 0.67	0.4 × TDA + 0.66	0.33 × TDA + 0.54	0.32 × TDA + 0.53	0.32 × TDA + 0.53

In addition to the 24 primary equipment classes analyzed, DOE evaluating existing and potentially amended standards for 23 secondary equipment classes of commercial refrigeration equipment covered in this rulemaking that were not directly analyzed in the engineering analysis. DOE's approach to evaluating standards for these secondary equipment classes involves extension multipliers developed using the engineering results for the primary equipment classes analyzed and a set of matched-pair analyses performed during the January 2009 final rule analysis.[87] In addition, DOE believes that standards for certain primary equipment classes can be directly applied to similar secondary equipment classes. Chapter 5 of the NOPR TSD discusses the development of the extension multipliers.

Using the extension multiplier approach, DOE developed an additional set of TSLs and associated equations for the secondary equipment classes, as shown in Table V.4. The TSLs shown in Table V.4 do not necessarily satisfy the criteria spelled out in section V.A. DOE is presenting the standards equations developed for each TSL for all 47 equipment classes to allow interested parties to better review the ramifications of each TSL across the range of equipment sizes on the market.

TABLE V.4—EQUATIONS REPRESENTING THE STANDARDS AT EACH TSL FOR ALL SECONDARY EQUIPMENT CLASSES

Equipment class	Trial standard levels for secondary equipment classes analyzed					
	Baseline	TSL 1	TSL 2	TSL 3	TSL 4	TSL 5
VOP.RC.I	2.89 × TDA + 8.7	2.83 × TDA + 8.54	2.69 × TDA + 8.12	2.68 × TDA + 8.08	2.68 × TDA + 8.08	2.63 × TDA + 7.95
SVO.RC.L	2.27 × TDA + 6.85	2.23 × TDA + 6.72	2.12 × TDA + 6.39	2.11 × TDA + 6.36	2.11 × TDA + 6.36	2.07 × TDA + 6.26
SVO.RC.I	2.89 × TDA + 8.7	2.83 × TDA + 8.54	2.69 × TDA + 8.12	2.68 × TDA + 8.08	2.68 × TDA + 8.08	2.63 × TDA + 7.95
HZO.RC.I	0.72 × TDA + 8.74	0.72 × TDA + 8.74	0.72 × TDA + 8.74	0.72 × TDA + 8.74	0.72 × TDA + 8.74	0.7 × TDA + 8.5
VOP.SC.L	4.37 × TDA + 11.82	4.27 × TDA + 11.57	4.21 × TDA + 11.4	3.8 × TDA + 10.29	3.79 × TDA + 10.26	3.77 × TDA + 10.2
VOP.SC.I	5.55 × TDA + 15.02	5.43 × TDA + 14.69	5.35 × TDA + 14.48	4.83 × TDA + 13.06	4.81 × TDA + 13.03	4.78 × TDA + 12.95
SVO.SC.L	4.34 × TDA + 11.51	4.18 × TDA + 11.09	4.12 × TDA + 10.93	3.78 × TDA + 10.04	3.77 × TDA + 10.01	3.76 × TDA + 9.96
SVO.SC.I	5.52 × TDA + 14.63	5.31 × TDA + 14.09	5.23 × TDA + 13.88	4.8 × TDA + 12.75	4.79 × TDA + 12.72	4.77 × TDA + 12.65
HZO.SC.I	2.44 × TDA + 9.0	2.44 × TDA + 9.0	2.44 × TDA + 9.0	2.44 × TDA + 9.0	2.44 × TDA + 9.0	2.42 × TDA + 8.93
SOC.RC.L	1.08 × TDA + 0.22	1.05 × TDA + 0.23	1.02 × TDA + 0.22	0.84 × TDA + 0.18	0.83 × TDA + 0.18	0.82 × TDA + 0.18
SOC.RC.I	1.26 × TDA + 0.26	1.23 × TDA + 0.27	1.2 × TDA + 0.26	0.98 × TDA + 0.21	0.97 × TDA + 0.21	0.96 × TDA + 0.21
SOC.SC.I	1.76 × TDA + 0.36	1.72 × TDA + 0.37	1.68 × TDA + 0.36	1.37 × TDA + 0.3	1.35 × TDA + 0.29	1.34 × TDA + 0.29
VCT.RC.I	0.66 × TDA + 3.05	0.52 × TDA + 2.44	0.51 × TDA + 2.39	0.51 × TDA + 2.37	0.51 × TDA + 2.37	0.48 × TDA + 2.26
HCT.RC.M	0.16 × TDA + 0.13	0.16 × TDA + 0.12	0.15 × TDA + 0.12	0.14 × TDA + 0.11	0.14 × TDA + 0.11	0.1 × TDA + 0.08
HCT.RC.L	0.34 × TDA + 0.26	0.33 × TDA + 0.26	0.32 × TDA + 0.24	0.3 × TDA + 0.23	0.3 × TDA + 0.23	0.22 × TDA + 0.17
HCT.RC.I	0.4 × TDA + 0.31	0.39 × TDA + 0.3	0.37 × TDA + 0.29	0.35 × TDA + 0.27	0.35 × TDA + 0.27	0.26 × TDA + 0.2
VCS.RC.M	0.11 × V + 0.26	0.11 × V + 0.24	0.1 × V + 0.24	0.1 × V + 0.24	0.1 × V + 0.24	0.1 × V + 0.22
VCS.RC.L	0.23 × V + 0.54	0.22 × V + 0.51	0.22 × V + 0.5	0.21 × V + 0.5	0.21 × V + 0.5	0.2 × V + 0.46
VCS.RC.I	0.27 × V + 0.63	0.26 × V + 0.6	0.25 × V + 0.58	0.25 × V + 0.58	0.25 × V + 0.58	0.23 × V + 0.54
HCS.SC.I	0.38 × V + 0.88	0.36 × V + 0.84	0.35 × V + 0.82	0.35 × V + 0.81	0.35 × V + 0.81	0.33 × V + 0.76
HCS.RC.M	0.11 × V + 0.26	0.11 × V + 0.24	0.1 × V + 0.24	0.1 × V + 0.24	0.1 × V + 0.24	0.1 × V + 0.22
HCS.RC.L	0.23 × V + 0.54	0.22 × V + 0.51	0.22 × V + 0.5	0.21 × V + 0.5	0.21 × V + 0.5	0.2 × V + 0.46
HCS.RC.I	0.27 × V + 0.63	0.26 × V + 0.6	0.25 × V + 0.58	0.25 × V + 0.58	0.25 × V + 0.58	0.23 × V + 0.54

[87] The matched-pair analyses compared calculated energy consumption levels for pieces of equipment with similar designs but one major construction or operational difference; for example, vertical open remote condensing cases operating at medium and low temperatures. The relationships between these sets of units were used to determine the effect of the design or operational difference on applicable equipment. For more information, please see chapter 5 of the 2009 final rule TSD, which can be found at *http://www.regulations.gov/#!documentDetail;D=EERE-2006-STD-0126-0058*.

TABLE V.4—EQUATIONS REPRESENTING THE STANDARDS AT EACH TSL FOR ALL SECONDARY EQUIPMENT CLASSES—Continued

Equipment class	Trial standard levels for secondary equipment classes analyzed					
	Baseline	TSL 1	TSL 2	TSL 3	TSL 4	TSL 5
SOC.SC.L* ..	0.75 × V + 4.10	0.84 × TDA + 1.4	0.83 × TDA + 1.39	0.68 × TDA + 1.14	0.67 × TDA + 1.12	0.66 × TDA + 1.11

* Equipment class SOC.SC.L was inadvertently grouped under the category self-contained commercial freezers with transparent doors in the standards prescribed by EPCA, as amended by EPACT 2005. (42 U.S.C. 6313(c)(2)) The baseline expression is thus given by the expression 0.75 × V + 4.10, which is the current standard for SOC.SC.L equipment. A similar anomaly (of inadvertent classification under a different equipment category) for SOC.SC.M equipment was corrected by the standard established by AEMTCA (see section IV.C.1.d for a detailed discussion). (42 U.S.C. 6313(c)(4)) However, no such corrective action has been prescribed for standards for SOC.SC.L equipment. In establishing a new standard for SOC.SC.M equipment, AEMTCA also changed the normalization metric from volume (V) to total display area (TDA). Accordingly, DOE is proposing the amended standards for SOC.SC.M equipment with TDA as the normalization metric (see Table V.3), DOE derives the proposed standards for secondary equipment classes based on the proposed standard of a primary equipment that has similar characteristics as the secondary equipment class under consideration (see chapter 5 of the NOPR TSD for details). For the equipment class SOC.SC.L, the proposed standards were derived from the proposed standards for equipment class SOC.SC.M. Since the proposed standards for SOC.SC.M are in terms of TDA, the proposed standards for SOC.SC.L equipment have also been specified in terms of TDA. Therefore, while the baseline expression has been shown with V as the normalization metric, the expressions for TSLs 1 through 5 have been shown in terms of TDA. This change of normalization metric for equipment class SOC.SC.L is consistent with the legislative intent, evident in AEMTCA, for equipment class SOC.SC.M.

B. Economic Justification and Energy Savings

1. Economic Impacts on Commercial Customers

a. Life-Cycle Cost and Payback Period

Customers affected by new or amended standards usually incur higher purchase prices and lower operating costs. DOE evaluates these impacts on individual customers by calculating the LCC and the PBP associated with the TSLs. The results of the LCC analysis for each TSL were obtained by comparing the installed and operating costs of the equipment in the base-case scenario (scenario with no amended energy conservation standards) against the standards-case scenarios at each TSL. The energy consumption values for both the base-case and standards-case scenarios were calculated based on the DOE test procedure conditions specified in the 2012 test procedure final rule. 77 FR 10292, 10318–21 (Feb 21, 2012) The DOE test procedure adopted an industry-accepted test method and has been widely accepted as a reasonably accurate representation of the conditions to which a vast majority of the equipment covered in this rulemaking is subjected during actual use. Using the approach described in section IV.H, DOE calculated the LCC savings and PBPs for the TSLs considered in this NOPR. The LCC analysis was carried out in the form of Monte Carlo simulations. Consequently, the results of LCC analysis are distributed over a range of values, as opposed to a single deterministic value. DOE presents the mean or median values, as appropriate, calculated from the distributions of results.

Table V.5 through Table V.29 show the results of LCC analysis for each equipment class. Each table presents the important results of the LCC analysis, including mean LCC, mean LCC savings, median PBP, and distribution of customer impacts in the form of percentages of customers who experience net cost, no impact, or net benefit.

All of the equipment classes have negative LCC savings values at TSL 5. Negative average LCC savings imply that, on average, customers experience an increase in LCC of the equipment as a consequence of buying equipment associated with that particular TSL. TSL 5 is associated with the max-tech level for all the equipment classes. Vacuum insulated panel technology is the design option associated with the max-tech efficiency levels for all equipment classes. The cost increments associated with vacuum insulated panels are considerably high, and the increase in LCC indicates that this design option may not be economically justified.

The mean LCC savings associated with TSL 4 are all either positive values or zero (in the case of equipment classes HZO.RC.M, HZO.RC.L, and HZO.SC.L) for all equipment classes, and the non-zero values range from $9 to $1,494. The mean LCC savings at all lower TSL levels are also positive. This implies that, on average, all the equipment classes show either no change in LCC or a decrease in LCC for TSL 1 through TSL 4. A comparison of LCC savings between TSL 4 and TSL 3, across all equipment classes, shows that the LCC savings associated with TSL 3 are either greater than or equal to the LCC savings associated with TSL 4. LCC savings are equal in cases in which both TSLs are associated with the same efficiency level.

As described in section IV.I.2, DOE used a ''roll-up'' scenario in this rulemaking. Under the roll-up scenario, DOE assumes that the market shares of the efficiency levels (in the base case) that do not meet the standard level under consideration would be ''rolled up'' into (meaning ''added to'') the market share of the efficiency level at the standard level under consideration, and the market shares of efficiency levels that are above the standard level under consideration would remain unaffected. Customers, in the base-case scenario, who buy the equipment at or above the TSL under consideration would be unaffected if the amended standard were to be set at that TSL. Customers, in the base-case scenario, who buy equipment below the TSL under consideration would be affected if the amended standard were to be set at that TSL. Among these affected customers, some may benefit from lower LCC of the equipment and some may incur net cost due to higher LCC, depending on the inputs to LCC analysis such as electricity prices, discount rates and markups. DOE's results clearly indicate that only a small percentage of customers may benefit from an amended standard that is set at TSL 5. At TSL 4, the percentage of customers who experience net benefits or no impacts ranges from 59 to 100 percent. At TSL 3, a larger percentage of customers experience net benefits or no impacts as compared to TSL 4. At TSLs 1 and 2, almost all customers experience either net benefits or no impacts.

For most of the equipment classes, the median PBPs for TSL 5 are greater than the average lifetime of the equipment, indicating that a majority of customers may not be able to recover the higher equipment installed costs through savings in operating costs throughout the life of the equipment. The median PBP values for TSL 4 range from 0.96 years to 6.40 years. The average lifetime of a majority of the commercial refrigeration equipment under consideration is 10 years. Therefore, PBP results for TSL 4 indicate that, in general, the majority of customers will be able to recover the increased purchase costs associated with equipment that is compliant with TSL 4 through operating cost savings within the lifetime of the equipment.

TABLE V.5—SUMMARY LCC AND PBP RESULTS FOR VOP.RC.M EQUIPMENT CLASS*

TSL	Annual energy consumption kWh/yr	Life-cycle cost, all customers 2012$			Life-cycle cost savings				Median payback period, years
		Installed cost	Discounted operating cost	LCC	Affected customers' average savings 2012$	% of Customers that experience**			
						Net cost	No impact	Net benefit	
1	17,095	9,490	20,618	30,108	236	0	76	24	1.73
2	16,180	9,633	19,849	29,482	743	0	52	48	1.77
3	13,033	10,823	17,364	28,187	1,789	0	28	72	3.77
4	12,962	10,898	17,303	28,201	1,494	11	15	74	3.91
5	12,798	14,006	17,162	31,168	(1,669)	90	2	8	11.76

* Values in parentheses are negative values.
** Percentages may not add up to 100 percent due to rounding.

TABLE V.6—SUMMARY LCC AND PBP RESULTS FOR VOP.RC.L EQUIPMENT CLASS*

TSL	Annual energy consumption kWh/yr	Life-cycle cost, all customers 2012$			Life-cycle cost savings				Median payback period, years
		Installed cost	Discounted operating cost	LCC	Affected customers' average savings 2012$	% of Customers that experience**			
						Net cost	No impact	Net benefit	
1	38,770	10,099	39,184	49,282	537	0	74	26	1.11
2	36,877	10,511	37,520	48,031	1,517	0	48	52	2.03
3	36,685	10,594	37,356	47,950	1,130	0	25	75	2.22
4	36,685	10,594	37,356	47,950	1,130	0	25	75	2.22
5	36,088	15,667	36,847	52,513	(3,693)	98	2	0	18.30

* Values in parentheses are negative values.
** Percentages may not add up to 100 percent due to rounding.

TABLE V.7—SUMMARY LCC AND PBP RESULTS FOR VOP.SC.M EQUIPMENT CLASS*

TSL	Annual energy consumption kWh/yr	Life-cycle cost, all customers 2012$			Life-cycle cost savings				Median payback period, years
		Installed cost	Discounted operating cost	LCC	Affected customers' average savings 2012$	% of Customers that experience**			
						Net cost	No impact	Net benefit	
1	10,960	4,650	15,471	20,120	171	0	62	38	1.61
2	10,804	4,693	15,314	20,008	227	0	43	57	2.17
3	9,747	5,183	14,180	19,364	815	0	25	75	4.12
4	9,718	5,234	14,147	19,381	691	11	14	75	4.39
5	9,660	6,293	14,079	20,373	(377)	77	3	20	11.37

* Values in parentheses are negative values.
** Percentages may not add up to 100 percent due to rounding.

TABLE V.8—SUMMARY LCC AND PBP RESULTS FOR VCT.RC.M EQUIPMENT CLASS*

TSL	Annual energy consumption kWh/yr	Life-cycle cost, all customers 2012$			Life-cycle cost savings				Median payback period, years
		Installed cost	Discounted Operating Cost	LCC	Affected customers' average savings 2012$	% of Customers that Experience**			
						Net cost	No impact	Net benefit	
1	5,679	12,070	11,800	23,870	175	0	81	19	1.23
2	2,955	12,669	9,411	22,081	1,864	0	62	38	2.42
3	2,285	12,819	8,809	21,629	1,759	0	46	54	2.43
4	2,177	12,929	8,715	21,644	1,108	26	16	57	2.70
5	2,005	16,537	8,560	25,097	(2,509)	94	2	4	13.09

* Values in parentheses are negative values.
** Percentages may not add up to 100 percent due to rounding.

TABLE V.9—SUMMARY LCC AND PBP RESULTS FOR VCT.RC.L EQUIPMENT CLASS*

TSL	Annual energy consumption kWh/yr	Life-cycle cost, all customers 2012$			Life-cycle cost savings				Median payback period, years
		Installed cost	Discounted operating cost	LCC	Affected customers' average savings 2012$	% of Customers that experience**			
						Net cost	No impact	Net benefit	
1	11,362	13,756	17,581	31,337	1,357	0	60	40	1.30
2	11,161	13,836	17,401	31,237	1,005	0	40	60	1.51
3	11,056	13,887	17,311	31,198	798	0	21	79	1.64
4	11,056	13,887	17,311	31,198	798	0	21	79	1.64
5	10,531	18,626	16,840	35,466	(3,624)	97	2	1	15.75

* Values in parentheses are negative values.
** Percentages may not add up to 100 percent due to rounding.

TABLE V.10—SUMMARY LCC AND PBP RESULTS FOR VCT.SC.M EQUIPMENT CLASS*

TSL	Annual energy consumption kWh/yr	Life-cycle cost, all customers 2012$			Life-cycle cost savings				Median payback period, years
		Installed cost	Discounted operating cost	LCC	Affected customers' average savings 2012$	% of Customers that experience**			
						Net cost	No impact	Net benefit	
1	2,758	4,594	5,261	9,855	566	0	83	17	0.86
2	1,488	4,849	3,916	8,764	1,364	0	66	34	1.73
3	1,182	4,999	3,583	8,582	1,122	0	51	49	2.21
4	1,082	5,088	3,489	8,578	641	27	13	60	2.54
5	979	6,362	3,377	9,739	(596)	74	2	24	8.13

* Values in parentheses are negative values.
** Percentages may not add up to 100 percent due to rounding.

TABLE V.11—SUMMARY LCC AND PBP RESULTS FOR VCT.SC.L EQUIPMENT CLASS

TSL	Annual energy consumption kWh/yr	Life-cycle cost, all customers 2012$			Life-cycle cost savings				Median payback period years
		Installed cost	Discounted operating cost	LCC	Affected customers' average savings 2012$	% of Customers that experience			
						Net cost	No impact	Net benefit	
1	4,921	6,101	8,222	14,323	4,186	0	76	24	0.58
2	4,853	6,120	8,150	14,270	2,523	0	60	40	0.61
3	4,541	6,271	7,811	14,082	1,984	0	44	56	0.83
4	4,411	6,364	7,692	14,056	1,343	7	15	78	0.96
5	4,222	8,077	7,486	15,562	(343)	74	2	24	3.65

* Values in parentheses are negative values.
** Percentages may not add up to 100 percent due to rounding.

TABLE V.12—SUMMARY LCC AND PBP RESULTS FOR VCT.SC.I EQUIPMENT CLASS*

TSL	Annual energy consumption kWh/yr	Life-cycle cost, all customers 2012$			Life-cycle cost savings				Median payback period years
		Installed cost	Discounted operating cost	LCC	Affected customers' average savings 2012$	% of Customers that experience			
						Net cost	No impact	Net benefit	
1	6,370	6,383	10,160	16,543	572	0	65	35	0.86
2	5,972	6,558	9,733	16,292	486	1	32	68	1.74
3	5,891	6,612	9,644	16,256	432	1	16	83	1.97
4	5,891	6,612	9,644	16,256	432	1	16	83	1.97
5	5,609	8,883	9,332	18,215	(1,592)	95	1	3	13.21

* Values in parentheses are negative values.
** Percentages may not add up to 100 percent due to rounding.

TABLE V.13—SUMMARY LCC AND PBP RESULTS FOR VCS.SC.M EQUIPMENT CLASS*

TSL	Annual energy consumption kWh/yr	Life-cycle cost, all customers 2012$			Life-cycle cost savings				Median payback period years
		Installed cost	Discounted operating cost	LCC	Affected customers' average savings 2012$	% of Customers that experience			
						Net cost	No impact	Net benefit	
1	863	3,386	2,122	5,508	279	0	72	28	0.78
2	793	3,406	2,070	5,476	163	0	42	58	0.98
3	659	3,484	1,967	5,451	132	7	13	80	1.75
4	659	3,484	1,967	5,451	132	7	13	80	1.75
5	507	4,771	1,837	6,608	(1,042)	99	1	0	14.11

* Values in parentheses are negative values.
** Percentages may not add up to 100 percent due to rounding.

TABLE V.14—SUMMARY LCC AND PBP RESULTS FOR VCS.SC.L EQUIPMENT CLASS*

TSL	Annual energy consumption kWh/yr	Life-cycle cost, all customers 2012$			Life-cycle cost savings				Median payback period years
		Installed cost	Discounted operating cost	LCC	Affected customers' average savings 2012$	% of Customers that experience			
						Net cost	No impact	Net benefit	
1	2,649	3,673	3,829	7,501	525	0	73	27	0.55
2	2,463	3,735	3,671	7,405	329	0	42	58	0.91
3	2,432	3,751	3,651	7,402	268	5	28	68	1.00
4	2,394	3,776	3,630	7,405	221	20	14	66	1.15
5	2,084	5,505	3,366	8,871	(1,274)	97	1	2	10.54

* Values in parentheses are negative values.
** Percentages may not add up to 100 percent due to rounding.

TABLE V.15—SUMMARY LCC AND PBP RESULTS FOR VCS.SC.I EQUIPMENT CLASS*

TSL	Annual energy consumption kWh/yr	Life-cycle cost, all customers 2012$			Life-cycle cost savings				Median payback period years
		Installed cost	Discounted operating cost	LCC	Affected customers' average savings 2012$	% of Customers that experience			
						Net cost	No impact	Net benefit	
1	6,657	4,148	7,526	11,674	237	0	67	33	0.80
2	6,492	4,218	7,392	11,610	177	0	32	68	2.07
3	6,438	4,243	7,357	11,600	153	3	16	81	2.42
4	6,438	4,243	7,357	11,600	153	3	16	81	2.42
5	6,034	6,535	7,013	13,548	(1,819)	99	1	0	27.19

* Values in parentheses are negative values.
** Percentages may not add up to 100 percent due to rounding.

TABLE V.16—SUMMARY LCC AND PBP RESULTS FOR SVO.RC.M EQUIPMENT CLASS*

TSL	Annual energy consumption kWh/yr	Life-cycle cost, all customers 2012$			Life-cycle cost savings				Median payback period years
		Installed cost	Discounted operating cost	LCC	Affected customers' average savings 2012$	% of Customers that experience			
						Net cost	No impact	Net benefit	
1	13,179	8,341	16,821	25,161	74	0	75	25	1.31
2	12,355	8,547	16,098	24,645	552	0	51	49	2.64
3	10,114	9,455	14,347	23,802	1,217	0	29	71	4.34
4	10,065	9,517	14,304	23,821	1,008	13	16	72	4.50
5	9,949	11,511	14,202	25,713	(1,015)	85	3	12	11.60

* Values in parentheses are negative values.
** Percentages may not add up to 100 percent due to rounding.

TABLE V.17—SUMMARY LCC AND PBP RESULTS FOR SVO.SC.M EQUIPMENT CLASS*

TSL	Annual energy consumption kWh/yr	Life-cycle cost, all customers 2012$			Life-cycle cost savings				Median payback period years
		Installed cost	Discounted operating cost	LCC	Affected customers' average savings 2012$	% of Customers that experience			
						Net cost	No impact	Net benefit	
9,396	3,885	12,744	16,629	324	0	61	39	1.97	9,396
9,255	3,914	12,600	16,514	335	0	43	57	2.06	9,255
8,501	4,314	11,866	16,180	588	0	25	75	4.43	8,501
8,481	4,359	11,843	16,202	492	12	14	75	4.75	8,481
8,439	5,049	11,796	16,844	(202)	69	4	27	10.36	8,439

* Values in parentheses are negative values.
** Percentages may not add up to 100 percent due to rounding.

TABLE V.18—SUMMARY LCC AND PBP RESULTS FOR SOC.RC.M EQUIPMENT CLASS*

TSL	Annual energy consumption kWh/yr	Life-cycle cost, all customers 2012$			Life-cycle cost savings				Median payback period years
		Installed cost	Discounted operating cost	LCC	Affected customers' average savings 2012$	% of Customers that experience**			
						Net cost	No impact	Net benefit	
1	9,353	12,766	15,106	27,872	118	0	82	18	1.25
2	9,115	12,799	14,906	27,704	226	0	64	36	1.44
3	7,455	13,343	13,511	26,854	998	0	47	53	3.31
4	7,356	13,570	13,443	27,012	495	29	18	53	4.41
5	7,274	15,050	13,372	28,423	(982)	89	5	6	11.88

* Values in parentheses are negative values.
** Percentages may not add up to 100 percent due to rounding.

TABLE V.19—SUMMARY LCC AND PBP RESULTS FOR HZO.RC.M EQUIPMENT CLASS*

TSL	Annual energy consumption kWh/yr	Life-cycle cost, all customers 2012$			Life-cycle cost savings				Median payback period years
		Installed cost	Discounted operating cost	LCC	Affected customers' average savings 2012$	% of Customers that experience			
						Net cost	No impact	Net benefit	
1	5,267	8,056	8,916	16,972	NA	NA	NA	NA	NA
2	5,267	8,056	8,916	16,972	NA	NA	NA	NA	NA
3	5,267	8,056	8,916	16,972	NA	NA	NA	NA	NA
4	5,267	8,056	8,916	16,972	NA	NA	NA	NA	NA
5	5,173	9,406	8,837	18,243	(1,271)	78	22	0	161.23

"NA" stands for not applicable. TSLs 1 through 4 are at the baseline efficiency level. Therefore, the LCC savings, distribution of customer impacts and PBP are shown as "NA."

* Values in parentheses are negative values.
** Percentages may not add up to 100 percent due to rounding.

TABLE V.20—SUMMARY LCC AND PBP RESULTS FOR HZO.RC.L EQUIPMENT CLASS*

TSL	Annual energy consumption kWh/yr	Life-cycle cost, all customers 2012$			Life-cycle cost savings				Median payback period years
		Installed cost	Discounted operating cost	LCC	Affected customers' average savings 2012$	% of Customers that experience			
						Net cost	No impact	Net benefit	
1	12,082	8,895	14,989	23,884	NA	NA	NA	NA	NA
2	12,082	8,895	14,989	23,884	NA	NA	NA	NA	NA
3	12,082	8,895	14,989	23,884	NA	NA	NA	NA	NA
4	12,082	8,895	14,989	23,884	NA	NA	NA	NA	NA
5	11,759	11,301	14,718	26,019	(2,135)	86	14	0	83.78

"NA" stands for not applicable. TSLs 1 through 4 are at the baseline efficiency level. Therefore, the LCC savings, distribution of customer impacts and PBP are shown as "NA."
* Values in parentheses are negative values.
** Percentages may not add up to 100 percent due to rounding.

TABLE V.21—SUMMARY LCC AND PBP RESULTS FOR HZO.SC.M EQUIPMENT CLASS*

TSL	Annual energy consumption kWh/yr	Life-cycle cost, all customers 2012$			Life-cycle cost savings				Median payback period years
		Installed cost	Discounted operating cost	LCC	Affected customers' average savings 2012$	% of Customers that experience			
						Net cost	No impact	Net benefit	
1	5,388	2,343	7,055	9,399	9	0	75	25	1.89
2	5,388	2,343	7,055	9,399	9	0	75	25	1.89
3	5,330	2,356	6,999	9,354	49	0	49	51	2.42
4	5,289	2,405	6,954	9,358	29	19	24	57	6.40
5	5,206	3,340	6,862	10,202	(822)	98	2	0	55.78

* Values in parentheses are negative values.
** Percentages may not add up to 100 percent due to rounding.

TABLE V.22—SUMMARY LCC AND PBP RESULTS FOR HZO.SC.L EQUIPMENT CLASS*

TSL	Annual energy consumption kWh/yr	Life-cycle cost, all customers 2012$			Life-cycle cost savings				Median payback period years
		Installed cost	Discounted operating cost	LCC	Affected customers' average savings 2012$	% of Customers that experience			
						Net cost	No impact	Net benefit	
1	10,994	3,691	13,891	17,582	NA	NA	NA	NA	NA
2	10,994	3,691	13,891	17,582	NA	NA	NA	NA	NA
3	10,994	3,691	13,891	17,582	NA	NA	NA	NA	NA
4	10,994	3,691	13,891	17,582	NA	NA	NA	NA	NA
5	10,916	4,251	13,804	18,056	(474)	72	28	0	73.62

"NA" stands for not applicable. TSLs 1 through 4 are at the baseline efficiency level. Therefore, the LCC savings, distribution of customer impacts and PBP are shown as "NA."
* Values in parentheses are negative values.
** Percentages may not add up to 100 percent due to rounding.

TABLE V.23—SUMMARY LCC AND PBP RESULTS FOR HCT.SC.M EQUIPMENT CLASS*

TSL	Annual energy consumption kWh/yr	Life-cycle cost, all customers 2012$			Life-cycle cost savings				Median payback period years
		Installed cost	Discounted operating cost	LCC	Affected customers' average savings 2012$	% of Customers that experience			
						Net cost	No impact	Net benefit	
1	683	2,057	1,685	3,742	107	0	70	30	0.69
2	305	2,161	1,263	3,423	359	0	38	62	2.24
3	275	2,175	1,236	3,411	307	0	25	75	2.42
4	244	2,220	1,200	3,420	254	18	12	70	3.08
5	181	2,812	1,127	3,939	(294)	89	1	10	12.26

* Values in parentheses are negative values.
** Percentages may not add up to 100 percent due to rounding.

TABLE V.24—SUMMARY LCC AND PBP RESULTS FOR HCT.SC.L EQUIPMENT CLASS*

TSL	Annual energy consumption kWh/yr	Life-cycle cost, all customers 2012$			Life-cycle cost savings				Median payback period years
		Installed cost	Discounted operating cost	LCC	Affected customers' average savings 2012$	% of Customers that experience**			
						Net cost	No impact	Net benefit	
1	1,499	2,240	2,336	4,576	217	0	75	26	0.53

TABLE V.24—SUMMARY LCC AND PBP RESULTS FOR HCT.SC.L EQUIPMENT CLASS*—Continued

TSL	Annual energy consumption kWh/yr	Life-cycle cost, all customers 2012$			Life-cycle cost savings				Median payback period years
		Installed cost	Discounted operating cost	LCC	Affected customers' average savings 2012$	% of Customers that experience**			
						Net cost	No impact	Net benefit	
2	667	2,337	1,589	3,926	791	0	61	39	1.00
3	647	2,344	1,574	3,918	571	0	45	55	1.05
4	572	2,403	1,513	3,916	369	23	14	63	1.47
5	432	3,204	1,385	4,590	(355)	76	1	23	7.15

* Values in parentheses are negative values.
** Percentages may not add up to 100 percent due to rounding.

TABLE V.25—SUMMARY LCC AND PBP RESULTS FOR HCT.SC.I EQUIPMENT CLASS*

TSL	Annual energy consumption kWh/yr	Life-cycle cost, all customers 2012$			Life-cycle cost savings				Median payback period years
		Installed cost	Discounted operating cost	LCC	Affected customers' average savings 2012$	% of Customers that experience**			
						Net cost	No impact	Net benefit	
1	1,174	2,331	1,991	4,322	22	0	74	26	0.88
2	1,121	2,346	1,953	4,299	35	0	49	51	2.39
3	1,045	2,391	1,889	4,279	42	2	23	75	4.28
4	1,045	2,391	1,889	4,279	42	2	23	75	4.28
5	776	3,461	1,663	5,124	(811)	99	1	0	27.99

* Values in parentheses are negative values.
** Percentages may not add up to 100 percent due to rounding.

TABLE V.26—SUMMARY LCC AND PBP RESULTS FOR HCS.SC.M EQUIPMENT CLASS*

TSL	Annual energy consumption kWh/yr	Life-cycle cost, all customers 2012$			Life-cycle cost savings				Median payback period years
		Installed cost	Discounted operating cost	LCC	Affected customers' average savings 2012$	% of Customers that experience**			
						Net cost	No impact	Net benefit	
1	238	1,951	972	2,924	23	0	83	17	0.50
2	220	1,957	959	2,916	19	0	65	35	1.64
3	203	1,964	948	2,912	17	1	48	51	2.54
4	183	1,979	937	2,916	9	29	31	40	4.28
5	90	2,490	857	3,347	(423)	98	2	0	34.05

* Values in parentheses are negative values.
** Percentages may not add up to 100 percent due to rounding.

TABLE V.27—SUMMARY LCC AND PBP RESULTS FOR HCS.SC.L EQUIPMENT CLASS*

TSL	Annual energy consumption kWh/yr	Life-cycle cost, all customers 2012$			Life-cycle cost savings				Median payback period years
		Installed cost	Discounted operating cost	LCC	Affected customers' average savings 2012$	% of Customers that experience**			
						Net cost	No impact	Net benefit	
1	588	1,988	1,284	3,272	75	0	50	50	0.86
2	534	2,003	1,244	3,246	81	0	33	67	1.36
3	464	2,046	1,184	3,231	81	2	16	82	2.57
4	464	2,046	1,184	3,231	81	2	16	82	2.57
5	271	2,681	1,020	3,700	(401)	98	2	0	14.98

* Values in parentheses are negative values.
** Percentages may not add up to 100 percent due to rounding.

TABLE V.28—SUMMARY LCC AND PBP RESULTS FOR PD.SC.M EQUIPMENT CLASS*

TSL	Annual energy consumption kWh/yr	Life-cycle cost, all customers 2012$			Life-cycle cost savings				Median payback period years
		Installed cost	Discounted operating cost	LCC	Affected customers' average savings 2012$	% of Customers that experience			
						Net cost	No impact	Net benefit	
1	1,423	3,002	2,926	5,927	1,010	0	86	14	0.53
2	1,423	3,002	2,926	5,927	1,010	0	86	14	0.53
3	815	3,121	2,322	5,444	934	0	69	31	1.10
4	597	3,348	2,112	5,460	310	41	11	48	2.27
5	517	4,347	2,031	6,379	(638)	86	1	13	7.61

* Values in parentheses are negative values.
** Percentages may not add up to 100 percent due to rounding.

TABLE V.29—SUMMARY LCC AND PBP RESULTS FOR SOC.SC.M EQUIPMENT CLASS*

TSL	Annual energy consumption kWh/yr	Life-cycle cost, all customers 2012$			Life-cycle cost savings				Median payback period years
		Installed cost	Discounted operating cost	LCC	Affected customers' average savings 2012$	% of customers that experience			
						Net cost	No impact	Net benefit	
1	9,869	12,314	14,364	26,678	646	0	70	30	1.12
2	9,783	12,339	14,301	26,640	466	0	55	45	1.24
3	8,039	12,883	12,863	25,747	1,242	0	40	60	2.35
4	7,920	13,110	12,777	25,887	740	25	16	60	2.99
5	7,814	14,591	12,687	27,277	(735)	80	5	16	7.42

* Values in parentheses are negative values.
** Percentages may not add up to 100 percent due to rounding.

b. Life-Cycle Cost Subgroup Analysis

As described in section IV.J, DOE estimated the impact of potential amended efficiency standards for commercial refrigeration equipment, at each TSL, on two customer subgroups, one belonging to the foodservice sector and one to the food-retail sector. For the small business segment in the foodservice sector, full-service restaurants were chosen as the representative subgroup, and for the food-retail sector, convenience stores with gas stations were chosen as the representative subgroup. DOE carried out two LCC subgroup analyses by using the LCC spreadsheet described in chapter 8 of the NOPR TSD, but with certain modifications. The input for business type was fixed to the identified subgroup, which ensured that the discount rates and electricity price rates associated with only that subgroup were selected in the Monte Carlo simulations (see chapter 8 of the NOPR TSD). The discount rate was further increased by applying the small firm premium to the WACC (See Table IV.9 for details). Another major modification to the LCC analysis was an added assumption that the subgroups do not have access to national accounts, which results in higher distribution channel markups for the subgroups, leading to higher equipment purchase prices. Apart from these changes, all other inputs for LCC subgroup analysis are same as those in the LCC analysis described in chapter 8 of the NOPR TSD.

The results for the small business subgroup in the foodservice sector (Table V.30, Table V.31, and Table V.32) are presented only for the self-contained equipment classes because full-service restaurants that are small businesses generally do not use remote condensing equipment. Table V.30 presents the comparison of mean LCC savings for the small business subgroup in foodservice sector (full-service restaurants) with the national average values (LCC savings results from chapter 8 of the NOPR TSD). For all TSLs in all equipment classes, the LCC savings for the small business subgroup are lower than the national average values. Table V.31 presents the percentage change in LCC savings compared to national average values for self-contained equipment. For many of the equipment classes in Table V.31, the percentage decrease in LCC savings is less than 15 percent. Equipment classes that show a substantial decrease in LCC savings, compared to national average values, are VOP.SC.M, VCT.SC.M, VCT.SC.L, VCT.SC.I, SVO.SC.M, HZO.SC.M, HCT.SC.I and PD.SC.M, which belong to the classification of self-contained display type equipment. It is uncommon to find display type equipment in small full-service restaurants. An overwhelming majority of commercial refrigeration equipment in small restaurants is composed of solid door refrigerators and freezers that are used for food storage in the kitchen. The solid-door equipment (VCS and HCS) exhibits a relatively smaller percentage decrease in LCC savings. In any case, the value of LCC savings at TSL 4 is positive for all equipment classes as shown in Table V.30. Therefore, even though the LCC savings for small business subgroup in foodservice sector are lower than the national average values, they are still positive, implying that small businesses still save money over the equipment lifetime at TSL 4. Table V.32 presents the comparison of median PBPs for the small business subgroup in the foodservice sector with national median values (median PBPs from chapter 8 of the NOPR TSD). The PBP values are higher for the small business subgroup in all cases, which is consistent with the decrease in LCC savings.

Table V.33 presents the comparison of mean LCC savings for the small business subgroup in the food-retail sector (convenience stores with gasoline stations) with the national average values (LCC savings results from chapter 8 of the NOPR TSD) at each TSL. This comparison shows mixed results, with higher LCC savings for the subgroup in some instances and lower LCC savings in others. The higher LCC savings for the subgroup are exhibited in the case of large display cases such as VOP.RC.M, VOP.RC.L, VCT.RC.M, VCT.RC.L, SVO.RC.M, and SOC.RC.M. This equipment is predominantly used in large grocery stores, where the average lifetime of the equipment was assumed to be 10 years, while the average lifetime of this equipment in convenience stores with gas stations was assumed to be 15 years (see chapter 8 of the NOPR TSD for discussion of equipment lifetime assumptions). In general, the longer the equipment lifetime, the lower the LCC values because of a longer available timeframe to offset the initial cost increases by savings in energy costs. Because the large display type equipment is predominantly used in larger grocery and multi-line retail stores, the national average values show lower LCC savings compared to the LCC savings of the subgroup. Self-contained equipment, on the other hand, was assumed to have a 10-year average lifetime in all businesses. For self-contained equipment, the subgroup LCC savings were lower than the national average LCC savings with the exception of the HCT.SC.L cases.

Table V.34 presents the percentage change in LCC savings of the customer subgroup in the food-retail sector compared to national average values at each TSL. For a majority of equipment classes that show a decrease in LCC savings for the subgroup, the percentage decrease in LCC savings is less than 15 percent. Equipment classes that show a substantial decrease in LCC savings, compared to national average values, are VOP.SC.M, SVO.SC.M, HZO.SC.M, HCT.SC.M, HCT.SC.I, and HSC.SC.M. Among these, the equipment classes that show decrease in LCC saving of greater than 15 percent at TSL 4 are VOP.SC.M (27 percent), SVO.SC.M (26 percent), HZO.SC.M (38 percent), HCT.SC.M (21 percent), HCT.SC.I (17 percent), and HCS.SC.M (15 percent). Even though the percentage decrease in

LCC savings for these equipment classes may appear to be high, the absolute value of decrease in LCC savings is small when compared to the total LCC for each equipment class. Table V.35 presents the comparison of median PBPs for small business subgroup in the foodservice sector with national median values (median PBPs from chapter 8 of the NOPR TSD) at each TSL. The PBP values are higher in the small business subgroup in all instances, including instances in which the LCC savings for the subgroup are higher than national average values. This is an expected outcome because the PBP values are obtained by dividing the increase in equipment installed cost by the first year savings in operating costs, and are not affected by the higher average lifetime of the equipment in the convenience stores with gas stations.

TABLE V.30—COMPARISON OF MEAN LCC SAVINGS FOR THE SMALL BUSINESS SUBGROUP IN THE FOODSERVICE SECTOR WITH THE NATIONAL AVERAGE VALUES

Equipment class*	Category	Mean LCC savings 2012$**				
		TSL 1	TSL 2	TSL 3	TSL 4	TSL 5
VOP.SC.M	Small Business	$157.27	$205.50	$690.22	$576.21	($586.43)
	All Business Types	170.78	227.17	814.91	691.27	(376.52)
VCT.SC.M	Small Business	421.59	960.34	752.15	405.47	(954.55)
	All Business Types	566.18	1,363.60	1,122.14	641.05	(595.52)
VCT.SC.L	Small Business	3,127.24	1,879.37	1,433.25	941.77	(906.58)
	All Business Types	4,186.06	2,522.67	1,984.45	1,342.84	(343.16)
VCT.SC.I	Small Business	414.02	310.26	261.24	261.24	(2,036.01)
	All Business Types	572.05	486.28	431.88	431.88	(1,591.87)
VCS.SC.M	Small Business	272.26	158.67	125.72	125.72	(1,079.78)
	All Business Types	278.84	162.88	131.80	131.80	(1,042.03)
VCS.SC.L	Small Business	511.64	318.96	259.10	213.08	(1,326.22)
	All Business Types	524.52	329.33	267.81	220.83	(1,274.03)
VCS.SC.I	Small Business	231.08	170.13	146.54	146.54	(1,884.22)
	All Business Types	236.77	176.83	152.69	152.69	(1,818.87)
SVO.SC.M	Small Business	296.25	305.21	486.70	397.67	(356.12)
	All Business Types	324.33	334.89	587.90	491.99	(201.61)
HZO.SC.M	Small Business	8.16	8.16	44.26	18.90	(925.33)
	All Business Types	8.85	8.85	48.60	28.78	(821.57)
HZO.SC.L †	Small Business	NA	NA	NA	NA	(532.72)
	All Business Types	NA	NA	NA	NA	(473.71)
HCT.SC.M	Small Business	99.52	323.44	274.76	219.49	(385.92)
	All Business Types	106.59	359.48	307.26	253.60	(293.54)
HCT.SC.L	Small Business	209.05	754.27	544.14	344.36	(458.19)
	All Business Types	217.19	790.53	571.07	368.92	(354.75)
HCT.SC.I	Small Business	21.15	32.20	35.19	35.19	(926.07)
	All Business Types	21.83	34.69	42.48	42.48	(811.31)
HCS.SC.M	Small Business	22.47	18.59	16.03	7.99	(436.55)
	All Business Types	23.07	19.18	16.66	8.68	(422.79)
HCS.SC.L	Small Business	72.79	78.72	76.67	76.67	(422.16)
	All Business Types	74.69	80.97	80.72	80.72	(400.63)
PD.SC.M	Small Business	815.04	815.04	729.72	187.05	(861.56)
	All Business Types	1,009.53	1,009.53	933.59	310.43	(637.94)
SOC.SC.M	Small Business	625.01	449.27	1,149.04	651.93	(959.99)
	All Business Types	646.15	466.47	1,241.60	739.75	(735.33)

* Only self-contained equipment have been shown for this subgroup analysis because the remote condensing equipment is not generally used by small full-service restaurants.

** Values in parentheses are negative values. Negative percentage values imply decrease in LCC savings and positive percentage values imply increase in LCC savings.

† TSLs 1 through 4 for equipment class HZO.SC.L are associated with the baseline efficiency level. Hence, the LCC savings are shown as "NA".

TABLE V.31—PERCENTAGE CHANGE IN MEAN LCC SAVINGS FOR THE SMALL BUSINESS SUBGROUP IN THE FOODSERVICE SECTOR COMPARED TO NATIONAL AVERAGE VALUES

Equipment class* (percent)	TSL 1** (percent)	TSL 2** (percent)	TSL 3** (percent)	TSL 4** (percent)	TSL 5** (percent)
VOP.SC.M	(8)	(10)	(15)	(17)	(56)
VCT.SC.M	(26)	(30)	(33)	(37)	(60)
VCT.SC.L	(25)	(26)	(28)	(30)	(164)
VCT.SC.I	(28)	(36)	(40)	(40)	(28)
VCS.SC.M	(2)	(3)	(5)	(5)	(4)
VCS.SC.L	(2)	(3)	(3)	(4)	(4)
VCS.SC.I	(2)	(4)	(4)	(4)	(4)
SVO.SC.M	(9)	(9)	(17)	(19)	(77)
HZO.SC.M	(8)	(8)	(9)	(34)	(13)
HZO.SC.L‡	NA	NA	NA	NA	(12)
HCT.SC.M	(7)	(10)	(11)	(13)	(31)

TABLE V.31—PERCENTAGE CHANGE IN MEAN LCC SAVINGS FOR THE SMALL BUSINESS SUBGROUP IN THE FOODSERVICE SECTOR COMPARED TO NATIONAL AVERAGE VALUES—Continued

Equipment class* (percent)	TSL 1** (percent)	TSL 2** (percent)	TSL 3** (percent)	TSL 4** (percent)	TSL 5** (percent)
HCT.SC.L	(4)	(5)	(5)	(7)	(29)
HCT.SC.I	(3)	(7)	(17)	(17)	(14)
HCS.SC.M	(3)	(3)	(4)	(8)	(3)
HCS.SC.L	(3)	(3)	(5)	(5)	(5)
PD.SC.M	(19)	(19)	(22)	(40)	(35)
SOC.SC.M	(3)	(4)	(7)	(12)	(31)

* Only self-contained equipment have been shown for this subgroup analysis because the remote condensing equipment is not generally used by small full-service restaurants.

** Values in parentheses are negative values. Negative percentage values imply decrease in LCC savings and positive percentage values imply increase in LCC savings.

† This value is high because of change of sign from subgroup value to national average value.

‡ TSLs 1 through 4 for equipment class HZO.SC.L are associated with the baseline efficiency level. Hence, the percentage changes in LCC savings are shown as ''NA''.

'0%' means the value is in between −0.5% and 0.5%.

TABLE V.32—COMPARISON OF MEDIAN PAYBACK PERIODS FOR THE SMALL BUSINESS SUBGROUP IN THE FOODSERVICE SECTOR WITH NATIONAL MEDIAN VALUES

Equipment class*	Category	Median payback period years				
		TSL 1	TSL 2	TSL 3	TSL 4	TSL 5
VOP.SC.M	Small Business	1.77	2.38	4.52	4.81	12.46
	All Business Types	1.61	2.17	4.12	4.39	11.37
VCT.SC.M	Small Business	0.89	1.77	2.27	2.61	8.34
	All Business Types	0.86	1.73	2.21	2.54	8.13
VCT.SC.L	Small Business	0.60	0.63	0.85	0.99	3.76
	All Business Types	0.58	0.61	0.83	0.96	3.65
VCT.SC.I	Small Business	0.93	1.89	2.14	2.14	14.34
	All Business Types	0.86	1.74	1.97	1.97	13.21
VCS.SC.M	Small Business	0.74	0.94	1.68	1.68	13.51
	All Business Types	0.78	0.98	1.75	1.75	14.11
VCS.SC.L	Small Business	0.53	0.87	0.96	1.10	10.11
	All Business Types	0.55	0.91	1.00	1.15	10.54
VCS.SC.I	Small Business	0.77	1.99	2.32	2.32	26.08
	All Business Types	0.80	2.07	2.42	2.42	27.19
SVO.SC.M	Small Business	2.15	2.25	4.83	5.17	11.30
	All Business Types	1.97	2.06	4.43	4.75	10.36
HZO.SC.M	Small Business	2.07	2.07	2.64	6.98	60.83
	All Business Types	1.89	1.89	2.42	6.40	55.78
HZO.SC.L**	Small Business	NA	NA	NA	NA	80.27
	All Business Types	NA	NA	NA	NA	73.62
HCT.SC.M	Small Business	0.77	2.49	2.69	3.43	13.64
	All Business Types	0.69	2.24	2.42	3.08	12.26
HCT.SC.L	Small Business	0.58	1.10	1.15	1.61	7.83
	All Business Types	0.53	1.00	1.05	1.47	7.15
HCT.SC.I	Small Business	0.96	2.60	4.67	4.67	30.57
	All Business Types	0.88	2.39	4.28	4.28	27.99
HCS.SC.M	Small Business	0.48	1.57	2.42	4.06	32.56
	All Business Types	0.50	1.64	2.54	4.28	34.05
HCS.SC.L	Small Business	0.82	1.30	2.47	2.47	14.38
	All Business Types	0.86	1.36	2.57	2.57	14.98
PD.SC.M	Small Business	0.53	0.53	1.11	2.28	7.63
	All Business Types	0.53	0.53	1.10	2.27	7.61
SOC.SC.M	Small Business	1.14	1.26	2.40	3.06	7.59
	All Business Types	1.12	1.24	2.35	2.99	7.42

* Only self-contained equipment have been shown for this subgroup analysis because the remote condensing equipment is not generally used by small full-service restaurants.

** TSLs 1 through 4 for equipment class HZO.SC.L are associated with the baseline efficiency level. Hence, the payback period is shown as ''NA.''

TABLE V.33—COMPARISON OF LCC SAVINGS FOR THE SMALL BUSINESS SUBGROUP IN THE FOOD-RETAIL SECTOR WITH THE NATIONAL AVERAGE VALUES

Equipment class	Category	Mean LCC savings 2012$*				
		TSL 1	TSL 2	TSL 3	TSL 4	TSL 5
VOP.RC.M	Small Business	$295.31	$927.25	$2,347.11	$1,970.10	($1,528.98)
	All Business Types	235.92	743.00	1,788.85	1,493.72	(1,668.79)
VOP.RC.L	Small Business	668.10	1,899.69	1,421.70	1,421.70	(3,855.19)
	All Business Types	537.27	1,516.59	1,129.51	1,129.51	(3,692.90)
VOP.SC.M	Small Business	145.72	187.71	608.29	503.17	(655.21)
	All Business Types	170.78	227.17	814.91	691.27	(376.52)
VCT.RC.M	Small Business	205.12	2,200.61	2,074.57	1,313.23	(2,663.30)
	All Business Types	175.23	1,864.44	1,758.73	1,108.13	(2,508.61)
VCT.RC.L	Small Business	1,586.15	1,177.93	937.97	937.97	(3,902.43)
	All Business Types	1,357.25	1,004.72	797.91	797.91	(3,624.20)
VCT.SC.M	Small Business	535.27	1,264.79	1,024.79	574.38	(784.35)
	All Business Types	566.18	1,363.60	1,122.14	641.05	(595.52)
VCT.SC.L	Small Business	3,980.86	2,396.41	1,864.97	1,248.55	(602.09)
	All Business Types	4,186.06	2,522.67	1,984.45	1,342.84	(343.16)
VCT.SC.I	Small Business	529.93	430.30	375.53	375.53	(1,881.48)
	All Business Types	572.05	486.28	431.88	431.88	(1,591.87)
VCS.SC.M	Small Business	271.17	157.63	124.30	124.30	(1,081.39)
	All Business Types	278.84	162.88	131.80	131.80	(1,042.03)
VCS.SC.L	Small Business	510.86	318.22	258.09	211.59	(1,328.25)
	All Business Types	524.52	329.33	267.81	220.83	(1,274.03)
VCS.SC.I	Small Business	230.24	169.16	145.08	145.08	(1,886.42)
	All Business Types	236.77	176.83	152.69	152.69	(1,818.87)
SVO.RC.M	Small Business	89.01	674.27	1,544.54	1,286.98	(949.64)
	All Business Types	73.77	551.98	1,216.77	1,008.46	(1,015.16)
SVO.SC.M	Small Business	285.37	292.93	449.78	364.68	(387.03)
	All Business Types	324.33	334.89	587.90	491.99	(201.61)
SOC.RC.M	Small Business	147.25	280.43	1,278.84	670.29	(960.27)
	All Business Types	118.36	226.26	997.89	494.51	(982.21)
HZO.RC.M**	Small Business	0.00	0.00	0.00	0.00	(1,384.63)
	All Business Types	0.00	0.00	0.00	0.00	(1,271.24)
HZO.RC.L**	Small Business	0.00	0.00	0.00	0.00	(2,306.30)
	All Business Types	0.00	0.00	0.00	0.00	(2,134.96)
HZO.SC.M	Small Business	8.05	8.05	43.45	17.89	(927.01)
	All Business Types	8.85	8.85	48.60	28.78	(821.57)
HZO.SC.L**	Small Business	0.00	0.00	0.00	0.00	(533.60)
	All Business Types	0.00	0.00	0.00	0.00	(473.71)
HCT.SC.M	Small Business	93.73	299.66	253.49	199.55	(407.29)
	All Business Types	106.59	359.48	307.26	253.60	(293.54)
HCT.SC.L	Small Business	249.39	906.61	655.15	425.64	(366.23)
	All Business Types	217.19	790.53	571.07	368.92	(354.75)
HCT.SC.I	Small Business	21.15	32.20	35.19	35.19	(926.07)
	All Business Types	21.83	34.69	42.48	42.48	(811.31)
HCS.SC.M	Small Business	22.48	18.44	15.75	7.40	(437.16)
	All Business Types	23.07	19.18	16.66	8.68	(422.79)
HCS.SC.L	Small Business	72.46	78.02	75.98	75.98	(423.21)
	All Business Types	74.69	80.97	80.72	80.72	(400.63)
PD.SC.M	Small Business	1,026.80	1,026.80	945.24	299.03	(744.27)
	All Business Types	1,009.53	1,009.53	933.59	310.43	(637.94)
SOC.SC.M	Small Business	619.20	444.70	1,138.70	643.60	(967.59)
	All Business Types	646.15	466.47	1,241.60	739.75	(735.33)

* Values in parentheses are negative values.
** TSLs 1 through 4 for equipment classes HZO.RC.M, HZO.RC.L, and HZO.SC.L are associated with the baseline efficiency level. Hence, the LCC savings are shown as "NA."

TABLE V.34—PERCENTAGE CHANGE IN MEAN LCC SAVINGS FOR THE SMALL BUSINESS SUBGROUP IN THE FOOD RETAIL SECTOR COMPARED TO NATIONAL AVERAGE VALUES

Equipment class	TSL 1* (percent)	TSL 2* (percent)	TSL 3* (percent)	TSL 4* (percent)	TSL 5* (percent)
VOP.RC.M	25	25	31	32	8
VOP.RC.L	24	25	26	26	(4)
VOP.SC.M	(15)	(17)	(25)	(27)	(74)
VCT.RC.M	17	18	18	19	(6)
VCT.RC.L	17	17	18	18	(8)
VCT.SC.M	(5)	(7)	(9)	(10)	(32)
VCT.SC.L	(5)	(5)	(6)	(7)	(75)

TABLE V.34—PERCENTAGE CHANGE IN MEAN LCC SAVINGS FOR THE SMALL BUSINESS SUBGROUP IN THE FOOD RETAIL SECTOR COMPARED TO NATIONAL AVERAGE VALUES—Continued

Equipment class	TSL 1* (percent)	TSL 2* (percent)	TSL 3* (percent)	TSL 4* (percent)	TSL 5* (percent)
VCT.SC.I	(7)	(12)	(13)	(13)	(18)
VCS.SC.M	(3)	(3)	(6)	(6)	(4)
VCS.SC.L	(3)	(3)	(4)	(4)	(4)
VCS.SC.I	(3)	(4)	(5)	(5)	(4)
SVO.RC.M	21	22	27	28	6
SVO.SC.M	(12)	(13)	(23)	(26)	(92)
SOC.RC.M	24	24	28	36	2
HZO.RC.M †	NA	NA	NA	NA	(9)
HZO.RC.L †	NA	NA	NA	NA	(8)
HZO.SC.M	(9)	(9)	(11)	(38)	(13)
HZO.SC.L†	NA	NA	NA	NA	(13)
HCT.SC.M	(12)	(17)	(17)	(21)	(39)
HCT.SC.L	15	15	15	15	(3)
HCT.SC.I	(3)	(7)	(17)	(17)	(14)
HCS.SC.M	(3)	(4)	(5)	(15)	(3)
HCS.SC.L	(3)	(4)	(6)	(6)	(6)
PD.SC.M	2	2	1	(4)	(17)
SOC.SC.M	(4)	(5)	(8)	(13)	(32)

* Values in parentheses are negative values. Negative percentage values imply decrease in LCC savings and positive percentage values imply increase in LCC savings.

† TSLs 1 through 4 for equipment classes HZO.RC.M, HZO.RC.L, and HZO.SC.L are associated with the baseline efficiency level. Hence, the LCC savings are zero and the decrease in LCC savings are shown as "NA."

'0%' implies the value is in between −0.5 and 0.5.

TABLE V.35—COMPARISON OF MEDIAN PAYBACK PERIODS FOR THE SMALL BUSINESS SUBGROUP IN THE FOOD-RETAIL SECTOR WITH THE NATIONAL MEDIAN VALUES

Equipment class	Category	Median payback period years				
		TSL 1	TSL 2	TSL 3	TSL 4	TSL 5
VOP.RC.M	Small Business	1.78	1.83	3.88	4.02	12.09
	All Business Types	1.73	1.77	3.77	3.91	11.76
VOP.RC.L	Small Business	1.15	2.10	2.30	2.30	18.90
	All Business Types	1.11	2.03	2.22	2.22	18.30
VOP.SC.M	Small Business	1.95	2.65	5.02	5.34	13.84
	All Business Types	1.61	2.17	4.12	4.39	11.37
VCT.RC.M	Small Business	1.28	2.51	2.53	2.80	13.61
	All Business Types	1.23	2.42	2.43	2.70	13.09
VCT.RC.L	Small Business	1.35	1.57	1.71	1.71	16.40
	All Business Types	1.30	1.51	1.64	1.64	15.75
VCT.SC.M	Small Business	0.98	1.95	2.49	2.87	9.17
	All Business Types	0.86	1.73	2.21	2.54	8.13
VCT.SC.L	Small Business	0.65	0.68	0.93	1.09	4.12
	All Business Types	0.58	0.61	0.83	0.96	3.65
VCT.SC.I	Small Business	1.02	2.08	2.35	2.35	15.75
	All Business Types	0.86	1.74	1.97	1.97	13.21
VCS.SC.M	Small Business	0.79	1.01	1.79	1.79	14.45
	All Business Types	0.78	0.98	1.75	1.75	14.11
VCS.SC.L	Small Business	0.56	0.93	1.03	1.18	10.80
	All Business Types	0.55	0.91	1.00	1.15	10.54
VCS.SC.I	Small Business	0.82	2.12	2.48	2.48	27.85
	All Business Types	0.80	2.07	2.42	2.42	27.19
SVO.RC.M	Small Business	1.36	2.74	4.49	4.66	12.01
	All Business Types	1.31	2.64	4.34	4.50	11.60
SVO.SC.M	Small Business	2.29	2.40	5.18	5.55	12.12
	All Business Types	1.97	2.06	4.43	4.75	10.36
SOC.RC.M	Small Business	1.28	1.48	3.41	4.54	12.24
	All Business Types	1.25	1.44	3.31	4.41	11.88
HZO.RC.M*	Small Business	0.00	0.00	0.00	0.00	166.41
	All Business Types	0.00	0.00	0.00	0.00	161.23
HZO.RC.L*	Small Business	0.00	0.00	0.00	0.00	86.47
	All Business Types	0.00	0.00	0.00	0.00	83.78
HZO.SC.M	Small Business	2.14	2.14	2.74	7.23	62.97
	All Business Types	1.89	1.89	2.42	6.40	55.78
HZO.SC.L*	Small Business	0.00	0.00	0.00	0.00	83.02
	All Business Types	0.00	0.00	0.00	0.00	73.62
HCT.SC.M	Small Business	0.80	2.60	2.81	3.58	14.23
	All Business Types	0.69	2.24	2.42	3.08	12.26

TABLE V.35—COMPARISON OF MEDIAN PAYBACK PERIODS FOR THE SMALL BUSINESS SUBGROUP IN THE FOOD-RETAIL SECTOR WITH THE NATIONAL MEDIAN VALUES—Continued

Equipment class	Category	Median payback period years				
		TSL 1	TSL 2	TSL 3	TSL 4	TSL 5
HCT.SC.L	Small Business	0.59	1.12	1.17	1.65	8.01
	All Business Types	0.53	1.00	1.05	1.47	7.15
HCT.SC.I	Small Business	0.96	2.60	4.67	4.67	30.57
	All Business Types	0.88	2.39	4.28	4.28	27.99
HCS.SC.M	Small Business	0.51	1.68	2.60	4.39	34.88
	All Business Types	0.50	1.64	2.54	4.28	34.05
HCS.SC.L	Small Business	0.88	1.40	2.63	2.63	15.35
	All Business Types	0.86	1.36	2.57	2.57	14.98
PD.SC.M	Small Business	0.58	0.58	1.22	2.50	8.40
	All Business Types	0.53	0.53	1.10	2.27	7.61
SOC.SC.M	Small Business	1.23	1.36	2.58	3.28	8.13
	All Business Types	1.12	1.24	2.35	2.99	7.42

* TSLs 1 through 4 for equipment classes HZO.RC.M, HZO.RC.L, and HZO.SC.L are associated with the baseline efficiency level. Hence, the payback period is shown as "NA."

2. Economic Impacts on Manufacturers

DOE performed an MIA to estimate the impact of amended energy conservation standards on manufacturers of commercial refrigeration equipment. The following section describes the expected impacts on manufacturers at each TSL. Chapter 12 of the NOPR TSD explains the analysis in further detail.

a. Industry Cash-Flow Analysis Results

The following tables depict the financial impacts (represented by changes in INPV) of amended energy standards on manufacturers as well as the conversion costs that DOE estimates manufacturers would incur for all equipment classes at each TSL. To evaluate the range of cash flow impacts on the commercial refrigeration industry, DOE modeled two different scenarios using different assumptions for markups that correspond to the range of anticipated market responses to amended standards.

To assess the lower (less severe) end of the range of potential impacts, DOE modeled a preservation of gross margin percentage markup scenario, in which a uniform ''gross margin percentage'' markup was applied across all potential efficiency levels. In this scenario, DOE assumed that a manufacturer's absolute dollar markup would increase as production costs increase in the amended standards case. Manufacturers have indicated that it is optimistic to assume that they would be able to maintain the same gross margin percentage markup as their production costs increase in response to an amended efficiency standard, particularly at higher TSLs. To assess the higher (more severe) end of the range of potential impacts, DOE modeled the preservation of operating profit markup scenario, which assumes that manufacturers would be able to earn the same operating margin in absolute dollars in the amended standards case as in the base case. Table V.36 and Table V.37 show the potential INPV impacts for commercial refrigeration equipment manufacturers at each TSL: Table V.36 reflects the lower bound of impacts and Table V.37 represents the upper bound.

Each of the modeled scenarios results in a unique set of cash flows and corresponding industry values at each TSL. In the following discussion, the INPV results refer to the difference in industry value between the base case and each potential amended standards case that results from the sum of discounted cash flows from the base year 2013 through 2046, the end of the analysis period. To provide perspective on the short-run cash flow impact, DOE includes in the discussion of the results below a comparison of free cash flow between the base case and the standards case at each TSL in the year before amended standards take effect.

TABLE V.36—MANUFACTURER IMPACT ANALYSIS FOR COMMERCIAL REFRIGERATION EQUIPMENT—PRESERVATION OF GROSS MARGIN PERCENTAGE MARKUP SCENARIO*

	Units	Base case	Trial standard level				
			1	2	3	4	5
INPV	2012$ Millions	1,162.0	1,158.4	1,146.9	1,135.7	1,116.1	1,136.5
Change in INPV	2012$ Millions		(3.6)	(15.2)	(26.3)	(45.9)	(25.5)
	(%)		(0.31)	(1.30)	(2.26)	(3.95)	(2.20)
Product Conversion Costs.	2012$ Millions		8.0	9.9	10.5	11.2	68.0
Capital Conversion Costs.	2012$ Millions			18.4	42.9	76.3	252.4
Total Conversion Costs.	2012$ Millions		8.0	28.3	53.4	87.5	320.4

* Values in parentheses are negative values.

TABLE V.37—MANUFACTURER IMPACT ANALYSIS FOR COMMERCIAL REFRIGERATION EQUIPMENT—PRESERVATION OF OPERATING PROFIT MARKUP SCENARIO*

	Units	Base case	Trial standard level				
			1	2	3	4	5
INPV	2012$ Millions	1,162.0	1,155.2	1,135.6	1,102.8	1,069.4	646.0
Change in INPV	2012$ Millions		(6.8)	(26.4)	(59.2)	(92.6)	(516.0)
	(%)		(0.58)	(2.27)	(5.09)	(7.97)	(44.41)
Product Conversion Costs.	2012$ Millions		8.0	9.9	10.5	11.2	68.0
Capital Conversion Costs.	2012$ Millions			18.4	42.9	76.3	252.4
Total Conversion Costs.	2012$ Millions		8.0	28.3	53.4	87.5	320.4

* Values in parentheses are negative values.

At TSL 1, DOE estimates impacts on INPV for commercial refrigeration equipment manufacturers to range from −$6.8 million to −$3.6 million, or a change in INPV of −0.58 percent to −0.31 percent. At this potential standard level, industry free cash flow is estimated to decrease by approximately 2.85 percent to $89.6 million, compared to the base-case value of $92.2 million in the year before the compliance date (2016).

DOE anticipates no capital conversion costs at TSL 1 because manufacturers would be able to make simple component swaps to meet the efficiency levels for each equipment class at this TSL. However, small product conversion costs may be incurred in order to incorporate the new components in existing designs.

At TSL 2, DOE estimates impacts on INPV for commercial refrigeration equipment manufacturers to range from −$26.4 million to −$15.2 million, or a change in INPV of −2.27 percent to −1.30 percent. At this potential standard level, industry free cash flow is estimated to decrease by approximately 12.48 percent to $80.7 million, compared to the base-case value of $92.2 million in the year before the compliance date (2016).

At TSL 2, DOE expects mild impacts on the industry. While capital conversion costs ramp up to $18.4 million for the industry, these costs are entirely accounted for by the VOP.RC.L and VCT.RC.L equipment classes. This is due to the potential need for foam insulation that is a half-inch thicker to meet a standard set at this level. Product conversion costs also slightly increase as design options that require new UL or NSF certification are incorporated. Detailed discussion can be found in chapter 12 of NOPR TSD.

At TSL 3, DOE estimates impacts on INPV for commercial refrigeration equipment manufacturers to range from −$59.2 million to −$26.3 million, or a change in INPV of −5.09 percent to −2.26 percent. At this potential standard level, industry free cash flow is estimated to decrease by approximately 24.65 percent to $69.5 million, compared to the base-case value of $92.2 million in the year before the compliance date (2016).

DOE expects mild, though slightly higher, conversion costs at TSL 3. The majority of the capital conversion costs are associated with the potential need for additional foam insulation for high-volume products, such as VCS.SC.M, which accounts for approximately 27 percent of total shipments, and for VCS.SC.L, which accounts for approximately16 percent. In total, DOE expects 8 of the 24 equipment classes to require new production equipment due to higher standards at this level.

At TSL 4, DOE estimates impacts on INPV for commercial refrigeration equipment manufacturers to range from −$92.6 million to −$45.9 million, or a change in INPV of −7.97 percent to −3.95 percent. At this proposed standard level, industry free cash flow is estimated to decrease by approximately 41.19 percent to $54.2 million, compared to the base-case value of $92.2 million in the year before the compliance date (2016).

At TSL 4, the drop in INPV is largely driven by continued increases in conversion costs. The increase in conversion costs is caused by the need for new tooling to accommodate additional foam insulation. At TSL 4, DOE expects 18 of the 24 equipment classes to require new production equipment due to higher standards.

At TSL 5, DOE estimates impacts on INPV for commercial refrigeration equipment manufacturers to range from −$516.0 million to −$25.5 million, or a change in INPV of −44.41 percent to 2.20 percent. At this potential standard level, industry free cash flow is estimated to decrease by approximately 147.31 percent to −$43.6 million, compared to the base-case value of $92.2 million in the year before the compliance date (2016).

A substantial increase in conversion costs are expected at TSL 5 due to the possible need for vacuum insulated panel technology required to meet a standard at TSL 5. Vacuum insulated panels are not currently used by any commercial refrigeration equipment manufacturers, and the production of vacuum insulated panels would require processes different from those used to produce standard foam panels. Therefore, high R&D investments may be necessary to redesign commercial refrigeration equipment cases. It is possible that substantial new equipment would be necessary to produce vacuum insulated panels for commercial refrigeration equipment applications. Current panel production equipment that cannot be used to produce vacuum insulated panels would be retired before it reaches the end of its useful life and would become a stranded asset.

b. Impacts on Direct Employment

To quantitatively assess the impacts of amended energy conservation standards on employment, DOE used the GRIM to estimate the domestic labor expenditures and number of employees in the base case and at each TSL from 2013 through 2046. DOE used statistical data from the U.S. Census Bureau's 2011 Annual Survey of Manufacturers (ASM), the results of the engineering analysis, the commercial refrigeration equipment shipments forecast, and interviews with manufacturers to determine the inputs necessary to calculate industry-wide labor expenditures and domestic employment levels. Labor expenditures related to manufacturing of the product are a function of the labor intensity of the product, the sales volume, and an assumption that wages remain fixed in real terms over time. The total labor expenditures in each year are calculated by multiplying the MPCs by the labor percentage of MPCs.

The total labor expenditures in the GRIM were then converted to domestic production employment levels by dividing production labor expenditures by the annual payment per production worker (production worker hours times the labor rate found in the U.S. Census Bureau's 2011 ASM). The estimates of production workers in this section cover workers, including line supervisors who are directly involved in fabricating and assembling a product within the OEM facility. Workers performing services that are closely associated with production operations, such as materials handling tasks using forklifts, are also included as production labor. DOE's estimates only account for production workers who manufacture the specific products covered by this rulemaking.

TABLE V.38—POTENTIAL CHANGES IN THE NUMBER OF COMMERCIAL REFRIGERATION EQUIPMENT PRODUCTION WORKERS IN 2017

	Base case	Trial Standard Level*				
		1	2	3	4	5
Total Number of Domestic Production Workers in 2017 (assuming no changes in production locations)	3,672	3,672	3,672	3,672	3,672	3,925
Range of Potential Changes in Domestic Production Workers in 2017 **		−3,672 to 0	−3,672 to 0	−3,672 to 0	−3,672 to 0	−3,672 to 253

* Numbers in parentheses are negative numbers.
** DOE presents a range of potential employment impacts, where the lower range represents the scenario in which all domestic manufacturers move production to other countries.

The employment impacts shown in Table V.38 represent the potential production employment changes that could result following the compliance date of an amended energy conservation standard. The upper end of the results in the table estimates the maximum increase in the number of production workers after the implementation of new energy conservation standards and it assumes that manufacturers would continue to produce the same scope of covered products within the United States. The lower end of the range indicates the total number of U.S. production workers in the industry who could lose their jobs if all existing production were moved outside of the United States. Though manufacturers stated in interviews that shifts in production to foreign countries is unlikely, the industry did not provide enough information for DOE fully quantify what percentage of the industry would move production at each evaluated standard level.

The majority of design options analyzed in the engineering analysis require manufacturers to purchase more-efficient components from suppliers. These components do not require significant additional labor to assemble. A key component of a commercial refrigeration equipment unit that requires fabrication labor by the commercial refrigeration equipment manufacturer is the shell of the unit, which needs to be formed and foamed in. Although this activity may require new production equipment if thicker insulation is needed to meet higher efficiency levels, the process of building the panels would essentially remain the same, and therefore require no additional labor costs. As a result, labor needs are not expected to increase as the amended energy conservation standard increases from baseline to TSL 4.

At TSL 5, the introduction of hybrid vacuum insulation panels may lead to greater labor requirements. In general, the production and handling of hybrid VIPs will require more labor than the production of standard panels. This is due to the delicate nature of VIPs and the additional labor necessary to embed them into a hybrid panel. The additional labor and handling associated with hybrid panels account for the increase in labor at the max-tech trial standard level.

DOE notes that the employment impacts discussed here are independent of the employment impacts to the broader U.S. economy, which are documented in the Employment Impact Analysis, chapter 16 of the TSD.

c. Impacts on Manufacturing Capacity

According to the majority of commercial refrigeration equipment manufacturers interviewed, amended energy conservation standards will not significantly affect manufacturers' production capacities. Any necessary redesign of commercial refrigeration equipment would not change the fundamental assembly of the equipment, but manufacturers do anticipate some potential for minor changes to tooling. The most significant of these would come as a result of any redesigns performed to accommodate additional foam insulation thickness. Additionally, most of the design options being evaluated are already available on the market as product options. Thus, DOE believes manufacturers would be able to maintain manufacturing capacity levels and continue to meet market demand under amended energy conservation standards.

d. Impacts on Subgroups of Manufacturers

Small manufacturers, niche equipment manufacturers, and manufacturers exhibiting a cost structure substantially different from the industry average could be affected disproportionately. As discussed in section IV.K, using average cost assumptions to develop an industry cash-flow estimate is inadequate to assess differential impacts among manufacturer subgroups.

For commercial refrigeration equipment, DOE identified and evaluated the impact of amended energy conservation standards on one subgroup: small manufacturers. The SBA defines a ''small business'' as having 750 employees or less for NAICS 333415, ''Air-Conditioning and Warm Air Heating Equipment and Commercial and Industrial Refrigeration Equipment Manufacturing.'' Based on this definition, DOE identified 32 manufacturers in the commercial refrigeration equipment industry that are small businesses.

For a discussion of the impacts on the small manufacturer subgroup, see the regulatory flexibility analysis in section VI.B of this notice and chapter 12 of the NOPR TSD.

e. Cumulative Regulatory Burden

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

During previous stages of this rulemaking, DOE identified a number of requirements in addition to amended energy conservation standards for commercial refrigeration equipment. The following section briefly addresses comments DOE received with respect to cumulative regulatory burden and summarizes other key related concerns that manufacturers raised during interviews.

Certification, Compliance, and Enforcement Rule

Multiple manufacturers have expressed concerns about the CC&E burdens for commercial refrigeration equipment. Traulsen stated that CC&E is the most significant cost item in terms of internal resources in the form of time and direct expenses. (Traulsen, No. 45 at pp. 4–5) NEEA expressed the opinion that the most significant issue associated with manufacturer impacts is testing and compliance for a wide array of equipment offerings, especially considering the large number of variations on single models. NEEA also agreed with manufacturers that testing each variation would create a significant potential burden, especially on small manufacturers. (NEEA, No. 36 at p. 7) AHRI stated that the CC&E requirements put in place by DOE have the potential to bankrupt the industry due to the excessive number of tests required. (AHRI, No. 43 at p. 3) In addition, Southern Store Fixtures stated that it would be difficult to produce information to estimate the compliance testing burden on manufacturers, as the certification and compliance requirements had not yet been finalized. (Southern Store Fixtures, Public Meeting Transcript, No. 31 at pp. 149–50) Southern Store Fixtures added that it is impossible to determine potential impacts of testing and certification on manufacturers until the issue of basic model is clarified. (Southern Store Fixtures, No. 38 at p. 1)

DOE understands that testing and certification requirements may have a significant impact on manufacturers, and the CC&E burden is identified as a key issue in the MIA. DOE also understands that CC&E requirements can be particularly onerous for manufacturers producing low volume or highly customized commercial refrigeration equipment. As a result, DOE is conducting a rulemaking to expand AEDM coverage and has issued a proposed rule to permit the application of AEDMs for commercial refrigeration equipment. 77 FR 32038 (May 31, 2012). More information about the AEDM rulemaking can be found at: *www1.eere.energy.gov/buildings/appliance_standards/certification_enforcement.html*.

EPA and ENERGY STAR

Some stakeholders also expressed concern regarding potential conflicts with other certification programs. Traulsen stated that redundancy of testing given other Federal programs (such as EPA ENERGY STAR), where there may be conflicting criteria, increases cost, and that cross-references to other databases with inconsistent tests, classes, and enforcement adds further complications. Traulsen estimated that the financial impact of meeting DOE and EPA ENERGY STAR requirements has been greater than 0.5 percent of revenue, and stated that it would be beneficial to reconcile the differences between DOE and EPA standards. (Traulsen, No. 45 at pp. 5–6) NEEA stated that the burden of certifications and associated testing is inherent in the manufacturing industry, and that this burden should have little to do with the standards rulemaking. However, NEEA added, any steps that can be taken to harmonize test methods and procedures between certifications should be taken. (NEEA, No. 36 at p. 7)

DOE realizes that the cumulative effect of several regulations on an industry may significantly increase the burden faced by manufacturers that need to comply with multiple regulations and certification programs from different organizations and levels of government. However, DOE notes that certain standards, such as ENERGY STAR, are optional for manufacturers. Harmonizing of test methods and procedures is not part of the energy conservation standards rulemaking. In its test procedure rulemaking, which culminated in the publication of the February 2012 test procedure final rule (77 FR 10292 (Feb. 21, 2012)), DOE attempted to set the test procedure in such a way so as to maximize the similarities between the DOE test procedure and the test procedure required for ENERGY STAR certification.

Other Federal Regulations

AHRI stated that there are several legislative and regulatory activities that could significantly burden manufacturers of commercial refrigeration equipment, including the upcoming amended energy conservation standards for walk-in coolers and freezers. AHRI also added that climate change bills that could be presented before Congress could have significant negative impact on the availability and price of HFC refrigerants. (AHRI, No. 43 at p. 4)

DOE recognizes the additional burden faced by manufacturers that produce both commercial refrigeration equipment and walk-in coolers and freezers. Companies that produce a wide range of regulated equipment may be faced with more capital and equipment design development expenditures than competitors with a narrower scope of production. However, DOE cannot consider the quantitative impacts of amended standards that have not yet been finalized, such as those for walk-ins. Likewise, DOE cannot consider the impacts of potential climate change bills because any potential impacts would be speculative in the absence of finalized legislation.

State Regulations

AHRI stated that California is currently working on new regulations as part of Title 24 that will likely establish new prescriptive requirements on commercial refrigeration equipment beginning in 2013. Additionally, AHRI added, other States on the West Coast are following California's lead and are likely to implement similar regulations in the near future. Finally, AHRI commented that several States have enacted their own climate change legislation, including regulations established by CARB to limit GHGs and reduce the usage of high-GWP refrigerants such as HFCs. AHRI stated that CARB will implement these regulations in 2011. (AHRI, No. 43 at p. 4)

According to the latest California Code of Regulations, title 24, part 6, any appliance for which there is a California energy conservation standard established in the California Appliance Efficiency Regulations may be installed only if the manufacturer has certified to the CEC, as specified in those regulations, that the appliance complies with the applicable standard for that appliance. The Commission's appliance efficiency regulations require that the

MDEC (in kilowatt-hours) for commercial refrigerators manufactured on or after January 1, 2010 does not exceed the following:

• Refrigerators with solid doors: 0.10V + 2.04
• refrigerators with transparent doors: 0.12V + 3.34
• freezers with solid doors: 0.40V + 1.38
• freezers with transparent doors: 0.75V + 4.10
• refrigerator/freezers with solid doors: the greater of 0.27AV–0.71 or 0.70
• refrigerators with self-condensing unit designed for pull-down temperature applications: 0.126V + 3.51

Since these standards are identical to the ones prescribed in EPACT 2005, and the efficiency levels set by the current rulemaking will either exceed or be equivalent to the EPACT 2005 levels, DOE does not expect the Title 24 regulations to create a cumulative regulatory burden on manufacturers. California has started a rulemaking proceeding to adopt changes to the building energy efficiency standards contained in the California Code of Regulations, title 24, part 6, but the CEC is currently in the pre-rulemaking stage and amended standards will not be published until 2013.

Further, CARB is currently limiting the in-State use of high-GWP refrigerants in non-residential refrigeration systems through its Refrigerant Management Program, effective January 1, 2011.[88] According to this new regulation, facilities with refrigeration systems that have a refrigerant capacity exceeding 50 pounds must repair leaks within 14 days of detection, maintain on-site records of all leak repairs, and keep receipts of all refrigerant purchases. The regulation applies to any person or company that installs, services, or disposes of appliances with high-GWP refrigerants. Refrigeration systems with a refrigerant capacity exceeding 50 pounds typically belong to food retail operations with remote condensing racks that store refrigerant serving multiple commercial refrigeration equipment units within a business. However, commercial refrigeration equipment units in food retail are usually installed and serviced by refrigeration contractors, not manufacturers. As a result, although these CARB regulations do apply to refrigeration technicians and owners of facilities with refrigeration systems, they are unlikely to represent a regulatory burden for commercial refrigeration manufacturers.

DOE discusses these and other requirements, and includes the full details of the cumulative regulatory burden analysis, in chapter 12 of the NOPR TSD.

3. National Impact Analysis

a. Amount and Significance of Energy Savings

DOE estimated the NES by calculating the difference in annual energy consumption for the base-case scenario and standards-case scenario at each TSL for each equipment class and summing up the annual energy savings for all equipment purchased in 2017–2046. The energy consumption calculated in the NIA is source energy, taking into account losses in the generation and transmission of electricity as discussed in section IV.I.

Table V.39 presents the NES for all equipment classes at each TSL and the sum total of NES for each TSL and Table V.40 presents estimated FFC energy savings for each considered TSL. The total NES progressively increases from 0.236 quads at TSL 1 to 1.278 quads at TSL 5. Table V.41 presents the energy savings at each TSL for each equipment class in the form of percentage of the cumulative energy use of the equipment stock in the base case scenario.

TABLE V.39—CUMULATIVE NATIONAL PRIMARY ENERGY SAVINGS FOR EQUIPMENT PURCHASED IN 2017–2046

Equipment class	Quads *				
	TSL 1	TSL 2	TSL 3	TSL 4	TSL 5
VOP.RC.M	0.007	0.045	0.238	0.244	0.257
VOP.RC.L	0.001	0.005	0.006	0.006	0.009
VOP.SC.M	0.001	0.003	0.017	0.018	0.019
VCT.RC.M	0.000	0.007	0.009	0.009	0.010
VCT.RC.L	0.061	0.071	0.078	0.078	0.121
VCT.SC.M	0.011	0.057	0.074	0.081	0.092
VCT.SC.L	0.005	0.005	0.006	0.007	0.008
VCT.SC.I	0.001	0.003	0.003	0.003	0.005
VCS.SC.M	0.047	0.064	0.111	0.111	0.176
VCS.SC.L	0.042	0.064	0.068	0.076	0.144
VCS.SC.I	0.000	0.000	0.000	0.000	0.001
SVO.RC.M	0.002	0.029	0.139	0.142	0.150
SVO.SC.M	0.004	0.006	0.021	0.022	0.023
SOC.RC.M	0.001	0.002	0.017	0.019	0.020
HZO.RC.M	-	-	-	-	0.001
HZO.RC.L	-	-	-	-	0.009
HZO.SC.M	0.000	0.000	0.000	0.000	0.000
HZO.SC.L	-	-	-	-	0.000
HCT.SC.M	0.000	0.000	0.000	0.000	0.001
HCT.SC.L	0.001	0.004	0.004	0.005	0.006
HCT.SC.I	0.000	0.000	0.001	0.001	0.005
HCS.SC.M	0.001	0.001	0.002	0.004	0.013
HCS.SC.L	0.001	0.001	0.002	0.002	0.005
PD.SC.M	0.047	0.047	0.105	0.157	0.181
SOC.SC.M	0.000	0.000	0.002	0.002	0.002

[88] California Air Resources Board. *Refrigerant Management Program Final Regulation.* 2011. *Cal. Code Regs. tit. 17, § 95386.* (Last accessed March 16, 2012.) *www.arb.ca.gov/cc/reftrack/reftrackrule.html.*

TABLE V.39—CUMULATIVE NATIONAL PRIMARY ENERGY SAVINGS FOR EQUIPMENT PURCHASED IN 2017–2046—Continued

Equipment class	Quads *				
	TSL 1	TSL 2	TSL 3	TSL 4	TSL 5
Net NES	0.233	0.416	0.905	0.985	1.257

'-' represents zero energy savings, since TSLs 1 through 4 for the equipment classes HZO.RC.M, HZO.RC.L, and HZO.SC.L are associated with the baseline efficiency level.
* A value of 0.000 means NES values are less than 0.0005 quads.

TABLE V.40—CUMULATIVE NATIONAL FULL-FUEL-CYCLE ENERGY SAVINGS FOR EQUIPMENT PURCHASED IN 2017–2046

Equipment class	Quads *				
	TSL 1	TSL 2	TSL 3	TSL 4	TSL 5
VOP.RC.M	0.007	0.046	0.242	0.248	0.262
VOP.RC.L	0.001	0.005	0.006	0.006	0.009
VOP.SC.M	0.001	0.003	0.018	0.018	0.019
VCT.RC.M	0.000	0.007	0.009	0.009	0.010
VCT.RC.L	0.062	0.072	0.079	0.079	0.123
VCT.SC.M	0.011	0.058	0.075	0.083	0.094
VCT.SC.L	0.005	0.006	0.006	0.007	0.008
VCT.SC.I	0.001	0.003	0.003	0.003	0.005
VCS.SC.M	0.048	0.065	0.112	0.112	0.179
VCS.SC.L	0.043	0.065	0.070	0.077	0.146
VCS.SC.I	0.000	0.000	0.000	0.000	0.001
SVO.RC.M	0.002	0.030	0.141	0.144	0.152
SVO.SC.M	0.004	0.006	0.022	0.022	0.023
SOC.RC.M	0.001	0.002	0.018	0.019	0.020
HZO.RC.M	-	-	-	-	0.001
HZO.RC.L	-	-	-	-	0.009
HZO.SC.M	0.000	0.000	0.000	0.000	0.000
HZO.SC.L	-	-	-	-	0.000
HCT.SC.M	0.000	0.000	0.000	0.000	0.001
HCT.SC.L	0.001	0.004	0.004	0.005	0.006
HCT.SC.I	0.000	0.000	0.001	0.001	0.005
HCS.SC.M	0.001	0.001	0.002	0.004	0.013
HCS.SC.L	0.001	0.001	0.002	0.002	0.005
PD.SC.M	0.048	0.048	0.106	0.159	0.184
SOC.SC.M	0.000	0.000	0.002	0.002	0.002
Net NES	0.236	0.422	0.920	1.001	1.278

'-' represents zero energy savings, since TSLs 1 through 4 for the equipment classes HZO.RC.M, HZO.RC.L, and HZO.SC.L are associated with the baseline efficiency level.
* A value of 0.000 means NES values are less than 0.0005 quads.

TABLE V.41—CUMULATIVE ENERGY SAVINGS BY TSL FOR EACH EQUIPMENT CLASS EXPRESSED AS A PERCENTAGE OF CUMULATIVE BASE-CASE ENERGY USAGE OF THE NEW COMMERCIAL REFRIGERATION EQUIPMENT STOCK PURCHASED IN 2017–2046

Equipment class	Total base-case energy use quads *	TSL Savings as percent of total base-case energy use				
		TSL 1 (percent)	TSL 2 (percent)	TSL 3 (percent)	TSL 4 (percent)	TSL 5 (percent)
VOP.RC.M	1.606	0	3	15	15	16
VOP.RC.L	0.203	0	3	3	3	4
VOP.SC.M	0.231	1	1	8	8	8
VCT.RC.M	0.027	1	25	33	35	39
VCT.RC.L	1.198	5	6	7	7	10
VCT.SC.M	0.235	5	25	32	35	40
VCT.SC.L	0.036	15	15	18	19	22
VCT.SC.I	0.047	3	6	7	7	10
VCS.SC.M	0.472	10	14	24	24	38
VCS.SC.L	0.720	6	9	10	11	20
VCS.SC.I	0.012	1	3	3	3	8
SVO.RC.M	0.990	0	3	14	15	15
SVO.SC.M	0.300	1	2	7	7	8
SOC.RC.M	0.173	0	1	10	11	12
HZO.RC.M	0.066	0	0	0	0	1
HZO.RC.L	0.475	0	0	0	0	2
HZO.SC.M	0.015	0	0	1	1	2

TABLE V.41—CUMULATIVE ENERGY SAVINGS BY TSL FOR EACH EQUIPMENT CLASS EXPRESSED AS A PERCENTAGE OF CUMULATIVE BASE-CASE ENERGY USAGE OF THE NEW COMMERCIAL REFRIGERATION EQUIPMENT STOCK PURCHASED IN 2017–2046—Continued

Equipment class	Total base-case energy use quads*	TSL Savings as percent of total base-case energy use				
		TSL 1 (percent)	TSL 2 (percent)	TSL 3 (percent)	TSL 4 (percent)	TSL 5 (percent)
HZO.SC.L	0.063	0	0	0	0	0
HCT.SC.M	0.001	5	40	43	48	57
HCT.SC.L	0.012	6	33	33	38	50
HCT.SC.I	0.017	1	3	7	7	27
HCS.SC.M	0.026	2	5	8	14	49
HCS.SC.L	0.010	8	13	21	21	48
PD.SC.M	0.401	12	12	27	40	46
SOC.SC.M	0.014	3	3	13	13	14
Totals	7.349	3	6	13	14	17

* Energy use of the entire commercial refrigeration equipment stock in the base-case scenario in 2017–2046 plus the energy use of the surviving stock of equipment in 2047–2060 for equipment purchased in 2017–2046.

'-' represents zero energy savings, since TSLs 1 through 4 for equipment classes HZO.RC.M, HZO.RC.L, and HZO.SC.L are associated with the baseline efficiency level.

Circular A–4 requires agencies to present analytical results, including separate schedules of the monetized benefits and costs that show the type and timing of benefits and costs. Circular A–4 also directs agencies to consider the variability of key elements underlying the estimates of benefits and costs. For this rulemaking, DOE undertook a sensitivity analysis using nine rather than 30 years of product shipments. The choice of a 9-year period is a proxy for the timeline in EPCA for the review of certain energy conservation standards and potential revision of and compliance with such revised standards.[89] We would note that the review timeframe established in EPCA generally does not overlap with the product lifetime, product manufacturing cycles or other factors specific to commercial refrigeration equipment. Thus, this information is presented for informational purposes only and is not indicative of any change in DOE's analytical methodology. The primary and full-fuel cycle NES results based on a 9-year analysis period are presented in Table V.42 and Table V.43, respectively. The impacts are counted over the lifetime of products purchased in 2017–2025.

TABLE V.42—CUMULATIVE NATIONAL PRIMARY ENERGY SAVINGS FOR 9-YEAR ANALYSIS PERIOD

[Equipment purchased in 2017–2025]

Equipment class	quads*				
	TSL 1	TSL 2	TSL 3	TSL 4	TSL 5
VOP.RC.M	0.001	0.009	0.049	0.050	0.053
VOP.RC.L	0.000	0.001	0.001	0.001	0.002
VOP.SC.M	0.000	0.001	0.004	0.004	0.004
VCT.RC.M	0.000	0.001	0.002	0.002	0.002
VCT.RC.L	0.012	0.015	0.016	0.016	0.025
VCT.SC.M	0.002	0.012	0.015	0.017	0.019
VCT.SC.L	0.001	0.001	0.001	0.001	0.002
VCT.SC.I	0.000	0.001	0.001	0.001	0.001
VCS.SC.M	0.010	0.013	0.023	0.023	0.036
VCS.SC.L	0.009	0.013	0.014	0.016	0.030
VCS.SC.I	0.000	0.000	0.000	0.000	0.000
SVO.RC.M	0.000	0.006	0.029	0.029	0.031
SVO.SC.M	0.001	0.001	0.004	0.004	0.005
SOC.RC.M	0.000	0.000	0.004	0.004	0.004
HZO.RC.M	-	-	-	-	0.000
HZO.RC.L	-	-	-	-	0.002
HZO.SC.M	0.000	0.000	0.000	0.000	0.000
HZO.SC.L	-	-	-	-	0.000
HCT.SC.M	0.000	0.000	0.000	0.000	0.000
HCT.SC.L	0.000	0.001	0.001	0.001	0.001
HCT.SC.I	0.000	0.000	0.000	0.000	0.001
HCS.SC.M	0.000	0.000	0.000	0.001	0.003
HCS.SC.L	0.000	0.000	0.000	0.000	0.001
PD.SC.M	0.010	0.010	0.021	0.032	0.037

[89] EPCA requires DOE to review its standards at least once every 6 years (42 U.S.C. 6295(m)(1), 6316(e)), and requires, for certain products, a 3-year period after any new standard is promulgated before compliance is required, except that in no case may any new standards be required within 6 years of the compliance date of the previous standards. (42 U.S.C. 6295(m)(4), 6316(e)).While adding a 6-year review to the 3-year compliance period sums to 9 years, DOE notes that it may undertake reviews at any time within the 6-year period, and that the 3 year compliance date may be extended to 5 years. A 9-year analysis period may not be appropriate given the variability that occurs in the timing of standards reviews and the fact that, for some consumer products, the period following establishment of a new or amended standard before which compliance is required is 5 years rather than 3 years.

TABLE V.42—CUMULATIVE NATIONAL PRIMARY ENERGY SAVINGS FOR 9-YEAR ANALYSIS PERIOD—Continued
[Equipment purchased in 2017–2025]

Equipment class	quads*				
	TSL 1	TSL 2	TSL 3	TSL 4	TSL 5
SOC.SC.M	0.000	0.000	0.000	0.000	0.000
Net NES	0.048	0.085	0.185	0.202	0.258

'-' represents zero energy savings, since TSLs 1 through 4 for the equipment classes HZO.RC.M, HZO.RC.L, and HZO.SC.L are associated with the baseline efficiency level.
* A value of 0.000 means NES values are less than 0.0005 quads.

TABLE V.43 CUMULATIVE FULL FUEL CYCLE NATIONAL ENERGY SAVINGS FOR 9-YEAR ANALYSIS PERIOD
[Equipment purchased in 2017–2025]

Equipment class	quads*				
	TSL 1	TSL 2	TSL 3	TSL 4	TSL 5
VOP.RC.M	0.001	0.009	0.050	0.051	0.054
VOP.RC.L	0.000	0.001	0.001	0.001	0.002
VOP.SC.M	0.000	0.001	0.004	0.004	0.004
VCT.RC.M	0.000	0.001	0.002	0.002	0.002
VCT.RC.L	0.013	0.015	0.016	0.016	0.025
VCT.SC.M	0.002	0.012	0.015	0.017	0.019
VCT.SC.L	0.001	0.001	0.001	0.001	0.002
VCT.SC.I	0.000	0.001	0.001	0.001	0.001
VCS.SC.M	0.010	0.013	0.023	0.023	0.037
VCS.SC.L	0.009	0.013	0.014	0.016	0.030
VCS.SC.I	0.000	0.000	0.000	0.000	0.000
SVO.RC.M	0.000	0.006	0.029	0.030	0.031
SVO.SC.M	0.001	0.001	0.004	0.005	0.005
SOC.RC.M	0.000	0.000	0.004	0.004	0.004
HZO.RC.M	-	-	-	-	0.000
HZO.RC.L	-	-	-	-	0.002
HZO.SC.M	0.000	0.000	0.000	0.000	0.000
HZO.SC.L	-	-	-	-	0.000
HCT.SC.M	0.000	0.000	0.000	0.000	0.000
HCT.SC.L	0.000	0.001	0.001	0.001	0.001
HCT.SC.I	0.000	0.000	0.000	0.000	0.001
HCS.SC.M	0.000	0.000	0.000	0.001	0.003
HCS.SC.L	0.000	0.000	0.000	0.000	0.001
PD.SC.M	0.010	0.010	0.022	0.033	0.038
SOC.SC.M	0.000	0.000	0.000	0.000	0.000
Net NES	0.048	0.087	0.189	0.205	0.262

'-' represents zero energy savings, since TSLs 1 through 4 for the equipment classes HZO.RC.M, HZO.RC.L, and HZO.SC.L are associated with the baseline efficiency level.
* A value of 0.000 means NES values are less than, 0.0005 quads.

b. Net Present Value of Customer Costs and Benefits

DOE estimated the cumulative NPV to the Nation of the total savings for the customers that would result from potential standards at each TSL. In accordance with OMB guidelines on regulatory analysis (OMB Circular A–4, section E, September 17, 2003), DOE calculated NPV using both a 7-percent and a 3-percent real discount rate. The 7-percent rate is an estimate of the average before-tax rate of return on private capital in the U.S. economy, and reflects the returns on real estate and small business capital, including corporate capital. DOE used this discount rate to approximate the opportunity cost of capital in the private sector because recent OMB analysis has found the average rate of return on capital to be near this rate. In addition, DOE used the 3-percent rate to capture the potential effects of amended standards on private consumption. This rate represents the rate at which society discounts future consumption flows to their present value. It can be approximated by the real rate of return on long-term government debt (*i.e.,* yield on Treasury notes minus annual rate of change in the Consumer Price Index), which has averaged about 3 percent on a pre-tax basis for the last 30 years.

Table V.44 and Table V.45 show the customer NPV results for each of the TSLs DOE considered for commercial refrigeration equipment at both 7-percent and 3-percent discount rates. In each case, the impacts cover the expected lifetime of equipment purchased in 2017–2046. Detailed NPV results are presented in chapter 10 of the NOPR TSD.

The NPV results at a 7-percent discount rate were negative for all equipment classes at TSL 5. This is consistent with the results of LCC analysis results for TSL 5, which showed significant increase in LCC and significantly high PBPs that were greater than the average equipment lifetimes. Efficiency levels for TSL 4 were chosen to correspond to the highest efficiency level with a positive NPV at a 7-percent discount rate for each equipment class.

Similarly, the criteria for choice of efficiency levels for TSL 3, TSL 2, and TSL 1 were such that the NPV values for all the equipment classes show positive values. The criterion for TSL 3 was to select efficiency levels with the highest NPV at a 7-percent discount rate. Consequently, the total NPV for commercial refrigeration equipment is highest for TSL 3, with a value of $1.705 billion (2012$) at a 7-percent discount rate. TSL 4 shows the second highest total NPV, with a value of $1.606 billion (2012$) at a 7-percent discount rate. TSL 2 and TSL 1 have a total NPV lower than TSL 4, while TSL 5 has a negative total NPV of $6.735 billion (2012$).

TABLE V.44—NET PRESENT VALUE AT A 7-PERCENT DISCOUNT RATE

Equipment class	Billion 2012$ * **				
	TSL 1	TSL 2	TSL 3	TSL 4	TSL 5
VOP.RC.M	0.016	0.099	0.466	0.461	(0.466)
VOP.RC.L	0.002	0.013	0.014	0.014	(0.062)
VOP.SC.M	0.003	0.005	0.027	0.025	(0.041)
VCT.RC.M	0.001	0.013	0.017	0.017	(0.060)
VCT.RC.L	0.141	0.155	0.161	0.161	(1.170)
VCT.SC.M	0.026	0.120	0.136	0.129	(0.340)
VCT.SC.L	0.014	0.014	0.015	0.015	(0.016)
VCT.SC.I	0.003	0.004	0.005	0.005	(0.042)
VCS.SC.M	0.113	0.135	0.153	0.153	(1.720)
VCS.SC.L	0.105	0.138	0.139	0.135	(1.084)
VCS.SC.I	0.000	0.001	0.001	0.001	(0.011)
SVO.RC.M	0.004	0.057	0.245	0.240	(0.231)
SVO.SC.M	0.008	0.012	0.029	0.027	(0.037)
SOC.RC.M	0.001	0.004	0.039	0.031	(0.056)
HZO.RC.M	-	-	-	-	(0.039)
HZO.RC.L	-	-	-	-	(0.229)
HZO.SC.M	0.000	0.000	0.000	0.000	(0.007)
HZO.SC.L	-	-	-	-	(0.006)
HCT.SC.M	0.000	0.001	0.001	0.001	(0.003)
HCT.SC.L	0.002	0.009	0.010	0.009	(0.016)
HCT.SC.I	0.000	0.001	0.001	0.001	(0.039)
HCS.SC.M	0.001	0.002	0.003	0.001	(0.166)
HCS.SC.L	0.002	0.002	0.003	0.003	(0.021)
PD.SC.M	0.119	0.119	0.237	0.176	(0.872)
SOC.SC.M	0.001	0.001	0.004	0.003	(0.003)
Sum Total	0.561	0.905	1.705	1.606	(6.735)

'-' represents zero energy savings, since TSLs 1 to 4 for equipment classes HZO.RC.M, HZO.RC.L, and HZO.SC.L are associated with the baseline efficiency level.

* A value of $0.000 means NES values are less than 0.001 billion 2012$.

** Values in parentheses are negative values.

TABLE V.45—NET PRESENT VALUE AT A 3-PERCENT DISCOUNT RATE

Equipment class	Billion 2012$ * **				
	TSL 1	TSL 2	TSL 3	TSL 4	TSL 5
VOP.RC.M	0.037	0.233	1.144	1.140	(0.549)
VOP.RC.L	0.005	0.030	0.032	0.032	(0.104)
VOP.SC.M	0.006	0.012	0.070	0.068	(0.053)
VCT.RC.M	0.001	0.031	0.041	0.041	(0.100)
VCT.RC.L	0.327	0.363	0.383	0.383	(2.017)
VCT.SC.M	0.059	0.283	0.331	0.326	(0.524)
VCT.SC.L	0.031	0.032	0.035	0.035	(0.020)
VCT.SC.I	0.007	0.011	0.012	0.012	(0.071)
VCS.SC.M	0.259	0.316	0.398	0.398	(2.976)
VCS.SC.L	0.239	0.323	0.329	0.327	(1.837)
VCS.SC.I	0.001	0.001	0.002	0.002	(0.018)
SVO.RC.M	0.008	0.137	0.615	0.608	(0.249)
SVO.SC.M	0.018	0.028	0.078	0.074	(0.043)
SOC.RC.M	0.003	0.010	0.093	0.079	(0.078)
HZO.RC.M	-	-	-	-	(0.071)
HZO.RC.L	-	-	-	-	(0.411)
HZO.SC.M	0.000	0.000	0.000	0.000	(0.013)
HZO.SC.L	-	-	-	-	(0.012)
HCT.SC.M	0.000	0.002	0.002	0.002	(0.004)
HCT.SC.L	0.004	0.022	0.022	0.022	(0.023)
HCT.SC.I	0.001	0.002	0.003	0.003	(0.066)
HCS.SC.M	0.003	0.005	0.007	0.006	(0.292)
HCS.SC.L	0.004	0.006	0.007	0.007	(0.034)
PD.SC.M	0.270	0.270	0.551	0.494	(1.406)

TABLE V.45—NET PRESENT VALUE AT A 3-PERCENT DISCOUNT RATE—Continued

Equipment class	Billion 2012$ * **				
	TSL 1	TSL 2	TSL 3	TSL 4	TSL 5
SOC.SC.M	0.002	0.002	0.009	0.008	(0.003)
Sum Total	1.285	2.118	4.165	4.067	(10.972)

'-' represents zero energy savings, since TSLs 1 to 4 for equipment classes HZO.RC.M, HZO.RC.L, and HZO.SC.L are associated with the baseline efficiency level.
* A value of $0.000 means NES values are less than 0.001 billion 2012$.
** Values in parentheses are negative values.

The NPV results based on the aforementioned 9-year analysis period are presented in Table V.46 and Table V.47. The impacts are counted over the lifetime of products purchased in 2017–2025. As mentioned previously, this information is presented for informational purposes only and is not indicative of any change in DOE's analytical methodology or decision criteria.

TABLE V.46—NET PRESENT VALUE AT A 7-PERCENT DISCOUNT RATE FOR 9-YEAR ANALYSIS PERIOD

[Equipment purchased in 2017–2025]

Equipment class	billion 2012$ * ** †				
	TSL 1	TSL 2	TSL 3	TSL 4	TSL 5
VOP.RC.M	0.008	0.039	0.154	0.150	(0.294)
VOP.RC.L	0.001	0.005	0.005	0.005	(0.032)
VOP.SC.M	0.001	0.002	0.008	0.007	(0.025)
VCT.RC.M	0.000	0.005	0.006	0.006	(0.031)
VCT.RC.L	0.054	0.059	0.060	0.060	(0.583)
VCT.SC.M	0.011	0.045	0.049	0.044	(0.182)
VCT.SC.L	0.005	0.005	0.006	0.006	(0.009)
VCT.SC.I	0.001	0.002	0.002	0.002	(0.021)
VCS.SC.M	0.043	0.051	0.049	0.049	(0.858)
VCS.SC.L	0.041	0.051	0.051	0.047	(0.548)
VCS.SC.I	0.000	0.000	0.000	0.000	(0.005)
SVO.RC.M	0.003	0.021	0.078	0.075	(0.151)
SVO.SC.M	0.003	0.004	0.008	0.007	(0.024)
SOC.RC.M	0.001	0.002	0.014	0.009	(0.032)
HZO.RC.M	-	-	-	-	(0.019)
HZO.RC.L	-	-	-	-	(0.111)
HZO.SC.M	0.000	0.000	0.000	(0.000)	(0.004)
HZO.SC.L	-	-	-	-	(0.003)
HCT.SC.M	0.000	0.000	0.000	0.000	(0.001)
HCT.SC.L	0.001	0.004	0.004	0.003	(0.009)
HCT.SC.I	0.000	0.000	0.000	0.000	(0.019)
HCS.SC.M	0.001	0.001	0.001	0.000	(0.082)
HCS.SC.L	0.001	0.001	0.001	0.001	(0.011)
PD.SC.M	0.047	0.047	0.090	0.049	(0.455)
SOC.SC.M	0.000	0.000	0.001	0.001	(0.002)
Sum Total	0.221	0.343	0.586	0.521	(3.509)

'-' represents zero energy savings, since TSLs 1 to 4 for equipment classes HZO.RC.M, HZO.RC.L, and HZO.SC.L are associated with the baseline efficiency level.
* A value of $0.000 means NES values are less than 0.001 billion 2012$.
** Values in parentheses are negative values.
† The impacts were calculated over the lifetime of the equipment purchased in 2017–2025.

TABLE V.47—NET PRESENT VALUE AT A 3-PERCENT DISCOUNT RATE FOR 9-YEAR ANALYSIS PERIOD

[Equipment purchased in 2017–2025]

Equipment class	Billion 2012$ * ** †				
	TSL 1	TSL 2	TSL 3	TSL 4	TSL 5
VOP.RC.M	0.013	0.063	0.267	0.263	(0.330)
VOP.RC.L	0.001	0.008	0.008	0.008	(0.040)
VOP.SC.M	0.002	0.003	0.015	0.014	(0.028)
VCT.RC.M	0.001	0.008	0.010	0.010	(0.039)
VCT.RC.L	0.088	0.096	0.099	0.099	(0.753)
VCT.SC.M	0.017	0.073	0.083	0.077	(0.222)
VCT.SC.L	0.008	0.009	0.009	0.009	(0.011)
VCT.SC.I	0.002	0.003	0.003	0.003	(0.027)

TABLE V.47—NET PRESENT VALUE AT A 3-PERCENT DISCOUNT RATE FOR 9-YEAR ANALYSIS PERIOD—Continued

[Equipment purchased in 2017–2025]

Equipment class	Billion 2012$ * ** †				
	TSL 1	TSL 2	TSL 3	TSL 4	TSL 5
VCS.SC.M	0.069	0.082	0.090	0.090	(1.111)
VCS.SC.L	0.064	0.083	0.084	0.080	(0.702)
VCS.SC.I	0.000	0.000	0.000	0.000	(0.007)
SVO.RC.M	0.004	0.036	0.138	0.135	(0.166)
SVO.SC.M	0.005	0.007	0.016	0.014	(0.027)
SOC.RC.M	0.001	0.003	0.023	0.017	(0.038)
HZO.RC.M	-	-	-	-	(0.025)
HZO.RC.L	-	-	-	-	(0.147)
HZO.SC.M	0.000	0.000	0.000	(0.000)	(0.005)
HZO.SC.L	-	-	-	-	(0.004)
HCT.SC.M	0.000	0.000	0.000	0.000	(0.002)
HCT.SC.L	0.001	0.006	0.006	0.006	(0.011)
HCT.SC.I	0.000	0.000	0.001	0.001	(0.025)
HCS.SC.M	0.001	0.001	0.002	0.001	(0.107)
HCS.SC.L	0.001	0.001	0.002	0.002	(0.014)
PD.SC.M	0.074	0.074	0.145	0.102	(0.568)
SOC.SC.M	0.001	0.001	0.002	0.002	(0.002)
Sum Total	0.352	0.558	1.003	0.934	(4.410)

'-' represents zero energy savings, since TSLs 1 to 4 for equipment classes HZO.RC.M, HZO.RC.L, and HZO.SC.L are associated with the baseline efficiency level.
* A value of $0.000 means NES values are less than 0.001 billion 2012$.
** Values in parentheses are negative values.
† The impacts were calculated over the lifetime of the equipment purchased in 2017–2025.

c. Employment Impacts

In addition to the direct impacts on manufacturing employment discussed in section V.B.2, DOE develops general estimates of the indirect employment impacts of proposed standards on the economy. As discussed above, DOE expects energy amended conservation standards for commercial refrigeration equipment to reduce energy bills for commercial customers, and the resulting net savings to be redirected to other forms of economic activity. DOE also realizes that these shifts in spending and economic activity by commercial refrigeration equipment owners could affect the demand for labor. Thus, 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 amended standards. These impacts may affect a variety of businesses not directly involved in the decision to make, operate, or pay the utility bills for commercial refrigeration equipment. To estimate these indirect economic effects, DOE used an input/output model of the U.S. economy using U.S. Department of Commerce, Bureau of Economic Analysis (BEA) and BLS data (as described in section IV.L of this notice; see chapter 16 of the NOPR TSD for more details).

Customers who purchase more-efficient equipment pay lower amounts towards utility bills, which results in job losses in the electric utilities sector. However, in the input/output model, the dollars saved on utility bills are re-invested in economic sectors that create more jobs than are lost in the electric utilities sector. Thus, the proposed amended energy conservation standards for commercial refrigeration equipment are likely to slightly increase the net demand for labor in the economy. However, the net increase in jobs might be offset by other, unanticipated effects on employment. Neither the BLS data nor the input/output model used by DOE includes the quality of jobs. As shown in Table V.48, DOE estimates that net indirect employment impacts from a proposed commercial refrigeration equipment amended standard are small relative to the national economy.

TABLE V.48—NET SHORT-TERM CHANGE IN EMPLOYMENT*

Trial standard level	2017	2021
1	35 to 38	198 to 201
2	53 to 61	345 to 354
3	74 to 108	719 to 749
4	60 to 105	760 to 801
5	(728) to (363)	130 to 504

* Values in parentheses are negative values.

4. Impact on Utility or Performance of Equipment

In performing the engineering analysis, DOE considers design options that would not lessen the utility or performance of the individual classes of equipment. (42 U.S.C. 6295(o)(2)(B)(i)(IV) and 6316(e)(1)) As presented in the screening analysis (chapter 4 of the NOPR TSD), DOE eliminates from consideration any design options that reduce the utility of the equipment. For this notice, DOE concluded that none of the efficiency levels proposed for commercial refrigeration equipment reduce the utility or performance of the equipment.

5. Impact of Any Lessening of Competition

EPCA directs DOE to consider any lessening of competition likely to result from amended standards. It directs the Attorney General to determine in writing the impact, if any, of any lessening of competition likely to result from a proposed standard. (42 U.S.C. 6295(o)(2)(B)(i)(V) and 6316(e)(1)) To assist the Attorney General in making such a determination, DOE provided the Department of Justice (DOJ) with copies of this notice and the TSD for review. During MIA interviews, domestic manufacturers indicated that foreign manufacturers have begun to enter the commercial refrigeration equipment industry, but not in significant numbers. Manufacturers also stated that consolidation has occurred among commercial refrigeration equipment manufacturers in recent years. Interviewed manufacturers believe that these trends may continue in this market even in the absence of amended standards.

DOE does not believe that amended standards would result in domestic firms moving their production facilities outside the United States. The majority of commercial refrigeration equipment is manufactured in the United States and, during interviews, manufacturers in general indicated they would modify their existing facilities to comply with amended energy conservation standards.

6. Need of the Nation to Conserve Energy

An improvement in the energy efficiency of the equipment subject to today's NOPR is likely to improve the security of the Nation's energy system by reducing overall demand for energy. Reduced electricity demand may also improve the reliability of the electricity system. Reductions in national electric generating capacity estimated for each considered TSL are reported in chapter 14 of the NOPR TSD.

Energy savings from amended standards for commercial refrigeration equipment could also produce environmental benefits in the form of reduced emissions of air pollutants and GHGs associated with electricity production. Table V.49 provides DOE's estimate of cumulative emissions reductions projected to result from the TSLs considered in this rule. The table includes both power sector emissions and upstream emissions. The upstream emissions were calculated using the multipliers discussed in section IV.N. DOE reports annual CO_2, NO_X, SO_2, NO_2, CH_4 and Hg emissions reductions for each TSL in chapter 15 of the NOPR TSD. As discussed in Section IV.N DOE also did not include NO_X emission reduction from power plants in States subject to CAIR because an amended energy conservation standard would not affect the overall level of NO_X emissions in those States due to the emission caps mandated by CAIR.

TABLE V.49—CUMULATIVE EMISSIONS REDUCTION ESTIMATED FOR COMMERCIAL REFRIGERATION EQUIPMENT TSLS FOR EQUIPMENT PURCHASED IN 2017–2046

	TSL				
	1	2	3	4	5
Primary Emissions					
CO_2 *(million metric tons)*	12.22	21.83	47.55	51.77	66.05
NO_X *(thousand tons)*	9.05	16.18	35.23	38.36	48.93
Hg *(tons)*	0.03	0.05	0.10	0.11	0.14
N_2O *(thousand tons)*	0.26	0.47	1.02	1.11	1.42
CH_4 *(thousand tons)*	1.53	2.73	5.95	6.48	8.27
SO_2 *(thousand tons)*	16.39	29.28	63.78	69.43	88.58
Upstream Emissions					
CO_2 *(million metric tons)*	0.73	1.31	2.85	3.10	3.96
NO_X *(thousand tons)*	10.08	18.01	39.23	42.71	54.49
Hg *(tons)*	0.000	0.001	0.002	0.002	0.002
N_2O *(thousand tons)*	0.01	0.01	0.03	0.03	0.04
CH_4 *(thousand tons)*	61.23	109.39	238.27	259.41	330.92
SO_2 *(thousand tons)*	0.16	0.28	0.61	0.67	0.85
Total Emissions					
CO_2 *(million metric tons)*	12.95	23.14	50.41	54.88	70.01
NO_X *(thousand tons)*	19.14	34.19	74.46	81.07	103.42
Hg *(tons)*	0.03	0.05	0.10	0.11	0.14
N_2O *(thousand tons)*	0.27	0.48	1.05	1.15	1.46
CH_4 *(thousand tons)*	62.76	112.13	244.22	265.89	339.19
SO_2 *(thousand tons)*	16.55	29.56	64.39	70.10	89.43

As part of the analysis for this NOPR, DOE estimated monetary benefits likely to result from the reduced emissions of CO_2 and NO_X that DOE estimated for each of the TSLs considered. As discussed in section IV.O for CO_2, DOE used values for the SCC developed by an interagency process. The interagency group selected four sets of SCC values for use in regulatory analyses. Three sets are based on the average SCC from three integrated assessment models, at discount rates of 2.5 percent, 3 percent, and 5 percent. The fourth set, which represents the 95th-percentile SCC estimate across all three models at a 3-percent discount rate, is included to represent higher-than-expected impacts from temperature change further out in the tails of the SCC distribution. The four SCC values for CO_2 emissions reductions in 2015, expressed in 2012$, are $12.9/ton, $40.8/ton, $62.2/ton, and $117.0/ton. These values for later years are higher due to increasing emissions-related costs as the magnitude of projected climate change increase.

Table V.50 presents the global value of CO_2 emissions reductions at each TSL. DOE calculated domestic values as a range from 7 percent to 23 percent of the global values, and these results are presented in chapter 14 of the NOPR TSD.

TABLE V.50—GLOBAL PRESENT VALUE OF CO_2 EMISSIONS REDUCTION FOR POTENTIAL STANDARDS FOR COMMERCIAL REFRIGERATION EQUIPMENT

TSL	SCC Scenario*			
	5% Discount rate, average	3% Discount rate, average	2.5% Discount rate, average	3% Discount rate, 95th percentile
	million 2012$			
Primary Emissions				
1	68.6	335.1	546.1	1,013.7
2	122.6	598.7	975.6	1,811.1
3	266.9	1,304.1	2,124.9	3,944.8
4	290.6	1,419.8	2,313.4	4,294.8
5	370.7	1,811.2	2,951.2	5,478.8
Upstream Emissions				
1	4.0	20.0	32.6	60.6
2	7.2	35.7	58.3	108.3
3	15.8	77.8	126.9	236.0
4	17.1	84.7	138.1	256.9
5	21.9	108.1	176.2	327.7
Total Emissions				
1	72.6	355.1	578.7	1,074.4
2	129.8	634.4	1,033.8	1,919.5
3	282.7	1,381.9	2,251.8	4,180.7
4	307.8	1,504.5	2,451.6	4,551.7
5	392.6	1,919.2	3,127.4	5,806.5

* For each of the four cases, the corresponding SCC value for emissions in 2015 is $12.9, $40.8, $62.2 and $117.0 per metric ton (2012$).

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

DOE also estimated a range for the cumulative monetary value of the economic benefits associated with NO_X emission reductions anticipated to result from amended commercial refrigeration equipment standards. Estimated monetary benefits for CO_2 and NO_X emission reductions are detailed in chapter 14 of the NOPR TSD. Table V.51 presents the present value of cumulative NO_X emissions reductions for each TSL calculated using the average dollar-per-ton values and 7-percent and 3-percent discount rates.

TABLE V.51—PRESENT VALUE OF NO_X EMISSIONS REDUCTION FOR POTENTIAL STANDARDS FOR COMMERCIAL REFRIGERATION EQUIPMENT

TSL	3% Discount rate	7% Discount rate
	million 2012$	
Primary Emissions		
1	12.0	5.6
2	21.4	10.0
3	46.6	21.7
4	50.7	23.6
5	64.7	30.1
Upstream Emissions		
1	13.4	6.2
2	24.0	11.0
3	52.3	24.0
4	56.9	26.1
5	72.6	33.3

TABLE V.51—PRESENT VALUE OF NO_X EMISSIONS REDUCTION FOR POTENTIAL STANDARDS FOR COMMERCIAL REFRIGERATION EQUIPMENT—Continued

TSL	3% Discount rate	7% Discount rate
Total Emissions		
1	25.4	11.7
2	45.4	21.0
3	98.9	45.7
4	107.6	49.8
5	137.3	63.5

The NPV of the monetized benefits associated with emission reductions can be viewed as a complement to the NPV of the customer savings calculated for each TSL considered in this NOPR. Table V.52 presents the NPV values that result from adding the estimates of the potential economic benefits resulting from reduced CO_2 and NO_X emissions in each of four valuation scenarios to the NPV of consumer savings calculated for each TSL considered in this rulemaking, at both a 7-percent and a 3-percent discount rate. The CO_2 values used in the table correspond to the four scenarios for the valuation of CO_2 emission reductions discussed above.

TABLE V.52—COMMERCIAL REFRIGERATION EQUIPMENT TSLS: NET PRESENT VALUE OF CONSUMER SAVINGS COMBINED WITH NET PRESENT VALUE OF MONETIZED BENEFITS FROM CO_2 AND NO_X EMISSIONS REDUCTIONS

TSL	Consumer NPV at 3% discount rate added with:			
	SCC Value of $12.9/metric ton CO_2* and low value for NO_X**	SCC Value of $40.8/metric ton CO_2* and medium value for NO_X**	SCC Value of $62.2/metric ton CO_2* and medium value for NO_X**	SCC Value of $117.0/metric ton CO_2* and high value for NO_X**
	billion 2012$			
1	*1.362*	*1.665*	*1.889*	*2.406*
2	*2.256*	*2.798*	*3.197*	*4.120*
3	*4.466*	*5.646*	*6.516*	*8.526*
4	*4.394*	*5.679*	*6.626*	*8.815*
5	*(10.555)*	*(8.916)*	*(7.708)*	*(4.916)*
TSL	Consumer NPV at 7% Discount Rate added with:			
	SCC Value of $12.9/metric ton CO_2* and Low Value for NO_X**	SCC Value of $40.8/metric ton CO_2* and Medium Value for NO_X**	SCC Value of $62.2/metric ton CO_2* and Medium Value for NO_X**	SCC Value of $117.0/metric ton CO_2* and High Value for NO_X**
	billion 2012$			
1	*0.636*	*0.928*	*1.151*	*1.657*
2	*1.038*	*1.560*	*1.959*	*2.862*
3	*1.996*	*3.133*	*4.002*	*5.969*
4	*1.922*	*3.160*	*4.107*	*6.248*
5	*(6.331)*	*(4.752)*	*(3.544)*	*(0.813)*

Note: Parentheses indicate negative values.*
* These label values represent the global SCC in 2015, in 2012$. The present values have been calculated with scenario-consistent discount rates.
** Low Value corresponds to $468 per ton of NO_X emissions. Medium Value corresponds to $2,639 per ton of NO_X emissions. High Value corresponds to $4,809 per ton of NO_X emissions.

Although adding the value of customer savings to the values of emission reductions provides a valuable perspective, two issues should be considered. First, the national operating cost savings are domestic U.S. customer monetary savings that occur as a result of market transactions, while the value of CO_2 reductions is based on a global value. Second, the assessments of operating cost savings and the SCC are performed with different methods that use quite different time frames for analysis. The national operating cost savings is measured for the lifetime of products shipped in 2017–2046. The SCC values, on the other hand, reflect the present value of future climate-related impacts resulting from the emission of one metric ton of CO_2 in each year. These impacts continue well beyond 2100.

7. Other Factors

EPCA allows the Secretary, in determining whether a proposed standard is economically justified, to consider any other factors that the Secretary deems to be relevant. (42 U.S.C. 6295(o)(2)(B)(i)(VII) and 6316(e)(1)) DOE considered LCC impacts on identifiable groups of customers, such as customers of different business types, who may be disproportionately affected by any amended national energy conservation standard level. DOE also considered the reduction in generation capacity that could result from the imposition of any amended national energy conservation standard level.

DOE carried out a RIA, as described in section IV.P, to study the impact of certain non-regulatory alternatives that may encourage customers to purchase higher efficiency equipment and, thus, achieve NES. The two major alternatives identified by DOE are customer rebates and customer tax credits. DOE surveyed the various rebate programs available in the United States. Typically, rebates are offered for grocery stores that retrofit their display cases with energy efficiency components such as LED lamps, electronically commutated motor (ECM) fan motors, night curtains, and higher efficiency doors. Based on comparison with the incremental MSP values obtained from the engineering analysis, DOE chose to model a scenario in which customers are offered, as rebates, 60 percent of the incremental equipment installed cost. The value of 60 percent is very high compared to most rebate programs and was chosen to represent the maximum possible rebate scenario.

For the tax credits scenario, DOE did not find a suitable program by which to model the scenario. Therefore, DOE used a 5-percent/10-percent tax credit scenario. DOE first calculated the MSP increments over baseline for each TSL for each equipment class. For TSLs that had an increase in MSP between 10 and 15 percent over the baseline MSP, DOE applied a 5-percent tax credit, where the amount of tax credit was equal to 5 percent of the MSP of the higher efficiency equipment. For TSLs that had increase of 15 percent or more in MSP values over the baseline MSP, DOE applied a 10-percent tax credit. This type of tax credit scenario is an attempt to approximate a model in which the tax credits are proportional to the magnitude of efficiency improvement with the implicit assumption that the magnitude of the increase in MSP is proportional to the magnitude of increase in energy efficiency.

Table V.53 and Table V.54 show the NES and NPV, respectively, for the non-regulatory alternatives analyzed. For comparison, the table includes the results of the NES and NPV for TSL 4, the proposed energy conservation standard. Energy savings are expressed in quads in terms of primary or source energy, which includes generation and transmission losses from electricity utility sector.

TABLE V.53—CUMULATIVE PRIMARY ENERGY SAVINGS OF NON-REGULATORY ALTERNATIVES COMPARED TO THE PROPOSED STANDARDS FOR COMMERCIAL REFRIGERATION EQUIPMENT *

Policy Alternatives	Cumulative NES Quads
No new regulatory action	0
Customer tax credits	0.151
Customer rebates	0.198
Voluntary energy efficiency targets**	NA
Early replacement**	NA
Proposed standards (TSL 4)	0.985

* Chapter 17 of the TSD describes the inputs and their respective sources for the RIA.
** Analysis of two non-regulatory alternatives: voluntary energy efficiency targets and early replacement were not performed as DOE expected minimal potential benefits as discussed in Chapter 17 of the TSD.

TABLE V.54—CUMULATIVE NPV OF NON-REGULATORY ALTERNATIVES COMPARED TO THE PROPOSED STANDARDS FOR COMMERCIAL REFRIGERATION EQUIPMENT

Policy Alternatives	Cumulative Net Present Value billion 2012$	
	7% Discount	3% Discount
No new regulatory action	0	0
Customer tax credits	0.257	0.489
Customer rebates	0.055	0.122
Voluntary energy efficiency targets*	NA	NA
Early replacement*	NA	NA
Proposed standards (TSL 4)	1.606	4.067

* Analysis of two non-regulatory alternatives: voluntary energy efficiency targets and early replacement, were not performed as DOE expected minimal potential benefits as discussed in Chapter 17 of the TSD.

As shown above, none of the policy alternatives DOE examined would achieve close to the amount of energy or monetary savings that could be realized under the proposed amended standard. Also, implementing either tax credits or customer rebates would incur initial and/or administrative costs that were not considered in this analysis.

C. Proposed Standard

DOE recognizes that when it considers proposed standards, it is subject to the EPCA requirement that any new or amended energy conservation standard for any type (or class) of covered product be designed to achieve the maximum improvement in energy efficiency that the Secretary determines is technologically feasible and economically justified. (42 U.S.C. 6295(o)(2)(A) and 6316(e)(1)) In determining whether a proposed standard is economically justified, the Secretary must determine whether the benefits of the standard exceed its burdens to the greatest extent practicable, in light of the seven statutory factors discussed previously. (42 U.S.C. 6295(o)(2)(B)(i) and 6316(e)(1)) The new or amended standard must also result in a significant conservation of energy. (42 U.S.C. 6295(o)(3)(B) and 6316(e)(1))

DOE considered the impacts of potential standards at each TSL, beginning with the maximum technologically feasible level, to determine whether that level met the evaluation criteria. If the max-tech level was not justified, DOE then considered the next most efficient level and undertook the same evaluation until it reached the highest efficiency level that is both technologically feasible and economically justified and saves a significant amount of energy.

DOE discusses the benefits and/or burdens of each TSL in the following sections. DOE bases its discussion on quantitative analytical results for each TSL, including NES, NPV (discounted at 7 and 3 percent), emission reductions, INPV, LCC, and customers' installed price increases. Beyond the quantitative results, DOE also considers other burdens and benefits that affect economic justification, including how technological feasibility, manufacturer costs, and impacts on competition may affect the economic results presented.

Table V.55, Table V.56, Table V.57 and Table V.58 present a summary of the results of DOE's quantitative analysis for each TSL. In addition to the quantitative results presented in the tables, DOE also considers other burdens and benefits that affect economic justification of certain customer subgroups that are disproportionately affected by the proposed standards. Section V.B.7 presents the estimated impacts of each TSL for these subgroups.

TABLE V.55—SUMMARY OF RESULTS FOR COMMERCIAL REFRIGERATION EQUIPMENT TSLS: NATIONAL IMPACTS *

Category	TSL 1	TSL 2	TSL 3	TSL 4	TSL5
Cumulative National Energy Savings 2017 through 2060 quads					
Undiscounted values.	0.236	0.422	0.920	1.001	1.278
Cumulative NPV of Customer Benefits 2017 through 2060 2012$ billion					
3% discount rate	$1.285	$2.118	$4.165	$4.067	($10.972)
7% discount rate	$0.561	$0.905	$1.705	$1.606	($6.735)
Industry Impacts					
Change in Industry NPV (2012$ million).	(3.6) to (6.8)	(15.2) to (26.4)	(26.3) to (59.2)	(45.9) to (92.6)	(25.5) to (516.0)
Change in Industry NPV (%).	(0.58) to (0.31)	(2.27) to (1.30)	(5.09) to (2.26)	(7.97) to (3.95)	(44.41) to (2.20)
Cumulative Emissions Reductions 2017 through 2060					
CO_2 (MMt)**	12.95	23.14	50.41	54.88	70.01
NO_X (kt)**	19.14	34.19	74.46	81.07	103.42
Hg (t)**	0.03	0.05	0.10	0.11	0.14
N_2O (kt)**	0.27	0.48	1.05	1.15	1.46
N_2O (kt CO_2eq)**	80.56	143.92	313.48	341.29	435.39
CH_4 (*kt*)**	62.76	112.13	244.22	265.89	339.19
CH_4 (*kt* CO_2eq) **	1,568.96	2,803.13	6,105.43	6,647.15	8,479.71
SO_2 (kt) **	16.55	29.56	64.39	70.10	89.43
Monetary Value of Cumulative Emissions Reductions 2017 through 2060 †					
CO_2 (2012$ million).	73 to 1,074	130 to 1,919	283 to 4,181	308 to 4,552	393 to 5,807
NO_X—3% discount rate (2012$ million).	4.5 to 46.3	8.1 to 82.7	17.5 to 180.2	19.1 to 196.2	24.4 to 250.2
NO_X—7% discount rate (2012$ million).	2.1 to 21.4	3.7 to 38.2	8.1 to 83.3	8.8 to 90.7	11.3 to 115.7
Employment Impacts					
Net Change in Indirect Domestic Jobs by 2021.	198 to 201	345 to 354	719 to 749	760 to 801	130 to 504

* Values in parentheses are negative values.
** "MMt" stands for million metric tons; "kt" stands for kilotons; "t" stands for tons. CO_2eq is the quantity of CO_2 that would have the same global warming potential (GWP)
† Range of the economic value of CO_2 reductions is based on estimates of the global benefit of reduced CO_2 emissions.

TABLE V.56—SUMMARY OF RESULTS FOR COMMERCIAL REFRIGERATION EQUIPMENT TSLS: MEAN LCC SAVINGS

Equipment class	TSL 1	TSL 2	TSL 3	TSL 4	TSL5
Mean LCC Savings* 2012$					
VOP.RC.M	$235.92	$743.00	$1,788.85	$1,493.72	($1,668.79)
VOP.RC.L	537.27	1,516.59	1,129.51	1,129.51	(3,692.90)
VOP.SC.M	170.78	227.17	814.91	691.27	(376.52)
VCT.RC.M	175.23	1,864.44	1,758.73	1,108.13	(2,508.61)
VCT.RC.L	1,357.25	1,004.72	797.91	797.91	(3,624.20)
VCT.SC.M	566.18	1,363.60	1,122.14	641.05	(595.52)
VCT.SC.L	4,186.06	2,522.67	1,984.45	1,342.84	(343.16)
VCT.SC.I	572.05	486.28	431.88	431.88	(1,591.87)
VCS.SC.M	278.84	162.88	131.80	131.80	(1,042.03)
VCS.SC.L	524.52	329.33	267.81	220.83	(1,274.03)

TABLE V.56—SUMMARY OF RESULTS FOR COMMERCIAL REFRIGERATION EQUIPMENT TSLS: MEAN LCC SAVINGS—Continued

Equipment class	TSL 1	TSL 2	TSL 3	TSL 4	TSL5
VCS.SC.I	236.77	176.83	152.69	152.69	(1,818.87)
SVO.RC.M	73.77	551.98	1,216.77	1,008.46	(1,015.16)
SVO.SC.M	324.33	334.89	587.90	491.99	(201.61)
SOC.RC.M	118.36	226.26	997.89	494.51	(982.21)
HZO.RC.M**	0.00	0.00	0.00	0.00	(1,271.24)
HZO.RC.L**	0.00	0.00	0.00	0.00	(2,134.96)
HZO.SC.M	8.85	8.85	48.60	28.78	(821.57)
HZO.SC.L**	0.00	0.00	0.00	0.00	(473.71)
HCT.SC.M	106.59	359.48	307.26	253.60	(293.54)
HCT.SC.L	217.19	790.53	571.07	368.92	(354.75)
HCT.SC.I	21.83	34.69	42.48	42.48	(811.31)
HCS.SC.M	23.07	19.18	16.66	8.68	(422.79)
HCS.SC.L	74.69	80.97	80.72	80.72	(400.63)
PD.SC.M	1,009.53	1,009.53	933.59	310.43	(637.94)
SOC.SC.M	646.15	466.47	1,241.60	739.75	(735.33)

* Values in parentheses are negative values.
** "NA" means "not applicable," because for equipment classes HZO.RC.M, HZO.RC.L, and HZO.SC.L, TSLs 1 through 4 are associated with the baseline efficiency level.

TABLE V.57—SUMMARY OF RESULTS FOR COMMERCIAL REFRIGERATION EQUIPMENT TSLS: MEDIAN PAYBACK PERIOD

Equipment class	TSL 1	TSL 2	TSL 3	TSL 4	TSL5
		Median Payback Period years			
VOP.RC.M	1.73	1.77	3.77	3.91	11.76
VOP.RC.L	1.11	2.03	2.22	2.22	18.30
VOP.SC.M	1.61	2.17	4.12	4.39	11.37
VCT.RC.M	1.23	2.42	2.43	2.70	13.09
VCT.RC.L	1.30	1.51	1.64	1.64	15.75
VCT.SC.M	0.86	1.73	2.21	2.54	8.13
VCT.SC.L	0.58	0.61	0.83	0.96	3.65
VCT.SC.I	0.86	1.74	1.97	1.97	13.21
VCS.SC.M	0.78	0.98	1.75	1.75	14.11
VCS.SC.L	0.55	0.91	1.00	1.15	10.54
VCS.SC.I	0.80	2.07	2.42	2.42	27.19
SVO.RC.M	1.31	2.64	4.34	4.50	11.60
SVO.SC.M	1.97	2.06	4.43	4.75	10.36
SOC.RC.M	1.25	1.44	3.31	4.41	11.88
HZO.RC.M*	0.00	0.00	0.00	0.00	161.23
HZO.RC.L*	0.00	0.00	0.00	0.00	83.78
HZO.SC.M	1.89	1.89	2.42	6.40	55.78
HZO.SC.L*	0.00	0.00	0.00	0.00	73.62
HCT.SC.M	0.69	2.24	2.42	3.08	12.26
HCT.SC.L	0.53	1.00	1.05	1.47	7.15
HCT.SC.I	0.88	2.39	4.28	4.28	27.99
HCS.SC.M	0.50	1.64	2.54	4.28	34.05
HCS.SC.L	0.86	1.36	2.57	2.57	14.98
PD.SC.M	0.53	0.53	1.10	2.27	7.61
SOC.SC.M	1.12	1.24	2.35	2.99	7.42

* "NA" means "not applicable," because for equipment classes HZO.RC.M, HZO.RC.L, and HZO.SC.L, TSLs 1 through 4 are associated with the baseline efficiency level.

TABLE V.58—SUMMARY OF RESULTS FOR COMMERCIAL REFRIGERATION EQUIPMENT TSLS: DISTRIBUTION OF CUSTOMER LCC IMPACTS

Category	TSL 1*	TSL 2*	TSL 3*	TSL 4*	TSL 5*
VOP.RC.M:					
Net Cost (%)	0	0	0	11	90
No Impact (%)	76	52	28	15	2
Net Benefit (%)	24	48	72	74	8
VOP.RC.L:					
Net Cost (%)	0	0	0	0	98
No Impact (%)	74	48	25	25	2
Net Benefit (%)	26	52	75	75	0
VOP.SC.M:					
Net Cost (%)	0	0	0	11	77

TABLE V.58—SUMMARY OF RESULTS FOR COMMERCIAL REFRIGERATION EQUIPMENT TSLS: DISTRIBUTION OF CUSTOMER LCC IMPACTS—Continued

Category	TSL 1*	TSL 2*	TSL 3*	TSL 4*	TSL 5*
No Impact (%)	62	43	25	14	3
Net Benefit (%)	38	57	75	75	20
VCT.RC.M:					
Net Cost (%)	0	0	0	26	94
No Impact (%)	81	62	46	16	2
Net Benefit (%)	19	38	54	57	4
VCT.RC.L:					
Net Cost (%)	0	0	0	0	97
No Impact (%)	60	40	21	21	2
Net Benefit (%)	40	60	79	79	1
VCT.SC.M:					
Net Cost (%)	0	0	0	27	74
No Impact (%)	83	66	51	13	2
Net Benefit (%)	17	34	49	60	24
VCT.SC.L:					
Net Cost (%)	0	0	0	7	74
No Impact (%)	76	60	44	15	2
Net Benefit (%)	24	40	56	78	24
VCT.SC.I:					
Net Cost (%)	0	1	1	1	95
No Impact (%)	65	32	16	16	1
Net Benefit (%)	35	68	83	83	3
VCS.SC.M:					
Net Cost (%)	0	0	7	7	99
No Impact (%)	72	42	13	13	1
Net Benefit (%)	28	58	80	80	0
VCS.SC.L:					
Net Cost (%)	0	0	5	20	97
No Impact (%)	73	42	28	14	1
Net Benefit (%)	27	58	68	66	2
VCS.SC.I:					
Net Cost (%)	0	0	3	3	99
No Impact (%)	67	32	16	16	1
Net Benefit (%)	33	68	81	81	0
SVO.RC.M:					
Net Cost (%)	0	0	0	13	85
No Impact (%)	75	51	29	16	3
Net Benefit (%)	25	49	71	72	12
SVO.SC.M:					
Net Cost (%)	0	0	0	12	69
No Impact (%)	61	43	25	14	4
Net Benefit (%)	39	57	75	75	27
SOC.RC.M:					
Net Cost (%)	0	0	0	29	89
No Impact (%)	82	64	47	18	5
Net Benefit (%)	18	36	53	53	6
HZO.RC.M:**					
Net Cost (%)	NA	NA	NA	NA	78
No Impact (%)	NA	NA	NA	NA	22
Net Benefit (%)	NA	NA	NA	NA	0
HZO.RC.L:**					
Net Cost (%)	NA	NA	NA	NA	86
No Impact (%)	NA	NA	NA	NA	14
Net Benefit (%)	NA	NA	NA	NA	0
HZO.SC.M:					
Net Cost (%)	0	0	0	19	98
No Impact (%)	75	75	49	24	2
Net Benefit (%)	25	25	51	57	0
HZO.SC.L:**					
Net Cost (%)	NA	NA	NA	NA	72
No Impact (%)	NA	NA	NA	NA	28
Net Benefit (%)	NA	NA	NA	NA	0
HCT.SC.M:					
Net Cost (%)	0	0	0	18	89
No Impact (%)	70	38	25	12	1
Net Benefit (%)	30	62	75	70	10
HCT.SC.L:					
Net Cost (%)	0	0	0	23	76
No Impact (%)	75	61	45	14	1
Net Benefit (%)	26	39	55	63	23
HCT.SC.I:					

TABLE V.58—SUMMARY OF RESULTS FOR COMMERCIAL REFRIGERATION EQUIPMENT TSLS: DISTRIBUTION OF CUSTOMER LCC IMPACTS—Continued

Category	TSL 1*	TSL 2*	TSL 3*	TSL 4*	TSL 5*
Net Cost (%)	0	0	2	2	99
No Impact (%)	74	49	23	23	1
Net Benefit (%)	26	51	75	75	0
HCS.SC.M:					
Net Cost (%)	0	0	1	29	98
No Impact (%)	83	65	48	31	2
Net Benefit (%)	17	35	51	40	0
HCS.SC.L:					
Net Cost (%)	0	0	2	2	98
No Impact (%)	50	33	16	16	2
Net Benefit (%)	50	67	82	82	0
PD.SC.M:					
Net Cost (%)	0	0	0	41	86
No Impact (%)	86	86	69	11	1
Net Benefit (%)	14	14	31	48	13
SOC.SC.M:					
Net Cost (%)	0	0	0	25	80
No Impact (%)	70	55	40	16	5
Net Benefit (%)	30	45	60	60	16

* Values have been rounded to the nearest integer. Therefore, some of the percentages may not add up to 100.
** "NA" means "not applicable"; because for equipment classes HZO.RC.M, HZO.RC.L and HZO.SC.L, TSLs 1 through 4 are associated with the baseline efficiency level.

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

While DOE is not prepared at present to provide a fuller quantifiable framework for estimating the benefits and costs of changes in consumer purchase decisions due to an amended energy conservation standard, DOE has posted a paper that discusses the issue of consumer welfare impacts of appliance energy efficiency standards, and potential enhancements to the methodology by which these impacts are defined and estimated in the regulatory process.[90] DOE is committed to developing a framework that can support empirical quantitative tools for improved assessment of the consumer welfare impacts of appliance standards. DOE welcomes comments on information and methods to better assess the potential impact of energy conservation standards on consumer choice and methods to quantify this impact in its regulatory analysis in future rulemakings.

TSL 5 corresponds to the max-tech level for all the equipment classes and offers the potential for the highest cumulative energy savings. The estimated energy savings from TSL 5 is 1.2784 quads of energy. DOE projects a net negative NPV for customers with estimated increased costs valued at $6.735 billion at a 7-percent discount rate. Estimated emissions reductions are 70.0 MMt of CO_2, and up to 103.4 kt of NO_X, and 89.4 kt of SO_2. DOE also projects a decrease in Hg emissions of up to 0.14 tons. The CO_2 emissions have a value of up to $5.8 billion and the NO_X emissions have a value of $115.7 million at a 7-percent discount rate.

For TSL 5 the mean LCC savings for all equipment classes are negative, implying an increase in LCC, with the increase ranging from $202 for the SVO.SC.M equipment class to $3,693 for the VOP.RC.L equipment class.

At TSL 5, manufacturers may expect diminished profitability due to large increases in product costs, capital investments in equipment and tooling, and expenditures related to engineering and testing. The projected change in INPV ranges from a decrease of $516.0 million to a decrease of $25.5 million based on DOE's manufacturer markup scenarios. The upper bound of -$25.5 million is considered an optimistic scenario for manufacturers because it assumes manufacturers can fully pass on substantial increases in equipment costs. DOE recognizes the risk of large negative impacts on industry if manufacturers' expectations concerning reduced profit margins are realized. TSL 5 could reduce commercial refrigeration equipment INPV by up to 44.41 percent if impacts reach the lower bound of the range.

After carefully considering the analyses results and weighing the benefits and burdens of TSL 5, DOE finds that the benefits to the Nation from TSL 5, in the form of energy savings and emissions reductions, including environmental and monetary benefits, are small compared to the

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

burdens, in the form of a decrease of $6.735 billion in customer NPV and a decrease of up to 44.41 percent in INPV. DOE concludes that the burdens of TSL 5 outweigh the benefits and, therefore, does not find TSL 5 to be economically justifiable. DOE is not proposing to adopt TSL 5 in this notice.

TSL 4 corresponds to the highest efficiency level, in each equipment class, with a positive NPV at a 7-percent discount rate. The estimated energy savings for equipment purchased in 2017–2046 is 1.001 quads of energy, an amount DOE deems significant. At TSL 4, DOE projects an increase in customer NPV of $1.606 billion at a 7-percent discount rate; estimated emissions reductions of 54.88 MMt of CO_2; up to 81.1 kt of NO_X, 0.11 in Hg and 70.1 kt of SO_2. The monetary value of these emissions was estimated to be up to $4.55 billion for CO_2 and up to $90.7 million for NO_X at a 7-percent discount rate.

At TSL 4, the mean LCC savings vary from $8.68 for HCS.SC.M to $1,493.72 for VOP.RC.M, which implies that on an average customers will experience a decrease in LCC. For equipment classes HZO.RC.M, HZO.RC.L, and HZO.SC.L, TSL 4 is associated with the baseline level because these equipment classes have only one efficiency level above baseline and each of those higher efficiency levels yields a negative NPV. Therefore, there are no efficiency levels that satisfy the criteria used for selection of TSLs 1 through 4. DOE is not proposing to amend the standards for these three equipment classes.

At TSL 4, the projected change in INPV ranges from a decrease of $92.6 million to a decrease of $45.9 million. At TSL 4, DOE recognizes the risk of negative impacts if manufacturers' expectations concerning reduced profit margins are realized. If the lower bound of the range of impacts is reached, as DOE expects, TSL 4 could result in a net loss of 7.97 percent in INPV for commercial refrigeration equipment manufacturers.

DOE contrasted the benefits and burdens of TSL 4 with those of TSL 3 because even though TSL 4 has higher energy savings than TSL 3, the customer NPV values at TSL 3 are higher than at TSL 4. The estimated energy savings at TSL 3 is 0.920 quads of energy, whereas at TSL 4 the energy savings are higher by about 9 percent at 1.001 quads. At TSL 3, DOE projects an increase in customer NPV of $1.705 billion at a 7-percent discount rate, whereas at TSL 4 the customer NPV is lower by about 6 percent at $1.606 billion, with the actual difference amounting to approximately $99 million. Estimated emissions reductions at TSL 3 are 50.41 MMt of CO_2 as opposed to 54.88 MMt at TSL 4, and up to 74.46 kt of NO_X at TSL 3 as compared to 81.07 kt at TSL 4. The monetary value of the CO_2 emissions reductions was estimated to be up to $4.18 billion at TSL 3 compared to $4.55 billion at TSL 4, and NO_X emission reductions at a 7-percent discount rate were valued at up to $83.3 million at TSL 3 compared to $90.7 million at TSL 4.

To facilitate a direct comparison between the benefits of TSL 3 versus those of TSL4, DOE evaluated the net social benefits of TSL 3 and TSL 4 by combining the customer NPV values with monetized emissions reductions. While Table V.55 provides a range of monetized values for CO_2 and NO_X emissions reductions, DOE calculated certain intermediate values here for the purpose of net benefits calculation. The monetized CO_2 emissions reduction values were calculated at $40.8 per ton in 2012$ and the monetized NO_X emissions reductions were calculated at an intermediate value of $2,639 per ton in 2012$. These monetized emissions reduction values were added to the customer NPV at a 7-percent discount rate to obtain a value of 3.133 billion at TSL 3. At TSL 4, the net benefit value of $3.160 billion is higher than that at TSL 3.

After careful consideration of the analyses results, weighing the benefits and burdens of TSL 4, and comparing them to those of TSL 3, DOE believes that setting the standards for commercial refrigeration equipment at TSL 4 represents the maximum improvement in energy efficiency that is technologically feasible and economically justified. TSL 4 is technologically feasible because the technologies required to achieve these levels already exist in the current market. TSL 4 is economically justified because the benefits to the Nation in the form of energy savings, customer NPV at 3 percent and at 7 percent, and emissions reductions outweigh the costs associated with reduced INPV.

Therefore, DOE has decided to propose the adoption of amended energy conservation standards for commercial refrigeration equipment at TSL 4. DOE specifically seeks comment on the magnitude of the estimated decline in INPV at TSL 4 compared to the baseline, and whether this impact could risk industry consolidation. DOE also specifically requests comment on whether DOE should adopt TSL 5, and in particular whether, compared to TSL 4, TSL 5's higher energy savings outweigh its lower NPV benefits and higher manufacturer impacts. DOE may reexamine this level depending on the nature of the information it receives during the comment period and adjust its final levels in response to that information.

VI. Procedural Issues and Regulatory Review

A. Review Under Executive Orders 12866 and 13563

Section 1(b)(1) of Executive Order 12866, ''Regulatory Planning and Review,'' 58 FR 51735 (Oct. 4, 1993), requires each agency to identify the problem that it intends to address, including, where applicable, the failures of private markets or public institutions that warrant new agency action, as well as to assess the significance of that problem. The problems that today's standards address are as follows:

1. There is a lack of consumer information and/or information processing capability about energy efficiency opportunities in the commercial refrigeration equipment market.

2. There is asymmetric information (one party to a transaction has more and better information than the other) and/or high transactions costs (costs of gathering information and effecting exchanges of goods and services).

3. There are external benefits resulting from improved energy efficiency of commercial refrigeration equipment that are not captured by the users of such equipment. These benefits include externalities related to environmental protection and energy security that are not reflected in energy prices, such as reduced emissions of GHGs.

In addition, DOE has determined that today's regulatory action is an ''economically significant regulatory action'' under section 3(f)(1) of Executive Order 12866. Accordingly, section 6(a)(3) of the Executive Order requires that DOE prepare an RIA on today's rule and that OIRA in OMB review this rule. DOE presented to OIRA for review the draft rule and other documents prepared for this rulemaking, including the RIA, and has included these documents in the rulemaking record. The assessments prepared pursuant to Executive Order 12866 can be found in the TSD for this rulemaking.

DOE has also reviewed this regulation pursuant to Executive Order 13563, issued on January 18, 2011. 76 FR 3281 (Jan. 21, 2011). Executive Order 13563 is supplemental to and explicitly reaffirms the principles, structures, and definitions governing regulatory review established in Executive Order 12866. To the extent permitted by law, agencies are required by Executive Order 13563 to: (1) Propose or adopt a regulation only upon a reasoned determination that its benefits justify its costs (recognizing that some benefits and costs are difficult to quantify); (2) tailor regulations to impose the least burden on society, consistent with obtaining regulatory objectives, taking into account, among other things, and to the extent practicable, the costs of cumulative regulations; (3) select, in choosing among alternative regulatory approaches, those approaches that maximize net benefits (including potential economic, environmental, public health and safety, and other advantages; distributive impacts; and equity); (4) to the extent feasible, specify performance objectives, rather than specifying the behavior or manner of compliance that regulated entities must adopt; and (5) identify and assess available alternatives to direct regulation, including providing economic incentives to encourage the desired behavior, such as user fees or marketable permits, or providing information upon which choices can be made by the public.

DOE emphasizes as well that Executive Order 13563 requires agencies to use the best available techniques to quantify anticipated present and future benefits and costs as accurately as possible. In its guidance, ORIA has emphasized that such techniques may include identifying changing future compliance costs that might result from technological innovation or anticipated behavioral changes. For the reasons stated in the preamble, DOE believes that today's NOPR is consistent with these principles, including the requirement that, to the extent permitted by law, benefits justify costs and that net benefits are maximized.

B. Review Under the Regulatory Flexibility Act

The Regulatory Flexibility Act (5 U.S.C. 601 *et seq.*) requires preparation of a final regulatory flexibility analysis (FRFA) for any rule that by law must be proposed for public comment, unless the agency certifies that the rule, if promulgated, will not have a significant economic impact on a substantial number of small entities. As required by Executive Order 13272, ''Proper Consideration of Small Entities in Agency Rulemaking'' 67 FR 53461 (Aug. 16, 2002), DOE published procedures and policies on February 19, 2003 to ensure that the potential impacts of its rules on small entities are properly considered during the rulemaking process. 68 FR 7990. DOE has made its procedures and policies available on the Office of the General Counsel's Web site (*http://energy.gov/gc/office-general-counsel*).

1. Description and Estimated Number of Small Entities Regulated

For the manufacturers of commercial refrigeration equipment, the SBA has set a size threshold, which defines those entities classified as ''small businesses'' for the purposes of the statute. DOE used the SBA's small business size standards to determine whether any small entities would be subject to the requirements of the rule. 65 FR 30836, 30848 (May 15, 2000), as amended at 65 FR 53533, 53544 (Sept. 5, 2000) and codified at 13 CFR part 121. The size standards are listed by NAICS code and industry description and are available at: *http://www.sba.gov/sites/default/files/files/Size_Standards_Table.pdf*. Commercial refrigeration equipment manufacturing is classified under NAICS 333415, ''Air-Conditioning and Warm Air Heating Equipment and Commercial and Industrial Refrigeration Equipment Manufacturing.'' The SBA sets a threshold of 750 employees or less for an entity to be considered as a small business for this category.

During its market survey, DOE used available public information to identify potential small manufacturers. DOE's research involved industry trade association membership directories (including AHRI), public databases (*e.g.,* AHRI Directory,[91] the SBA Database[92]), individual company Web sites, and market research tools (*e.g.,* Dunn and Bradstreet reports[93] and Hoovers reports)[94] to create a list of companies that manufacture or sell products covered by this rulemaking. DOE also asked stakeholders and industry representatives if they were aware of any other small manufacturers during manufacturer interviews and at DOE public meetings. DOE reviewed publicly available data and contacted select companies on its list, as necessary, to determine whether they met the SBA's definition of a small business manufacturer of covered commercial refrigeration equipment. DOE screened out companies that do not offer products covered by this rulemaking, do not meet the definition of a ''small business,'' or are foreign owned.

DOE identified 54 companies selling commercial refrigeration equipment products in the United States. Nine of the companies are foreign-owned firms. Of the remaining 45 companies, about 70 percent (32 companies) are small domestic manufacturers. DOE contacted eight domestic commercial refrigeration equipment manufacturers for interviews and all eight companies accepted. Of these eight companies, four were small businesses.

2. Description and Estimate of Compliance Requirements

The 32 identified domestic manufacturers of commercial refrigeration equipment that qualify as small businesses under the SBA size standard account for approximately 26 percent of commercial refrigeration equipment shipments.[95] While some small businesses have significant market share (*e.g.,* Continental has a 4-percent market share for foodservice commercial refrigeration)[95], the majority of small businesses have less than a 1-percent market share. These smaller firms often specialize in designing custom products and servicing niche markets.

At the proposed level, the average small manufacturer is expected to face capital conversion costs that are more than triple the average annual capital expenditures, and product conversion costs that are 80% of annual R&D spending, as shown in Table VI.1. At the proposed level, the conversion costs are driven by the incorporation of thicker insulation into case designs. The thicker cases design may necessitate the purchase of new jigs for production. Manufacturer estimates of the cost of a new jig ranged from $50,000 to $300,000 in 2011, depending on the jig design. In addition to the cost of jigs, changes in case thickness may require product redesign due to changes in the interior volume of the equipment and may require new industry certifications.

The proposed standard could cause small manufacturers to be at a disadvantage relative to large manufacturers. The capital conversion costs represent a smaller percentage of annual capital expenditures for large manufacturers than for small manufacturers. The capital conversion costs are 60 percent of annual capital expenditures for an average large manufacturer, while capital conversion costs are 423 percent of annual capital expenditures for an average small manufacturer. Small manufacturers may have greater difficulty obtaining credit, or may obtain less favorable terms than larger competitors when financing the equipment necessary to meet an amended standard.

[91] See *www.ahridirectory.org/ahriDirectory/pages/home.aspx*.

[92] See *http://dsbs.sba.gov/dsbs/search/dsp_dsbs.cfm*.

[93] See *www.dnb.com/*.

[94] See *www.hoovers.com/*.

[95] 32nd Annual Portrait of the U.S. Appliance Industry. *Appliance Magazine.* September 2009. 66(7).

Additionally, small manufacturers may be disproportionately affected by equipment conversion costs. Product redesign and industry certification costs tend to be fixed and do not scale with sales volume. For each equipment platform, small businesses must make equipment redesign investments that are similar to their large competitors. However, small manufacturer costs are spread over a much lower volume of units, making cost recovery more difficult.

Manufacturers indicated that many design options evaluated in the engineering analysis (*e.g.,* higher efficiency lighting, motors, and compressors) would force them to purchase more expensive components. Due to smaller purchasing volumes, small manufacturers typically pay higher prices for components, while their large competitors receive volume discounts. At the proposed standard, small businesses will likely have greater increases in component costs than large businesses and will thus be at a pricing disadvantage.

Small firms would likely be at a disadvantage relative to larger firms in meeting an amended energy conservation standard for commercial refrigeration equipment. The small businesses face disadvantages in terms of access to capital, the cost of product redesigns, and pricing for key components. As a result, DOE could not certify that the proposed standards would not have a significant impact on a significant number of small businesses.

To estimate how small manufacturers would be potentially impacted, DOE used the market share of small manufacturers to estimate the annual revenue, earnings before interest and tax (EBIT), R&D expense, and capital expenditures for a typical small manufacturer. DOE then compared these costs to the required capital and product conversion costs at each TSL for both an average small manufacturer (Table VI.1) and an average large manufacturer (Table VI.2). In the following tables, TSL 4 represents the proposed standard.

TABLE VI.1—COMPARISON OF AN AVERAGE SMALL COMMERCIAL REFRIGERATION EQUIPMENT MANUFACTURER'S CONVERSION COSTS TO ANNUAL EXPENSES, REVENUE, AND PROFIT

TSL	Capital conversion cost as a percentage of annual capital expenditures	Product conversion cost as a percentage of annual R&D expense	Total conversion cost as a percentage of annual revenue	Total conversion cost as a percentage of annual EBIT
TSL 1	0	0	0	0
TSL 2	102	71	5	63
TSL 3	238	76	10	119
TSL 4	423	80	17	196
TSL 5	1400	489	62	717

TABLE VI.2—COMPARISON OF AN AVERAGE LARGE COMMERCIAL REFRIGERATION EQUIPMENT MANUFACTURER'S CONVERSION COSTS TO ANNUAL EXPENSES, REVENUE, AND PROFIT

TSL	Capital conversion cost as a percentage of annual capital expenditures	Product conversion cost as a percentage of annual R&D expense	Total conversion cost as a percentage of annual revenue	Total conversion cost as a percentage of annual EBIT
TSL 1	0	0	0	0
TSL 2	15	10	1	9
TSL 3	34	11	1	17
TSL 4	60	11	2	28
TSL 5	200	70	9	102

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

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

4. Significant Alternatives to the Rule

The primary alternatives to the proposed rule are the TSLs other than the one proposed today, TSL 4. DOE explicitly considered the role of manufacturers, including small manufacturers, in its selection of TSL 4 rather than TSL 5. Though TSL 5 results in greater energy savings for the country, the standard would place excessive burdens on manufacturers. Chapter 12 of the NOPR TSD contains additional information about the impact of this rulemaking on manufacturers.

In addition to the other TSLs being considered, the NOPR TSD includes an RIA. For commercial refrigeration equipment, the RIA discusses the following policy alternatives: (1) No change in standard; (2) customer rebates; (3) customer tax credits; (4) manufacturer tax credits; and (5) early replacement. While these alternatives may mitigate to some varying extent the economic impacts on small entities compared to the amended standards, DOE determined that the energy savings of these regulatory alternatives would be at least five times smaller than those that would be expected to result from adoption of the proposed amended standard levels. Thus, DOE rejected these alternatives and is proposing to adopt the amended standards set forth in this rulemaking. (See chapter 17 of the NOPR TSD for further detail on the policy alternatives DOE considered.)

However, DOE seeks comment and, in particular, data on the impacts of this rulemaking on small businesses. (See Issue 10 under ''Issues on Which DOE Seeks Comment'' in section VII.E of this NOPR.)

C. Review Under the Paperwork Reduction Act

Manufacturers of commercial refrigeration equipment must certify to DOE that their products comply with any applicable energy conservation standards. In certifying compliance, manufacturers must test their products according to the DOE test procedures for commercial refrigeration equipment, including any amendments adopted for those test procedures. DOE has established regulations for the certification and recordkeeping requirements for all covered consumer products and commercial equipment, including commercial refrigeration equipment. 76 FR 12422 (March 7, 2011). The collection-of-information requirement for the certification and recordkeeping is subject to review and approval by OMB under the Paperwork Reduction Act (PRA). This requirement has been approved by OMB under OMB Control Number 1910–1400. Public reporting burden for the certification is estimated to average 20 hours per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information.

Notwithstanding any other provision of the law, no person is required to respond to, nor shall any person be subject to a penalty for failure to comply with, a collection of information subject to the requirements of the PRA, unless that collection of information displays a currently valid OMB Control Number.

D. Review Under the National Environmental Policy Act of 1969

Pursuant to the National Environmental Policy Act (NEPA) of 1969, (42 U.S.C. 4321 *et seq.*) DOE has determined that the proposed rule fits within the category of actions included in Categorical Exclusion (CX) B5.1 and otherwise meets the requirements for application of a CX. *See* 10 CFR part 1021, appendix B, B5.1(b); 1021.410(b) and appendix B, B(1)–(5). The proposed rule fits within the category of actions because it is a rulemaking that establishes energy conservation standards for consumer products or industrial equipment, and for which none of the exceptions identified in CX B5.1(b) apply. Therefore, DOE has made a CX determination for this rulemaking, and DOE does not need to prepare an Environmental Assessment or Environmental Impact Statement for this proposed rule. DOE's CX determination for this proposed rule is available at *http://cxnepa.energy.gov/.*

E. Review Under Executive Order 13132

Executive Order 13132, ''Federalism,'' 64 FR 43255 (Aug. 10, 1999), imposes certain requirements on Federal agencies formulating and implementing policies or regulations that preempt State law or that have Federalism implications. The Executive Order requires agencies to examine the constitutional and statutory authority supporting any action that would limit the policymaking discretion of the States and to carefully assess the necessity for such actions. The Executive Order also requires agencies to have an accountable process to ensure meaningful and timely input by State and local officials in the development of regulatory policies that have Federalism implications. On March 14, 2000, DOE published a statement of policy describing the intergovernmental consultation process it will follow in the development of such regulations. 65 FR 13735. EPCA governs and prescribes Federal preemption of State regulations as to energy conservation for the products that are the subject of today's proposed rule. States can petition DOE for exemption from such preemption to the extent, and based on criteria, set forth in EPCA. (42 U.S.C. 6297) No further action is required by Executive Order 13132.

F. Review Under Executive Order 12988

With respect to the review of existing regulations and the promulgation of new regulations, section 3(a) of Executive Order 12988, ''Civil Justice Reform,'' imposes on Federal agencies the general duty to adhere to the following requirements: (1) eliminate drafting errors and ambiguity; (2) write regulations to minimize litigation; and (3) provide a clear legal standard for affected conduct rather than a general standard and promote simplification and burden reduction. 61 FR 4729 (Feb. 7, 1996). Section 3(b) of Executive Order 12988 specifically requires that Executive agencies make every reasonable effort to ensure that the regulation: (1) Clearly specifies the preemptive effect, if any; (2) clearly specifies any effect on existing Federal law or regulation; (3) provides a clear legal standard for affected conduct while promoting simplification and burden reduction; (4) specifies the retroactive effect, if any; (5) adequately defines key terms; and (6) addresses other important issues affecting clarity and general draftsmanship under any guidelines issued by the Attorney General. Section 3(c) of Executive Order 12988 requires Executive agencies to review regulations in light of applicable standards in section 3(a) and section 3(b) to determine whether they are met or it is unreasonable to meet one or more of them. DOE has completed the required review and determined that, to the extent permitted by law, this proposed rule meets the relevant standards of Executive Order 12988.

G. Review Under the Unfunded Mandates Reform Act of 1995

Title II of the Unfunded Mandates Reform Act of 1995 (UMRA) requires each Federal agency to assess the effects of Federal regulatory actions on State, local, and Tribal governments and the private sector. Public Law 104–4, sec. 201 (codified at 2 U.S.C. 1531). For a proposed regulatory action likely to result in a rule that may cause the expenditure by State, local, and Tribal governments, in the aggregate, or by the private sector of $100 million or more in any one year (adjusted annually for inflation), section 202 of UMRA requires a Federal agency to publish a written statement that estimates the resulting costs, benefits, and other effects on the national economy. (2 U.S.C. 1532(a), (b)) The UMRA also requires a Federal agency to develop an effective process to permit timely input by elected officers of State, local, and Tribal governments on a proposed ''significant intergovernmental mandate,'' and requires an agency plan for giving notice and opportunity for timely input to potentially affected small governments before establishing any requirements that might significantly or uniquely affect small governments. On March 18, 1997, DOE published a statement of policy on its process for intergovernmental consultation under UMRA. 62 FR 12820. DOE's policy statement is also available at *http://energy.gov/gc/office-general-counsel*.

Although today's proposed rule does not contain a Federal intergovernmental mandate, it may require expenditures of $100 million or more on the private sector. Specifically, the proposed rule will likely result in a final rule that could require expenditures of $100 million or more. Such expenditures may include: (1) Investment in research and development and in capital expenditures by commercial refrigeration equipment manufacturers in the years between the final rule and the compliance date for the new standards; and (2) incremental additional expenditures by customers to purchase higher efficiency commercial refrigeration equipment, starting at the compliance date for the applicable standard.

Section 202 of UMRA authorizes a Federal agency to respond to the content requirements of UMRA in any other statement or analysis that accompanies the proposed rule. (2 U.S.C. 1532(c)) The content requirements of section 202(b) of UMRA relevant to a private sector mandate substantially overlap the economic analysis requirements that apply under section 325(o) of EPCA and

Executive Order 12866. The **SUPPLEMENTARY INFORMATION** section of this NOPR and the ''Regulatory Impact Analysis'' section of the NOPR TSD for this proposed rule respond to those requirements.

Under section 205 of UMRA, DOE is obligated to identify and consider a reasonable number of regulatory alternatives before promulgating a rule for which a written statement under section 202 is required. (2 U.S.C. 1535(a)) DOE is required to select from those alternatives the most cost-effective and least burdensome alternative that achieves the objectives of the proposed rule unless DOE publishes an explanation for doing otherwise, or the selection of such an alternative is inconsistent with law. As required by 42 U.S.C. 6295(d), (f), and (o), 6313(e), and 6316(a), today's proposed rule would establish energy conservation standards for commercial refrigeration equipment that are designed to achieve the maximum improvement in energy efficiency that DOE has determined to be both technologically feasible and economically justified. A full discussion of the alternatives considered by DOE is presented in the ''Regulatory Impact Analysis'' section of the TSD for today's proposed rule.

H. Review Under the Treasury and General Government Appropriations Act, 1999

Section 654 of the Treasury and General Government Appropriations Act, 1999 (Pub. L. 105–277) requires Federal agencies to issue a Family Policymaking Assessment for any rule that may affect family well-being. This rule would not have any impact on the autonomy or integrity of the family as an institution. Accordingly, DOE has concluded that it is not necessary to prepare a Family Policymaking Assessment.

I. Review Under Executive Order 12630

DOE has determined, under Executive Order 12630, ''Governmental Actions and Interference with Constitutionally Protected Property Rights,'' 53 FR 8859 (Mar. 18, 1988), that this regulation would not result in any takings that might require compensation under the Fifth Amendment to the U.S. Constitution.

J. Review Under the Treasury and General Government Appropriations Act, 2001

Section 515 of the Treasury and General Government Appropriations Act, 2001 (44 U.S.C. 3516, note) provides for Federal agencies to review most disseminations of information to the public under guidelines established by each agency pursuant to general guidelines issued by OMB. OMB's guidelines were published at 67 FR 8452 (Feb. 22, 2002), and DOE's guidelines were published at 67 FR 62446 (Oct. 7, 2002). DOE has reviewed today's NOPR under the OMB and DOE guidelines and has concluded that it is consistent with applicable policies in those guidelines.

K. Review Under Executive Order 13211

Executive Order 13211, ''Actions Concerning Regulations That Significantly Affect Energy Supply, Distribution, or Use,'' 66 FR 28355 (May 22, 2001), requires Federal agencies to prepare and submit to OIRA at OMB a Statement of Energy Effects for any proposed significant energy action. A ''significant energy action'' is defined as any action by an agency that promulgates or is expected to lead to promulgation of a final rule, and that: (1) Is a significant regulatory action under Executive Order 12866, or any successor order; and (2) is likely to have a significant adverse effect on the supply, distribution, or use of energy, or (3) is designated by the Administrator of OIRA as a significant energy action. For any proposed significant energy action, the agency must give a detailed statement of any adverse effects on energy supply, distribution, or use should the proposal be implemented, and of reasonable alternatives to the action and their expected benefits on energy supply, distribution, and use.

DOE has tentatively concluded that today's regulatory action, which sets forth proposed energy conservation standards for commercial refrigeration equipment, is not a significant energy action because the proposed standards are not likely to have a significant adverse effect on the supply, distribution, or use of energy, nor has it been designated as such by the Administrator at OIRA. Accordingly, DOE has not prepared a Statement of Energy Effects on the proposed rule.

L. Review Under the Information Quality Bulletin for Peer Review

On December 16, 2004, OMB, in consultation with the Office of Science and Technology Policy (OSTP), issued its Final Information Quality Bulletin for Peer Review (the Bulletin). 70 FR 2664 (Jan. 14, 2005). The Bulletin establishes that certain scientific information shall be peer reviewed by qualified specialists before it is disseminated by the Federal Government, including influential scientific information related to agency regulatory actions. The purpose of the Bulletin is to enhance the quality and credibility of the Government's scientific information. Under the Bulletin, the energy conservation standards rulemaking analyses are ''influential scientific information,'' which the Bulletin defines as scientific information the agency reasonably can determine will have, or does have, a clear and substantial impact on important public policies or private sector decisions. 70 FR 2667 (Jan. 14, 2005).

In response to OMB's Bulletin, DOE conducted formal in-progress peer reviews of the energy conservation standards development process and analyses and has prepared a Peer Review Report pertaining to the energy conservation standards rulemaking analyses. Generation of this report involved a rigorous, formal, and documented evaluation using objective criteria and qualified and independent reviewers to make a judgment as to the technical/scientific/business merit, the actual or anticipated results, and the productivity and management effectiveness of programs and/or projects. The ''Energy Conservation Standards Rulemaking Peer Review Report,'' dated February 2007, has been disseminated and is available at the following Web site: *www1.eere.energy.gov/buildings/appliance_standards/peer_review.html.*

VII. Public Participation

A. Attendance at the Public Meeting

The time, date, and location of the public meeting are listed in the **DATES** and **ADDRESSES** sections at the beginning of this notice. If you plan to attend the public meeting, please notify Ms. Brenda Edwards at (202) 586–2945 or *Brenda.Edwards@ee.doe.gov*. Please note that foreign nationals visiting DOE Headquarters are subject to advance security screening procedures. Any foreign national wishing to participate in the meeting should advise DOE as soon as possible by contacting Ms. Edwards to initiate the necessary procedures. Please also note that those wishing to bring laptops into the Forrestal Building will be required to obtain a property pass. Visitors should avoid bringing laptops, or allow an extra 45 minutes.

In addition, you can attend the public meeting via webinar. Webinar registration information, participant instructions, and information about the capabilities available to webinar participants will be published on DOE's Web site at: *www1.eere.energy.gov/buildings/appliance_standards/product.aspx/productid/52*. Participants are responsible for ensuring their systems are compatible with the webinar software.

B. Procedure for Submitting Prepared General Statements for Distribution

Any person who has plans to present a prepared general statement may request that copies of his or her statement be made available at the public meeting. Such persons may submit requests, along with an advance electronic copy of their statement in PDF (preferred), Microsoft Word or Excel, WordPerfect, or text (ASCII) file format, to the appropriate address shown in the **ADDRESSES** section at the beginning of this notice. The request and advance copy of statements must be received at least one week before the public meeting and may be emailed, hand-delivered, or sent by mail. DOE prefers to receive requests and advance copies via email. Please include a telephone number to enable DOE staff to make follow-up contact, if needed.

C. Conduct of the Public Meeting

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

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

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

A transcript of the public meeting will be included in the docket, which can be viewed as described in the *Docket* section at the beginning of this notice. In addition, any person may buy a copy of the transcript from the transcribing reporter.

D. Submission of Comments

DOE will accept comments, data, and information regarding this proposed rule before or after the public meeting, but no later than the date provided in the **DATES** section at the beginning of this proposed rule. Interested parties may submit comments, data, and other information using any of the methods described in the **ADDRESSES** section at the beginning of this notice.

Submitting comments via *regulations.gov.* The *regulations.gov* Web page will require you to provide your name and contact information. Your contact information will be viewable to DOE Building Technologies staff only. Your contact information will not be publicly viewable except for your first and last names, organization name (if any), and submitter representative name (if any). If your comment is not processed properly because of technical difficulties, DOE will use this information to contact you. If DOE cannot read your comment due to technical difficulties and cannot contact you for clarification, DOE may not be able to consider your comment.

However, your contact information will be publicly viewable if you include it in the comment itself or in any documents attached to your comment. Any information that you do not want to be publicly viewable should not be included in your comment, nor in any document attached to your comment. Otherwise, persons viewing comments will see only first and last names, organization names, correspondence containing comments, and any documents submitted with the comments.

Do not submit to *regulations.gov* information for which disclosure is restricted by statute, such as trade secrets and commercial or financial information (hereinafter referred to as Confidential Business Information (CBI)). Comments submitted through regulations.gov cannot be claimed as CBI. Comments received through the Web site will waive any CBI claims for the information submitted. For information on submitting CBI, see the Confidential Business Information section below.

DOE processes submissions made through regulations.gov before posting. Normally, comments will be posted within a few days of being submitted. However, if large volumes of comments are being processed simultaneously, your comment may not be viewable for up to several weeks. Please keep the comment tracking number that regulations.gov provides after you have successfully uploaded your comment.

Submitting comments via email, hand delivery/courier, or mail. Comments and documents submitted via email, hand delivery, or mail also will be posted to *regulations.gov.* If you do not want your personal contact information to be publicly viewable, do not include it in your comment or any accompanying documents. Instead, provide your contact information in a cover letter. Include your first and last names, email address, telephone number, and optional mailing address. The cover letter will not be publicly viewable as long as it does not include any comments.

Include contact information each time you submit comments, data, documents, and other information to DOE. If you submit via mail or hand delivery/courier, please provide all items on a CD, if feasible. It is not necessary to submit printed copies. No facsimiles (faxes) will be accepted.

Comments, data, and other information submitted to DOE electronically should be provided in PDF (preferred), Microsoft Word or Excel, WordPerfect, or text (ASCII) file format. Provide documents that are not secured, that are written in English, and that are free of any defects or viruses. Documents should not contain special characters or any form of encryption and, if possible, they should carry the electronic signature of the author.

Campaign form letters. Please submit campaign form letters by the originating organization in batches of between 50 to 500 form letters per PDF or as one form letter with a list of supporters' names compiled into one or more PDFs. This reduces comment processing and posting time.

Confidential Business Information. According to 10 CFR 1004.11, any person submitting information that he or she believes to be confidential and exempt by law from public disclosure should submit via email, postal mail, or hand delivery/courier two well-marked copies: One copy of the document marked confidential including all the information believed to be confidential, and one copy of the document marked non-confidential with the information believed to be confidential deleted. Submit these documents via email or on a CD, if feasible. DOE will make its own determination about the confidential status of the information and treat it according to its determination.

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

It is DOE's policy that all comments may be included in the public docket, without change and as received, including any personal information provided in the comments (except information deemed to be exempt from public disclosure).

E. Issues on Which DOE Seeks Comment

Although DOE welcomes comments on any aspect of this proposal, DOE is particularly interested in receiving comments and views of interested parties concerning the following issues.

1. Primary and Secondary Equipment Classes

In the January 2009 final rule analysis, DOE selected 15 ''primary'' classes to analyze directly in its engineering analyses, and designated the remaining 23 classes as ''secondary'' classes, for which standards were developed based on the primary class results. These designations were based on shipment-volume data coupled with input from stakeholders during that rulemaking process. As this rulemaking seeks to review and potentially amend standards for the 38 total equipment classes examined in the January 2009 final rule, DOE retained those primary and secondary class designations in its analyses. Additionally, equipment for which EPACT 2005 directly set standards was incorporated into the scope of this rulemaking. DOE treated all of these equipment classes previously covered by EPACT 2005 standards as primary classes. DOE seeks comment regarding its designation of primary and secondary equipment classes.

2. Design Option and Core Case Costs

During the NOPR analyses, DOE performed physical teardowns on a selection of units currently on the market. From the bills of materials and cost model developed using this teardown data, DOE calculated an estimate of the manufacturer production cost of the core case assembly for each of the primary equipment classes in the engineering analysis. DOE also developed estimates of the costs for components that affect energy consumption, namely those it considered as design options. These estimates were obtained from a combination of sources, including publicly available prices from vendors and confidential estimates provided by manufacturers. This price data was aggregated for use in the engineering analysis. DOE seeks comment and data regarding the manufacturer production costs for commercial refrigeration equipment cases and components and the technological feasibility of applying technologies identified in the engineering analysis to meeting the proposed standards.

3. Offset Factors

In its January 2009 final rule, DOE developed offset factors as a way to adjust the energy efficiency requirements for smaller equipment in each equipment class analyzed. These offset factors accounted for certain components of the refrigeration load (such as conduction end effects) that remain constant when equipment size varies and thus affect smaller cases disproportionately. The offset factors were intended to approximate these constant loads and provide a fixed end point, corresponding to a zero-volume or zero-TDA case, in an equation that describes the relationship between energy consumption and the corresponding TDA or volume metric. Similarly, the EPACT 2005 standards also contained values that did not vary with unit volume and which served a similar purpose. In developing standard level equations for the proposed amended standards, DOE scaled the existing offset factors by the ratio of the amount of energy consumption allowed by the existing standards for a given representative unit and the energy use calculated in the engineering analysis at each TSL. This adjustment of the offset factors ensures that neither larger nor smaller units are disadvantaged by these proposed standards. DOE seeks comment on its methodology for developing offset factors for the standard level equations presented in this NOPR.

4. Extension of Standards

In its January 2009 final rule, DOE developed a quantitative method for applying the standards developed for its primary equipment classes to the remaining, secondary classes. This approach involved extension multipliers created using results from the analysis of the primary equipment classes and a set of focused matched-pair analyses. Additionally, DOE applied standards developed for certain primary equipment classes directly to other similar secondary classes. In this rulemaking, DOE retained the extension multipliers from the January 2009 final rule and reapplied them to the equipment classes from that rulemaking for which DOE is proposing amended standards. DOE believes that the relationship between the performances of various types of equipment is still adequately modeled by the use of those multipliers. DOE's approach in developing extension multipliers in the 2009 rulemaking and its rationale for retaining them in this rulemaking are discussed in detail in section 5.9 of the NOPR TSD. DOE seeks comment on its approach to extending the results of the engineering analysis to secondary equipment classes. Specifically, DOE requests comment on whether the assumptions underlying its development and application of extension multipliers are appropriate, or whether there are additional differences between related equipment classes that DOE should take into account.

5. Types of Refrigerant Analyzed

DOE based its analysis on refrigeration equipment using R404A and R134a, HFC refrigerants widely used in the commercial refrigeration industry. DOE received comments regarding the consideration of refrigerants with lower GWP due to possible shifts in the marketplace toward these refrigerants and notes that a number of lower-GWP alternatives are available for use within certain portions of the commercial refrigeration sector.[96] The use of alternative refrigerants could be impacting to Climate Change and the environment. DOE requests comment on the extent of the current use or likely future use of lower-GWP refrigerants,

[96] For an overview of lower-GWP alternatives available to certain sections of the commercial refrigeration equipment sector, please see *http://www.epa.gov/ozone/downloads/EPA_HFC_ComRef.pdf*

and asks manufacturers to submit data related to the ability of equipment (either existing or redesigned) using these refrigerants to meet the proposed standard. DOE seeks input as to the impacts of alternative refrigerants to the refrigeration system in this rulemaking.

6. Distribution Channel Market Shares and Markups

DOE has revised the distribution channel market shares for some of the equipment classes based on comments received during April 2011 preliminary analysis public meeting. The markup values associated with each distribution channel have been updated based on currently available industry profit data. DOE welcomes comment on the assumptions and values used for the markups analysis.

7. Market Shares of Efficiency Levels

DOE seeks comments on the market shares of efficiency levels used for this NOPR analysis. DOE is currently using a model to predict the market share of efficiency levels. According to commenters, the calculated market shares are biased toward the higher efficiency levels. However, DOE has cited lack of data as the primary reason for its lack of more accurate numbers. DOE welcomes information from stakeholders that would aid DOE in improving upon the numbers for market shares of efficiency levels.

8. Maintenance and Repair Costs at Higher Efficiency Levels.

Currently, DOE assumes no increase in regular maintenance costs at higher efficiency levels contemplated in the proposed rule. Lighting maintenance and repair costs are estimated based on OEM costs; they vary with higher efficiency levels. DOE welcomes stakeholder input and additional information to improve upon these estimates with respect to maintenance and repair costs. Data pertaining to cost increases specifically associated with the design options considered in this rulemaking would be greatly appreciated.

9. Impact of Amended Standards on Future Shipments

Currently, DOE assumes that future shipments of commercial refrigeration equipment will not be affected by amended standards. While DOE has cited strong reasons to believe that this assumption is true for display cases, the assumption may not be entirely true in the case of equipment used in the foodservice industry. While there may be a small effect in the initial years of amended standards, DOE does not have data for the commercial refrigeration industry to obtain a reasonably accurate estimate of this effect. DOE welcomes stakeholder input and estimates on the effect of amended standards on future commercial refrigeration equipment shipments. DOE also welcomes input and data on the demand elasticity estimates used in the analysis.

10. Learning Impacts on Price Forecast for Future Shipments

Currently, DOE projects future prices by subtracting the cost reductions associated with learning effects from the cost associated with the amended standards. DOE analyzes learning effects using PPI, a quantity adjusted index of wholesale prices, as a proxy for price of commercial refrigerators. DOE is seeking input, and price data that could be used in place of PPI. Also DOE is seeking input on the magnitude of the price data and the cause of those price changes.

11. Product Attributes

DOE requests comment on whether there are features or attributes of the more energy-efficient commercial refrigerators that manufacturers would produce to meet the standards in this proposed rule that might affect how they would be used by different customer categories (e.g., refrigeration in grocery stores or restaurants). One example of such an effect might be that grocers or restaurant operators would change where, how, and how long food items would be stored or displayed. DOE requests comment specifically on how any such effects should be weighed in the choice of standards for these refrigerators for the final rule.

12. Analytical Timeline

For this rulemaking, DOE analyzed the effects of this proposal assuming that the commercial refrigerators would be available to purchase for 30 years and undertook a sensitivity analysis using 9 years rather than 30 years of product shipments. The choice of a 30-year period of shipments is consistent with the DOE analysis for other products and commercial equipment. The choice of a 9-year period is a proxy for the timeline in EPCA for the review of certain energy conservation standards and potential revision of and compliance with such revised standards. We are seeking input, information and data on whether there are ways to refine the analytic timeline further.

13. Equipment Lifetime

DOE defines lifetime as the age at which a commercial refrigeration equipment unit is retired from service. DOE based expected equipment lifetime on discussions with industry experts and concluded that a typical lifetime of 10 years is appropriate for most commercial refrigeration equipment in large grocery/multi-line stores and restaurants. Operators of small food retail stores, on the other hand, tend to use display cases longer. DOE used 15 years as the average equipment lifetime for display cases used in such retail stores. DOE welcomes further input on the average equipment lifetimes for the LCC analysis and NIA.

14. Small Businesses

During the Framework and preliminary analysis public meetings, DOE received many comments regarding the potential impacts of amended energy conservation standards on small business manufacturers of commercial refrigeration equipment. In its market and technology assessment and manufacturer impact analysis research, DOE developed a list of companies falling under its classification of small businesses, and sought specific feedback regarding potentially disproportionate impacts of amended standards on these businesses. DOE incorporated this feedback into its analyses for the NOPR and has presented its results in this notice and the technical support document. However, DOE seeks comment and, in particular, data, in its efforts to quantify the impacts of this rulemaking on small business manufacturers. In addition, DOE seeks comment on any disproportionate impacts of amended standards on any particular customer groups, such as small businesses that are small grocery, convenience stores, and restaurants.

15. Update to Social Cost of Carbon Values

DOE solicits comment on the application of the new SCC values used to determine the social benefits of CO_2 emissions reductions over the rulemaking analysis period. The rulemaking analysis period covers from 2017 to 2046 plus an additional 15 years to account for the lifetime of the equipment purchased between 2017 and 2046. In particular, the agency solicits comment on the agency's derivation of SCC values after 2050 where the agency applied the average annual growth rate of the SCC estimates in 2040–2050 associated with each of the four sets of values.

16. Cumulative Regulatory Burdens

The agency seeks input on the cumulative regulatory burden that may be imposed on industry either from recently implemented rulemakings for this product class or other rulemakings that affect the same industry.

17. Compliance Date

Pursuant to EPCA, any amended standards established in this rulemaking must apply to equipment that is manufactured on or after 3 years after the final rule is published in the **Federal Register** unless DOE determines, by rule, that a 3-year period is inadequate, in which case DOE may extend the compliance date for that standard by an additional 2 years. DOE proposes to provide 3 years for compliance with this standard, but seeks comment on whether it should consider a longer compliance date as authorized, and, if so, by how much.

VIII. Approval of the Office of the Secretary

The Secretary of Energy has approved publication of today's proposed rule.

List of Subjects in 10 CFR Part 431

Administrative practice and procedure, Confidential business information, Energy conservation, and Reporting and recordkeeping requirements.

Issued in Washington, DC, on August 29, 2013.

Mike Carr,

Acting Assistant Secretary, Energy Efficiency and Renewable Energy.

For the reasons set forth in the preamble, DOE proposes to amend part 431 of chapter II of title 10, of the Code of Federal Regulations, as set forth below:

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

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

Authority: 42 U.S.C. 6291–6317.

■ 2. Section 431.62 is amended by adding in alphabetical order a definition for ''service over counter,'' to read as follows:

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

* * * * *

Service over counter means equipment with sliding or hinged doors in the back intended for use by sales personnel for loading and retrieving items for sale and fixed, sliding or hinged transparent panels in the front for displaying merchandise. The equipment has a height no greater than 66 inches and is intended to serve as a counter for transactions between sales personnel and customers.

* * * * *

■ 3. Section 431.66 is amended by:
■ a. Revising paragraph (a)(3);
■ b. Revising paragraph (b) introductory text;
■ c. Revising paragraph (c);
■ d. Revising paragraph (d) introductory text; and
■ c. Adding paragraph (e).

The revisions and addition read as follows:

§ 431.66 Energy conservation standards and their effective dates.

(a) * * *

(3) For the purpose of paragraph (d) of this section, the term ''TDA'' means the total display area (ft^2) of the case, as defined in ARI Standard 1200–2006, appendix D (incorporated by reference, see § 431.63). For the purpose of paragraph (e) of this section, the term ''TDA'' means the total display area (ft^2) of the case, as defined in AHRI Standard 1200 (I–P)-2010, appendix D (incorporated by reference, see § 431.63).

(b) Each commercial refrigerator, freezer, and refrigerator-freezer with a self-contained condensing unit designed for holding temperature applications manufactured on or after January 1, 2010 and before [*date 3 years after date of publication of the final rule in the* ***Federal Register***] shall have a daily energy consumption (in kilowatt-hours per day) that does not exceed the following:

* * * * *

(c) Each commercial refrigerator with a self-contained condensing unit designed for pull-down temperature applications and transparent doors manufactured on or after January 1, 2010 and before [*date 3 years after date of publication of the final rule in the* ***Federal Register***] shall have a daily energy consumption (in kilowatt-hours per day) of not more than 0.126V + 3.51.

(d) Each commercial refrigerator, freezer, and refrigerator-freezer with a self-contained condensing unit and without doors; commercial refrigerator, freezer, and refrigerator-freezer with a remote condensing unit; and commercial ice-cream freezer manufactured on or after January 1, 2012 and before [*date 3 years after date of publication of the final rule in the* ***Federal Register***] shall have a daily energy consumption (in kilowatt-hours per day) that does not exceed the levels specified:

* * * * *

(e) Each commercial refrigerator, freezer, and refrigerator-freezer with a self-contained condensing unit designed for holding temperature applications and with solid or transparent doors; commercial refrigerator with a self-contained condensing unit designed for pull-down temperature applications and with transparent doors; commercial refrigerator, freezer, and refrigerator-freezer with a self-contained condensing unit and without doors; commercial refrigerator, freezer, and refrigerator-freezer with a remote condensing unit; and commercial ice-cream freezer manufactured on or after [*date 3 years after date of publication of the final rule in the* ***Federal Register***], shall have a daily energy consumption (in kilowatt-hours per day) that does not exceed the levels specified:

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

Equipment category	Condensing unit configuration	Equipment family	Rating temp. °F	Operating temp. °F	Equipment class designation*	Maximum daily energy consumption kWh/day
Remote Condensing Commercial Refrigerators and Commercial Freezers.	Remote (RC)	Vertical Open (VOP)	38 (M)	≥32	VOP.RC.M	0.61 × TDA + 3.03
			0 (L)	<32	VOP.RC.L	2.11 × TDA + 6.36
		Semivertical Open (SVO).	38 (M)	≥32	SVO.RC.M	0.63 × TDA + 2.41
			0 (L)	<32	SVO.RC.L	2.11 × TDA + 6.36
		Horizontal Open (HZO).	38 (M)	≥32	HZO.RC.M	0.35 × TDA + 2.88
			0 (L)	<32	HZO.RC.L	0.57 × TDA + 6.88
		Vertical Closed Transparent (VCT).	38 (M)	≥32	VCT.RC.M	0.08 × TDA + 0.72
			0 (L)	<32	VCT.RC.L	0.43 × TDA + 2.03
		Horizontal Closed Transparent (HCT).	38 (M)	≥32	HCT.RC.M	0.14 × TDA + 0.11
			0 (L)	<32	HCT.RC.L	0.3 × TDA + 0.23
		Vertical Closed Solid (VCS).	38 (M)	≥32	VCS.RC.M	0.1 × V + 0.24
			0 (L)	<32	VCS.RC.L	0.21 × V + 0.5

Equipment category	Condensing unit configuration	Equipment family	Rating temp. °F	Operating temp. °F	Equipment class designation*	Maximum daily energy consumption kWh/day
		Horizontal Closed Solid (HCS).	38 (M)	≥32	HCS.RC.M	0.1 × V + 0.24
			0 (L)	<32	HCS.RC.L	0.21 × V + 0.5
		Service Over Counter (SOC).	38 (M)	≥32	SOC.RC.M	0.39 × TDA + 0.08
			0 (L)	<32	SOC.RC.L	0.83 × TDA + 0.18
Self-Contained Commercial Refrigerators and Commercial Freezers Without Doors.	Self-Contained (SC)	Vertical Open (VOP)	38 (M)	≥32	VOP.SC.M	1.51 × TDA + 4.09
			0 (L)	<32	VOP.SC.L	3.79 × TDA + 10.26
		Semivertical Open (SVO).	38 (M)	≥32	SVO.SC.M	1.5 × TDA + 3.99
			0 (L)	<32	SVO.SC.L	3.77 × TDA + 10.01
		Horizontal Open (HZO).	38 (M)	≥32	HZO.SC.M	0.75 × TDA + 5.44
			0 (L)	<32	HZO.SC.L	1.92 × TDA + 7.08
Self-Contained Commercial Refrigerators and Commercial Freezers With Doors.	Self-Contained (SC)	Vertical Closed Transparent (VCT).	38 (M)	≥32	VCT.SC.M	0.04 × V + 1.07
			0 (L)	<32	VCT.SC.L	0.22 × V + 1.21
		Vertical Closed Solid (VCS).	38 (M)	≥32	VCS.SC.M	0.03 × V + 0.53
			0(L)	<32	VCS.SC.L	0.13 × V + 0.43
		Horizontal Closed Transparent (HCT).	38 (M)	≥32	HCT.SC.M	0.02 × V + 0.51
			0 (L)	<32	HCT.SC.L	0.11 × V + 0.6
		Horizontal Closed Solid (HCS).		≥32	HCS.SC.M	0.02 × V + 0.37
			0 (L).	<32	HCS.SC.L	0.12 × V + 0.42
		Service Over Counter (SOC).		≥32	SOC.SC.M	0.32 × TDA + 0.53
			0 (L).	<32	SOC.SC.L	0.67 × TDA + 1.12
Self-Contained Commercial Refrigerators with Transparent Doors for Pull-Down Temperature Applications.	Self-Contained (SC)	Pull-Down (PD)	38 (M)	≥32	PD.SC.M	0.03 × V + 0.83
Commercial Ice-Cream Freezers.	Remote (RC)	Vertical Open (VOP)	−15 (I)	≤−5**	VOP.RC.I	2.68 × TDA + 8.08
		Semivertical Open (SVO).			SVO.RC.I	2.68 × TDA + 8.08
		Horizontal Open (HZO).			HZO.RC.I	0.72 × TDA + 8.74
		Vertical Closed Transparent (VCT).			VCT.RC.I	0.51 × TDA + 2.37
		Horizontal Closed Transparent (HCT).			HCT.RC.I	0.35 × TDA + 0.27
		Vertical Closed Solid (VCS).			VCS.RC.I	0.25 × V + 0.58
		Horizontal Closed Solid (HCS).			HCS.RC.I	0.25 × V + 0.58
		Service Over Counter (SOC).			SOC.RC.I	0.97 × TDA + 0.21
	Self-Contained (SC)	Vertical Open (VOP)			VOP.SC.I	4.81 × TDA + 13.03
		Semivertical Open (SVO)\.			SVO.SC.I	4.79 × TDA + 12.72
		Horizontal Open (HZO).			HZO.SC.I	2.44 × TDA + 9.0
		Vertical Closed Transparent (VCT).			VCT.SC.I	0.52 × TDA + 2.56
		Horizontal Closed Transparent (HCT).			HCT.SC.I	0.49 × TDA + 0.37
		Vertical Closed Solid (VCS).			VCS.SC.I	0.35 × V + 0.81
		Horizontal Closed Solid (HCS).			HCS.SC.I	0.35 × V + 0.81
		Service Over Counter (SOC).			SOC.SC.I	1.35 × TDA + 0.29

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

** Ice-cream freezer is defined in 10 CFR 431.62 as 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.

(2) For commercial refrigeration equipment with two or more compartments (*i.e.,* hybrid refrigerators, hybrid freezers, hybrid refrigerator-freezers, and non-hybrid refrigerator-freezers), the maximum daily energy consumption for each model shall be the sum of the MDEC values for all of its compartments. For each compartment, measure the TDA or volume of that compartment, and determine the appropriate equipment class based on that compartment's equipment family, condensing unit configuration, and designed operating temperature. The MDEC limit for each compartment shall be the calculated value obtained by entering that compartment's TDA or volume into the standard equation in paragraph (e)(1) of this section for that compartment's equipment class. Measure the CDEC or TDEC for the entire case as described in § 431.66(d)(2)(i) through (iii), except

that where measurements and calculations reference ARI Standard 1200–2006 (incorporated by reference, see § 431.63), AHRI Standard 1200 (I–P)-2010 (incorporated by reference, see § 431.63) shall be used.

(3) For remote condensing and self-contained wedge cases, measure the CDEC or TDEC according to the AHRI Standard 1200 (I–P)-2010 test procedure (incorporated by reference, see § 431.63). For wedge cases in equipment classes for which a volume metric is used, the MDEC shall be the amount derived from the appropriate standards equation in paragraph (e)(1) of this section. For wedge cases of equipment classes for which a TDA metric is used, the MDEC for each model shall be the amount derived by incorporating into the standards equation in paragraph (e)(1) of this section for the equipment class a value for the TDA that is the product of:

(i) The vertical height of the air curtain (or glass in a transparent door) and

(ii) The largest overall width of the case, when viewed from the front.

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