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[6450-01-P]

DEPARTMENT OF ENERGY

10 CFR Part 431

[Docket No. EERE–2008–BT–STD–0015]

RIN: 1904-AB86

Energy Conservation Program: Energy Conservation Standards for Walk-in Coolers and Freezers

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

ACTION: Notice of proposed rulemaking (NOPR) 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 walk-in coolers and walk-in freezers. 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 walk-in coolers and walk-in freezers. 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 Wednesday, October 9, 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 [**INSERT DATE 60 DAYS AFTER DATE OF PUBLICATION IN THE FEDERAL REGISTER PUBLICATION**]. 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. For more information, refer to section VII, Public Participation.

Any comments submitted must identify the NOPR for Energy Conservation Standards for walk-in coolers and freezers, and provide docket number EERE-2008–BT–STD–0015 and/or regulatory information number (RIN) number 1904-AB86. Comments may be submitted using any of the following methods:

1. Federal eRulemaking Portal: www.regulations.gov. Follow the instructions for submitting comments.

2. E-mail: WICF-2008-STD-0015@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 Office, 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 Office, 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 e-mail 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 webpage can be found at: http://www1.eere.energy.gov/buildings/appliance_standards/rulemaking.aspx/ruleid/30. This webpage contains a link to the docket for this notice on the regulations.gov site. The regulations.gov webpage contains 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. E-mail: walk-in_coolers_and_walk-in_freezers@EE.Doe.Gov .

Mr. Michael Kido, U.S. Department of Energy, Office of the General Counsel, GC-71, 1000 Independence Avenue, SW., Washington, DC, 20585-0121. Telephone: (202) 586-8145. E-mail: Michael.Kido@hq.doe.gov.

SUPPLEMENTARY INFORMATION:

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I. Summary of the Proposed Rule

DOE proposes creating new performance-based energy conservation standards for walk-in coolers and walk-in freezers (collectively, "walk-ins" or "WICFs"). The proposed standards, which are expressed as an annual walk-in energy factor (AWEF) for refrigeration systems, the maximum allowable U-factor expressed as a function of the ratio of edge area to core area for panels, and the maximum allowable daily energy use expressed as a function of the surface area for non-display and display doors, are shown in Table I.1. These proposed standards, if adopted, would apply to all products listed in Table I.1 and manufactured in, or imported into, the United States on or after 3 years after the publication date of any final rule establishing energy conservation standards for walk-ins. Appendix 10D of the TSD lists the technologies that DOE assumes manufacturers will use to meet the proposed standards.

Table I-1 Proposed Energy Conservation Standards for Walk-in Coolers and Walk-in Freezers (Assumes Compliance Starting 3 Years After the Publication Date of any Final Rule)

Class Descriptor	Class	Proposed Standard Level
Refrigeration Systems		**Minimum AWEF (Btu/W-h)***
Dedicated Condensing, Medium Temperature, Indoor System, < 9,000 Btu/h Capacity	DC.M.I, < 9,000	$2.63 \times 10^{-4} \times Q + 4.53$
Dedicated Condensing, Medium Temperature, Indoor System, ≥ 9,000 Btu/h Capacity	DC.M.I, ≥ 9,000	6.90
Dedicated Condensing, Medium Temperature, Outdoor System, < 9,000 Btu/h Capacity	DC.M.O, < 9,000	$1.34 \times 10^{-3} \times Q + 0.12$
Dedicated Condensing, Medium Temperature, Outdoor System, ≥ 9,000 Btu/h Capacity	DC.M.O, ≥ 9,000	12.21
Dedicated Condensing, Low Temperature, Indoor System, < 9,000 Btu/h Capacity	DC.L.I, < 9,000	$1.93 \times 10^{-4} \times Q + 1.89$
Dedicated Condensing, Low Temperature, Indoor System, ≥ 9,000 Btu/h Capacity	DC.L.I, ≥ 9,000	3.63
Dedicated Condensing, Low Temperature, Outdoor System, < 9,000 Btu/h Capacity	DC.L.O, < 9,000	$5.70 \times 10^{-4} \times Q + 1.02$
Dedicated Condensing, Low Temperature, Outdoor System, ≥ 9,000 Btu/h Capacity	DC.L.O, ≥ 9,000	6.15
Multiplex Condensing, Medium Temperature	MC.M	10.74
Multiplex Condensing, Low Temperature	MC.L	5.53
Panels		**Maximum U-Factor (Btu/h-ft^2-°F)****
Structural Panel, Medium Temperature	SP.M	$-0.012 \times \left(\frac{A_{\text{nf edge}}}{A_{\text{nf core}}}\right)^2 + 0.024 \times \left(\frac{A_{\text{nf edge}}}{A_{\text{nf core}}}\right) + 0.041$
Structural Panel, Low Temperature	SP.L	$-0.0083 \times \left(\frac{A_{\text{nf edge}}}{A_{\text{nf core}}}\right)^2 + 0.017 \times \left(\frac{A_{\text{nf edge}}}{A_{\text{nf core}}}\right) + 0.029$
Floor Panel, Low Temperature	FP.L	$-0.0091 \times \left(\frac{A_{\text{fp edge}}}{A_{\text{fp core}}}\right)^2 + 0.018 \times \left(\frac{A_{\text{fp edge}}}{A_{\text{fp core}}}\right) + 0.033$
Non-Display Doors		**Maximum Energy Consumption (kWh/day)†**
Passage Door, Medium Temperature	PD.M	$0.0032 \times A_{nd} + 0.22$

Passage Door, Low Temperature	PD.L	$0.14 \times A_{nd} + 4.0$
Freight Door, Medium Temperature	FD.M	$0.0073 \times A_{nd} + 0.082$
Freight Door, Low Temperature	FD.L	$0.11 \times A_{nd} + 5.4$
Display Doors		**Maximum Energy Consumption (kWh/day)††**
Display Door, Medium Temperature	DD.M	$0.049 \times A_{dd} + 0.39$
Display Door, Low Temperature	DD.L	$0.33 \times A_{dd} + 0.38$

*Q represents the system gross capacity as calculated in AHRI 1250.
**$A_{nf\ edge}$ and $A_{nf\ core}$ represent the edge and core surface area of the structural panel, respectively. $A_{fp\ edge}$ and $A_{fp\ core}$ represent the edge and core surface area of the floor panel, respectively.
† A_{nd} represents the surface area of the non-display door.
†† A_{dd} represents the surface area of the display door.

A. Benefits and Costs to Consumers

Table I-2 presents DOE's evaluation of the economic impacts of the proposed standards on consumers of walk-in coolers and freezers, as measured by the shipment-weighted average life-cycle cost (LCC) savings[1] and the median payback period[2]. The average LCC savings are positive for all equipment classes. At TSL 4, the percentage of customers who experience net benefits or no impacts ranges from 55 to 100 percent, and the percentage of customers experiencing a net cost ranges from 0 to 45 percent. Chapter 11 presents the LCC subgroup analysis on groups of customers that may be disproportionately affected by the proposed standard. The installed cost increase over the 9-year analysis period (2017-2025) for the proposed TSL is 1.98 billion discounted at 7 percent.

[1] 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.
[2] 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.

Table I-2 Shipment-Weighted Average Impacts of Proposed Standards (TSL 4) on Consumers of Walk-in Coolers and Walk-in Freezers

Equipment Class	Average LCC Savings (2012$)	Median Payback Period (years)
Refrigeration System Class*		
DC.M.I	$611	4.4
DC.M.O	$3,195	2.2
DC.L.I	$1,117	2.7
DC.L.O	$2,664	2.3
MC.M	$1,724	0.5
MC.L	$2,061	0.4
Panel Class		
SP.M**	$8	4.5
SP.L**	$72	3.6
FP.L**	$30	4.5
Non-Display Door Class		
PD.M	$0.3	5.5
PD.L	$52	4.7
FD.M	$1	5.4
FD.L	$136	2.9
Display Door Class		
DD.M	$228	2.2
DD.L	$200	N/A

*For dedicated condensing (DC) refrigeration systems, results include both capacity ranges.
**Results are per 100 square feet.

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 through the end of the analysis period (2013 to 2046). Using real discount rates of 10.5 percent for panels, 9.4 percent for doors, and 10.4 percent for refrigeration[3], DOE estimates that the industry net present value (INPV) for manufacturers of walk-in cooler and freezer refrigeration systems, panels, and doors in the base case (without new standards) is $851 million in 2012$. Under the proposed standards, DOE expects the impact on INPV to range from no change to a 9 percent decrease. Total industry conversion costs estimated to be $51 million are assumed to be incurred in the years prior to the start of compliance with the

[3] These rates were used to discount future cash flows in the Manufacturer Impact Analysis. The discount rates were calculated from SEC filings and then adjusted based on cost of capital feedback collected from walk-in door, panel, and refrigeration manufacturers in MIA interviews. For a detailed explanation of how DOE arrived at these discount rates, refer to Chapter 12 of the NOPR TSD.

standards. Based on DOE's interviews with the manufacturers of walk-in coolers and walk-in freezers, DOE does not expect significant loss of employment.

C. National Benefits[4]

DOE's analyses indicate that the proposed standards would save a significant amount of energy. The lifetime full-fuel-cycle energy savings for walk-in coolers and freezers purchased in the 30-year period that begins in the year of compliance with new standards (2017–2046) amount to 5.39 quadrillion British thermal units (quads). The average annual energy savings over the life of walk-in coolers and freezers purchased in 2017 through 2046 is 0.18 quads, which is equivalent to 14.8 percent of the annual U.S commercial refrigeration sector energy.[5]

The cumulative net present value (NPV) of total consumer costs and savings of the proposed standards ranges from $8.6 billion (at a 7-percent discount rate) to $24.3 billion (at a 3-percent discount rate) for walk-in coolers and freezers. This NPV expresses the estimated total value to customers of future operating cost savings minus the estimated increased product costs for products purchased in 2017–2046.

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[4] All monetary values in this section are expressed in 2012 dollars and are discounted to 2013.

[5] 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

In addition, the proposed standards would have significant environmental benefits. The energy savings would result in cumulative emission reductions of 298 million metric tons (Mt)[6] of carbon dioxide (CO_2), 1,428 thousand tons of methane, 379.5 thousand tons of sulfur dioxide (SO_2), 443.8 thousand tons of nitrogen oxides (NO_X), and 0.6 tons of mercury (Hg).[7, 8]

The value of the CO_2 reductions is calculated using a range of values per metric CO_2 (otherwise known as the Social Cost of Carbon, or SCC) developed by an interagency process. The derivation of the SCC values is discussed in section IV.M. DOE estimates the net present monetary value of the CO_2 emissions reduction is between $1.9 billion and $27.5 billion, depending on the SCC value used, over a 30-year analysis period. DOE also estimates the net present monetary value of the NO_X emissions reduction is $243 million at a 7-percent discount rate and $553 million at a 3-percent discount rate over a 30-year analysis period. Over a 9-year analysis period, DOE estimates the net present monetary value of the CO_2 emissions reduction is between $0.33 billion and $4.07 billion, depending on the SCC value used, while the net present monetary value of the NO_X emissions reduction is $70.5 million at a 7-percent discount rate and $99.8 million at a 3-percent discount rate.[9] DOE notes that the estimated total social benefits of the rule outweigh the costs whether a 30-year or a 9-year analysis period is used.

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

[7] DOE calculates 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.

[8] 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 79 million metric tons CO_2, 7,897 thousand tons CO_2eq for CH_4, and 338 thousand tons CO_2eq for N_2O.

[9] DOE has decided to await further guidance regarding consistent valuation and reporting of Hg emissions before it monetizes Hg in its rulemakings.

Table I-3 summarizes the national economic costs and benefits expected to result from from the proposed standards for walk-in coolers and walk-in freezers.

Table I-3 Summary of National Economic Benefits and Costs of Walk-in Cooler and Walk-in Freezer Energy Conservation Standards

Category	Present Value Billion 2012$	Discount Rate
Benefits		
Operating Cost Savings	12.4	7%
	31.6	3%
CO_2 Reduction Monetized Value (at $12.9/t case)*	1.9	5%
CO_2 Reduction Monetized Value (at $40.8/t case)*	9.0	3%
CO_2 Reduction Monetized Value (at $62.2/t case)*	14.4	2.5%
CO_2 Reduction Monetized Value (at $117.0/t case)*	27.5	3%
NO_X Reduction Monetized Value (at $2,639/Ton)**	0.24	7%
	0.55	3%
Total Benefits†	21.6	7%
	41.1	3%
Costs		
Incremental Installed Costs	3.8	7%
	7.2	3%
Net Benefits		
Including CO_2 and NO_X Reduction Monetized Value	17.8	7%
	33.9	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 percent and 7 percent 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 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 consumer operation of equipment that meets the proposed standards (consisting primarily of operating cost savings from using less energy, minus increases in equipment purchase and installation costs, and (2) the annualized monetary value of the benefits of emission reductions, including CO_2 emission reductions.[10]

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. consumer 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 for the lifetime of walk-ins shipped from 2017–2046. The SCC values, on the other hand, reflect the present value of some future climate-related impacts resulting from the emission of one ton of carbon dioxide in each year. These impacts continue well beyond 2100.

Table I-4 shows the estimates of annualized benefits and costs of the proposed standards. (All monetary values below are expressed in 2012$.) The results under the

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[10] 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 three and seven 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.3. From the present value, DOE then calculated the fixed annual payment over a 30-year period (2014 through 2043) 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.

primary estimate are as follows. Using a 7-percent discount rate for benefits and costs other than CO_2 reduction, for which DOE used a 3-percent discount rate along with the average SCC series that uses a 3-percent discount rate, the cost of the standards proposed in today's rule is $367 million per year in increased equipment costs, while the annualized benefits are $1.225 billion per year in reduced equipment operating costs, $499 million in CO_2 reductions, and $24 million in reduced NO_X emissions. In this case, the net benefit amounts to $1.382 billion per year. Using a 3-percent discount rate for all benefits and costs and the average SCC series, the cost of the standards proposed in today's rule is $399 million per year in increased equipment costs, while the benefits are $1.606 billion per year in reduced operating costs, $499 million in CO_2 reductions, and $31 million in reduced NO_X emissions. In this case, the net benefit amounts to $1.737 billion per year.

Table I-4 Annualized Benefits and Costs of Proposed Standards for Walk-in Coolers and Walk-in Freezers

	Discount Rate	Primary Estimate*	Low Net Benefits Estimate*	High Net Benefits Estimate*
		(million 2012$/year)		
Benefits				
Operating Cost Savings	7%	1,225	1,188	1,279
	3%	1,606	1,544	1,687
CO_2 Reduction Monetized Value (at $12.9/t case)**	5%	142	142	142
CO_2 Reduction Monetized Value (at $40.8/t case)**	3%	499	499	499
CO_2 Reduction Monetized Value (at $62.2/t case)**	2.50%	739	739	739
CO_2 Reduction Monetized Value (at $117.0/t case)**	3%	1,534	1,534	1,534
NO_X Reduction Monetized Value (at $2,639/Ton)**	7%	24	24	24
	3%	31	31	31
Total Benefits†	7% plus CO_2 range	1,748	1,712	1,803
	7%	1,249	1,212	1,303
	3%	1,637	1,574	1,718
	3% plus CO_2 range	2,136	2,074	2,217
Costs				
Total Incremental Installed Costs	7%	367	377	357
	3%	399	414	385
Net Benefits				
Total†	7% plus CO_2 range	1,382	1,335	1,446
	7%	883	835	946
	3%	1,238	1,160	1,333
	3% plus CO_2 range	1,737	1,660	1,832

* This table presents the annualized costs and benefits associated with walk-in coolers and freezers shipped in 2017−2046. These results include benefits to consumers which accrue after 2046 from the walk-in coolers and freezers purchased in 2017−2046. Costs incurred by manufacturers, some of which may be incurred in preparation for the rule, are not directly included, but are indirectly included as part of incremental equipment costs. The Primary, Low Benefits, and High Benefits Estimates utilize projections of energy prices from the AEO2013 Reference case, Low Estimate, and High Estimate, respectively. In addition, incremental product costs reflect a medium decline rate for projected product price trends in the Primary Estimate, a low decline rate for projected product price trends using a Low Benefits Estimate, and a high decline rate for projected product price trends using a High Benefits Estimate.

** 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 represent the maximum improvement in energy efficiency that is technologically feasible and economically justified. DOE further notes that manufacturers already produce commercially available equipment that achieve these levels for most, if not all, 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 consumer benefits, consumer LCC savings, and emission reductions) would outweigh the burdens (loss of INPV for manufacturers).

DOE also considered more-stringent and less-stringent efficiency 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 efficiency 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 efficiency 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 walk-ins.

A. Authority

Title III, Part C of EPCA, Pub. L. 94-163 (42 U.S.C. 6311-6317, as codified), added by Pub. L. 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 walk-in coolers and walk-in freezers that are the focus of this notice. [11,12] (42 U.S.C. 6311(1), (20), 6313(f) and 6314(a)(9)) Walk-ins consist of two major pieces – the structural "envelope" within which items are stored and a refrigeration system that cools the air in the envelope's interior.

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 walk-ins, DOE is responsible for the entirety of this program. The DOE test procedures for walk-ins, including those prescribed by Congress in EISA 2007 and those established by DOE in the test procedure final rule, currently appear at title 10 of the Code of Federal Regulations (CFR) part 431, section 304.

Any new or amended performance standards that DOE prescribes for walk-ins must achieve the maximum improvement in energy efficiency that is technologically feasible and economically justified. (42 U.S.C. 6313(f)(4)(A)) For purposes of this rulemaking, DOE also plans to adopt those standards that are likely to result in a significant conservation of energy that satisfies both of these requirements. See 42 U.S.C. 6295(o)(3)(B).

[11] All references to EPCA in this document refer to the statute as amended through the American Energy Manufacturing Technical Corrections Act (AEMTCA), Pub. L. 112-210 (Dec. 18, 2012).
[12] For editorial reasons, upon codification in the U.S. Code, Part C was re-designated Part A-1.

Technological feasibility is determined by examining technologies or designs that could be used to improve the efficiency of the covered equipment. DOE considers a design to be technologically feasible if it is in use by the relevant industry or if research has progressed to the development of a working prototype.

In ascertaining whether a particular standard is economically justified, DOE considers, to the greatest extent practicable, the following 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 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 of Energy (Secretary) considers relevant. (42 U.S.C. 6295(o)(2)(B)(i) (I)–(VII))

DOE does not plan to 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. Further, under EPCA's provisions for consumer products, there is 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. (42 U.S.C. 6295(o)(2)(B)(iii)) For purposes of its walk-in analysis, DOE plans to account for these factors.

Additionally, when a type or class of covered equipment such as walk-ins has two or more subcategories, in promulgating standards for such equipment, DOE often specifies more than one standard level. DOE generally will adopt a different standard level than that which applies generally to such type or class of products for any group of covered products that have the same function or intended use if DOE determines that products within such group (A) consume a different kind of energy than that consumed by other covered products within such type (or class) or (B) have a capacity or other performance-related feature that other products within such type (or class) do not have, and which justifies a higher or lower standard. Generally, in determining whether a performance-related feature justifies a different standard for a group of products, DOE considers such factors as the utility to the consumer of the feature and other factors DOE deems appropriate. In a rule prescribing such a standard, DOE typically includes an explanation of the basis on which such higher or lower level was established. DOE plans to follow a similar process in the context of today's rulemaking.

DOE notes that since the inception of the statutory requirements setting standards for walk-ins, Congress has since made one additional amendment to those provisions. That amendment provides that the wall, ceiling, and door insulation requirements detailed in 42 U.S.C. 6313(f)(1)(C) do not apply to the given component if the component's manufacturer has demonstrated to the Secretary's satisfaction that "the component reduces energy consumption at least as much" if those specified requirements were to apply to that manufacturer's component. American Energy Manufacturing Technology Corrections Act, Pub. L. No. 112-210, Sec. 2 (Dec. 18, 2012) (codified at 42 U.S.C. 6313(f)(6)) (AEMTCA). Manufacturers seeking to avail themselves of this provision must "provide to the Secretary all data and technical information necessary to fully evaluate its application." *Id.* DOE is proposing to codify this amendment into its regulations.

Since its codification, one company, HH Technologies, submitted data on May 24, 2013, demonstrating that its RollSeal doors satisfied this new AEMTCA provision. DOE reviewed these data and all other submitted information and concluded that the RollSeal doors at issue satisfied 42 U.S.C. 6313(f)(6). Accordingly, DOE issued a determination letter on June 14, 2013, indicating that these doors met Section 6313(f)(6) and that the applicable insulation requirements did not apply to the RollSeal doors HH Technologies identified. Nothing in this proposed rule affects the previous determination regarding HH Technologies.

Federal energy conservation requirements generally pre-empt state laws or regulations concerning energy conservation testing, labeling, and standards. (42 U.S.C. 6297(a); 42 U.S.C. 6316(b)) However, EPCA provides that for walk-ins in particular, any state standard issued before publication of the final rule shall not be pre-empted until the standards established in the final rule take effect. (42 U.S.C 6316(h)(2)(B))

Where applicable, DOE generally considers standby and off mode energy use for certain covered products or equipment when developing energy conservation standards. See 42 U.S.C. 6295(gg)(3). Because the vast majority of walk-in coolers and walk-in freezers operate continuously to keep their contents cold at all times, DOE is not proposing standards for standby and off mode energy use.

B. Background

1. Current Standards

EPCA defines a walk-in cooler and a walk-in freezer as an enclosed storage space refrigerated to temperatures above, and at or below, respectively, 32 °F that can be walked into. The statute also defines walk-in coolers and freezers as having a total chilled storage area of less than 3,000 square feet, excluding products designed and marketed exclusively for medical, scientific, or research purposes. (42 U.S.C 6311(20)) EPCA also provides prescriptive standards for walk-in coolers and freezers manufactured on or after January 1, 2009, which are described below.

First, EPCA sets forth general prescriptive standards for walk-ins. Walk-ins must have automatic door closers that firmly close all walk-in doors that have been closed to within 1 inch of full closure, for all doors narrower than 3 feet 9 inches and shorter than 7 feet; walk-ins must also have strip doors, spring hinged doors, or other methods of minimizing infiltration when doors are open. Walk-ins must also contain wall, ceiling, and door insulation of at least R-25 for coolers and R-32 for freezers, excluding glazed portions of doors and structural members, and floor insulation of at least R-28 for freezers. Walk-in evaporator fan motors of under 1 horsepower and less than 460 volts must be electronically commutated motors (brushless direct current motors) or three-phase motors, and walk-in condenser fan motors of under 1 horsepower must use permanent split capacitor motors, electronically commutated motors, or three-phase motors. Interior light sources must have an efficacy of 40 lumens per watt or more, including any ballast losses; less-efficacious lights may only be used in conjunction with a timer or device that turns off the lights within 15 minutes of when the walk-in is unoccupied. See 42 U.S.C. 6313(f)(1).

Second, EPCA sets forth new requirements related to electronically commutated motors for use in walk-ins. See 42 U.S.C. 6313(f)(2)). Specifically, in those walk-ins that use an evaporator fan motor with a rating of under 1 horsepower and less than 460 volts, that motor must be either a three-phase motor or an electronically commutated motor unless DOE determined prior to January 1, 2009 that electronically commutated motors are available from only one manufacturer. (42 U.S.C. 6313(f)(2)(A)) DOE determined by January 1, 2009 that these motors were available from more than one manufacturer; thus, according to EPCA, walk-in evaporator fan motors with a rating of under 1 horsepower and less than 460 volts must be either three-phase motors or electronically commutated motors. DOE documented this determination in the rulemaking docket as docket ID EERE-2008-BT-STD-0015-0072. This document can be found at http://www.regulations.gov/#!documentDetail;D=EERE-2008-BT-STD-0015-0072. Additionally, EISA provided DOE with the authority to permit the use of other types of motors as evaporative fan motors—if DOE determines that, on average, those other motor types use no more energy in evaporative fan applications than electronically commutated motors. (42 U.S.C. 6313(f)(2)(B)) DOE is unaware of any other motors that would offer performance levels comparable to the electronically commutated motors required by Congress. Accordingly, all evaporator motors rated at under 1 horsepower and under 460 volts must be electronically commutated motors or three-phase motors.

Third, EPCA sets forth additional requirements for walk-ins with transparent reach-in doors. Freezer doors must have triple-pane glass with either heat-reflective treated glass or gas fill for doors and windows for freezers. Cooler doors must have either double-pane glass with treated glass and gas fill or triple-pane glass with treated glass or gas fill. (42 U.S.C. 6313(f)(3)(A)-(B)) For walk-ins with transparent reach-in doors, EISA also prescribed specific anti-sweat heater-related requirements: walk-ins without anti-sweat heater controls must have a heater power draw of no more than 7.1 or 3.0 watts per square foot of door opening for freezers and coolers, respectively. Walk-ins with anti-sweat heater controls must either have a heater power draw of no more than 7.1 or 3.0 watts per square foot of door opening for freezers and coolers, respectively, or the anti-sweat heater controls must reduce the energy use of the heater in a quantity corresponding to the relative humidity of the air outside the door or to the condensation on the inner glass pane. See 42 U.S.C. 6313(f)(3)(C)-(D).

2. History of Standards Rulemaking for Walk-in Coolers and Freezers

EPCA directs the Secretary to issue performance-based standards for walk-ins that would apply to equipment manufactured 3 years after the final rule is published, or 5 years if the Secretary determines by rule that a 3-year period is inadequate. (42 U.S.C. 6313(f)(4))

DOE initiated the current rulemaking by publishing a notice announcing the availability of its "Walk-In Coolers and Walk-In Freezers Energy Conservation Standard Framework Document" and a meeting to discuss the document. The notice also solicited comment on the matters raised in the document. 74 FR 411 (Jan 6, 2009). More information on the framework document is available at: http://www1.eere.energy.gov/buildings/appliance_standards/rulemaking.aspx/ruleid/30. The framework document described the procedural and analytical approaches that DOE anticipated using to evaluate energy conservation standards for walk-ins and identified various issues to be resolved in conducting this rulemaking.

DOE held the framework public meeting on February 4, 2009, in 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) development of a test procedure and appropriate test metrics; (3) manufacturer and market information, including distribution channels; (4) equipment classes, baseline units, and design options to improve efficiency; and (5) life-cycle costs to consumers, including installation, maintenance, and repair costs, and any consumer 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 walk-ins relevant to this rulemaking.

DOE then gathered additional information and performed preliminary analyses to help develop potential energy conservation standards for this equipment. This process culminated in DOE's announcement of another public meeting to discuss and receive comments on the following matters: (1) the equipment classes DOE planned to analyze; (2) the analytical framework, models, and tools that DOE used to evaluate standards; (3) the results of the preliminary analyses performed by DOE; and (4) potential standard levels that DOE could consider. 75 FR 17080 (April 5, 2010) (the April 2010 Notice). DOE also invited written comments on these subjects and announced the availability on its website of a preliminary technical support document (preliminary TSD) it had prepared to inform interested parties and enable them to provide comments. Id. (More information about the preliminary TSD is available at:
http://www1.eere.energy.gov/buildings/appliance_standards/rulemaking.aspx/ruleid/30.)Finally, DOE sought views on other relevant issues that participants believed either would impact walk-in standards or that the proposal should address. Id. at 17083.

The preliminary TSD provided an overview of the activities DOE undertook to develop standards for walk-ins and discussed the comments DOE received in response to the framework document. The preliminary TSD also addressed separate standards for the walk-in envelope and the refrigeration system, as well as compliance and enforcement responsibilities and food safety regulatory concerns. The document also described the analytical framework that DOE used (and continues to use) in considering standards for walk-in coolers and freezers, 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 TSD presented in detail each analysis that DOE had performed for these products 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 the potential classes for walk-in coolers and freezers, characterized the markets for these products, and reviewed techniques and approaches for improving their efficiency;
- A screening analysis reviewed technology options to improve the efficiency of walk-in coolers and freezers, 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 walk-in coolers and freezers;
- An energy use analysis estimated the annual energy use of walk-in coolers and freezers;
- A markups analysis converted estimated MSPs derived from the engineering analysis to consumer prices;
- A life-cycle cost analysis calculated, for individual consumers, the discounted savings in operating costs throughout the estimated average life of walk-in coolers and freezers, 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 takes individual consumers to recover the higher purchase price expense of more energy-efficient products through lower operating costs;
- A shipments analysis estimated shipments of walk-in coolers and freezers over the time period examined in the analysis, and was used in performing the national impact analysis;
- A national impact analysis assessed the national energy savings and the national net present value of total consumer costs and savings that are expected to result from specific potential energy conservation standards for walk-in coolers and freezers; and
- A preliminary manufacturer impact analysis (MIA) took the initial steps in evaluating the effects on manufacturers of new efficiency standards.

The public meeting announced in the April 2010 Notice took place on May 19, 2010. At this meeting, DOE presented the methodologies and results of the analyses set forth in the preliminary TSD. Interested parties that participated in the public meeting discussed a variety of topics, but the comments centered on the following issues: (1) separate standards for the refrigeration system and the walk-in envelope; (2) responsibility for compliance; (3) equipment classes; (4) technology options; (5) energy modeling; (6) installation, maintenance, and repair costs; (7) markups and distributions chains; (8) walk-in cooler and freezer shipments; and (9) test procedures. The comments received since publication of the April 2010 Notice, including those received at the May 2010 public meeting, have contributed to DOE's proposed resolution of the issues in this rulemaking as they pertain to walk-ins. This NOPR responds to the issues raised by the commenters. (A parenthetical reference at the end of a quotation or paraphrase provides the location of the item in the public record.)

III. General Discussion

In preparing today's notice, DOE considered input from the various interested parties who commented on the framework document and preliminary analysis, information obtained from manufacturer interviews, and additional research that DOE conducted. The interested parties who provided comments to DOE during the framework document and preliminary analysis phases included the following:

Table III-1 Framework and Preliminary Analysis Commenters

Commenter(s)	Abbreviated Designation	Affiliation	Comment Number(s) in Docket
AFM Corporation	AFM	Manufacturer	0012.1
Air-Conditioning, Heating, and Refrigeration Institute	AHRI	Trade Association	0036.1, 0055.1
American Chemistry Council	ACC	Material Supplier	0062.1
American Chemistry Council Center for the Polyurethanes Industry	CPI	Material Supplier	0052.1
American Council for an Energy Efficient Economy, Appliance Standards Awareness Project, Alliance to Save Energy, Natural Resources Defense Council, Northwest Energy Efficiency Alliance	Joint Advocates	Energy Efficiency Advocates	0070.1
American Panel Corporation	American Panel	Manufacturer	0039.1, 0048.1
AmeriKooler, Inc.	AmeriKooler	Manufacturer	0065.1
Appliance Standards Awareness Project	ASAP	Energy Efficiency Advocate	0024.1
Bally Refrigerated Boxes, Inc.	Bally	Manufacturer	0023.1
Carpenter Co. Chemical Systems Division	Carpenter	Material Supplier	0068.1
Craig Industries, Inc. and U.S. Cooler Company	Craig Industries	Manufacturer	0064.1
Craig Industries, Inc. and US Cooler Company	Craig Industries	Manufacturer	0011.1, 0025.1, 0038.1, 0064.1, 0071.1
CrownTonka Walk-ins	CrownTonka	Manufacturer	0026.1, 0057.1
Earthjustice	Earthjustice	Energy Efficiency Advocate	0027.1, 0047.1
Edison Electric Institute	EEI	Energy Efficiency Advocate	0028.1
Eliason Corporation	Eliason	Manufacturer	0013.1, 0022.1
Foam Supplies, Inc.	FSI	Material Supplier	0029.1
Heatcraft Refrigeration Products LLC	Heatcraft	Manufacturer	0058.1, 0069.1
Heating, Air-conditioning & Refrigeration Distributors International	HARDI	Trade Association	0031.1
Hill Phoenix Walk-Ins	Hill Phoenix	Manufacturer	0066.1
Hired Hand Technologies	Hired Hand	Manufacturer	0030.1, 0050.1
Hussmann and Ingersoll Rand	Ingersoll Rand	Manufacturer	0053.1
Kason Industries, Inc.	Kason	Component Supplier	0009.1, 0019.1
Kysor Panel Systems	Kysor	Manufacturer	0032.1, 0054.1
Manitowoc Ice	Manitowoc	Manufacturer	0056.1
Master-Bilt Products, Inc.	Master-Bilt	Manufacturer	0033.1, 0046.1
NanoPore Insulation, LLC	NanoPore	Material Supplier	0067.1
Nor-Lake, Incorporated	Nor-Lake	Manufacturer	0049.1
Owens Corning Foam Insulation, LLC	Owens Corning	Material Supplier	0034.1
Southern California Edison and Technology Test Centers	SCE	Utility	0035.1
Southern California Edison, San Diego Gas & Electric, Pacific Gas & Electric Company, Sacramento Municipal Utility District	Joint Utilities	Utility Group	0061.1
The Northwest Energy Efficiency Alliance and the Northeast Power Coordinating Council	NEEA and NPCC	Utility Representative	0021.1, 0059.1
Zero-Zone, Inc.	Zero-Zone	Manufacturer	0051.1

A. Component Level Standards

In the framework document, DOE considered setting standards that would apply to the entire walk-in. See the framework document at http://www1.eere.energy.gov/buildings/appliance_standards/commercial/pdfs/wicf_framework_doc.pdf. Several interested parties expressed concern about this approach because of the variety among assembled walk-ins, which would make compliance with such a walk-in standard difficult and burdensome. Stakeholders also stated that different components of each walk-in would likely be manufactured by different entities, which would make it difficult to enforce any standard that applied to an entire walk-in.

After considering the comments submitted on the framework document, DOE modified its approach in the preliminary analysis. During that phase, it had tentatively identified two primary components of a walk-in: the envelope (the insulated box that separates the exterior from the interior) and the refrigeration system (the mechanical equipment that cools the envelope's interior). DOE also indicated that it was tentatively considering developing separate standards for refrigeration systems and envelopes.

Several interested parties agreed with this general approach. Manitowoc supported separate standards for the envelope and refrigeration system, stating that the envelope is typically supplied by one manufacturer and the refrigeration system is typically supplied by one or more manufacturers. (Manitowoc, Public Meeting Transcript, No. 0045 at p. 38 and No. 0056.1 at p. 1) Manitowoc further stated that it would not be practical to regulate the energy used by the entire walk-in assembly because walk-ins are highly customized. Manitowoc estimated that fewer than 20 percent of its walk-ins use a standard envelope and refrigeration system combination. (Manitowoc, No. 0056.1 at p. 1) Pacific Gas and Electric Company, Southern California Edison, Sempra Energy Utility, and the Sacramento Municipal Utility District (hereafter referred to as the "Joint Utilities") also agreed with DOE's proposal to separate the refrigeration system standards from the envelope standards because the components are separately produced and often separately sold. (Joint Utilities, No. 0061.1 at pp. 2-3) American Panel stated that the envelope and refrigeration systems must be considered separately because the majority of WICFs are custom-made. (American Panel, No. 0048.1 at p. 4) Kysor, Master-Bilt, AHRI, and CrownTonka all supported separate standards for the envelope and refrigeration systems. (Kysor, Public Meeting Transcript, No. 0045 at p. 39; Master-Bilt, No. 0046.1 at p. 1; AHRI, No. 0055.1 at p. 2; CrownTonka, No. 0057.1 at p. 1) One interested party did not agree with this approach. Craig Industries, also doing business as U.S. Cooler, commented that DOE should establish a combination standard for the envelope and refrigeration system to permit manufacturers greater flexibility when designing walk-ins. Under this combination approach, a more efficient envelope could be paired with a less efficient refrigeration system, or vice versa, to achieve the same overall efficiency at a lower cost. (Craig Industries, No. 0064.1 at p. 1)

Additionally, interested parties suggested that DOE extend the idea of separate standards to subcomponents of envelopes and refrigeration systems. The Joint Utilities stated that a component performance approach would accurately capture efficiency measurements associated with the components, and that energy savings associated with targeted components would apply to different configurations of whole walk-ins and possibly even to repairs and retrofits. (Joint

Utilities, No. 0061.1 at p. 4) The Joint Utilities further added that DOE should consider component performance standards for major walk-in components that could be enforced at the level of the manufacturer's catalog and could be labeled for easy inspection. (Joint Utilities, No. 0061.1 at p. 12) Hill Phoenix also recommended that large construction-based envelopes (i.e., those constructed in a manner similar to a building) be regulated at the component level, asserting that these envelopes may need many different options and design flexibility, without which a whole-envelope calculation would likely limit the accuracy of any estimate of a walk-in's total energy use. (Hill Phoenix, No. 0066.1 at p. 1) As stated previously, Manitowoc agreed that it would not be practical to regulate the energy used by the entire walk-in assembly because walk-ins are highly customized. (Manitowoc, No. 0056.1 at p. 1) Manitowoc also remarked that performance metrics could be developed for sub-classes of the components of an envelope, and the component manufacturers should be responsible for their own components. (Manitowoc, Public Meeting Transcript, No. 0045 at p. 46)

Other stakeholders discussed specific sub-components of the envelope or the refrigeration system that could be regulated. Kysor mentioned panels and doors as envelope components that should be considered separately and stated that because these components are often manufactured by separate parties, the manufacturer of each component should be responsible for the performance of that component. (Kysor, Public Meeting Transcript, No. 0045 at p. 41) The Northwest Energy Efficiency Alliance (NEEA) and Northwest Power Conservation Council (NPCC) recommended that DOE develop efficiency performance standards for display and solid doors separately so that an envelope manufacturer could certify that the envelope meets specified standards. (NEEA and NPCC, No. 0059.1 at p. 2)

Likewise, with regard to the refrigeration system, NEAA and NPCC recommended that DOE regulate the efficiency of the cooling system components separately, an example of which would be setting a performance requirement for the specific efficiency of unit coolers based on control algorithms. (NEAA and NPCC, No. 0059.1 at pp. 2 and 7) The Joint Utilities also stated that a refrigeration system requirement should not be based on a single metric and added that the indoor unit (i.e., unit cooler) could have a minimum efficiency requirement regardless of other components of the refrigeration system. (Joint Utilities, No. 0061.1 at p. 4 and Public Meeting Transcript, No. 0045 at p. 64) Manitowoc, on the other hand, recommended that manufacturers have the option of rating the entire refrigeration system and that considering the condensing unit separately would not allow manufacturers to implement options that would improve the efficiency of a matched system. (Manitowoc, Public Meeting Transcript, No. 0045 at p. 38) Manitowoc further remarked that testing the refrigeration system as an integrated, single component and calculating the overall annual efficiency has the greatest potential for optimizing energy efficiency, but added that DOE should permit the individual components to be tested and the performance stated for the individual parts. (Manitowoc, Public Meeting Transcript, No. 0045 at p. 59)

After carefully considering the comments described above, DOE proposes an approach for the envelope that would set separate standards for panels, display doors, and non-display doors for the reasons set forth below.

Different manufacturers typically produce panels and doors (both display and non-display types) for use in walk-in applications. In particular, display doors are commonly manufactured separately because their unique construction and materials require specialized manufacturing methods. Additionally, the modular nature of a walk-in envelope means that it is constructed of relatively standardized components that can be assembled in a virtually infinite number of configurations that may affect the overall consumption of a given walk-in unit. By regulating the performance of those standardized components, manufacturers will be able to choose compliant components that should help ensure that whatever walk-in configuration is built satisfies the minimal level of energy consumption and efficiency that DOE may prescribe. Because of the large number of possible combinations of panels and doors that could make up an envelope, the burdens presented by a system-based approach for the entire walk-in unit would also likely be significantly greater than the burdens of the proposed approach because each walk-in envelope configuration would need to be separately certified as compliant. Alternatively, if DOE were to establish a set envelope of specified dimensions for a manufacturer to build and then to certify as compliant, the efficiency or energy usage measurement from that envelope would not only be more costly to obtain, but it would also not necessarily reflect the actual energy usage or efficiency of a given walk-in that is installed in the field.

DOE also notes that requiring an overall envelope performance standard would be likely to present significant enforcement burdens, as it would likely require DOE to test several fully constructed envelopes in order to ascertain the energy efficiency performance of a given envelope. DOE tentatively believes that such an approach, at this time, would be unduly burdensome.

DOE is not, however, proposing to set standards for the constituent components of refrigeration systems separately. To ensure that manufacturers have sufficient flexibility to improve the energy efficiency performance of their systems, DOE proposes to set a performance standard for the overall refrigeration system and to regulate that system as a single component. This approach would help ensure that the final refrigeration system assembled by the manufacturer would meet a given level of efficiency and would account for the interactive effects of the numerous components comprising the overall system. For example, some refrigeration systems implement complex control strategies, the benefits of which could not be adequately demonstrated if the condensing unit and unit cooler were considered separately for purposes of setting standards.

In summary, DOE proposes to set specific component standards for the panels, display doors, and non-display doors of a walk-in, and a single standard to assess the overall performance of the refrigeration system. DOE acknowledges that, by not establishing a standard for the energy use of the entire walk-in, manufacturers cannot meet the standard by pairing a more-efficient envelope with a less-efficient refrigeration system, and vice versa. Also, DOE would not account for the energy use of some components, such as the electricity use of overhead lighting or heat load due to the infiltration of warm air into the walk-in, and would not consider design options whose efficacy depends on the interaction between the different covered components. Including these factors as part of the current rulemaking would likely introduce significant complications with respect to compliance and enforcement while yielding a comparatively small benefit in energy savings. DOE believes, however, that the proposed approach would help ensure that the walk-in components used by manufacturers satisfy some minimal level of energy efficiency and reduce the overall certification and enforcement burden on manufacturers. DOE may reconsider this issue in the future, particularly if accurate computer modeling, such as through an alternative efficiency determination method, becomes possible with respect to predicting the energy usage and efficiency of fully constructed walk-in units. DOE continues to invite comments on the approach presented in this NOPR.

B. Test Procedures and Metrics

While Congress had initially prescribed certain performance standards and test procedures concerning walk-ins as part of the EISA 2007 amendments, Congress also instructed DOE to develop specific test procedures to cover walk-in equipment. DOE subsequently established a test procedure for walk-ins. See 76 FR 21580 (April 15, 2011). See also 76 FR 33631 (June 9, 2011) (final technical corrections). The test procedure lays out an approach that bases compliance on the ability of component manufacturers to produce components that meet the required standards. This approach is also consistent with the framework established by Congress, which set specific energy efficiency performance requirements on a component-level basis. (42 U.S.C. 6313(f)) The approach is discussed more fully below.

1. Panels

In the final test procedure rule for walk-ins, DOE defines "panel" as a construction component, excluding doors, used to construct the envelope of the walk-in (i.e., elements that separate the interior refrigerated environment of the walk-in from the exterior). 76 FR 33631 (June 9, 2011). The rule explains that panel manufacturers would test their panels to obtain a thermal transmittance metric—known as U-factor, measured in Btu/h-ft^2-$^\circ$F—and identifies three types of panels: display panels, floor panels, and non-floor panels. A display panel is defined as a panel that is entirely or partially comprised of glass, a transparent material, or both, and is used for display purposes. Id. It is considered equivalent to a window and the U-factor is determined by NFRC 100-2010-E0A1, "Procedure for Determining Fenestration Product U-factors." 76 FR at 33639. Floor panels are used for walk-in floors, whereas non-floor panels are used for walls and ceilings.

The U-factor for floor and non-floor panels accounts for any structural members internal to the panel and the long-term thermal aging of foam. This value is determined by a three-step process. First, both floor and non-floor panels must be tested using ASTM C1363-10, "Standard Test Method for Thermal Performance of Building Materials and Envelope Assemblies by Means of a Hot Box Apparatus." The panel's core and edge regions must be used during testing. Second, the panel's core U-factor must be adjusted with a degradation factor to account for foam aging. The degradation factor is determined by EN 13165:2009-02, "Thermal Insulation Products for Buildings - Factory Made Rigid Polyurethane Foam (PUR) Products - Specification," or EN 13164:2009-02, "Thermal Insulation Products for Buildings - Factory Made Products of Extruded Polystyrene Foam (XPS) – Specification," as applicable. Third, the edge and modified core U-factors are then combined to produce the panel's overall U-factor. All industry protocols were incorporated by reference most recently in the test procedure final rule correction. 76 FR 33631.

2. Doors

The walk-in test procedure final rule addressed two door types: display and non-display doors. Within the general context of walk-ins, a door consists of the door panel, glass, framing materials, door plug, mullion, and any other elements that form the door or part of its connection to the wall. DOE defines display doors as doors designed for product movement, display, or both, rather than the passage of persons; a non-display door is interpreted to mean any type of door that is not captured by the definition of a display door. 76 FR at 33631.

The test metric for doors is in terms of energy use, measured in kilowatt-hours per day (kWh/day). The energy use accounts for thermal transmittance through the door and the electricity use of any electrical components associated with the door. The thermal transmittance is measured by NFRC 100-2010-E0A1, and is converted to energy consumption via conduction losses using an assumed efficiency of the refrigeration system in accordance with the test procedure. See 76 FR at 33636-33637. The electrical energy consumption of the door is calculated by summing each electrical device's individual consumption and accounts for all device controls by applying a "percent time off" value to the appropriate device's energy consumption. For any device that is located on the internal face of the door or inside the door, 75 percent of its power is assumed to contribute to an additional heat load on the compressor. Finally, the total energy consumption of the door is found by combining the conduction load, electrical load, and additional compressor load.

3. Refrigeration

The test procedure incorporates an industry test procedure applied to walk-in refrigeration systems: AHRI 1250 (I-P)-2009, “2009 Standard for Performance Rating of Walk-In Coolers and Freezers” (“AHRI 1250-2009”). 76 FR at 33631. This procedure applies to unit coolers and condensing units sold together as a matched system, unit coolers and condensing units sold separately, and unit coolers connected to compressor racks or multiplex condensing systems. It also describes methods for measuring the refrigeration capacity, on-cycle electrical energy consumption, off-cycle fan energy, and defrost energy. Standard test conditions, which are different for indoor and outdoor locations and for coolers and freezers, are also specified.

The test procedure includes a calculation methodology to compute an annual walk-in energy factor (AWEF), which is the ratio of heat removed from the envelope to the total energy input of the refrigeration system over a year. AWEF is measured in Btu/W-h and measures the efficiency of a refrigeration system. DOE established a metric based on efficiency, rather than energy use, for describing refrigeration system performance, because a refrigeration system’s energy use would be expected to increase based on the size of the walk-in and on the heat load that the walk-in produces. An efficiency-based metric would account for this relationship and would simplify the comparison of refrigeration systems to each other. Therefore, DOE proposes to use an energy conservation standard for refrigeration systems that would be presented in terms of AWEF.

C. Prescriptive Versus Performance Standards

EPCA established standards for certain WICF components, while also directing the Secretary to establish "performance-based standards," which are the subject of this rulemaking. (42 U.S.C. 6313(f)(4)(A)) Some interested parties suggested that DOE establish prescriptive standards for certain components in addition to the performance-based standards that DOE is proposing. NEEA and NPCC stated that DOE should establish a prescriptive (i.e., design) standard for electronically commutated motors. (NEEA and NPCC, No. 0059.1 at p. 7) The Joint Utilities recommended that DOE consider the precedent set by EPCA, as the EPCA provisions include both prescriptive and performance standards, and further recommended that DOE include additional prescriptive requirements for various components of a walk-in as necessary to maximize energy savings, and performance standards for the unit cooler. (Joint Utilities, No. 0061.1 at p. 11) The Joint Utilities also recommended that DOE base new standards using those design requirements already prescribed by Title 20 of California's Code as the baseline when developing a performance standard. (Joint Utilities, No. 0061.1 at p. 13) SCE also referred to the prescriptive standards in Title 20, and suggested that because EPCA already established prescriptive measures, there will be limited additional benefit from performance measures. SCE further recommended that a standard for infiltration should be implemented through ASHRAE 90.1 (SCE, Public Meeting Transcript, No. 0045 at p. 63) The Joint Utilities recommended other specific prescriptive requirements that DOE should implement, including a minimum solar reflective index for the roof of a walk-in located outdoors, adjustable variable speed fan control for unit coolers, and floating head pressure control (a control that allows the pressure of the refrigerant at the compressor exit point to reach an optimal level). (Joint Utilities, No. 0061.1 at pp. 5 and 12; Public Meeting Transcript, No. 0045 at p. 29) The Joint Utilities also asked DOE to examine how controls could be specified in a performance standard. (Joint Utilities, No. 0061.1 at p. 13)

DOE notes that EPCA requires the promulgation of "performance-based standards" for walk-ins. That phrase indicates that DOE must set standards based on energy-related performance. See 42 U.S.C. 6313(f)(4). Accordingly, the design requirements suggested by commenters would be inconsistent with this requirement.

D. Certification, Compliance, and Enforcement

Walk-ins consist primarily of panels, display and non-display doors, and a refrigeration system, as described in section III.A. A number of arrangements exist for manufacturing walk-ins. One company may manufacture the panels, purchase the display and/or non-display doors and refrigeration system, assemble the walk-in at the factory, and ship the walk-in to a consumer. Alternatively, the same company may ship the walk-in without a refrigeration system, which is then purchased separately by the consumer and installed on the walk-in. A contractor may purchase all the components from the component manufacturers and assemble the walk-in on-site. Other scenarios may also exist. Given the wide variety of scenarios under which a walk-in is manufactured, it is important to identify an entity or entities responsible for complying with standards and certifying compliance to DOE, and against whom a possible enforcement action could be taken.

During the preliminary analysis public meeting, many interested parties expressed concern about compliance responsibilities and whether those burdens would fall on the envelope and refrigeration manufacturers individually, the installer, or another party. Additionally, the Joint Advocates submitted a comment urging DOE to ensure that the separate system components would be compliant with the energy conservation standards, and stating that each manufacturer should be held accountable for their products (e.g., door manufacturers are responsible for compliance with door standards). (Joint Advocates, No. 0070.1 at pp. 2–3) Craig Industries recommended that the definition of a manufacturer be expanded to include the installer of the unit, because the installer has the ability to ensure that the installed unit meets the energy conservation standards. (Craig Industries, No. 0071.1 at p. 1). Comments on this issue were summarized in the 2011 Certification, Compliance, and Enforcement for Consumer Products and Commercial and Industrial Equipment (referred to hereafter as the CCE final rule), and are not repeated here. 76 FR 12422, 12442–12446 (March 7, 2011).

DOE notes that within the context of today's proposal, the agency is contemplating an approach that would place the primary certification and compliance burden on those entities that manufacture particular key components of a walk-in—that is, the panels, doors, and refrigeration system. This approach dovetails with that outlined in the recent test procedure final rule. The various requirements that manufacturers would need to follow are detailed in the 2011 final rule noted above regarding manufacturer certification, compliance, and enforcement-related responsibilities. 76 FR 12422. For further details, see 76 FR at 12491.

E. Technological Feasibility

1. General

In each standards rulemaking, DOE conducts a screening analysis, which it bases on information 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 means for improving efficiency are technologically feasible. DOE considers technologies incorporated in commercial products or in working prototypes to be 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), as it could allow a single manufacturer to monopolize the market.

Once DOE has determined that particular design options are technologically feasible, it generally 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) Section IV.B of this notice discusses the results of the screening analyses for walk-in coolers and freezers. Specifically, it presents the designs DOE considered, those it screened out, and those that are the basis for the TSLs in this rulemaking. For further details on the screening analysis for this rulemaking, see chapter 4 of the TSD.

2. Maximum Technologically Feasible Levels

When DOE proposes to adopt a new or amended or new energy conservation standard for a type or class of covered equipment such as walk-ins, it determines the maximum improvement in energy efficiency that is technologically feasible for such equipment. Accordingly, DOE determined the maximum technologically feasible (max-tech) improvements in energy efficiency for walk-ins by applying those design parameters that passed the screening analysis to the engineering analysis that DOE prepared as part of the preliminary analysis.

In a comment on the max-tech levels in the preliminary analysis, AHRI commented that max-tech efficiency levels would be achieved only by a few units, and it requested that DOE demonstrate that max-tech levels can be achieved by commonly used products. (AHRI, No. 0055.1 at p. 3)

As indicated previously, whether efficiency levels exist or can be achieved in commonly used products does not determine whether they are max-tech levels. DOE considers technologies to be technologically feasible if they are incorporated in any commercially available equipment or working prototypes. A maximum technologically feasible level results from the combination of design options that result in the highest efficiency level for an equipment class, with such design options consisting of technologies already incorporated in commercial products or working prototypes. DOE notes that it re-evaluated 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 analysis.

For panels, non-display doors, display doors, and refrigeration systems, the max-tech efficiency levels DOE has identified represent products with the most efficient design options available on the market, or previously offered for sale, in the given equipment class. No products at higher efficiencies are available or have been in the past, and DOE is not aware of any working prototype designs that would allow manufacturers to achieve higher efficiencies. Table III-2, Table III-3, Table III-4, and Table III-5 list the max-tech levels for panels, display doors, non-display doors, and refrigeration systems, respectively. (See section IV.A.3 for a description of the equipment classes.)

For structural cooler and freezer panels, the max-tech level is represented by a single value for U-factor. For all other TSLs (and for all floor panel levels including the max-tech level), the level is represented by a polynomial equation expressing the U-factor in terms of certain panel dimensions, but the max tech level does not result in a polynomial equation because the U-factor does not vary with the size of the panel. (See section V.A.2 for a list of equations for all TSLs.) At max-tech, panels are designed without structural members, making the panel uniformly comprised of hybrid insulation. See section IV.C.5 and chapter 5 of the TSD for the list of technologies included in max-tech equipment.

Table III-2 Max-Tech Levels for Panels

Equipment Class	**Equations for Maximum U-Factor (Btu/h-ft^2-°F)***
Structural Panel, Medium Temperature	0.011
Structural Panel, Low Temperature	0.011
Floor Panel, Low Temperature	$-0.021\times\left(\frac{A_{\text{fp edge}}}{A_{\text{fp core}}}\right)^2+0.041\times\left(\frac{A_{\text{fp edge}}}{A_{\text{fp core}}}\right)+0.011$

*$A_{\text{fp edge}}$ and $A_{\text{fp core}}$ represent the edge and core surface area of the floor panel, respectively.

Table III-3 Max-Tech Levels for Display Doors

Equipment Class	Equations for Maximum Energy Consumption (kWh/day)*
Display Door, Medium Temperature	$0.0080 \times A_{dd} + 0.29$
Display Door, Low Temperature	$0.11 \times A_{dd} + 0.32$

*A_{dd} represents the surface area of the display door.

Table III-4 Max-Tech Levels for Non-Display Doors

Equipment Class	Equations for Maximum Energy Consumption (kWh/day)*
Passage Door, Medium Temperature	$0.00093 \times A_{nd} + 0.0083$
Passage Door, Low Temperature	$0.13 \times A_{nd} + 3.9$
Freight Door, Medium Temperature	$0.00092 \times A_{nd} + 0.13$
Freight Door, Low Temperature	$0.094 \times A_{nd} + 5.2$

*A_{nd} represents the surface area of the non-display door.

Table III-5 Max-Tech Levels for Refrigeration Systems

Equipment Class	Equations for Minimum AWEF (Btu/W-h)*
Dedicated Condensing, Medium Temperature, Indoor System, < 9,000 Btu/h Capacity	$2.63 \times 10^{-4} \times Q + 4.53$
Dedicated Condensing, Medium Temperature, Indoor System, ≥ 9,000 Btu/h Capacity	6.90
Dedicated Condensing, Medium Temperature, Outdoor System, < 9,000 Btu/h Capacity	$9.23 \times 10^{-4} \times Q + 3.90$
Dedicated Condensing, Medium Temperature, Outdoor System, ≥ 9,000 Btu/h Capacity	12.21
Dedicated Condensing, Low Temperature, Indoor System, < 9,000 Btu/h Capacity	$1.93 \times 10^{-4} \times Q + 1.93$
Dedicated Condensing, Low Temperature, Indoor System, ≥ 9,000 Btu/h Capacity	3.67
Dedicated Condensing, Low Temperature, Outdoor System, < 9,000 Btu/h Capacity	$4.53 \times 10^{-4} \times Q + 2.17$
Dedicated Condensing, Low Temperature, Outdoor System, ≥ 9,000 Btu/h Capacity	6.25
Multiplex Condensing, Medium Temperature	10.82
Multiplex Condensing, Low Temperature	5.91

*Q represents the system gross capacity as calculated in AHRI 1250.

F. Energy Savings

1. Determination of Savings

For each TSL, DOE projected energy savings from the products that are the subject of this rulemaking purchased in the 30-year period that begins in the year of compliance with new standards (2017–2046). The savings are measured over the entire lifetime of products purchased in the 30-year period.[13] DOE quantified the energy savings attributable to each TSL as the difference in energy consumption between each standards case and the base case. The base case represents a projection of energy consumption in the absence of amended mandatory efficiency standards and considers market forces and policies that affect demand for more efficient products.

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.G of this notice and chapter 10 of the TSD) 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).

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 (i.e., coal, natural gas, petroleum 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

[13] 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 in 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.

types used by covered products. For more information on FFC energy savings, see sections IV.G.3 and IV.L and appendix 10G of the TSD.

2. Significance of Savings

DOE may not adopt a standard that would not result in significant additional energy savings. While the term "significant" is not defined in the Act, the U.S. Circuit 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 analysis period for the trial standard levels considered in this rulemaking range from 4.28 to 6.37 quadrillion Btu (quads), an amount DOE considers significant.

G. 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. The following sections generally discuss how DOE addresses 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 Consumers

In determining the impacts of an amended standard on manufacturers, DOE first uses an annual cash-flow approach to determine the quantitative impacts. This step includes both a short-term assessment—based on the cost and capital requirements during the period between when a regulation is issued and when entities must comply with the regulation—and a long-term assessment over a 30-year period. The industry-wide impacts analyzed include industry net present value (INPV), which values the industry on the basis of 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 impacts on different types of manufacturers, including impacts on small manufacturers. Third, DOE considers the impact of standards on domestic manufacturer employment and manufacturing capacity, as well as the potential for standards to result in plant closures and loss of capital investment. Finally, DOE takes into account cumulative impacts of various DOE regulations and other regulatory requirements on manufacturers.

For individual consumers, 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, is discussed in the following section. For consumers in the aggregate, DOE also calculates the net present value from a national perspective of the economic impacts on consumers over the forecast period used in a particular rulemaking. For the results of DOE's analyses related to the economic impact on consumers, see section V.B.1 of this notice and chapters 8 and 11 of the TSD. For the results of DOE's analyses related to the economic impact on manufacturers, see section V.B.2 of this notice and chapter 12 of the TSD.

b. Life-Cycle Costs

The LCC is the sum of the purchase price of equipment (including the cost of its installation) and the operating expense (including energy and maintenance and repair expenditures) discounted over the lifetime of the equipment. The LCC savings for the considered efficiency levels are calculated relative to a base case that reflects likely trends in the absence of new standards. The LCC analysis requires a variety of inputs, such as equipment prices, equipment energy consumption, energy prices, maintenance and repair costs, equipment lifetime, and consumer discount rates. DOE assumes in its analysis that consumers 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 distribution of values with probabilities attached to each value. A distinct advantage of this approach is that DOE can identify the percentage of consumers estimated to receive LCC savings or experience an LCC increase. In addition to identifying ranges of impacts, DOE evaluates the LCC impacts of potential standards on identifiable subgroups of consumers that may be disproportionately affected by a new national standard. For the results of DOE's analyses related to the life-cycle costs of equipment, see section V.B.1.a of this notice and chapter 8 of the TSD.

c. Energy Savings

While significant conservation of energy is a separate statutory requirement for imposing an energy conservation standard, EPCA 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. DOE uses the 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 V.B.3.a of this notice and chapter 10 of the TSD.

d. Lessening of Utility or Performance of Products

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. During the screening analysis, DOE eliminated from consideration any technology that would adversely impact consumer utility. For the results of DOE's analyses related to the potential impact of new standards on equipment utility and performance, see section IV.B of this notice and chapter 4 of the 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. It also directs the Attorney General to determine the impact, if any, of any lessening of competition likely to result from a proposed standard and to transmit such determination to the Secretary within 60 days of the publication of a proposed rule, together with an analysis of the nature and extent of the impact. DOE will transmit a copy of today's proposed rule to the Attorney General with a request that the Department of Justice (DOJ) provide its determination on this issue. DOE will address the Attorney General's determination in the final rule.

f. Need of the Nation to Conserve Energy

The energy savings from the proposed standards are likely to provide improvements to the security and reliability of the nation's energy system. Reductions in the demand for electricity also may result in reduced costs for maintaining the reliability of the nation's electricity system. DOE conducts a utility impact analysis to estimate how standards may affect the nation's needed power generation capacity. The utility impact analysis is contained in chapter 14 of the TSD.

The proposed standards also are likely to result in environmental benefits in the form of reduced emissions of air pollutants and greenhouse gases associated with energy production. DOE reports the emissions impacts from today's standards, and from each TSL it considered, in section V.B.6 of this notice and chapter 15 of the TSD. DOE also reports estimates of the economic value of emissions reductions resulting from the considered TSLs.

g. Other Factors

EPCA allows the Secretary, in determining whether a standard is economically justified, to consider any other factors that the Secretary deems to be relevant. 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), EPCA provides for a rebuttable presumption that an energy conservation standard is economically justified if the additional cost to the consumer of equipment that meets the 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 which can be used to calculate the payback period for consumers of products or equipment that meet the proposed standards. These analyses include, but are not limited to, the three-year payback period contemplated under the rebuttable presumption test. However, DOE routinely conducts a full economic analysis that considers the full range of impacts to the consumer, manufacturer, nation, and environment, as required under 42 U.S.C. 6295(o)(2)(B)(i). The results of this analysis serve as the basis for DOE to evaluate the economic justification for a potential standard level (thereby supporting or rebutting the results of any preliminary determination of economic justification). The rebuttable presumption payback calculation is discussed in section IV.F.12 of this NOPR and chapter 8 of the TSD.

IV. Methodology and Discussion

A. Market and Technology Assessment

When beginning an energy conservation standards rulemaking, DOE develops information that provides an overall picture of the market for the products concerned, including the purpose of the products, 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 and 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 products sold and offered for sale; (2) retail market trends; (3) products 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 products under examination. DOE researched manufacturers of panels, display doors, non-display doors, and refrigeration equipment. DOE also identified and characterized small business manufacturers of these components. See chapter 3 of the TSD for further discussion of the market and technology assessment.

In the preliminary TSD, DOE presented market performance data. Typically, DOE's analysis of market data uses catalog and performance data to determine the number of products on the market at varying efficiency levels. However, WICF systems and equipment have not previously been rated for efficiency by manufacturers, nor has an efficiency metric been established for this equipment. Based on the available data, DOE presented a sample of equipment at various sizes in the preliminary TSD and estimated the energy consumption of the equipment using the preliminary engineering spreadsheet. For refrigeration equipment in particular, DOE found that, as expected, the relationship between capacity and energy consumption was roughly linear.

In a comment on the market performance data DOE presented, Manitowoc expressed concern that DOE's use of linear trends to establish the relationship between energy consumption and net capacity will lead to an overestimation of the potential benefits of refrigeration system standards. (Manitowoc, No. 0056.1 at p. 2)

DOE presented the market performance data to illustrate its understanding of the market. In response to Manitowoc's concern, DOE notes that the benefits of the rule are not derived from the estimates of market performance data but are determined from the LCC analysis and NIA. DOE seeks market performance data to help inform DOE's analysis.

1. Definitions Related to Walk-In Coolers and Freezers

DOE proposes to amend the definition of display door and to adopt definitions for passage and freight door in order to clarify the boundaries separating these equipment classes. The display door definition was modified to permit transparent doors used for the passage of people to be categorized as display doors rather than as non-display passage doors. DOE is proposing to define transparent passage doors as a type of display door because transparent passage doors are generally constructed in the same manner and with the same materials as transparent reach-in doors. DOE proposes to include definitions for non-display passage and freight doors in order to clarify the distinction between the two types of doors. Non-display passage doors are typically smaller than freight doors and are designed for passage of people and small machines, whereas non-display freight doors are larger than passage doors and designed for the passage of large machines like forklifts.

a. Display Doors

As described in section III.B of this notice, DOE established a definition for display door in the test procedure. 76 FR 33631 (June 9, 2011). DOE is now proposing to amend this definition to include all doors that are comprised of 75 percent or more glass or other transparent material. This amendment is intended to classify passage doors that are mostly comprised of glass as display doors because the utility and construction of glass passage doors more closely resembles that of a display door. DOE proposes to define a display door as one that "(1) is designed for product display; or (2) has 75 percent or more of its surface area comprised of glass or another transparent material." DOE requests comment on this proposed definition.

b. Freight Doors

DOE is proposing to separate non-display doors into two equipment classes, passage doors and freight doors. DOE proposes to define freight doors in order to clarify the distinction between these two equipment classes and remove any ambiguity about which energy standards apply to a given door. The two types of doors are constructed differently—for example, freight doors tend to have more structural support because they are bulkier — and warrant different standards for each type. DOE is proposing a definition of freight doors that would account for the fact that these doors are typically larger than passage doors and are used to allow large machines, like forklifts, into walk-ins. Specifically, DOE proposes to define a freight door to mean "a door that is not a display door and is equal to or larger than 4 feet wide and 8 feet tall." DOE based these proposed dimensions on the standard size of a walk-in panel, which is 4 feet wide by 8 feet tall. In DOE's estimation doors used for the passage of people small machines would be less than the standard size of a walk-in panel and therefore all other doors would be freight doors. DOE requests comment on its proposed definition.

c. Passage Doors

DOE proposes a definition of passage doors to differentiate passage doors from freight doors and display doors. Passage doors are mostly intended for the passage of people and small machines like hand carts and not for product display. DOE proposes to define this term to mean "a door that is not a freight or display door." DOE requests comment on this proposed definition.

2. Equipment Included in this Rulemaking

a. Panels and Doors

As mentioned in section III.B.1, DOE identified three types of panels used in the walk-in industry: display panels, floor panels, and non-floor panels. Based on its research, DOE determined that display panels, typically found in beer caves (walk-ins used for the display and storage of beer or other alcoholic beverages often found in a supermarket) make up a small percentage of all panels currently present in the market. Therefore, because of the extremely limited energy savings potential currently projected to result from amending the requirements that these panels must meet, DOE is not proposing standards for walk-in display panels in this NOPR. Display panels, however, must still follow all applicable design standards already prescribed by EPCA, as discussed in section II.B.1 of this notice.

DOE is also not proposing to require the installation of walk-in cooler floor panels. DOE did not consider including walk-in cooler floor panels in its analysis because of their complex nature. Through manufacturer interviews and market research, DOE determined that, unlike walk-in freezers, the majority of walk-in coolers are made with concrete floors and do not use insulated floor panels. The entity that installs the cooler floor is considered the floor's manufacturer and is responsible for testing and complying with a walk-in cooler floor standard. If DOE were to require that all walk-in coolers to be equipped with floor panels, the onus of complying with this requirement would likely fall on entities that do not specialize in constructing walk-in coolers, and the accompanying burden in using these components and certifying compliance with the appropriate standards would likely be costly and difficult for that entity to fulfill. Therefore, at this time, it is DOE's view that requiring the use of floor panels -- along with the accompanying compliance costs -- would present an undue burden to those entities that would be responsible for meeting these requirements. For these reasons, DOE is not proposing to require walk-in coolers to have floor panels, nor is DOE proposing energy efficiency standards for cooler floor panels. (DOE is, however, proposing energy efficiency standards for walk-in freezer floor panels and notes that EPCA requires floor insulation of at least R-28 for walk-in freezers. (42 U.S.C. 6313(f)(1)(D)).)

DOE also identified two types of doors in the walk-in market, display doors and non-display doors, which are discussed in section III.B.2 of this NOPR. All types of doors will be subject to the performance standards proposed in this rulemaking.

b. Refrigeration System

DOE defines the refrigeration system of a walk-in as the mechanism (including all controls and other components integral to the system's operations) used to create the refrigerated environment in the interior of the walk-in cooler and freezer, consisting of either (1) a packaged system where the unit cooler and condensing unit are integrated into a single piece of equipment, (2) a split system with separate unit cooler and condensing unit sections, or (3) a unit cooler that is connected to a multiplex condensing system. 76 FR at 33631.

DOE based its preliminary results used in today's proposal on an analysis of storage coolers and freezers. DOE did not analyze blast freezer walk-ins, which are designed to quickly freeze food and then store it at a specified holding temperature. American Panel commented that blast freezer performance differs from storage freezer performance due to the large product loads experienced with this specialized equipment. (American Panel, No. 0048.1 at p. 4) Heatcraft added that blast freezer refrigeration systems' energy consumption would be higher than that of storage freezers and that they require wider fin spacing because of a higher rate of frost accumulation. (Heatcraft, No. 0058.1 at p. 1)

DOE agrees with American Panel and Heatcraft that blast freezer refrigeration systems have different energy characteristics from storage freezers, but questions whether they would necessarily have a lower rated efficiency. DOE is not proposing to include blast freezers in this rulemaking analysis because they make up a small percentage of walk-ins currently present in the market. DOE requests comment on whether blast freezer refrigeration systems would have difficulty complying with DOE's refrigeration efficiency standards and, if so, to direct DOE to (and supply it with) any test procedure data supporting this conclusion. DOE proposes to apply the same standards to blast freezer refrigeration systems as to storage freezer refrigeration systems, unless DOE finds that blast freezer refrigeration systems would have difficulty complying with DOE's standards. Otherwise, DOE will consider excluding blast freezers from coverage under this rulemaking, although they would still have to comply with the already statutorily-prescribed standards in EPCA.

Regarding the particular refrigerant to be used in the analysis, DOE analyzed refrigeration equipment using R404A, a hydrofluorocarbon (HFC) refrigerant blend, in the preliminary analysis. Heatcraft supported DOE's approach to use only HFC refrigerants in the analysis, but also suggested that DOE consider lower global warming potential (GWP) refrigerants—such as R134a, R407A, or R407C—in the analyses as well because of shifts in the marketplace towards these products, even though these refrigerants may have lower efficiencies. (Heatcraft, No. 0069.1 at p. 3)

DOE used R404A in its analysis for this NOPR because it is widely used currently in the walk-in industry. DOE appreciates Heatcraft's suggestion to analyze alternative refrigerants, especially those with a lower GWPs given the interest by many manufacturers to use these alternatives, and requests comment on the extent of the use or likely phase-in of lower GWP refrigerants and asks manufacturers to submit data related to the ability of the equipment (either existing or redesigned) using these refrigerants to meet the proposed standard, as well as the cost of such equipment.

3. Equipment Classes

a. Panels and Doors

In the preliminary analysis, DOE proposed to divide the envelope into two separate equipment classes: display and non-display walk-ins (that is, walk-ins with and without glass). Display walk-ins are walk-ins that have doors for display purposes, are typically made with glass, and are inherently less efficient than walk-ins without glass because glass is not as insulative as the insulation material used in non-display walk-ins (typically polyurethane or polystyrene).

Interested parties commented on the need to separate display and non-display walk-ins into two different equipment classes. Nor-Lake and AHRI agreed with the equipment classes proposed by DOE, and AHRI commented that the equipment classes represent the most common walk-in configurations. (Nor-Lake, No. 0049.1 at p. 1; AHRI, No. 0055.1 at p. 2) Manitowoc stated that classification of envelopes into storage and display types is appropriate as it may allow for different performance levels for certain components. (Manitowoc, No. 0056.1 at p. 2) However, CrownTonka contended that it was unnecessary to have two equipment classes for display and non-display walk-ins and that separate classes for coolers and freezers are adequate. (CrownTonka, No. 0057.1 at p. 1) ASAP and SCE opined that one equipment class is sufficient and that the difference between non-display and display doors could be accounted for through a weighted average of the opaque and glass surface areas. (ASAP, Public Meeting Transcript, No. 0045 at p. 70; SCE, Public Meeting Transcript, No. 0045 at p. 79) However, NEAA, NPCC and Manitowoc countered that there should not be a single metric for both display and non-display doors because it would not account for the unique utility offered by display walk-ins (i.e., permitting the display of stored items). (NEAA and NPCC, Public Meeting Transcript, No. 0045 at p. 76; Manitowoc, Public Meeting Transcript, No. 0045 at p. 78) NEAA and NPCC stated that, if DOE were to separate display and non-display walk-ins into two different classes, DOE should carefully define the boundary between the two classes. (NEAA and NPCC, Public Meeting Transcript, No. 0045 at p. 77) NEAA and NPCC also suggested that, as an alternative to having one equipment class for display and non-display walk-ins with a single performance metric, DOE should move to component level-based classes with separate performance metrics. (NEAA and NPCC, Public Meeting Transcript, No. 0045 at p. 76)

Interested parties also submitted comments about the names of the equipment classes. NEAA and NPCC stated that if DOE has two separate equipment classes for display and non-display walk-ins, DOE should carefully define the boundary between the two classes. (NEAA and NPCC, Public Meeting Transcript, No. 0045 at p. 77) Kysor stated that the class names DOE suggested were confusing and offered an alternative -- "coolers with glass doors" instead of "display coolers" -- to help clarify the difference between the two separate equipment classes. (Kysor, Public Meeting Transcript, No. 0045 at p. 78)

In light of the component level standards described in section III.A, DOE proposes to create separate equipment classes for panels, display doors, and non-display doors. These different items comprise the main components of a walk-in envelope. DOE proposes separate classes for panels, display doors, and non-display doors because each component type has a different utility to the consumer and possesses different energy use characteristics.

In the preliminary analysis, DOE also considered the possibility of creating separate classes for walk-in coolers and walk-in freezers because EPCA specifically divides walk-in equipment into coolers (above 32°F) and freezers (at or below 32°F), (42 U.S.C. 6311(20)), and prescribes unique design requirements for each. (42 U.S.C. 6313(f)(1)(C)-(D)(3)) DOE has continued to apply this approach in its analysis.

Panels

DOE has placed panels into two equipment classes: freezer floor panels and non-floor panels (also called structural panels). DOE understands that freezer floor panels and structural panels serve two different utilities. Freezer floor panels, which are panels used to construct the floor of a walk-in, must often support the load of small machines like hand carts and pallet jacks on their horizontal faces. Non-floor panels or structural panels, which include panels used to construct the ceiling or wall of a walk-in, provide structure for the walk-in. Because of their different utilities, the two classes of panels are constructed differently from each other and use different amounts of framing material, which affects the panels' energy consumption.

Structural panels are further divided into two more classes based on temperature — i.e., cooler versus freezer panels. Cooler structural panels are rated with their internal faces exposed to a temperature of 35°F, as called for in the test procedure final rule. Freezer structural panels are used in walk-in freezers and rated with its internal face exposed to a temperature of -10°F, as required by the test procedure final rule. 76 FR at 21606; 10 CFR 431.303. EPCA also requires walk-in freezer panels to have a higher R-value than walk-in cooler panels. These differences result in different amounts of insulating foam between these panel types and affect the panel's U-value.

Doors

DOE has distinguished between two different door types used in walk-in coolers and freezers: display doors and non-display doors. DOE proposed separate classes for display doors and non-display doors to retain consistency with the dual approach laid out by EPCA for these walk-in components. (42 U.S.C. 6313(f)(1)(C) and (3)) Non-display doors and display doors also serve separate purposes in a walk-in. Display doors contain mainly glass in order to display products or objects located inside the walk-in. Non-display doors function as passage and freight doors and are mainly used to allow people and products to be moved into and out of the walk-in. Because of their different utilities, display and non-display doors are made up of different material. Display doors are made of glass or other transparent material, while non-display doors are made of highly insulative materials like polyurethane. The different materials found in display and non-display doors significantly affect their energy consumption.

DOE divided display doors into two equipment classes based on temperature differences: cooler and freezer display doors. Cooler display doors and freezer display doors are exposed to different internal temperature conditions, which affect the total energy consumption of the doors. In the test procedure final rule, DOE established an internal rating temperature of 35°F for walk-in cooler display doors and -10°F for walk-in freezer display doors. 76 FR at 21606; 10 CFR Part 431, Subpart R, Appendix A, Section 5.3.

DOE also separated non-display doors into two equipment classes, passage and freight doors. Passage doors are typically smaller doors and mostly used as a means of access for people and small machines, like hand carts. Freight doors typically are larger doors used to allow access for larger machines, like forklifts, into walk-ins. The different shape and size of passage and freight doors affects the energy consumption of the doors. Both passage and freight doors are also separated into cooler and freezer classes because, as explained for display doors, cooler and freezer doors are rated at different temperature conditions. A different rating temperature impacts the door's energy consumption.

In the preliminary analysis, DOE did not consider outdoor envelopes as a separate equipment class. Walk-ins located outdoors have very similar features to walk-ins located indoors, and DOE could not identify any additional design options that improved the energy consumption only of outdoor walk-ins. The Joint Utilities, NEEA and NPCC, CrownTonka, Nor-Lake, and Hill Phoenix stated that DOE should differentiate equipment classes by their external environment. (Joint Utilities, No. 0061.1 at p. 5; NEEA and NPCC, No. 0059.1 at p. 6; CrownTonka, Public Meeting Transcript, No. 0045 at p. 81; Nor-Lake, No. 0049.1 at p.2; Hill Phoenix, No. 0066.1 at p.2) The Joint Utilities requested that DOE evaluate cost-effective insulation levels for outdoor walk-ins, and stated that there would be a loss in energy savings if DOE did not consider region-specific insulation levels. (Joint Utilities, Public Meeting Transcript, No. 0045 at pp. 80 and 82) Nor-Lake contested DOE's claim that walk-ins designed as outdoor units include no additional features that impact energy consumption, stating that the ambient temperature and product load will change the energy consumption for both the indoor and outdoor units. (Nor-Lake, No. 0049.1 at p.2) Hill Phoenix recommended a separate equipment class for outdoor walk-ins because outdoor walk-ins must have thicker panels to withstand environmental conditions. (Hill Phoenix, No. 0066.1 at p. 2) American Panel observed that a walk-in located outdoors has an added benefit in that no building space was constructed to house the walk-in, which is a significant energy savings not considered in the preliminary analysis. (American Panel, No. 0048.1 at p.3)

Some commenters described how DOE could include equipment classes that capture the external conditions. SCE suggested that DOE set a series of different conditions by the location of the wall such as an outdoor, indoor, or demising wall (i.e., a dividing wall to separate spaces) between a cooler and a freezer space. (SCE, Public Meeting Transcript, No. 0045 at pp. 80 and 82-–83) NEEA and NPCC recommended changing the equipment classes to indoor cooler, indoor freezer, outdoor cooler, and outdoor freezer. (NEEA and NPCC, No. 0059.1 at p. 6)

Other interested parties agreed with DOE's assertion that it was unnecessary to consider outdoor walk-ins as a separate equipment class. Kysor explained that the envelope would be designed for whatever ambient conditions it may be subjected to, and that adding additional performance requirements would be unnecessary. (Kysor, Public Meeting Transcript, No. 0045 at p. 80) Manitowoc stated that there should not be any classification based on external environments as there are times when the envelope is exposed to both internal and external conditions. (Manitowoc, Public Meeting Transcript, No. 0045 at p. 82)

DOE is not proposing to include any panel or door equipment class that accounts for the different external environmental conditions that a walk-in could experience in real world applications. DOE does not find outdoor and indoor walk-in envelope components to have distinct utilities. Components for outdoor walk-ins and indoor walk-ins are generally constructed with the same design and materials and serve the same purpose. In response to Nor-Lake's comment about DOE's assumption about additional features, DOE clarifies that while the difference in outdoor temperatures affects the real world energy consumption of the walk-in envelope, DOE was referring to design features, such as different types of insulation, which differ from the design options found on indoor walk-ins and improve the energy efficiency of the outdoor walk-in. As to Hill Phoenix's comment that a panel facing external conditions requires more insulation, DOE notes that panels with thicker insulation already surpass the baseline panel specifications, which would make it easier for these types of panels to meet the standards in today's proposal.

Hill Phoenix also recommended that DOE divide envelopes into factory assembled step-in style walk-ins and larger construction-based walk-ins. (Hill Phoenix, No. 0066.1 at p. 1) Because it is not proposing standards for walk-in envelopes, but rather for the panels and doors that are components of the envelopes, DOE has not adopted Hill Phoenix's recommendation in today's proposal. DOE has, however, separated into different equipment classes the components typically found in factory-assembled walk-ins, such as passage doors and floor panels, and those components found in large construction-based walk-ins, such as freight doors. DOE believes this approach will achieve the objective of the Hill Phoenix recommendation, namely that the proposed standards reflect the different energy use characteristics of factory-assembled and construction-based walk-ins.

Table IV-1 lists the equipment classes DOE proposes to create in this NOPR. In the table below, medium temperature refers to cooler equipment and low temperature refers to freezer equipment. The column entitled "Class" lists the codes that will be used to abbreviate each equipment class, and will be used throughout the NOPR.

Table IV-1 Equipment Classes for Panels and Doors

Product	Temperature	Class
Structural Panel	Medium	SP.M
	Low	SP.L
Floor Panel	Low	FP.L
Display Door	Medium	DD.M
	Low	DD.L
Passage Door	Medium	PD.M
	Low	PD.L
Freight Door	Medium	FD.M
	Low	FD.L

b. Refrigeration Systems

In the preliminary analysis, DOE considered dividing walk-in refrigeration systems into six equipment classes based on key physical characteristics that affect equipment efficiency: (1) the type of condensing unit (i.e., whether the system has a dedicated condensing unit or is connected to a multiplex system), (2) the operating temperature, and (3) the location of the walk-in (i.e., indoors or outdoors). In this NOPR, DOE also proposes to differentiate refrigeration system classes based on capacity. DOE discusses the four proposed class differentiations below.

Type of Condensing Unit

Due to the significant impact of the condensing unit on the overall energy consumption of the walk-in (as much as 90 percent), the preliminary analysis differentiated between two different condensing unit types: dedicated condensing systems and multiplex condensing systems. In a dedicated condensing system, only one condensing unit (consisting of one or more compressors and condensers) serves a single walk-in. A multiplex condensing system consists of a rack of compressors usually located in a mechanical room, a large condenser or condensers usually located on the roof, and several unit coolers or evaporators belonging to various types of refrigeration equipment, including walk-ins. The only part of a multiplex condensing system that would be covered under the proposed standard would be a unit cooler in a walk-in -- a "unit cooler connected to a multiplex condensing system." The compressor and condenser of a multiplex system would not be covered under the walk-in standard because they serve equipment other than walk-ins. Furthermore, DOE would be unable to attribute the portion of energy use related to only the walk-in, at the point of manufacture of the compressor and condenser of the multiplex system.

DOE received several comments about the classification of condensing types. AHRI, Nor-Lake and Manitowoc agreed with DOE's equipment classes proposed in the preliminary analysis, while the Joint Utilities suggested redesignating the multiplex and dedicated equipment classes as remote and self-contained, respectively. (AHRI, Public Meeting Transcript, No. 0045 at p. 74, Nor-Lake, No. 0049.1 at p. 1, Manitowoc, No. 0056 at p. 2, Manitowoc, Public Meeting Transcript, No. 0045 at p. 73, Joint Utilities, Public Meeting Transcript, No. 0045 at p. 71) The Joint Utilities suggested regulating condensing units in a manner similar to that used by DOE for commercial refrigeration equipment, which, in their view, would result in coverage of most of the condensing units serving the walk-in industry. (Joint Utilities, No. 0061.1 at p. 11, 12) The Joint Advocates suggested that DOE conduct a separate rulemaking for condensing units. (Joint Advocates, No. 0070.1 at p. 3) They added that DOE should reduce the number of refrigeration types to self-contained and unit coolers only, while the Joint Utilities recommended against including remote condensing units as part of this rulemaking. (Joint Advocates, No. 0070.1 at p. 3, Joint Utilities, No. 0045 at p. 22)

DOE believes the refrigeration systems covered by the two classes of equipment, dedicated condensing and multiplex condensing, accurately represent the range of refrigeration equipment used in walk-in coolers and freezers. Although the proposed classes differ from the classes designated in the commercial refrigeration equipment rulemaking, there are key differences between commercial refrigeration equipment refrigeration systems and walk-in refrigeration systems. The Joint Advocates and Joint Utilities refer to two types of refrigeration systems commonly used with commercial refrigeration equipment: “self-contained” (meaning the entire refrigeration system is built into the case) and “remote condensing” (meaning the unit cooler is built into the case, but the whole case is connected to a central system of compressors and condensers, called a “rack” or “multiplex condensing system”, connected to most or all of the refrigeration units in a building). “Remote condensing”, however, can also refer to a configuration in which the unit cooler is connected to a dedicated (i.e., only serving that one unit) compressor and condenser that are located somewhere away from the unit cooler. This configuration is rare for commercial refrigeration equipment, but comprises a large proportion of walk-in refrigeration system applications.

To avoid confusion over the different configurations for walk-ins and commercial refrigeration equipment that can be classified as “remote condensing”, DOE is not proposing to classify walk-in refrigeration systems as “remote condensing” and “self-contained”. Also, DOE does not agree that the compressor and condenser parts should not be covered under the walk-in coolers and freezers rulemaking. Instead, DOE is proposing to include dedicated condensing units in the rule, even if remotely located, because these units could be viewed as part of the walk-in as long as they are connected only to that particular walk-in and not to other refrigeration equipment. For systems where the walk-in is connected to a multiplex condensing system that runs multiple pieces of equipment, the compressor and condenser would not be covered because they are not exclusively part of the walk-in.

In consideration of the above, DOE proposes to create two classes of refrigeration systems: dedicated condensing and multiplex condensing. DOE believes that dedicated remote condensing units represent a substantial opportunity for energy savings in a regulation for walk-in components because the configuration of a dedicated remote condensing unit is widespread in several market segments, such as restaurants. Manufacturers can optimize the dedicated remote condensing unit with the unit cooler to take advantage of certain conditions, such as low ambient outdoor temperatures.

DOE does not propose to create separate classes for dedicated packaged systems (where the unit cooler and condensing unit are integrated into a single piece of equipment) and dedicated split systems (with separate unit cooler and condensing unit sections). Packaged systems are potentially more efficient than split systems because they do not experience as much energy loss in the refrigerant lines. However, because packaged systems comprise a small share of the refrigeration market, DOE currently believes that little additional energy savings could be achieved by considering them as a separate class. Accordingly, DOE is not proposing to consider the creation of a separate packaged systems class.

DOE also notes that its proposed standards for dedicated condensing systems are based on an analysis of split systems. DOE requests comment on its proposal not to consider dedicated packaged systems and dedicated split systems as separate classes and whether this proposal would unfairly disadvantage any manufacturers.

Operating Temperature

The second physical characteristic that DOE proposes as a basis for dividing refrigeration systems into equipment classes is the operating temperature. EPCA divides walk-in equipment into coolers (above 32 °F) and freezers (at or below 32 °F) (42 U.S.C. 6311(20)) Using this distinction, DOE is proposing to categorize refrigeration systems as low or medium temperature systems based on the temperature profiles of their unit coolers. The medium (M) and low (L) temperature units are differentiated by their operating temperatures, which are greater than 32 °F (for coolers) and less than or equal to 32 °F (for freezers). In response to DOE's discussion of these classes in the preliminary analysis, Ingersoll Rand suggested that any walk-in with defrost be rated as a freezer regardless of the operating temperature. (Ingersoll Rand, No. 0053.1 at p. 1) DOE has not adopted these suggestions because doing so would conflict with the statutory distinction created by Congress that relies on operating temperature to distinguish between walk-in coolers and freezers. See 42 U.S.C. 6311(2) (treating walk-ins as separate equipment based on whether they are coolers or freezers).

Furthermore, applying the rating conditions for low temperature refrigeration systems is unlikely to enable a tester to accurately measure the efficiency of a medium temperature refrigeration system. Requiring a refrigeration system with defrost to be rated at the low temperature rating conditions even if it is designed to operate closer to the medium temperature rating conditions could lead to inaccurate equipment ratings for such equipment. In certain cases, applying temperature ratings in this manner may not permit this type of equipment to be rated at low temperature rating conditions if it is not designed to operate at those conditions.[14]

Location of the Walk-in

The third physical characteristic DOE considered is the location of the condensing unit (i.e., indoor or outdoor), which also affects the energy consumption of dedicated condensing systems. Indoor refrigeration systems generally operate at fixed ambient temperatures, while outdoor refrigeration systems experience varying temperatures through the year. This change in temperature affects the performance of the refrigeration system by requiring it to operate more during warmer conditions and less during colder ones. Accordingly, the test procedure has one ambient rating condition for indoor systems and three ambient rating temperatures for outdoor systems.

In the preliminary analysis, DOE considered creating separate classes for refrigeration systems with indoor (I) and outdoor (O) condensing units because of their different energy consumption characteristics. Outdoor condensing units can also implement a wide variety of design options to run more efficiently at low ambient temperatures. (In contrast, DOE did not consider indoor and outdoor envelope components as belonging to separate classes partly because of the absence of available options for improving efficiency based on the ambient

[14] For example, most medium temperature unit coolers are designed to operate between 15 °F and 45 °F, and would not be able to operate at the low temperature rating condition of -10 °F.

temperature. See section IV.A.3.a for details.) Following the preliminary analysis, DOE did not receive any comments regarding the indoor and outdoor condensing unit classes, and therefore proposes the same differentiation in this NOPR.

Refrigeration Equipment Size

In the preliminary analysis, DOE did not consider different equipment classes based on refrigeration equipment size. Heatcraft suggested adding sub-categories to the proposed equipment classes, stating that the size of refrigeration systems varies with envelope size. (Heatcraft, No. 0069.1 at p. 1) Manitowoc commented that small sized equipment would struggle to meet minimum standards if DOE based the metric on a larger size, largely due to the efficiency difference of each system size. (Manitowoc, Public Meeting Transcript, No. 0044 at p. 118)

DOE is not proposing to base refrigeration system classes on envelope size because it is taking a component-level approach that sets standards for the refrigeration system independent of the envelope. In reaching this tentative decision, DOE examined the ability of various sized equipment to meet a proposed standard. For the NOPR analysis, DOE analyzed a wider range of equipment sizes than it did for the preliminary analysis, as described later in section IV.C.1.b. As a result of this expanded analysis, DOE observed that small sized equipment may have difficulty meeting an efficiency standard that is based on an analysis of large equipment, as Manitowoc noted. DOE found that this result was primarily due to a lack of availability of the more efficient compressor types (e.g., scroll compressors) at lower capacities. Additionally, certain design options, mainly controls, generally have a fixed cost, but their benefit decreases with lower capacities, so they are less cost-effective for lower-capacity equipment. Therefore, DOE proposes one equipment class for high-capacity equipment and another for low-capacity equipment within the dedicated condensing category (because the compressor is covered only for DC systems). DOE has tentatively chosen 9,000 Btu/h as the capacity threshold for small- and large-capacity equipment based on the efficiency characteristics of available compressors, among other factors. See chapter 3 for details. DOE requests comment on the capacity threshold between the two capacity classes for dedicated condensing systems.

Proposed Classes

Using the proposed combinations of condensing unit types, operating temperatures, location, and size, ten equipment classes are possible for walk-in cooler or freezer refrigeration systems. DOE believes that these ten classes accurately represent the refrigeration units used in the walk-in market today.

Table IV-2 lists the equipment classes for refrigeration equipment that DOE is proposing in this NOPR. The column entitled “Class” lists the codes that will be used to abbreviate each equipment class, and will be used throughout the NOPR.

Table IV-2 Equipment Classes for Refrigeration Equipment

Condensing Type	Operating Temperature	Condenser Location	Refrigeration Capacity (Btu/h)	Class
Dedicated	Medium	Indoor	< 9,000	DC.M.I, < 9,000
			≥ 9,000	DC.M.I, ≥ 9,000
		Outdoor	< 9,000	DC.M.O, < 9,000
			≥ 9,000	DC.M.O, ≥ 9,000
	Low	Indoor	< 9,000	DC.L.I, < 9,000
			≥ 9,000	DC.L.I, ≥ 9,000
		Outdoor	< 9,000	DC.L.O, < 9,000
			≥ 9,000	DC.L.O, ≥ 9,000
Multiplex	Medium	-	-	MC.M
	Low	-	-	MC.L

4. Technology Assessment

In a technology assessment, DOE identifies technologies and designs that could be used to improve the energy efficiency or performance of covered equipment. For the preliminary analysis, DOE conducted a technology assessment to identify all technologies and designs that could be used to improve the energy efficiency of walk-ins or walk-in components. DOE described these technologies in chapter 3 of the preliminary TSD.

DOE received several comments in response to its preliminary list of technology options. NEEA and NPCC recommended that DOE include modulating condenser fan controls in its analysis because there are significant potential energy savings from this technology. (NEEA and NPCC, No. 0059.1 at p. 8) Emerson agreed and noted that higher-efficiency compressors often require modulating fan controls to realize the full benefit of the higher-efficiency compressors. (Emerson, Public Meeting Transcript, No. 0045 at p. 90) The Joint Utilities pointed out that DOE did not include variable speed controls for condenser fans. (Joint Utilities, No. 0061.1 at p.10) In addition, NEEA and NPCC recommended that DOE include liquid suction heat exchangers in its analysis because there are significant potential energy savings from this technology. (NEEA and NPCC, No. 0059.1 at p. 8)

In response to the recommendation that DOE consider condenser fan controls, DOE has added condenser fan controls as a design option because it determined through further analysis that they could be an effective means of saving energy. As to NEEA and NPCC's recommendation that DOE include liquid suction heat exchangers, DOE also considered liquid suction heat exchangers in the technology assessment because this technology could potentially be used to save energy. However, DOE screened this option from further consideration because further examination indicated that it would be unlikely to yield significant energy savings under the rating conditions used in setting standards for walk-in equipment. See chapters 3, 4, and 5 of the TSD for more details on the technologies considered in the analysis.

B. 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 (1) are not technologically feasible; (2) are not practicable to manufacture, install, or service; (3) have adverse impacts on product utility or product availability; or (4) have adverse impacts on health or safety. 10 CFR 430, subpart C, appendix A, sections (4)(a)(4) and (5)(b).)

1. Technologies That Do Not Affect Rated Performance

In the preliminary analysis TSD, DOE proposed to screen out the following technologies because they do not improve energy efficiency: non-penetrative internal racks and shelving, air and water infiltration sensors, humidity sensors, and heat flux sensors.

For the reasons stated in the test procedure final rule, DOE's test procedure establishes metrics to test the energy consumption or energy use of walk-in components and does not include heat load caused by infiltration. See 76 FR at 21594-21595. As a result, DOE included additional infiltration-related technologies in the following list of technologies that do not improve rated performance:

- internal racks and shelving that are non-penetrative;
- air and water infiltration sensors;
- extruded polystyrene insulation;
- humidity sensors;
- heat flux sensors;
- door gasketing improvements and panel interface systems;
- automatic door opening and closing systems;
- air curtains;
- strip curtains;
- vestibule entryways; and
- insulation with improved moisture resistance.

In the preliminary analysis, DOE listed hot gas defrost as a technology that does not improve rated performance of refrigeration equipment. In response, the Joint Utilities stated that DOE should include hot gas defrost. (Joint Utilities, Public Meeting Transcript, No. 0045 at p. 25; Joint Utilities, No. 0061.1 at pp. 3, 7, and 10). DOE has included hot gas defrost as a design option for multiplex condensing systems, but not for dedicated condensing systems due to its lack of effectiveness in improving efficiency. Specifically, for multiplex condensing systems, the hot gas defrost system utilizes hot gas generated by the compressor rack. Because at least one of the compressors in the rack is likely to be running (because the rack also has to operate with other refrigeration units) no new energy is consumed to generate the hot gas. In contrast, for dedicated systems, the condensing unit typically turns off during an electric defrost cycle. Running the compressor to generate hot gas at a time when it would normally be off results in energy use that outweighs the energy saved by using hot gas defrost instead of electric defrost. See chapters 3 and 5 of the TSD for details.

Also as part of the preliminary analysis, DOE analyzed the envelope and the refrigeration system separately and did not consider design options that depend on the interaction between the envelope and the refrigeration system. SCE suggested that DOE consider control options that depend on the interaction between envelope components and the refrigeration system, such as a control that turns off the evaporator fan when the door is opened. SCE suggested that DOE evaluate such technologies by establishing a typical, nominal savings value for use in energy consumption equations. (SCE, Public Meeting Transcript, No. 0045 at p. 25) Similarly, NEEA and NPCC stated that such technological controls have not been included in the design options. (NEEA and NPCC, No. 0059.1 at p. 7)

A nominal savings value, as suggested by SCE, would be highly dependent on many assumptions about the application of the walk-in and the pairing of the refrigeration system with the walk-in. As a result, DOE does not believe that it would be reasonable to apply this shared value to all refrigeration system or door manufacturers because of the wide variety of equipment produced by these entities for walk-in applications. Moreover, DOE’s proposed component level approach eliminates the need to consider design options whose efficacy depends on the interaction between different components.

DOE also did not consider design options whose benefits would not be captured by the test procedure, such as economizer cooling. Economizer cooling consists of directly venting outside air into the interior of the walk-in when the outside air is as cold as or colder than the interior of the walk-in. This technique relieves the load on the refrigeration system when a pull-down load (i.e., a load due to items brought into the walk-in at a higher temperature than the operating temperature and must then be cooled to the operating temperature) is necessary. However, the test procedure does not include a method for accounting for economizer cooling, as it does not specify conditions for air that would be vented into the walk-in, nor does it provide a method for measuring the energy use of the economizer. Therefore, any benefits from including an economizer on a WICF would not be captured by the test procedure.

2. Screened-Out Technologies

a. Panels and Doors

In the preliminary analysis, DOE screened out the following technologies for envelopes: revolving doors, energy storage systems, fiber optic natural light, non-electric anti-sweat systems, and automatic insulation deployment systems. DOE did not receive comments regarding any of the screened-out technologies, and will continue to exclude them from this rulemaking. DOE has also screened out additional technologies as part of its proposal to regulate the components of the envelope separately (i.e., display doors, non-display doors, and panels.) See chapter 4 of the TSD for more details on the screened-out technologies.

b. Refrigeration

In the preliminary analysis, DOE screened out the following technologies for refrigeration systems: higher-efficiency evaporator fan motors, improved evaporator coil, three-phase motors, and economizer cooling. In response to DOE's request for comment on the screening analysis, American Panel, AHRI and CrownTonka agreed with this approach to screen out these technologies. (American Panel, Public Meeting Transcript, No. 0045 at p. 98; AHRI. Public Meeting Transcript, No. 0045 at p. 99; CrownTonka, No. 0057.1 at p. 1) Emerson, however, disagreed with DOE's decision to screen out economizer cooling because there are potential energy savings under certain circumstances. (Emerson, Public Meeting Transcript, No. 0045 at p. 100) Also, Heatcraft disagreed with the exclusion of phase motor technology because three-phase motors are the dominant motor type in the larger walk-in envelopes that are a part of this rulemaking. (Heatcraft No. 0069.1 at p. 2) Manitowoc remarked that there are other ways to achieve an effective economizer cooling cycle and encouraged DOE to investigate other options to improve cycle efficiency, but did not provide any specific recommendations. (Manitowoc, Public Meeting Transcript, No. 0045 at p. 92)

DOE continues to screen out three-phase motor technology. The use of three-phase motor technology generally provides higher energy savings as compared to single-phase motors. Three-phase power is commonly used to power large motors and heavy electrical loads; however, it is not available for all businesses, particularly small business consumers of walk-ins. DOE did not consider three-phase motor technology as a design option based on utility to the consumer, one of the four screening criteria. In addition, use of three-phase motor technology may also be impracticable to install and service given the lack of three-phase power for some businesses. DOE did find that, as Heatcraft noted, very large refrigeration systems typically use three-phase power, and notes that manufacturers may use three-phase motors to improve the efficiency ratings of their equipment as the benefit would likely be captured by the test procedure. However, DOE continued to screen three-phase motor technology from its analysis for the reasons discussed above.

DOE also did not consider economizer cooling in its analysis. Although there are potential energy savings under certain circumstances, as Emerson mentioned, these energy savings are not captured by the test procedure, as discussed in section IV.B.1.

Regarding Manitowoc's remark about considering other options to improve cycle efficiency, DOE did not identify any options to improve cycle efficiency beyond what was already considered. DOE requests specific recommendations on how to improve cycle efficiency.

3. Screened-In Technologies

Based on DOE's decision to regulate walk-ins on a component level, DOE will consider separate technologies for each covered walk-in component (i.e. panels, display doors, non-display doors, and refrigeration systems). The remaining technologies that were not "screened-out" are called the "screened-in" technologies and will be used to create design options for improving the efficiency of the walk-in components. The "screened-in" technologies for each covered component include:

- Panels
  - Insulation thickness
  - Insulation material
  - Framing material
- Display doors
  - High-efficiency lighting
  - Occupancy sensors
  - Improved glass system insulation performance
  - Anti-sweat heater controls
- Non-display doors
  - Insulation thickness
  - Insulation material
  - Framing material

- Improved window glass systems
- Anti-sweat heat controls

- Refrigeration Systems
  - Higher efficiency compressors
  - Improved condenser coil
  - Higher efficiency condenser fan motors
  - Improved condenser fan blades
  - Condenser fan control
  - Ambient sub-cooling
  - Improved evaporator fan blades
  - Evaporator fan control
  - Defrost controls
  - Hot gas defrost
  - Head pressure control

C. Engineering Analysis

The engineering analysis determines the manufacturing costs of achieving increased efficiency or decreased energy consumption. DOE has identified the following three methodologies to generate the manufacturing costs needed for the engineering analysis: (1) the design-option approach, which provides the incremental costs of adding design options to a baseline model to 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.

DOE conducted the engineering analyses for this rulemaking using a combination of the design-option and cost-assessment approaches in analyzing the U-factor standards for panels, maximum energy use for non-display doors and display doors, and minimum AWEF for refrigeration systems. More specifically, DOE identified design options for analysis and then used the cost-assessment approach to determine the manufacturing costs and analytical modeling to determine the energy consumption at those levels. Additional details of the engineering analysis are in chapter 5 of the NOPR TSD.

1. Representative Equipment

a. Panels and Doors

In presenting the preliminary analysis, DOE proposed three representative sizes for each envelope equipment class: small, medium, and large. American Panel agreed with the sizes that DOE proposed. (American Panel, No. 0048.1 at p. 4) CrownTonka recommended that the equipment classes for envelopes be divided into only two sections, small and medium, because EPCA covers only walk-ins of less than 3,000 square feet, which excludes sizes that are typically considered "large." (CrownTonka, Public Meeting Transcript, No. 0045 at p.111) Heatcraft agreed that the sizes chosen are small, as all the sizes considered must be less than 3,000 square feet, and they recommended that the distribution of envelope sizes include larger sizes approaching the 3,000 square foot limit, the maximum size limit defined in the statute. Heatcraft also stated that the selected envelope sizes will have an effect on the engineering analysis because certain technologies are utilized at different sizes. (Heatcraft, Public Meeting Transcript, No. 0045 at p. 111, No. 0058.1 at p. 4) American Panel suggested that DOE use three sizes and investigate using an extra large size. (American Panel, Public Meeting Transcript, No. 0045 at p. 114) Manitowoc asserted that DOE did not include a large enough range of sizes and should consider smaller sized walk-ins to correctly represent the energy consumption of a given unit. Additionally, Manitowoc noted that as the walk-in's size increases, there are different base levels of performance and that if DOE sets the minimum efficiency based on a larger size, manufacturers will not be able to make small-sized equipment meeting the standards. (Manitowoc, Public Meeting Transcript, No. 0045 at pp. 116 and 118) Hill Phoenix recommended that the envelope sizes be determined by surface area or volume. (Hill Phoenix, No. 0066.1 at p. 2) NEEA and NPCC suggested that DOE establish a standard based on the square feet of panels shipped each year and use the square footage to determine the energy consumption of a complete functioning envelope. (NEEA and NPCC, No. 0059.1 at p. 8)

DOE notes that its proposal rests on a component-based approach and does not include infiltration losses. As a result, the size of the walk-in envelope does not affect the energy consumption of the components. In regard to American Panel's and Heatcraft's comments about large sized walk-ins, DOE analyzed a large panel size that it considered to represent the large panels found in the industry. DOE anticipated the possibility raised by Manitowoc that small panels might not be able to meet a standard based on the large panel size previously under consideration and is now considering the adoption of an approach that considers small, medium, and large sizes. As Hill Phoenix suggested, DOE determined the size of the panel based on the panel's surface area. Also, similar to NEEA and NPCC's suggestion, DOE is proposing a standard for walk-in panels based on the panel's surface area.

Panels

As explained previously, the engineering analysis for walk-in panels uses three different panel sizes to represent the variations within each class. DOE determined the sizes based on market research and the impact on the test metric U-factor. Table IV-3 shows each equipment class and the representative sizes associated with that class. DOE requests comment on the representative sizes used in the proposed analysis.

Table IV-3 Sizes Analyzed: Panels

Equipment Class	Size Code	Representative Height (feet)	Representative Width (feet)
SP.M	SML	8	1.5
	MED	8	4
	LRG	9	5.5
SP.L	SML	8	1.5
	MED	8	4
	LRG	9	5.5
FP.L	SML	8	2
	MED	8	4
	LRG	9	6

Doors

Similar to the panel analysis, the engineering analyses for walk-in display and non-display doors both use three different sizes to represent the differences in doors within each size class DOE examined. The door sizes were determined using market research. Details are provided in Table IV-4 for non-display doors and Table IV-5 for display doors.

Table IV-4 Sizes Analyzed: Non-Display Doors

Equipment Class	Size Code	Representative Height (feet)	Representative Width (feet)
PD.M	SML	6.5	2.5
	MED	7	3
	LRG	7.5	4
PD.L	SML	6.5	2.5
	MED	7	3
	LRG	7.5	4
FD.M	SML	8	5
	MED	9	7
	LRG	12	7
FD.L	SML	8	5
	MED	9	7
	LRG	12	7

Table IV-5 Sizes Analyzed: Display Doors

Equipment Class	Size Code	Representative Height (feet)	Representative Width (feet)
DD.M	SML	5.25	2.25
	MED	6.25	2.5
	LRG	7	3
DD.L	SML	5.25	2.25
	MED	6.25	2.5
	LRG	7	3

b. Refrigeration

In the engineering analysis for walk-in refrigeration systems, DOE used a range of capacities as analysis points for each equipment class. The name of each equipment class along with the naming convention was discussed in section IV.A.3.b. In addition to the multiple analysis points, scroll, hermetic, and semi-hermetic compressors were also investigated because different compressor types have different efficiencies and costs.[15] Due to the wide range of capacities considered for each condenser type, and the availability of compressors at certain capacities, compressors closely matching the condenser capacities were examined in terms of their performance at varying operating temperatures.

Table IV-6 identifies, for each class of refrigeration system, the sizes of the equipment DOE analyzed in the engineering analysis. Chapter 5 of the NOPR TSD includes additional details on the representative equipment classes used in the analysis.

Table IV-6 Sizes Analyzed: Refrigeration System

Equipment Class	Sizes Analyzed (Btu/h)	Compressors Analyzed
DC.M.I, < 9,000	6,000	Hermetic, Semi-hermetic
DC.M.I, ≥ 9,000	18,000	Hermetic, Semi-hermetic, Scroll
	54,000	Semi-Hermetic, Scroll
	96,000	Semi-Hermetic, Scroll
DC.M.O, < 9,000	6,000	Hermetic, Semi-hermetic
DC.M.O, ≥ 9,000	18,000	Hermetic, Semi-hermetic, Scroll
	54,000	Semi-Hermetic, Scroll
	96,000	Semi-Hermetic, Scroll
DC.L.I, < 9,000	6,000	Hermetic, Semi-hermetic, Scroll
DC.L.I, ≥ 9,000	9,000	Hermetic, Semi-hermetic, Scroll
	54,000	Semi-Hermetic, Scroll
DC.L.O, < 9,000	6,000	Hermetic, Semi-hermetic, Scroll
DC.L.O, ≥ 9,000	9,000	Hermetic, Semi-hermetic, Scroll
	54,000	Semi-Hermetic, Scroll
	72,000	Semi-Hermetic
MC.M	4,000	-
	9,000	-
	24,000	-
MC.L	4,000	-
	9,000	-
	18,000	-
	40,000	-

[15] Scroll compressors are compressors that operate using two interlocking, rotating scrolls that compress the refrigerant. Hermetic and semi-hermetic compressors are piston-based compressors and the key difference between the two is that hermetic compressors are sealed and hence more difficult to repair, resulting in higher replacement costs, while semi-hermetic compressors can be repaired relatively easily.

2. Energy Modeling Methodology

In the preliminary analysis, DOE proposed using an energy consumption model to estimate separately the energy consumption rating of entire envelopes and entire refrigeration systems at various performance levels using a design-option approach. DOE developed the model as a Microsoft Excel spreadsheet. The spreadsheet calculated the cumulative effect on the energy consumption of adding options above the baseline.

DOE continues to use a spreadsheet-based model, but is now modeling panels, display doors, non-display doors, and refrigeration systems separately because these components are tested separately. As mentioned above, the purpose of the engineering analysis is to determine the manufacturing costs of achieving increased efficiency or decreased energy consumption. DOE assumes that manufacturers will only incur costs to achieve efficiency gains or energy reductions that are accounted for in their certified equipment rating. Therefore, the energy models estimate the performance rating that the manufacturer would obtain by testing their equipment using the DOE test procedure because manufacturers are required to rate the components using the test procedure. The models estimate the energy ratings of baseline equipment and levels of performance above the baseline associated with specific design options that are added cumulatively to the baseline equipment. The model does not account for interactions between refrigeration systems and envelope components, nor does it address how a design option for one component may affect the energy consumption of other components, because such effects are not accounted for in the test procedure. Component performance results are found in appendix 5A of the TSD. DOE requests comment on the performance data found in appendix 5A of the TSD and requests data about the performance of panels, display doors, or non-display doors and their design options.

a. Refrigeration

The refrigeration energy model calculates the annual energy consumption and the AWEF of walk-in refrigeration systems at various performance levels using a design option approach. AWEF is the ratio of the total heat removed, in Btus, from a walk-in envelope during a one-year period of use (not including the heat generated by operation of the refrigeration system) to the total energy input of refrigeration systems, in watt-hours, during the same period. DOE proposes to base its standards for the refrigeration system using the AWEF metric and seeks comment on this approach.

This model was used to analyze specific examples of equipment in each refrigeration system equipment class. For a given class, the analysis consists of calculating the annual energy consumption and the AWEF for the baseline and several levels of performance above the baseline. See chapter 5 of the TSD for further details about the analytical models used in the engineering analysis.

For the preliminary analysis, DOE partially relied on refrigeration catalog information to obtain equipment specifications for its energy model. Manitowoc and the Joint Utilities believed that catalog information was not the best source from an analytical standpoint. Manitowoc observed that catalog information is provided mainly for sizing equipment and not for representing equipment performance, while the Joint Utilities pointed out that the rating methodology that produced the data in the catalogs could be different from the rating methodology for walk-ins, which could make the data inappropriate for analyzing walk-ins. (Manitowoc, Public Meeting Transcript, No. 0045 at p. 31; Joint Utilities, No. 0061.1 at p. 3)

In recognition of these comments, DOE conducted further research into refrigeration system performance and has improved the analysis for the NOPR in several ways. First, the energy model now calculates system performance based on a whole-system approach using thermodynamic principles. The model determines the refrigerant properties (pressure, temperature, etc.) at each point in the system and these properties, rather than catalog specifications, are used to calculate refrigeration capacity. Second, for any catalog information based on specific rating conditions, DOE ensured the rating conditions were consistent with those for walk-in refrigeration systems, or adjusted the specifications accordingly. Third, while it continued to rely on catalog data directly for some equipment specifications (e.g., typical number of fans and fan horsepower for units of the sizes analyzed), DOE also surveyed catalogs from various manufacturers to determine the most representative specifications for a particular type and size of equipment. See chapter 5 for more details on the refrigeration system energy model and other enhancements made to its analysis.

The energy consumption calculations in the engineering analysis are based on calculations in AHRI 1250-2009, the industry test procedure incorporated by reference in the walk-in test procedure. 76 FR at 33631. These calculations involve the refrigeration system running at a high load for one-third of the time and a low load for two-thirds of the time.

American Panel noted that the load profile for restaurants would generally be reversed (i.e., the refrigeration system is sized for running at a high load two-thirds of the time and a low load one-third of the time) and requested DOE to adjust the load assumptions based on the walk-in application. (American Panel, No. 0048.1 at p. 8)

DOE's assumption in the engineering analysis about the refrigeration load profile was made for purposes of comparing the performance of different types of refrigeration equipment that have varying features. Furthermore, the analysis attempts to assess the impacts of technologies manufacturers might use to improve the efficiencies of their equipment, including impacts on the efficiency ratings of the equipment. DOE will base any standards it adopts on the use of some or all of these technologies, and the DOE test procedure would serve as the basis for rating equipment and determining compliance. Therefore, the test procedure calculations are used in the analysis to determine the efficiency ratings of equipment utilizing the various technologies on which DOE might base the standards.

However, DOE does not treat the load profile assumptions used in the engineering analysis as equivalent to the actual duty cycle of every class or application of refrigeration systems. Rather, where warranted, DOE evaluates other duty cycle assumptions in its energy use analysis, which examines the actual energy consumption of the refrigeration system under a variety of operating conditions and applications. In the energy use analysis, DOE has adjusted its assumptions for actual duty cycles based in part on American Panel's recommendation. See section IV.E.1 and chapter 7 of the TSD for details.

In the preliminary analysis, DOE analyzed the result of adding design options cumulatively to the baseline. DOE observed that some design options (e.g., larger condenser coil) increased the efficiency of the refrigeration system while also increasing its capacity. To distinguish between these effects, DOE created a "normalized energy consumption" metric in the preliminary analysis which represented the energy consumption per unit capacity. DOE expected that the normalized energy consumption metric would generally be analogous to an efficiency metric. For example, for two units of the same capacity, the unit with lower normalized energy consumption would be more efficient because it would use less energy for the same heat removal capability.

In a comment on the preliminary analysis, American Panel stated that it was not beneficial for the capacity of a unit to increase because the refrigeration system must balance the heat load to control temperature and humidity. (American Panel, Public Meeting Transcript, No. 0045 at p. 175) After interviewing manufacturers and examining refrigeration catalogs, DOE observed that manufacturers typically offer refrigeration systems in specific, discrete capacities while providing consumers with options for improving system efficiency. DOE reasoned that manufacturers would likely design their systems for a certain set of capacities regardless of the efficiency options available and, consequently, implementing efficiency options on a system would be unlikely to change the capacity of the system because the manufacturer would prefer to market the system at the established capacity. Therefore, DOE agrees with American Panel's assessment and has implemented its suggestion into the NOPR analysis.

DOE notes that it analyzed six classes of refrigeration systems at various capacity points, as explained in section IV.C.1.b. When a design option is added to the baseline, it does not change the capacity of the unit; instead, other aspects of the system are adjusted to maintain the capacity at the specified point. See chapter 5 of the TSD for details.

In the preliminary analysis, DOE considered the effects of adding design options to the baseline. Some interested parties commented on the interactive effects of design options. Thermocore stated that there are substantial differences in performances based on the integrated system as opposed to considering options separately. (Thermocore, Public Meeting Transcript, No. 0045 at p. 86) Emerson stated that DOE must account for how the technologies are combined because the effects will vary depending on what is already included in the system. (Emerson, Public Meeting Transcript, No. 0045 at p. 93) AHRI agreed that efficiency gains due to combinations of certain design options are not necessarily additive and noted that assessing the aggregate benefit from combined design options requires rigorous analysis and simulation of the total system. (AHRI, No. 0055.1 at p. 2)

DOE recognizes that the interactive effects of design options must be considered because the efficacy of certain design options differs depending on whether they are analyzed separately or in conjunction with other design options. DOE has taken a system-based approach to the refrigeration system energy model that calculates the effect on the entire system of adding design options. Each efficiency level above the baseline consists of a design option added cumulatively and the interactive effects of each new design option on all previously added design options are considered. In formulating the cost-efficiency curves, DOE attempted to capture the most cost-effective design option at each efficiency level, given all previously added design options at that level. Manufacturers may use any combination of design options to meet the future energy conservation standard. See chapter 5 of the TSD for further discussion on the interactive effects of design options.

Some commenters disagreed with DOE's refrigeration energy modeling approach. SCE recommended using DOE 2.2R (an expanded version of the building simulation program DOE 2.2) to directly model certain design options, such as modulating the fan speed for the on-cycle fan power for a unit cooler connected to a multiplex system. (SCE, Public Meeting Transcript, No. 0045 at p. 138) NEEA and NPCC also stated that the spreadsheet-based model does not adequately evaluate all of the design options and their combinations, and that DOE should consider using DOE 2.2R for modeling instead. (NEEA and NPCC, No. 0059.1 at p. 9)

DOE 2.2R is designed to simulate the operation of building refrigeration systems, such as those found in supermarkets, refrigerated warehouses, and industrial facilities. Although DOE 2.2R is a powerful simulation tool that can aid in refrigeration system design, DOE believes it is inappropriate for the energy modeling that DOE is conducting as part of this rulemaking. This rulemaking is taking a component-level approach and determining the performance of each component (the panels, the doors, and the refrigeration system) separately, whereas DOE 2.2R models the interactions of components that comprise an entire building. Also, the component performance as modeled in the engineering analysis must be based on the operating conditions and calculations contained in the test procedure, which DOE believes is not consistent with the simulation methodology in DOE 2.2R. To address the concerns of SCE, NEEA and NPCC that a spreadsheet model would be inadequate for certain options or combinations of options, DOE has modified the spreadsheet model to more accurately account for combinations of design options and interactive effects of design options within a component. To address the Joint Utilities' concerns with fan speed modulation, DOE included calculations for fan speed modulation that are consistent with the test procedure.

Although DOE is not conducting the analysis using DOE 2.2R, DOE encourages interested parties to submit their own simulation results from DOE 2.2R modeling and compare them to DOE's engineering results.

3. Cost Assessment Methodology

a. Teardown Analysis

To calculate the manufacturing costs of the different components of walk-in coolers and freezers, DOE disassembled baseline equipment. This process of disassembling systems to obtain information on their baseline components is referred to as a "physical teardown." During the physical teardown, DOE characterized each component that makes up the disassembled equipment according to its weight, dimensions, material, quantity, and the manufacturing processes used to fabricate and assemble it. The information was used to compile a bill of materials (BOM) that incorporates all materials, components, and fasteners classified as either raw materials or purchased parts and assemblies.

DOE also used a supplementary method, called a "virtual teardown," which examines published manufacturer catalogs and supplementary component data to estimate the major physical differences between equipment that was physically disassembled and similar equipment that was not. For virtual teardowns, DOE gathered product data such as dimensions, weight, and design features from publicly-available information, such as manufacturer catalogs.

The teardown analyses allowed DOE to identify the technologies that manufacturers typically incorporate into their equipment. The end result of each teardown is a structured BOM, which DOE developed for each of the physical and virtual teardowns. DOE then used the BOM from the teardown analyses as one of the inputs to the cost model to calculate the manufacturer production cost (MPC) for the product that was torn down. The MPCs derived from the physical and virtual 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.

For display doors and non-display freight doors, limited information was publicly available, particularly as to the assembly process and shipping. To compensate for this situation, DOE conducted physical teardowns for two representative units, one within each of these equipment classes. DOE supplemented the cost data it derived from these teardowns with information from manufacturer interviews. The cost models for panels and for non-display structural doors were created by using public catalog and brochure information posted on manufacturer websites and information gathered during manufacturer interviews.

For the refrigeration system, DOE conducted physical teardowns of unit cooler and condensing unit samples to construct a BOM. The selected systems were considered representative of baseline, medium-capacity systems, and used to determine the base components and accurately estimate the materials, processes, and labor required to manufacture each individual component. From these teardowns, DOE gleaned important information and data not typically found in catalogs and brochures, such as heat exchanger and fan motor details, assembly parts and processes, and shipment packaging.

Along with the physical teardowns, DOE performed several virtual teardowns of refrigeration units for the NOPR analysis. The complete set of teardowns helped DOE obtain the baseline average MPC for all equipment classes proposed.

b. Cost Model

The cost model is one of the analytical tools DOE used in constructing cost-efficiency curves. DOE derived the cost model from the teardown BOMs and the raw material and purchased parts databases. Cost model results are based on material prices, conversion processes used by manufacturers, labor rates, and overhead factors such as depreciation and utilities. For purchased parts, the cost model considers the purchasing volumes and adjusts prices accordingly. Original equipment manufacturers (OEMs), i.e., the manufacturers of WICF components, convert raw materials into parts for assembly, and also purchase parts that arrive as finished goods, ready-to-assemble. DOE bases most raw material prices on past manufacturer quotes that have been inflated to present day prices using Bureau of Labor Statistics (BLS) and American Metal Market (AMM) inflators. DOE inflates the costs of purchased parts similarly and also considers the purchasing volume – the higher the volume, the lower the price. Prices of all purchased parts and non-metal raw materials are based on the most current prices available, while raw metals are priced on the basis of a 5-year average to smooth out spikes. Chapter 5 of the NOPR TSD describes DOE's cost model and definitions, assumptions, data sources, and estimates.

For panels, non-display doors, and display doors DOE used a "parameterized" computational cost model, which allows a user to manipulate the components parameters such as height and length by inputting different numerical values for these features to produce new cost estimates. This parameterized model, coupled with the design specifications chosen for each representative unit modeled in the engineering analysis, was used to develop fundamental MPC costs. The fundamental MPC costs were then incorporated into the engineering analysis model where they were combined with additional costs associated with each design option. Costs for each design option were calculated based on discussions with panel, non-display, and display door manufacturers and pricing from commercially available sources.

As previously mentioned in section IV.B.3, DOE is considering high efficiency lighting, specifically light-emitting diode (LED) lighting, as a design option to improve the efficiency of display doors. 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, in an effort to capture the anticipated cost reduction in LED fixtures in the analyses for this rulemaking, DOE incorporated price projections from its Solid State Lighting program into its MPC values. The price projections for LED lighting were developed using projections created for the DOE's Solid State Lighting Program's 2012 report, *Energy Savings Potential of Solid-State Lighting in General Illumination Applications 2010 to 2030* ("the energy savings report"). 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 a proxy for a cost projection to apply to LEDs on walk-in display doors.

The price projections presented in the Solid State Lighting program's energy savings report are based on the DOE's 2011 Solid State Lighting R&D Multi-Year Program Plan (MYPP)[16]. 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 were collected for the NOPR analyses of this rulemaking from catalogs, manufacturer interviews, and other sources. DOE started with LED cost data specific to walk-in manufacturers and then applied the

[16] The DOE Solid-State Lighting Research and Development Multi-Year Program Plan is a document that 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.

anticipated trend from the energy savings report to forecast the projected cost of LED fixtures at the time of required compliance with the proposed rule (2017). These 2017 cost figures were incorporated into the engineering analysis to calculate the MPC of display doors with LEDs as a design option. The LCC analysis (section IV.F) was carried out with the engineering numbers that account for the 2017 cost of LED luminaires. The reduction in costs of LED luminaires from 2018 to 2030 were taken into account in the NIA (section IV.G). The cost reductions were calculated for each year from 2018 and 2030 and subtracted from the equipment costs in the NIA.

During the preliminary analysis, DOE developed a cost model for the proposed representative sizes of walk-in envelopes. Panel manufacturers generally make panels with a combination of raw materials and purchased parts, and DOE estimated manufacturing process parameters, the required initial material quantity, scrap, and other factors to determine the value of each component. DOE then aggregated all parameters related to manufacture and assembly to determine facility requirements at various manufacturing scales and the final unit cost.

To more accurately model walk-in costs, DOE used common factory parameters, which affect the cost of each unit produced (e.g., labor and fabrication rates). American Panel commented on some of the factors assumed in the cost model and the resulting values. In particular, in its view, approximately 1 million square feet of panels are manufactured per year per manufacturer, and most door manufacturers produce 1,800 doors per year. Accordingly, these numbers suggest a total walk-in production volume of well under DOE's initial estimate of 30,000 per year per manufacturer. American Panel believed that overestimating the amount of panels manufactured per year would cause the small manufacturers to be at a disadvantage. (American Panel, Public Meeting Transcript, No. 0045 at p. 14–15; American Panel, No. 0048.1 at pp.5–6)

Assuming an average walk-in surface area of 500 ft^2 (roughly corresponding to an 8-foot by 10-foot walk-in), American Panel's estimate equates to approximately 2,000 walk-ins per year, per manufacturer – much lower than DOE's estimate. DOE understands that its estimate may be more reasonable for a large manufacturer than a small one and agrees with American Panel that impacts on small manufacturers may be underestimated in an analysis that assumes a high production capacity. Thus, DOE has considered particular impacts on small manufacturers in the MIA by adjusting for their reduced production capacity as compared to larger manufacturers. See sections IV.I.3.c and V.B.2.d (Manufacturer Impact Analysis) and VI.B (Regulatory Flexibility Analysis, which specifically address the impact of the rule on small business manufacturers).

Additionally, American Panel, citing its own experience, stated that other DOE cost estimates needed adjusting. Some examples include the following:

- The cost of the tongue and groove design found on panels should be increased by a factor of 10.8.
- The cost of the advanced door sweep should increase by a factor of 7.8.
- The DOE cost per square foot of panel was too high and actual costs were closer to $0.25 per square foot.
- The actual MSP for walk-in cooler envelopes was 70–112 percent lower than the DOE estimate.

- The actual MSP for walk-in freezer envelopes was 24–42 percent lower than the DOE estimate. (American Panel, Public Meeting Transcript, No. 0045 at pp. 14–15; American Panel, No. 0048.1 at pp. 5–6)

DOE appreciates the efforts made by American Panel in preparing detailed comments and providing useful information about factory parameters, material costs, and the resulting manufacturing selling price for walk-in envelopes. Some of the differences can be explained based on the parameters used in the cost model, such as the material costs. DOE particularly appreciates American Panel's comments related to the costs of certain designs and has taken these costs into consideration in its analysis by aggregating them with other data DOE has received through research and confidential manufacturer interviews. For instance, American Panel's cost per square foot of panel was particularly useful in helping DOE estimate the costs of certain materials that make up the panel.

DOE was not, however, able to use some of the cost data —for example, costs related to infiltration-reducing measures were not used because DOE is no longer considering infiltration in the analysis. Also, DOE has not calculated costs related to the assembly of the entire envelope —for instance, the MSP of the envelope —as part of the engineering analysis because of the component-based approach DOE is proposing to use. Consequently, DOE is now using the cost model to determine the manufacturer production costs and manufacturer selling prices of the individual components covered by the standards.

DOE estimated installation costs for the refrigeration systems and the envelope components separately as part of the life-cycle cost analysis. DOE has proposed new manufacturer cost estimates in chapter 5 of the TSD and seeks comment on the new parameters proposed for each component.

c. Manufacturing Production Cost

Once it finalized the cost estimates for all the components in each teardown unit, DOE totaled the cost of the materials, labor, and direct overhead used to manufacture the unit to calculate the manufacturer production cost of such equipment. The total cost of the equipment was broken down into two main costs: (1) the full manufacturer production cost, referred to as MPC; and (2) the non-production cost, which includes selling, general, and administration (SG&A) costs; the cost of research and development; and interest from borrowing for operations or capital expenditures. DOE estimated the MPC at each design level considered for each equipment class, from the baseline through max-tech. After incorporating all of the data into the cost model, DOE calculated the percentages attributable to each element of total production cost (i.e., materials, labor, depreciation, and overhead). These percentages were used to validate the data by comparing them to manufacturers' actual financial data published in annual reports, along with feedback obtained from manufacturers during interviews. DOE uses these production cost percentages in the MIA (see section IV.I).

In the preliminary analysis, DOE developed both an envelope cost and a refrigeration system cost for each equipment class and size using a manufacturing cost model. See chapter 5 of the preliminary TSD. American Panel suggested that manufacturer cost should be estimated using a sample from 40 manufacturers and representative volumes. (American Panel, Public Meeting Transcript, No. 0045 at p. 312) In response to American Panel's comment, DOE believes it is infeasible to sample so many manufacturers because data on manufacturing cost and representative volumes are not publicly available for most manufacturers of walk-ins and walk-in components, particularly small, private companies. Additionally, not all manufacturers were willing to share cost information with DOE. DOE did hold confidential interviews with manufacturers, some of whom chose not to share this information. DOE notes that cost information it did obtain was helpful in enabling the agency to develop and refine its estimates of manufacturer cost. The interview process is explained in chapter 12 of the TSD.

d. Manufacturing Markup

DOE uses MSPs to conduct its downstream economic analyses. DOE calculated the MSPs by multiplying the manufacturer production cost by a markup and adding the equipment's shipping cost. The production price of the equipment is marked up to ensure that manufacturers can make a profit on the sale of the equipment. DOE gathered information from manufacturer interviews to determine the markup used by different equipment manufacturers. Using this information, DOE calculated an average markup for each component of a walk-in. DOE requests comments on the proposed markups listed in Table IV-7.

Table IV-7 Manufacturer Markups

Walk-In Component	Markup
Panels	32%
Display Doors	50%
Non-Display Doors	62%
Refrigeration Equipment	35%

e. Shipping Costs

In the preliminary analysis TSD, DOE calculated manufacturer shipping costs assuming that manufacturers include outbound freight as part of their equipment selling price. In response to DOE's request for comment on shipping assumptions, American Panel and NEEA and NPCC remarked that DOE's costs were significantly higher than actual industry shipping rates. (American Panel, Public Meeting Transcript, No. 0045 at p. 15, 142; NEEA and NPCC, No. 0059 at p. 9) Additionally, American Panel stated that freight costs are typically paid in full by the customer and not absorbed by the manufacturer who is selling the equipment. (American Panel, No. 0048.1 at p. 5) Both American Panel and CrownTonka said that sometimes the freight cost would be included as part of the selling price and sometimes it would be entirely separate; i.e., paid by the buyer directly to the freight company. (American Panel, Public Meeting Transcript, No. 0045 at p. 143; CrownTonka, Public Meeting Transcript, No. 0045 at p. 144) NEEA and NPCC stated that freight costs are normally included in the packaged price to consumers. (NEEA and NPCC, No. 0059.1 at p. 9)

DOE re-evaluated the shipping rates in preparing this NOPR. These rates were developed by conducting additional research on shipping rates and by interviewing manufacturers of the covered equipment. For example, DOE found through its research that most panel, display door, and non-display door manufacturers use less than truck load freight to ship their respective components and revised its estimated shipping rates accordingly. DOE also found that most manufacturers, when ordering component equipment for installation in their particular manufactured product, do not pay separately for shipping costs; rather, it is included in the selling price of the equipment. However, when manufacturers include the shipping costs in the equipment selling price, they typically do not mark up the shipping costs for profit, but instead include the full cost of shipping as part of the price quote. DOE has revised its methodology accordingly. Please refer to chapter 5 of the TSD for details.

4. Baseline Specifications

a. Panels and Doors

In the preliminary analysis, DOE set the baseline level of performance to correspond to the most common least efficient component that is compliant with the standards set forth in EPCA. (42 U.S.C. 6313(f)(1)(3)) DOE determined specifications for each equipment class by surveying currently available units and models. This approach was used for the NOPR analyses to determine the baseline units for panels, display doors, and non-display doors. More detail about the specifications for each baseline model can be found in chapter 5 of the TSD.

Because the walk-in market is comprised of panels insulated with polyurethane and extruded polystyrene, DOE proposed in the preliminary analysis that the R-value for the baseline insulation used in the walk-in envelope would be the average of the typical long term thermal resistance (LTTR) R-values of polyurethane and extruded polystyrene. CPI opposed the use of an average R-value for extruded polystyrene and polyurethane because it would affect the accuracy of the normalized energy consumption calculation for the envelope. (CPI, No. 0052.1, at p.1) DOE agrees with CPI’s concern and is using in the revised analysis foam-in-place polyurethane as the baseline insulation for panels and non-display doors. Polyurethane is more commonly used as panel or non-display door insulation, has a better long term thermal resistance, and is less expensive than extruded polystyrene. DOE notes that extruded polystyrene may outperform polyurethane in other respects, like moisture absorption, which are not captured in the energy consumption model because they are not included in the test procedure.

DOE's analysis also uses wood framing members as the baseline framing material in panels. The analysis assumes the typical wood frame completely borders the insulation and is 1.5 inches wide. DOE requests comment on its baseline specifications for walk-in panels, specifically the assumptions about framing material and framing dimensions.

The baseline display doors modeled in DOE's analysis are based on the minimum specifications set by EPCA. (42 U.S.C. 6313(f)(3)) DOE modeled baseline display cooler doors comprised of two panes of glass with argon gas fill and hard coat low emittance or low-e coating. The baseline cooler display door requires 2.9 Watts per square foot of anti-sweat heater wire and does not have a heater wire controller. The baseline display freezer doors modeled in DOE's analysis consist of three panes of glass, argon gas, and soft coat low-e coating. Baseline freezer doors use 15.23 watts per square foot of anti-sweat heater wire power and require an anti-sweat heater wire controller. DOE also estimates that each baseline door includes one fluorescent light with electronic ballasts, with a door shorter than 6.5 feet having a 5-foot fluorescent bulb and a door equal to or taller than 6.5 feet having a 6-foot fluorescent bulb. DOE requests comment on the baseline assumptions for display cooler and freezer doors. In particular, DOE requests data illustrating the energy consumption of anti-sweat heaters found on cooler and freezer display doors.

DOE's analysis assumes that the baseline non-display doors are constructed in a similar manner to baseline panels. Therefore, DOE's analysis uses baseline non-display doors that consist of wood framing materials 1.5 inches wide that completely border the foamed-in-place polyurethane insulation. DOE also includes a small window in a non-display door that conforms to the standards set by EPCA. DOE estimates that all passage doors have a 2.25 square foot window regardless of the passage door's size. DOE analyzed two different size windows for non-display freight doors. The small freight doors have a 2.25 square foot window and both the medium and large freight doors have a 4-square foot window. DOE requests comment on the baseline specifications for non-display doors, and specifically on the size of the windows included in the baseline doors.

DOE also received comments about the amount of energy savings attributed to infiltration reduction devices (IRDs) on baseline walk-in doors. NEEA and NPCC commented that even though EISA requires an infiltration reduction device on the baseline door, DOE should also include additional IRDs as a design option. NEEA and NPCC continued to suggest that DOE should re-evaluate the amount of energy savings associated with IRDs. (NEEA and NPCC, Public Meeting Transcript, No. 0045 at p. 170) The Joint Utilities also believed that DOE overestimated the impacts of IRDs in the baseline doors and explained that overestimating the baseline savings from an IRD affects the amount of savings achieved by the design options DOE evaluated. (Joint Utilities, No. 0061.1 at p. 5) DOE agrees with NEEA and NPCC and the Joint Utilities that a baseline door must have an IRD because this is required by EPCA. (42 U.S.C. 6313(f)(1)(A)(B)) However, the walk-in test procedure does not measure energy consumption from door-opening infiltration so there is no rated energy saving from IRDs and DOE is not estimating the amount of energy saved from IRDs on baseline doors.

b. Refrigeration

As with panels and doors, DOE set the baseline level of refrigeration system performance to correspond to components that were the least efficient but compliant with the standards set forth in EPCA. See 42 U.S.C. 6313(f)(1)-(3). DOE determined specifications for each equipment class by surveying currently available models. See chapter 5 of the TSD for more details about the specifications for each baseline model.

In the preliminary analysis, DOE analyzed several representative baseline units for refrigeration systems and requested comment on the characterization of the baseline units. In response to DOE's request for comment on the representative units analyzed, several stakeholders expressed concern that the range of refrigeration systems DOE evaluated was too limited. Heatcraft and the Joint Utilities encouraged DOE to include larger capacity equipment and different compressor types. (Heatcraft, No. 0058.1 at pp. 3–4; Heatcraft, No. 0069.1 at p. 2; Joint Utilities, No. 0061.1 at p. 3) American Panel echoed this concern and stated that DOE should explore the full range of condensing units and that WICF envelopes should be paired with different sized refrigeration systems based on use. (American Panel, No. 0048.1 at pp. 8–9) DOE has considered these comments and has expanded its analysis to include a larger range of refrigeration system capacities. DOE has also included different compressor types in the refrigeration system analysis; see section IV.C.5.b and chapter 5 of the TSD for details. DOE has not considered pairing WICF envelopes and refrigeration systems in the engineering analysis, however, because DOE is applying a component-based approach.

The preliminary analysis also presented estimated baseline specifications and costs for the representative units it analyzed. American Panel remarked that the baseline costs in the engineering analysis were too low and were not comparable to their data. Additionally, it stated that the refrigeration load will increase if the product is not at the same temperature as the walk-in cooler or freezer. (American Panel, No. 0048.1 at p. 7) Interested parties also commented on certain baseline unit subcomponents that were not included in the engineering analysis. American Panel noted that baseline units could include a downstream solenoid valve that would prevent refrigerant from migrating to the evaporator and Heatcraft encouraged DOE to make sure that the amount of refrigerant, piping, and insulation scale properly with size. (American Panel, No. 0048.1 at p. 7; Heatcraft, No. 0069.1 at p. 3)

In response to American Panel's comments on refrigeration system costs, DOE adjusted its cost model as described in section IV.C.3 and believes its costs are now more representative of typical equipment. Regarding refrigeration load, DOE does not consider the effect of different product loads in the engineering analysis because the engineering analysis is based on the rating conditions; DOE considers product loads in the energy use analysis as explained in section IV.E.3. In response to American Panel's and Heatcraft's comments about subcomponents of refrigeration equipment, the revised analysis now includes all necessary subcomponents from the manufacturer —i.e., those subcomponents needed for the unit to operate. The analysis includes a calculation of refrigerant charge that is scaled with the size of the unit, as Heatcraft suggested.

DOE has tentatively decided not to include piping and insulation between the unit cooler and condensing unit, as it believes these components would not be supplied by the manufacturer or included in the equipment's MSP, but by the contractor upon installation of the equipment. DOE requests comment on this assumption.

In the preliminary analysis, DOE made certain assumptions regarding saturated evaporator temperature (SET) and saturated condensing temperature (SCT) that it used in the analysis for freezers and coolers and indoor and outdoor units. In general, DOE based these temperatures on an assumed temperature difference (TD) between the coil temperature and the ambient temperature where the ambient temperature for indoor and outdoor units was specified by the rating conditions in AHRI 1250-2009, the test procedure for refrigeration systems. 76 FR at 33631. The Joint Utilities and Heatcraft both submitted comments about the temperature set points in the baseline equipment; the Joint Utilities suggested a condensing temperature control point of 90 °F for both freezers and coolers, while Heatcraft recommended different temperatures for several equipment classes. (Joint Utilities, No. 0061.1 at p. 10; Heatcraft, No. 0069.1 at p.2)

In determining appropriate temperature set points, DOE considered information from various sources when formulating its assumptions, including comments, research, and discussions with manufacturers and other parties. DOE notes that the ambient temperature for the test procedure is 90 and 95 °F for indoor and outdoor condensing units, respectively. Given that the system must maintain a reasonable TD between the SCT and the ambient temperature, the SCT during the test procedure would be higher than the 90–95 °F assumption recommended by the Joint Utilities. Even though the set point during actual use may be lower, equipment is rated—and evaluated for meeting the standard—at the test procedure rating points. For these reasons, DOE believes its SCT assumptions are reasonable for baseline equipment operating at the rating conditions required for the test procedure. DOE requests comment on this assumption, particularly whether the TDs for baseline and higher efficiency equipment are appropriate. See chapter 5 of the TSD for details.

5. Design Options

a. Panels and Doors

For the preliminary analysis, DOE included the following design options for the walk-in envelope:

- Improved wall, ceiling, and floor insulation
- Improved door gaskets and panel interface systems
- Electronic lighting ballasts and high-efficiency lighting
- Occupancy sensors and automatic door opening and closing systems
- Air curtains and strip curtains
- Vestibule entryways
- Display and window glass system insulation enhancements
- Anti-sweat heater controls and no anti sweat heat systems

In the preliminary analysis, DOE presented tables detailing each design option, including the cost of implementing each option and a description of the design option's properties. The discussion below sets forth comments received on these design options for panels and doors, as well as DOE's proposed approach in today's NOPR.

Panels

Stakeholders commented on steady state IRDs that DOE initially considered including as design options for the walk-in envelope. Craig Industries commented that DOE should consider different caulking materials as a design option because it is inexpensive and would reduce infiltration by sealing the joints of walk-ins, but noted that this design option would conflict with the current National Sanitation Foundation (NSF) standards. (Craig Industries, No. 0064.1 at p. 3) American Panel stated that changing the gasketing or joint profile of an insulated panel would require a new test burden of $20,000, and that the improved gasketing is not necessarily going to be functional. It also noted that improved panel interfaces may not mate with existing walk-in panels, which would prevent manufacturers from supplying replacement panels. Lastly, in its view, the complex gasketing and panel interface systems could cause walk-ins to become more difficult to build. (American Panel, No. 0048.1 at p. 6; American Panel, Public Meeting Transcript, No. 0045 at p. 121) Hill Phoenix commented that enhancing the gasketing between panels will not have a significant impact on the walk-in's energy consumption. In its view, the main heat load caused by infiltration is from door openings as opposed to steady state infiltration. (Hill Phoenix, No. 0066.1 at p. 3)

For the reasons stated in the test procedure final rule, the test procedure promulgated by DOE no longer requires manufacturers to measure a walk-in's steady-state infiltration. Therefore, design options for reducing steady state infiltration, including caulking and improved gasketing, would not impact the rated energy consumption of any of the walk-in components addressed in this rulemaking. 76 FR 21580, 21595 (April 15, 2011). Furthermore, DOE would screen out any design options (including caulking) that would be likely to have significant adverse impacts on the utility of the equipment or had an adverse impact on health or safety, according to the screening criteria described in section IV.B. .

In the preliminary analysis, DOE considered design options that increased the baseline insulation thickness and improved insulation material. The preliminary analysis used a baseline insulation thickness of 4 inches and analyzed design options with increased insulation thicknesses of 5 inches, 6 inches, and 7 inches. The baseline panel insulation R-value was an average of extruded polystyrene and foamed-in-place polyurethane. The improved insulation materials in the preliminary analysis were vacuum insulated panel (VIP) insulation and hybrid insulation, a combination of the baseline material and vacuum insulated panels.

Many stakeholders commented on the proposed insulation improvements. American Panel did not agree with the initial costs DOE initially presented for the increased thicknesses of insulation. In its view, costs were higher due to the increased difficulty of manufacturing thicker panels. To accurately reflect this inefficiency, American Panel suggested DOE increase the cost of labor per panel because it takes more time to foam the fixture. (American Panel, No. 0048.1 at p. 5) American Panel also remarked that most manufacturers possess tooling that is adjustable only from 4–6 inches. (American Panel, Public Meeting Transcript, No. 0045 at p. 121) Hill Phoenix stated that panel thicknesses above 5.5 inches will have a costly impact on the manufacturer and end user because manufacturers need to purchase more equipment to deal with the increased weight and the end-user will need more floor space to house or site the walk-in. (Hill Phoenix, No. 0066.1 at p. 3) American Panel criticized the preliminary analysis for omitting insulating floor panels or an insulation slab with vertical breaks as design options. American Panel explained that although the payback period would be longer if these options are included, DOE should still consider the long term energy savings that these options may yield. (American Panel, No. 0048.1 at p. 5)

DOE agrees with American Panel that most manufacturers do not currently have the tooling to produce panels with more than 6 inches of insulation. In addition, DOE finds that constructing and handling panels thicker than 6 inches would be unduly burdensome to the manufacturer because panels thicker than 6 inches would be very difficult to handle, store, ship, and produce at typical industry production volumes. Because panels thicker than 6 inches would not be practicable to manufacture, DOE screened them out from its analysis. DOE’s NOPR analysis limits the maximum insulation thickness to 6 inches of foam and DOE does not expect its proposed standard to require panels thicker than 5 inches (see chapter 5 and appendix 10D of the TSD); however, the agency requests comment on this assumption in the analysis. DOE notes Hill Phoenix’s comment about the increased labor cost associated with increasing the panel thickness and proposes to account for the increased cost of handling large panels in its cost-efficiency analysis. DOE also agrees with American Panel’s comment that requiring insulated floor panels for walk-in coolers would produce long term energy savings. However, DOE is not proposing to set a standard for walk-in cooler floors as explained in section IV.A.2.a of this notice.

Two stakeholders made comments specifically about VIPs. NanoPore stated that silica-carbon based core materials have a better lifetime performance than fiberglass core materials when using vacuum insulated panels, and noted that VIPs have reached a point of large scale commercialization. (NanoPore, No. 0067.1 at pp. 1 and 6) However, Hill Phoenix commented that VIPs are impractical because of the high cost to the manufacturer, and that vacuum insulated panels would require additional labor and tooling. (Hill Phoenix, No. 0066.1 at p. 3)

DOE included hybrid insulation (half foam-in-place polyurethane and half VIP) as a design option to improve the efficiency of walk-in panels and non-display doors. It did not, however, include VIP insulation as a design option because DOE cannot definitively conclude that VIPs have the structural capability of supporting typical walk-in loads, particularly since VIPs can easily be punctured, which would cause a loss in thermal insulation (see chapter 5 of the TSD for details). DOE notes that while NanoPore stressed the benefits of silica-carbon based VIP, DOE did not specify the type of VIP used in the engineering analysis in order to maximize manufacturer flexibility in meeting the proposed standard. DOE agrees with Hill Phoenix that VIPs are more expensive and may require additional tooling, but DOE does not find this increased cost would prevent manufacturers from implementing VIPs. DOE also notes that the high costs of VIPs are captured in the engineering analysis for panels and non-display doors.

In its engineering analysis for walk-in panels, DOE included design options which increase the baseline insulation thickness, change the baseline insulation material from foam-in-place polyurethane to a hybrid of polyurethane and VIP, change the baseline framing material from wood to high density polyurethane, and eliminate a structural panel's framing material.

DOE assumed in its analysis that freezer floor panels retain some type of framing material to maintain structural integrity because the foam itself may be unable to support heavy, perpendicular loads -- e.g. personnel, machinery, and products -- to the panel's face. DOE also assumed that high density polyurethane framing materials used in a panel have the same dimensions as the wood framing materials used in a wood-framed panel. DOE seeks comment on these panel design options, particularly with respect to the specifications for high density polyurethane framing materials.

Doors

Stakeholders also commented on design options that would reduce the infiltration from door openings: namely, automatic door opening and closing systems, which automatically open and close the door by sensing when a person is about to pass or has passed through; air curtains and strip curtains, both of which provide a secondary barrier to air infiltration when the door is open; and vestibule entryways, which consist of a series of two doors separated by a space through which one would pass to enter the walk-in. Hired Hand noted that the engineering analysis omitted automatic roll-up doors or bi-folding envelope doors, and that these doors cannot be adequately subsumed under "automatic door opening and closing" (which DOE did include) because this option does not capture the full benefit of these doors. (Hired Hand, No. 0050.1 at pp. 1-2) American Panel was skeptical that automatic door opening and closing sensors existed in the industry and did not agree with DOE's proposed cost of the technology. (American Panel, No. 0048.1 at p.6) American Panel also stated that a vestibule is not a practical design option because the cost of the floor space and the layout of standard stores would be prohibitive to the end user. It noted that the cost of a vestibule is higher than DOE estimated, and predicted that the cost for materials and equipment would be well over $2,500. (American Panel, No. 0048.1 at pp. 3 and 6)

For the reasons stated in its recent final rule, the test procedure does not include a method for measuring the door opening infiltration associated with walk-ins. See 76 FR at 21595. Therefore, the energy consumption caused by door opening infiltration is not accounted for in the panel, display door, or non-display door engineering analyses, and design options related to door opening infiltration would not affect the energy consumption of the walk-in components.

Some stakeholders specifically commented about the strip curtains design option. NEEA and NPCC stated that strip curtains are already required by EPCA, and should not be considered a design option, but that infiltration load could still be reduced by additional IRDs. (NEEA and NPCC, Public Meeting Transcript, No. 0045 at p. 170; NEEA and NPCC, No. 0059.1 at p. 8) NEEA, NPCC and Master-Bilt disagreed with DOE's assumption that strip curtains can reduce the total energy consumption of a walk-in by half. NEEA and NPCC suggested strip curtains would more likely reduce the energy consumption by one third, according to a Pacific Northwest study, and Master-Bilt commented that strip curtains reduce the compressor load by less than 5 percent according to their own field tests. (NEEA and NPCC, Public Meeting Transcript, No. 0045 at p. 152; NEEA and NPCC, No. 0059.1 at p. 8; Master-Bilt, Public Meeting Transcript, No. 0045 at p.159; Master-Bilt, No. 0046.1 at p. 1) American Panel noted that strip curtain manufacturers indicated that the device achieves a 25 percent reduction in air infiltration, much lower than DOE's assumption of 90 percent effectiveness. (American Panel, Public Meeting Transcript, No. 0045 at p. 154; American Panel, No. 0048.1 at p. 6) Lastly, AHRI also commented that DOE overestimated the benefit of strip curtains, and that DOE should verify their assumptions with field data; AHRI did not provide any alternative data on the benefit of strip curtains. (AHRI, No. 0055.1 at p. 2) As explained in section IV.B.1 of this document, however, infiltration devices are no longer included in the engineering analysis.

Stakeholders also commented on the door lighting design options presented in the preliminary analysis; specifically, occupancy sensors that cause the lights to operate only when people are present; electronic lighting ballasts, which are more efficient than typical magnetic ballasts; and high-efficiency light-emitting diode (LED) lighting, a type of lighting that uses semiconducting materials to produce light and uses less energy per lumen than incandescent or fluorescent lighting. American Panel stated that LED lighting is not a viable design option because the LED fixture and bulb payback period is 2.5 years. (American Panel, No. 0048.1 at p. 6) The Joint Utilities suggested that DOE should add LED lighting with motion controls as a design option for display cases. (Joint Utilities, Public Meeting Transcript, No. 0045 at p. 26; Joint Utilities, Public Meeting Transcript, No. 0045 at p. 89; Joint Utilities, No. 0061.1 at p. 3)

In response to American Panel's concern about the cost of LED lighting, DOE accounts for the cost of the bulb and fixture when estimating the total cost of LED lighting. However, DOE has not automatically eliminated LED lighting from consideration based on payback period but includes it in the range of design options it is considering. For more details on the payback period analysis, see section IV.F. In response to the suggestion from Joint Utilities, a combined design option with LED lighting and motion control sensors is not warranted because DOE already includes a lighting sensor and LED lighting as separate design options in the walk-in display door engineering analysis. A separate design option for lighting sensors allows the sensor to be applied to fluorescent as well as LED lighting.

Some stakeholders commented on the anti-sweat heater wire design option. CrownTonka commented that anti-sweat heater wire should be applied to non-display freezer doors and any windows in non-display doors. (CrownTonka, Public Meeting Transcript, No. 0045 at p. 89) Craig Industries supported the inclusion of self-regulating heater wire and noted that this wire is readily available and more efficient than other types of heater wires. (Craig Industries, No. 0064.1 at p. 1) DOE agrees with CrownTonka and proposes to include anti-sweat heater wire around the outer edge of non-display freezer doors as well as on the windows located on non-display doors as design options. In response to Craig Industries' suggestion, the energy savings from self-regulating anti-sweat heater wire alone cannot be captured in the proposed engineering analysis for display and non-display doors because the energy savings are not captured by the test procedure. The test procedure credits the manufacturer with energy savings if a preinstalled timer, control system or other auto-shut-off system is used in conjunction with anti-sweat heater wire. The credit is called a percent time off (PTO) credit, which reduces the calculated power associated with the device. 76 FR 33631, 33635, 33637 (June 9, 2011).

The display door design options used in the analysis include improved glass packs—where "glass pack" refers to the combination of glass panes, gas fill, and low-emission coatings making up the transparent part of the door; anti-sweat heater controls for cooler doors; LED lighting; and lighting sensors that control when the lights turn on and off. DOE did not analyze anti-sweat heater controls for freezer display doors because baseline freezer doors are already required to have a controller to regulate the power consumed by the anti-sweat heater wire. EISA requires all freezer doors to have an anti-sweat heater control if the anti-sweat heater wire consumes more than 7.1 watts per square foot of door opening, and DOE estimated that baseline display doors consume 15.2 watts per square foot of door opening. Therefore, baseline display doors already have an anti-sweat heater wire control system in order to comply with EISA.

As explained previously, the walk-in cooler and freezer test procedure credits the manufacturer for having a control. The type or amount of controls does not change the credit nor increase the energy savings realized by the DOE test procedure. For these reasons, DOE did not include control systems as a design option. Additionally, DOE did not consider eliminating anti-sweat heater wire as a separate design option. The improvements made to the glass pack cause a reduction in the power draw of the anti-sweat heater wire. In the case of display cooler doors, the performance of the glass pack is improved enough so that anti-sweat heater wire is no longer required on the door. DOE also did not consider higher efficiency ballasts in its analysis because it found that electronic ballasts already incorporated into baseline units and DOE is not aware of more efficient ballasts. DOE requests comment on its analyzed design options and specifically seeks any heat transfer data for the improved glass packs detailed in chapter 5 of the TSD.

The design options that DOE analyzed in the engineering analysis for non-display doors include increasing the insulation thickness, changing the insulation material from baseline to a hybrid of polyurethane and VIP, changing the baseline framing material from wood to high density polyurethane, improving the window’s glass pack, and adding an anti-sweat heater wire controller to the door.   These options are more fully described in chapter 5 of the TSD. DOE requests comment on the non-display door design options it analyzed, particularly with respect to the cost of the window improvements detailed in chapter 5 of the TSD.

American Panel suggested that DOE consider low cost methods for extending the envelope and door lifetimes. (American Panel, No. 0048.1 at p. 9) DOE has not considered options in this analysis that do not improve the rated performance of the equipment, as described in section IV.B.1. The purpose of the engineering analysis is to analyze the manufacturing cost and the performance of the covered equipment as rated by the test procedure. Examining methods to extend the life of walk-in equipment, including the impact of such methods on standards adopted by DOE, would complicate and create a significant impediment to completion of this rulemaking, without any clear prospect that it would affect the standards DOE ultimately adopts. For this reason, DOE has decided not to pursue this issue.

After considering all the comments it received on the design options, DOE is including the following design options in the NOPR analysis for panels, display doors, and non-display doors:

<u>Panels</u>

- Increased insulation thickness up to 6 inches
- Improved insulation material
- Improved framing material

<u>Display Doors</u>

- High-efficiency lighting

- Occupancy sensors
- Display and window glass system insulation performance
- Anti-sweat heater controls

Non-Display Doors

- Increased insulation thickness up to 6 inches
- Improved insulation material
- Improved panel framing material
- Display and window glass system insulation performance
- Anti-sweat heater controls
- No anti-sweat systems

b. Refrigeration

In the preliminary analysis, DOE included the following design options for the walk-in refrigeration system:

- High-efficiency compressors
- Improved condenser coil
- High-efficiency condenser fan motors
- Improved condenser fan blades
- Improved evaporator coil
- Improved evaporator fan blades
- Evaporator fan controls

- Floating head pressure
- Defrost controls

The preliminary analysis contained tables detailing each design option, including the cost of implementing each option and a description of the design option's properties. The discussion below sets forth comments received on these design options for refrigeration systems, as well as DOE's proposed approach in today's NOPR.

One option DOE considered was high-efficiency compressors. For example, DOE suggested using scroll compressors to represent the performance associated with higher efficiency compressors in walk-in applications. In response, Master-Bilt and Heatcraft commented that scroll compressors are not necessarily more efficient than other compressor types and are limited by their application and the prevalent conditions in which the compressor operates. (Master-Bilt, Public Meeting Transcript, No. 0045 at p. 1; Heatcraft, No. 0058.1 at p. 2) Heatcraft also stated that with increasing horsepower, fewer compressor types are available. (Heatcraft, No. 0069.1 at p. 1) The Joint Utilities added that for larger walk-in units, semi-hermetic compressors are more efficient than scroll types—except at low temperatures where, in their view, scroll compressors are more often utilized—but they did not provide information supporting the same. In addition, the Joint Utilities stated that hermetic compressors hold an added cost advantage over semi-hermetic compressors. (Joint Utilities, No. 0061.1 at pp. 6 and 10) With regard to the types of compressors used in the food service market, American Panel suggested that hermetic compressors were dominant and stated that semi-hermetic compressors' high initial cost made them less prevalent generally. (American Panel, No. 0048.1 at p. 9)

DOE conducted additional research on available compressors and found that the prevalence of some compressor types varied at certain sizes. DOE also ensured that its analysis accounted for the effect that different applications and conditions may have on the relative efficiency of compressor types. In particular, the NOPR analysis includes an evaluation of a wide range of refrigeration capacities, and DOE has separately evaluated the different compressor types available at each capacity point. DOE believes that this modified analysis adequately captures the performance of each compressor type at each size and set of operating conditions.

To obtain data on compressor performance, DOE's preliminary analysis relied on manufacturer websites and related product specification sheets and did not consider the effect of the return gas conditions. The compressor data were based on return gas conditions under which the individual compressors were rated. The Joint Utilities stated that the return gas conditions were inconsistent with the typical operating conditions of walk-ins. (Joint Utilities, Public Meeting Transcript, No. 0045 at p. 27 and No. 0061.1 at p. 11) In consideration of the Joint Utilities' comment, DOE investigated the effect of the return gas conditions on compressor performance and has updated the compressor characteristics using return gas conditions that are consistent with the rating conditions in AHRI 1250-2009, which are different from the rating conditions for individual compressors. The conditions are contained within AHRI 1250-2009 itself, which DOE has incorporated into its test procedure. 76 FR at 33631.

After considering the stakeholder comments and conducting further research, DOE expanded its initial compressor range beyond scroll compressors and hermetic compressors to now include semi-hermetic compressors in the list of compressor options in order to capture most of the market share. This was done specifically due to the varying compressor efficiencies at different operating temperatures, and the lack of availability of certain compressor types at all capacity ranges. For example, it is difficult to obtain hermetic compressors at capacities exceeding 30,000 Btu/h, so manufacturers may be more likely to use semi-hermetic compressors at these capacities as a lower-cost alternative to scroll compressors.

The preliminary TSD discusses the evaporator and condensing coil baseline and improved efficiency as coil size increases. In that analysis, DOE selected increased coil size as a design option because increasing the coil size corresponds to a drop in temperature difference, which would increase compressor capacity and result in lower normalized energy consumption.

DOE received several comments about heat exchanger coil size and the associated savings. The Joint Utilities, Manitowoc and Heatcraft commented that the analysis did not consider an increase in fan power with an increase in coil size. (Joint Utilities, Public Meeting Transcript, No. 0045 at p. 27 and No. 0061.1 at p. 6; Manitowoc, No. 0056.1 at p. 2; Heatcraft, No. 0058.1 at pp. 2 and 3) American Panel stated that increasing condenser coil size would also require an increase in evaporator coil size, while Manitowoc suggested that the coil heat transfer equation should use log-mean temperature. (American Panel, No. 0048.1 at p. 6; Manitowoc, No. 0056.1 at p. 2)

After carefully considering these comments, DOE modified its analysis by increasing fan power proportionally to coil size. DOE found through its analysis, however, that as coil size increases, the decrease in compressor power far exceeds the increase in fan power, which ultimately decreases the net energy consumption. As a result, DOE retained increased coil size as a design option in its analysis. DOE agrees with Manitowoc's comment that using log mean temperature difference is a more accurate way to calculate heat transfer because this method accounts for changes in air temperature and refrigerant temperature across the refrigerant coil rather than assuming that these temperatures are constant. DOE's analysis had used a simplified form of the heat transfer equations in the preliminary analysis, but now includes a log mean temperature difference in its analysis for the NOPR. In response to American Panel's comment about requiring an increase in evaporator coil with condenser coil, DOE has taken a complete system modeling approach in analyzing the refrigeration system's performance to capture any effects on the evaporator conditions from condenser coil changes. At this point, DOE believes that increasing the coil size of the condenser does not necessarily require an increase in coil size for the evaporator because the manufacturer would balance other aspects of the system to maintain the same capacity. DOE requests comment on this assumption, particularly from manufacturers who currently utilize larger condenser coils.

Condenser Fan Motors

In chapter 5 of the preliminary TSD, DOE discussed more efficient condenser fan motors as a viable design option. EPCA requires that walk-in condenser fan motors of less than 1 horsepower must use permanent split capacitor motors, electronically commutated motors, or three-phase motors. (42 U.S.C. 6313(f)(1)(F)) Permanent split capacitor (PSC) motors are less expensive and less efficient than electronically-commutated (EC) motors and are currently used by the majority of manufacturers. DOE also assumed the same motor efficiencies for PSC and EC motors that were assumed in the ANSI/ARI Standard 1200-2006 -- that is, 29 percent and 66 percent respectively. (The analysis screened out three-phase motors as a design option based on utility to the consumer, as explained in section IV.B.2.b, although manufacturers may still use this technology to improve the overall efficiency of the equipment they manufacture.)

DOE received comments about the assumed efficiency of fan motors. Manitowoc commented that DOE's assumed efficiency for PSC motors was too low and should be about 50 percent, while Heatcraft stated that PSC motor efficiency would likely be between 45 and 55 percent, three-phase motor efficiency would be approximately 80 percent, and EC motor efficiency would range from 60 to 90 percent. (Manitowoc, No. 0056.1 at p. 2; Heatcraft, No. 0058.1 at p. 2 and No. 0069.1 at p. 2) The Joint Utilities suggested that the methodology of determining input power from efficiency ratings for small motors was inaccurate. (Joint Utilities, No. 0061.1 at p. 8) Heatcraft provided a list of parts to be added to the engineering analysis. (Heatcraft, No. 0069.1 at p. 1)

DOE has considered the suggestions of Manitowoc and Heatcraft regarding motor efficiency and has changed its assumptions for PSC motors to 50 percent and EC motors to 75 percent after researching currently available motors. Additionally, regarding comments received from Heatcraft about three-phase motors, DOE did not include three-phase motors as a design option or as part of the design of smaller baseline equipment due to adverse utility to the consumer and impracticability to manufacture, install and service, because many consumers do not have three-phase power sources; however, DOE assumed that larger baseline equipment would use three-phase motors. See section IV.B.2.b for more details. DOE also included in its analysis the fan motor parts Heatcraft identified after evaluating teardown data and conducting further analysis of those parts. In response to the Joint Utilities' comment that DOE should not determine input power from efficiency ratings, DOE has used this method as its best estimate for motor power consumption. DOE has not identified a more accurate methodology for determining input power and requests feedback on this issue.

Chapter 5 of the preliminary TSD presented several fan blade options for the evaporator and condenser fan blade design option. Responding to these options, Heatcraft suggested the inclusion of swept fan blades as they are more aerodynamic and reduce vibrations and noise that result in inefficiencies. In addition, it also suggested that motor efficiency is independent from fan blade efficiency because more efficient fan blades do not result in high efficiencies for motors and vice versa. Rather, the efficiency of each component is due to its own intrinsic characteristics. After considering Heatcraft's comment, DOE is continuing to treat the motor and fan blade options separately.

The preliminary analysis examined evaporator fan controls as a design option. The impacts of fan controls were analyzed consistent with the test procedure requirement that "controls shall be adjusted so that the greater of a 25 percent duty cycle or the manufacturer default is used for measuring off-cycle fan energy. For variable-speed controls, the greater of 25 percent fan speed or the manufacturer's default fan speed shall be used for measuring off-cycle fan energy." Because of this requirement, DOE set a 75 percent reduction in off-cycle fan energy as the energy savings achieved for the fan control technology option. DOE did not differentiate between modulated fan controls and variable speed fan controls in the preliminary analysis. DOE received comments both on its characterization of the fan control design option and on the energy results for that design option. NEEA and NPCC expressed concern that DOE's analysis caused the evaporator fan control option to appear less cost-effective compared to other design options, possibly indicating that DOE underestimated its potential energy savings. (NEEA and NPCC, No. 0059.1 at p. 7) The Joint Utilities cited studies indicating that fan speed control is one of the most, if not the most, cost-effective design option for many refrigeration systems. (Joint Utilities, Public Meeting Transcript, No. 0045 at p. 28; No. 0061.1 at pp. 2 and 6) The Joint Utilities also criticized DOE's initial approach of not distinguishing between fan cycling and fan speed control. They indicated that the approach taken by DOE overly simplified the analysis, which then yielded considerably smaller projected savings for multiplex systems. Because of the complexity of the size ranges and system variations of these units, a more detailed analysis than the single design option used in the preliminary analysis is, in their view, required to sufficiently evaluate the potential energy savings from using a fan control system. They recommended that an analysis of fan speed controls include the benefit of operating at reduced fan speeds for the majority of the time the system operates. (Joint Utilities, No. 0061.1 at pp. 6 and 9) NEEA and NPCC agreed with DOE's approach insofar as fan controls that adjust envelope interior temperature conditions should be applied to every walk-in. (NEEA and NPCC, No. 0059.1 at p. 7)

Some interested parties also cautioned DOE about the unintended consequences of implementing different types of fan controls. The Joint Utilities stated that a fan duty-cycling control strategy would be unacceptable in many applications because of the increased likelihood of uneven temperatures and the related concern for perishable products. (Joint Utilities, No. 0061.1 at p. 9) Zero Zone stated that variable speed evaporator fan motors could prevent the walk-in from maintaining the desired product temperature. (Zero Zone, No. 0051.1 at p. 1) American Panel stated that if fan controls cause the compressor to run for longer periods, energy consumption will increase because the compressor draws more power than the fans. American Panel also recommended that DOE ensure that whatever standards it may propose, that air defrost evaporators still be able to defrost ice build-up on refrigeration coils during off-cycle periods using lower fan speeds. (American Panel, No. 0048.1 at p. 7)

One interested party commented on DOE's assumed cost of the fan control option. The Joint Utilities stated that the assumed cost of $300 for fan control would likely be lower, particularly for small walk-ins, because the EC motors have inherent variable speed capability and the microcontrollers used to control these motors can provide the required voltage signal to control the EC motors. (Joint Utilities, No. 0061.1 at p. 9)

To address these concerns, DOE has made several changes to its fan control analysis. DOE is now considering both modulated (fan cycling) and variable speed controls as potential design options. Modulated fan controls cycle the fans at 50 percent runtime at 100 percent speed when the compressor is off, while variable speed controls set the fan speed to 50 percent of maximum speed at 100 percent runtime when the compressor is off. DOE's analysis applies the commonly used fan power laws, which describe the relationship between power and speed during a fan’s operation. A reduction in fan speed causes a reduction in fan power to the third power. For example, reducing speed to 50 percent of full speed reduces the power to 12.5 percent of full power. Thus, variable speed controls would be expected to save more energy than modulated fan controls for the particular control strategies analyzed.

DOE applied both modulated fan controls and variable speed fan controls as a design option for all classes analyzed. DOE did not, however, consider controls that respond to specific box conditions because, as stated in the test procedure final rule, the impact of these controls would not be captured using the component-level approach, which analyzes refrigeration systems separately from envelope components. DOE notes that, as a result of the enhancements made to its analytical approach, the NOPR analysis indicates that modulated and variable speed fan controls would likely be among the primary options to improve walk-in refrigeration system efficiency.

DOE appreciates the concerns about fan controls raised by American Panel, the Joint Utilities, and Zero Zone. DOE’s research does not indicate that air defrost would be adversely affected by fan controls. Therefore, air defrost would likely still be adequate with reduced fan speed. To address commenters’ concerns about the potential effects of fan controls on food safety, DOE estimates that the outcome of using such controls would be equivalent to an overall 50 percent decrease in runtime (for a cycle control) or a 50 percent decrease in speed (for a variable-speed control) and has tentatively concluded that the impact of the controls it analyzed will be limited and not affect the maintenance of safe food temperatures. See chapter 5 for details. DOE requests comment from interested parties as to whether food temperatures would be adequately maintained in the specific control cases it has analyzed and, if not, what an appropriate control strategy would be. DOE seeks any data that interested parties can provide to show the relationship between fan controls and food temperatures. DOE also seeks information as to whether additional components are necessary to ensure food temperature, such as extra thermostats located in certain areas of the walk-in. To address American Panel's comment about compressor runtime, DOE does not expect compressor runtime to increase from the inclusion of fan control implementation because the fans run at full speed while the compressor is running and fan speed or cycling controls are activated only when the compressor is off. DOE also does not expect controls to increase the amount of time the compressor is off because the compressor cycles on based on the walk-in's interior temperature, which DOE believes will not be significantly affected by the fan control strategy modeled in the analysis.

Defrost Controls

In the preliminary analysis, DOE evaluated several defrost control options available in the market. DOE considered using time-initiated, time-terminated defrost as the baseline. The design option involved a generic defrost control that would result in half as many defrosts per day. Heatcraft and American Panel doubted whether existing defrost controls could achieve the 50 percent reduction in defrosts assumed in the preliminary analysis. (American Panel, No. 0048.1 at p. 7; Heatcraft, No. 0058.1 at p. 4) In addition, Heatcraft, American Panel and the Joint Utilities suggested DOE replace time termination with temperature termination in the base case. (Heatcraft, No. 0058.1 at p. 4; American Panel, No. 0048.1 at p. 7; Joint Utilities, Public Meeting Transcript, No. 0045 at p. 26) Heatcraft and the Joint Utilities also noted that defrost time should be dependent on system size to account for the greater surface area of larger units and suggested that the baseline defrost control strategy be a time-initiated, temperature-terminated scheme, which is the industry standard. (Heatcraft, No. 0058.1 at pp. 3-4; Joint Utilities, No. 0061.1 at p. 3)

In response to comments received about defrost control, DOE's analysis now applies a temperature-terminated defrost approach for all defrost control schemes (baseline or higher). The defrost cycle ends once the coil temperature reaches 45 °F. For the defrost design option, DOE is continuing to apply a generic defrost control that would reduce the number of defrosts per day. The magnitude of the reduction is set at 40 percent, which is less than the 50 percent level originally assumed in the preliminary analysis. DOE chose this reduced level because it would result in significant energy savings while still maintaining adequate defrost capability. Further details about the defrost control parameters are found in chapter 5 of the TSD.

Floating Head Pressure

In the preliminary analysis, DOE also considered floating head pressure as a design option. With floating head pressure, the compressor pressure and the saturated condensing temperature (SCT) float down to the minimum level at which the compressor can operate. DOE assumed that floating head pressure would allow the SCT to float down to 70° F. DOE also assumed that the SCT would decrease at the same rate as the ambient temperature such that the system would maintain the same temperature difference (TD) between the SCT and the ambient air. This change resulted in a predicted reduction in energy consumption because compressors generally run more efficiently at a lower SCT. The capacity of the system was related to the SCT and the TD.

Some interested parties commented on DOE’s assumptions relating to floating head pressure. Heatcraft disagreed with DOE’s assumption that the TD would be constant as SCT decreases and stated that the TD increases as SCT decreases. To illustrate its point, Heatcraft calculated the TD of a system at an SCT of 115 °F and again at an SCT of 70 °F and found that the ratio of the condenser TD between these two SCT conditions would be approximately 1.19, not 1.0 (where a ratio of 1.0 would correspond to no change in TD as SCT decreases). This value was calculated using the total heat of rejection (THR) of the condenser. (Heatcraft, No. 0058.1 at p. 4) The Joint Utilities had several comments relating to the implementation of floating head pressure. They recommended that DOE account for the additional fan power required for floating head pressure, and stated that varying the speed of condenser fans as part of a floating head pressure control has effects on the system such as more stable operation of the expansion valve and less likelihood of compressor damage due to liquid refrigerant reaching the compressor. (Joint Utilities, No. 0061.1 at pp. 6 and 10) The Joint Utilities also identified two different head pressure control types that have an impact on projected energy savings: fan control or fan cycling and a condenser valve to maintain the minimum condensing temperature. (Joint Utilities, No. 0061.1 at p. 10) Finally, the Joint Utilities pointed out that if a lower initial or baseline SCT value is assumed, the estimated savings for floating head pressure will be less. (Joint Utilities, No. 0061.1 at p. 10)

To account for the suggestions made by commenters, DOE has implemented changes to its NOPR analysis of floating head pressure. First, DOE investigated the control methods identified by the Joint Utilities. In the current model used for the NOPR analysis, fan modulation is implemented in the baseline to maintain a fixed head pressure. When floating head pressure is implemented, a valve and accompanying controls are added to maintain a minimum condensing temperature. Regarding the comments on fan power submitted by the Joint Utilities, DOE agrees that at lower ambient temperatures, the required fan airflow is higher when floating head pressure is implemented because the TD is smaller. DOE's current energy model calculates the fan power necessary to maintain adequate heat transfer when floating head pressure is implemented. DOE assumed that condenser fans would be modulated in the baseline; variable speed condenser fans are considered as a separate design option. DOE's model calculates the energy savings of variable speed condenser fans with or without floating head pressure implemented. The energy model does not capture increased stability in the expansion valve or the reduced possibility of compressor damage because the energy model attempts to capture the performance as rated by the test procedure, and for the reasons stated in the test procedure final rule, the test procedure established by DOE is designed to rate only certain aspects of the equipment -- e.g., AWEF and capacity. 76 FR 21580, 21597-21598 (April 15, 2011).

DOE also assumes that a system tested by the manufacturer would likely be a new system, which is unlikely to experience decreased stability in the expansion valve; therefore, DOE did not capture expansion valve stability in the energy model. The energy model also does not capture long-term compressor damage because DOE assumes the test procedure would be performed at the point of manufacture of the equipment, and would therefore not capture such damage to the compressor. Compressor replacement is, however, addressed in the life cycle cost analysis (see section IV.F.6). Any additional benefits that accrue due to reduced maintenance are also not captured in the engineering analysis.

DOE also acknowledges the Joint Utilities' observation that the savings for the floating head pressure option depends on the baseline SCT and DOE's energy modeling confirms their assertion that the floating head pressure option would appear to save less energy if the baseline SCT were lower. However, DOE chose certain baseline SCT values for each class that would be realistic considering the equipment rating conditions, as explained in section IV.C.4.b. To address Heatcraft's comment that TD would increase with decreasing SCT, DOE analyzed the total heat of rejection of sample systems using the specified temperatures in the test procedure and found an average TD ratio corresponding to each compressor type analyzed. DOE implemented the TD ratio in the engineering analysis. See chapter 5 of the TSD for more details on the floating head pressure design option. DOE requests comment on its assumptions and implementation of this option, particularly regarding the cost to implement various floating head pressure control schemes and the energy savings that would be achieved.

Refrigeration Summary

After considering all the comments it received on the design options, DOE is including the following design options in the NOPR analysis:

- Higher efficiency compressors
- Improved condenser coil

- Higher efficiency condenser fan motors
- Improved condenser and evaporator fan blades
- Ambient sub-cooling
- Evaporator and condenser fan control
- Defrost control
- Hot gas defrost
- Head pressure control

Each design option is explained in detail in chapter 5 of the TSD.

6. Cost-Efficiency Results

a. Panels and Doors

In the preliminary analysis, DOE plotted total energy consumption in kilowatt-hours per day versus the increasing cost of representative walk-in envelopes. Because DOE is proposing to set component level standards, each of the three main products that make up walk-in envelopes have independent cost-efficiency curves. For panels, DOE measured the U-factor, a measure of thermal conductivity expressed in British thermal units per hour-square foot-Fahrenheit (Btu/h-ft^2-F); that is, the heat conducted through the panel per unit time, per square foot of panel surface area, per degree Fahrenheit. A lower U-factor corresponds to less heat conducted through the panel, indirectly decreasing the energy use of the walk-in because the refrigeration system does not have to expend additional energy to remove heat from the walk-in. DOE plotted the decrease in U-factor versus the increase in cost of a single panel. For non-display doors and display doors, DOE plotted energy consumption in kWh/day versus the increasing cost of an individual non-display door. For a more detailed description of the engineering analysis results, see appendix 5A of the TSD.

b. Refrigeration

In the preliminary analysis, DOE chose refrigeration system sizes that best represented the market, but did not attempt to match the refrigeration systems to any particular envelope in the engineering analysis. DOE received several comments on the preliminary analysis regarding matching the refrigeration system to the envelope size. American Panel suggested that, because of their interdependence, refrigeration and walk-in size should be analyzed together. (American Panel, Public Meeting Transcript, No. 0045 at p. 115) NEEA, NPCC, Heatcraft, and American Panel recommended that the refrigeration system size match the envelope size. (NEEA and NPCC, No. 0059.1 at p. 9, Heatcraft, No. 0069.1 at p. 1, American Panel, No. 0048.1 at p. 4)

DOE is proposing to regulate the refrigeration system as an individual component in accordance with its proposed component-level approach, and is also analyzing the individual components of an envelope (panels and doors), rather than the entire envelope. For these reasons, DOE did not attempt to match refrigeration systems with any particular envelope size. Rather, DOE chose refrigeration system sizes for the analysis that capture the range of systems that might be used in a walk-in.

In the preliminary analysis, DOE plotted the cost-efficiency data points using normalized energy consumption for its engineering analysis. AHRI recommended using AWEF and commented that the normalized values favor design options, which, in its view, do not necessarily reduce energy consumption. The Joint Utilities believed that non-normalized values would be helpful to understand the analyses. (AHRI, No. 0055.1 at pp. 2–3; Joint Utilities, Public Meeting Transcript, No. 0045 at p. 171) Consistent with the test procedure final rule and AHRI's suggestion, DOE is using AWEF to construct its cost-efficiency curves. See 76 FR 21597-21598, 10 CFR 431.302.

In chapter 5, Appendix A of the preliminary TSD, DOE provided cost-efficiency curves for all the equipment classes. Numerous stakeholders requested that DOE provide more detail about the methodology behind the cost efficiency curves because they are concerned about the accuracy of these curves. (Emerson, Public Meeting Transcript, No. 0045 at p. 165; AHRI, Public Meeting Transcript, No. 0045 at p. 169 and No. 0055.1 at p. 2,4; Manitowoc, No. 0056.1 at p. 2 and Public Meeting Transcript, No. 0045 at p. 125) Additionally, Manitowoc suggested that a broader view of the industry's costs and sizes is required to improve the accuracy of the results (Manitowoc, Public Meeting Transcript, No. 0045 at p. 162)

DOE appreciates the stakeholder comments and notes that it has updated its initial cost-efficiency curves based on changes to its analysis. DOE has provided more detail in this NOPR and the NOPR TSD about the calculation methodology used in the engineering analysis, particularly due to the publication of the test procedure final rule. DOE also updated its analysis with the most recent pricing data related to the costs of materials and purchased parts and adjusted the projected energy savings of certain design options as detailed in section IV.C.5.b.

c. Numerical Results

Table IV-8, Table IV-9, Table IV-10, and Table IV-11 present cost-efficiency data for panels, display doors, non-display doors, and refrigeration systems, respectively. For refrigeration systems, because of the large number of analysis points, DOE presents results for only one type of system, DC.L.O, in this notice. See appendix 5A of the TSD for complete cost-efficiency results.

Table IV-8 Cost-Efficiency Results for Panels

		Efficiency Level						
Class/Size		Base-line	1	2	3	4	5	6
SP.M.SML	Cost [$]	$54	$58	$61	$67	$73	$86	$231
	U-factor [Btu/h-ft-F]	0.082	0.046	0.040	0.032	0.027	0.024	0.011
SP.M.MED	Cost [$]	$153	$159	$165	$179	$192	$229	$615
	U-factor [Btu/h-ft-F]	0.061	0.043	0.038	0.030	0.025	0.024	0.011
SP.M.LRG	Cost [$]	$240	$247	$256	$276	$296	$354	$951
	U-factor [Btu/h-ft-F]	0.056	0.042	0.037	0.030	0.025	0.024	0.011
SP.L.SML	Cost [$]	$56	$61	$67	$73	$86	$231	-
	U-factor [Btu/h-ft-F]	0.073	0.040	0.032	0.027	0.024	0.011	-
SP.L.MED	Cost [$]	$159	$165	$179	$192	$229	$615	-
	U-factor [Btu/h-ft-F]	0.053	0.038	0.030	0.025	0.024	0.011	-
SP.L.LRG	Cost [$]	$249	$256	$276	$296	$354	$951	-
	U-factor [Btu/h-ft-F]	0.050	0.037	0.030	0.025	0.024	0.011	-
FP.L.SML	Cost [$]	$85	$93	$97	$104	$111	$270	-
	U-factor [Btu/h-ft-F]	0.071	0.041	0.036	0.030	0.025	0.018	-
FP.L.MED	Cost [$]	$176	$190	$195	$209	$222	$566	-
	U-factor [Btu/h-ft-F]	0.059	0.039	0.035	0.029	0.024	0.015	-
FP.L.LRG	Cost [$]	$301	$322	$331	$353	$374	$973	-
	U-factor [Btu/h-ft-F]	0.054	0.039	0.035	0.028	0.024	0.014	-

Table IV-9 Cost-Efficiency Results for Display Doors

		Efficiency Level						
Class/ Size		Baseline	1	2	3	4	5	6
DD.M. SML	Cost [$]	$277	$274	$340	$423	$544	$710	$1,375
	Energy Use [kWh/day]	2.50	1.74	0.98	0.84	0.68	0.58	0.38
DD.M. MED	Cost [$]	$357	$354	$420	$530	$651	$870	$1,751
	Energy Use [kWh/day]	2.91	2.15	1.14	0.96	0.80	0.66	0.40
DD.M.L RG	Cost [$]	$470	$478	$544	$692	$813	$1,108	$2,291
	Energy Use [kWh/day]	3.76	2.78	1.43	1.18	0.99	0.81	0.46
DD.L. SML	Cost [$]	$509	$506	$627	$793	$960	$1,375	-
	Energy Use [kWh/day]	5.22	4.34	4.14	2.73	2.02	1.66	-
DD.L.M ED	Cost [$]	$643	$640	$761	$980	$1,202	$1,751	-
	Energy Use [kWh/day]	6.47	5.58	5.39	3.49	2.56	2.08	-
DD.L. LRG	Cost [$]	$831	$839	$1,135	$1,432	$1,553	$2,291	-
	Energy Use [kWh/day]	8.54	7.40	4.83	3.57	3.36	2.70	-

Table IV-10 Cost-Efficiency Results for Non-Display Doors

Class/ Size		Efficiency Level									
		Base-line	1	2	3	4	5	6	7	8	9
PD.M. SML	Cost [$]	$180	$184	$210	$214	$222	$273	$281	$487	$655	-
	Energy Use [kWh/day]	0.30	0.27	0.22	0.22	0.21	0.17	0.16	0.04	0.02	-
PD.M. MED	Cost [$]	$210	$214	$240	$245	$255	$306	$316	$522	$741	-
	Energy Use [kWh/day]	0.32	0.28	0.24	0.23	0.22	0.18	0.17	0.05	0.03	-
PD.M. LRG	Cost [$]	$265	$270	$296	$303	$316	$368	$381	$587	$904	-
	Energy Use [kWh/day]	0.36	0.31	0.27	0.25	0.24	0.20	0.19	0.06	0.04	-
PD.L. SML	Cost [$]	$235	$240	$291	$342	$351	$359	$425	$553	$728	-
	Energy Use [kWh/day]	7.08	6.96	6.52	6.26	6.23	6.20	6.07	6.01	5.98	-
PD.L. MED	Cost [$]	$265	$270	$322	$373	$383	$393	$459	$587	$814	-
	Energy Use [kWh/day]	7.82	7.69	7.25	6.99	6.95	6.92	6.79	6.72	6.67	-
PD.L. LRG	Cost [$]	$322	$328	$380	$431	$445	$459	$524	$653	$978	-
	Energy Use [kWh/day]	9.03	8.88	8.43	8.18	8.11	8.07	7.94	7.88	7.79	-
FD.M. SML	Cost [$]	$356	$362	$388	$398	$417	$469	$489	$694	$1,119	-
	Energy Use [kWh/day]	0.39	0.35	0.30	0.28	0.26	0.22	0.21	0.08	0.05	-
FD.M. MED	Cost [$]	$574	$581	$647	$662	$692	$738	$768	$860	$1,225	$1,899
	Energy Use [kWh/day]	0.65	0.60	0.46	0.44	0.40	0.36	0.34	0.31	0.25	0.19
FD.M. LRG	Cost [$]	$719	$727	$793	$813	$853	$898	$938	$1,029	$1,394	$2,296
	Energy Use [kWh/day]	0.73	0.66	0.53	0.49	0.45	0.41	0.38	0.35	0.29	0.21
FD.L. SML	Cost [$]	$416	$423	$474	$526	$546	$566	$632	$760	$1,194	-
	Energy Use [kWh/day]	10.25	10.08	9.63	9.38	9.29	9.23	9.10	9.03	8.92	-
FD.L. MED	Cost [$]	$679	$688	$753	$845	$875	$905	$997	$1,225	$1,911	-
	Energy Use [kWh/day]	13.71	13.49	12.58	12.13	11.99	11.90	11.67	11.55	11.35	-
FD.L. LRG	Cost [$]	$828	$838	$904	$995	$1,035	$1,075	$1,167	$1,394	$2,310	-
	Energy Use [kWh/day]	15.62	15.36	14.45	14.00	13.81	13.69	13.45	13.34	13.06	-

Table IV-11 Cost-Efficiency Results for Refrigeration Systems

		Efficiency Level												
Class/ Size		Base-line	1	2	3	4	5	6	7	8	9	10	11	12
DC.L.O HER* 6 kBtu	Cost [$]	$1591	$1616	$1641	$1671	$1745	$1749	$1760	$1798	$1848	$1898	$2058	-	-
	AWEF Btu/Wh	2.40	2.62	2.81	2.97	3.30	3.31	3.34	3.43	3.56	3.62	3.65	-	-
DC.L.O HER 9 kBtu	Cost [$]	$1720	$1745	$1770	$1800	$1876	$1881	$1919	$1969	$1980	$2144	$2194	-	-
	AWEF Btu/Wh	2.91	3.10	3.27	3.47	3.86	3.87	3.96	4.07	4.09	4.38	4.44	-	-
DC.L.O SCR 6 kBtu	Cost [$]	$1838	$1863	$1888	$1918	$1992	$1996	$2034	$2084	$2095	$2250	$2300	-	-
	AWEF Btu/Wh	2.86	3.14	3.39	3.70	4.07	4.09	4.24	4.44	4.48	4.79	4.89	-	-
DC.L.O SCR 9 kBtu	Cost [$]	$1944	$1969	$1999	$2024	$2100	$2105	$2143	$2193	$2204	$2381	$2531	$2581	-
	AWEF Btu/Wh	3.70	3.98	4.35	4.64	5.11	5.13	5.28	5.48	5.52	5.86	6.15	6.25	-
DC.L.O SCR 54 kBtu	Cost [$]	$6938	$6968	$7018	$7068	$7188	$7288	$7312	$7362	$7512	$7594	$10312	$10337	$11062
	AWEF Btu/Wh	4.09	4.44	4.92	5.38	5.93	6.27	6.34	6.43	6.58	6.64	7.77	7.78	7.91
DC.L.O SEM 6 kBtu	Cost [$]	$2095	$2120	$2145	$2175	$2248	$2253	$2291	$2341	$2352	$2402	$2555	-	-
	AWEF Btu/Wh	2.47	2.69	2.90	3.15	3.48	3.50	3.60	3.74	3.77	3.84	3.93	-	-
DC.L.O SEM 9 kBtu	Cost [$]	$2270	$2295	$2320	$2350	$2426	$2430	$2468	$2518	$2666	$2677	$2727	-	-
	AWEF Btu/Wh	2.78	2.96	3.12	3.40	3.77	3.78	3.86	3.96	4.28	4.30	4.36	-	-
DC.L.O SEM 54 kBtu	Cost [$]	$7776	$7806	$7856	$7906	$8006	$8129	$8208	$8258	$8340	$11254	$11720	$11804	-
	AWEF Btu/Wh	3.36	3.63	3.99	4.32	4.74	5.24	5.36	5.43	5.47	6.37	6.52	6.54	-
DC.L.O SEM 72 kBtu	Cost [$]	$9772	$9802	$9877	$9952	$10075	$10175	$10225	$10304	$10427	$11091	$13999	$14083	-
	AWEF Btu/Wh	3.41	3.70	4.11	4.50	4.96	5.36	5.44	5.53	5.58	5.79	6.71	6.72	-

*HER indicates a hermetic compressor, SCR indicates a scroll compressor, and SEM indicates a semi-hermetic compressor.

D. Markups Analysis

This section explains how DOE developed the distribution channel and supply chain markups to determine installed costs for the end-users of refrigeration systems and envelope components.

In the preliminary analysis, DOE described different distribution channels for the two broadly defined segments of the WICF market: the food sales (grocery) segment and the food service segment for the purposes of calculating markups. In the food sales segment, the refrigeration systems are predominantly unit coolers connected to multiplex condensing systems. In the food service and convenience store market segment, the refrigeration systems are mostly dedicated condensing systems. DOE acknowledged that walk-in units may also be assembled in the field, with key components sourced from different vendors through different channels. However, in the preliminary analysis, DOE conducted the markups analysis on complete walk-in systems and did not apply separate markups for different components. Consequently, DOE assumed in the preliminary analysis that the refrigeration system and the envelope followed identical distribution channels even if they were manufactured by a different set of manufacturers.

One interested party recommended that DOE include an additional distribution channel. Heatcraft commented that the refrigeration system manufacturers often sell directly to the envelope manufacturers, who integrate the refrigeration systems with the envelopes and then sell the assembled units. (Heatcraft, Public Meeting Transcript, No. 0045 at p. 187) Heatcraft identified this market segment as OEMs and observed that this important channel of distribution was not considered by DOE, even though 50 percent of the refrigeration system business is distributed through the OEM market segment.

The revised NOPR analysis uses component-level standards for specific envelope components and for the refrigeration systems. Because of this component-level standards approach, DOE conducts all the key analysis steps separately for the refrigeration systems and the selected envelope components in the NOPR analysis. As part of this approach, DOE includes a distinct OEM distribution channel in the markup analysis. Based on interviews with several manufacturers, DOE estimates that the percentage share of the aggregate shipments of refrigeration systems attributable to the OEM segment of the market is 55 percent for all dedicated condensing refrigeration systems, similar to the 50 percent share indicated by Heatcraft.

Another interested party commented on the relative shares of the different market segments DOE identified. In the preliminary analysis, DOE estimated that for walk-ins with dedicated condensing units, 50 percent of aggregate sales were for the food service segment and the remaining 50 percent were for the convenience and small grocery stores segment. American Panel commented that for walk-in equipment sold with dedicated condensing equipment, the share of the food service segment across the two broad market segments should be 80 percent and the share of the convenience and small grocery stores segment should be 20 percent. (American

Panel, No. 0048.1 at p. 8) In the NOPR, DOE revised its shipment analysis as described in chapter 9 of the TSD and noted that for the walk-ins with dedicated condensing equipment, the relative shares for the food service segment and the convenience and small grocery stores segment are now 78 percent and 22 percent, respectively, compared to 50 percent each for these two segments estimated in the preliminary analysis. These new values closely match the percentage shares indicated by American Panel..

Several interested parties commented on the shares of different distribution channels across the market segments that DOE previously applied. In the preliminary analysis, DOE indicated that the percentage share of the aggregate shipments of refrigeration systems through refrigeration wholesalers was 15 percent for multiplex equipment and 57.5 percent for dedicated condensing equipment on an average basis for all the market segments. Heatcraft stated that the percentage share of the aggregate shipments of refrigeration systems through the refrigeration wholesalers is 50 percent. (Heatcraft, Public Meeting Transcript, No. 0045 at p. 284) Based on information gathered through interviews with manufacturers of refrigeration systems, DOE has revised its estimates for the percentage share of the aggregate shipments of refrigeration systems through wholesalers. For the NOPR, DOE revised these estimates to 42 percent for dedicated condensing systems and 45 percent for the unit coolers connected to a multiplex condensing system.

In the preliminary analysis, DOE assumed that the share of electronic commerce (E-commerce) resellers in the food service market for dedicated condensing systems is 10 percent. American Panel commented that this figure was too high and should be 1 percent or, at most, 2 percent. (American Panel, Public Meeting Transcript, No. 0045 at p. 195 and No. 0048.1 at p. 8) Manitowoc pointed out that E-commerce resellers often represent food service equipment distributors selling to territories outside the specific territory assigned to them by the manufacturer and that their sales could be considered distributor sales. In its view, if this aspect is considered, then the share of the E-commerce business estimated by DOE in the preliminary analysis is too high. (Manitowoc, Public Meeting Transcript, No. 0045 at p. 195) NEEA and NPCC reinforced the observations made by American Panel and Manitowoc, and suggested that DOE adjust the markup analysis accordingly. (NEEA and NPCC, No. 0059.1 at p. 9) DOE agrees with Manitowoc's observation that the E-commerce share of total sales is essentially composed of sales through the distributor segment and, therefore, there is no need to identify this channel of distribution separately. As a result of this observation, DOE did not identify this as a separate distribution channel in the NOPR analysis.

American Panel noted that the distribution channel shares described by DOE for walk-ins with dedicated condensing equipment sold in the food service market segment are accurate for the national accounts and distributors under the current economic situation, but it expected to see the market share of the national chains increase to 20 percent with the economy improving in the next 2 to 3 years.

(American Panel, Public Meeting Transcript, No. 0045 at p. 144) American Panel also pointed out that, for walk-ins with dedicated condensing equipment sold to the food service segment, the market share for contractors should be 5 percent instead of 10 percent. (American Panel, Public Meeting Transcript, No. 0045 at p. 194) In the NOPR markup analysis, DOE has factored American Panel's estimates and revised the corresponding market shares to 10 percent for the national chains and 5 percent for the contractors.

Regarding the values of the markup multipliers presented in chapter 6 of the preliminary TSD, several interested parties commented on the methodology for arriving at the multiplier. AHRI stated that, when multiple-stage markups (manufacturer, distributor, dealer, and contractor) are estimated separately and multiplied to estimate the overall markups, the errors in the different stages are compounded in the final result. (AHRI, No. 0055.1 at p. 3) AHRI suggested that DOE avoid compounding errors and instead use retail prices in the analysis. DOE notes that the current methodology of the markup analysis is standardized in DOE's economic analysis in its energy conservation rulemaking activities. A retail price analysis is not feasible, because a representative sample of direct end-user prices is difficult to obtain from distributors and contractors because pricing data are considered business-sensitive. Furthermore, these parties often use aggregate markups on the entire contract and separate markups for labor and/or equipment installations cannot be established. Therefore, DOE continues to use a markup analysis in this NOPR.

Craig Industries commented that the mechanical contractor may not always purchase envelope components from the distributor, but can purchase them directly from the manufacturers and, therefore, the baseline markup for the mechanical contractor should not include the distributor markup. (Craig Industries, No. 0064.1 at p. 1) In the NOPR, DOE is proposing component-level standards for the envelope components and has revised the markup analysis accordingly. DOE assumes that the general contractors would purchase the envelope components directly from the manufacturer, and hence, did not include the markup percentages of the distributors in the estimated overall markups for sales through the contractor channel in the NOPR analysis.

Regarding the values of the markup multipliers presented in chapter 6 of the preliminary TSD, American Panel commented that the markup multiplier values were too high and should correspond to approximately 10–12 percent of the markup. (American Panel, Public Meeting Transcript, No. 0045 at p. 201) American Panel also questioned DOE’s assumption that the markup multipliers for unit coolers connected to multiplex systems would be substantially lower than the multipliers for the dedicated condensing equipment, when both types of equipment move through the same channel of distribution. (American Panel, No. 0048.1 at p. 8) In response to the first comment, DOE notes that the markup multipliers obtained in the revised analysis are consistent with the markup multipliers derived for other refrigeration products that often share the same distribution channels with walk-in coolers and freezers. Therefore, DOE considers the markup multipliers to be representative of the industry.

Regarding the second comment, DOE notes that the overall markup multipliers depend not only on the channels through which the products are sold, but also on the relative shares of sales of the distribution channels. Because unit coolers connected to multiplex condensing systems are predominantly used in food sales, and a larger percentage of such equipment is sold directly to contractors, the equipment would be expected to have lower weighted average markup multipliers. The NOPR analysis uses weighted average baseline markup multipliers for multiplex and non-multiplex equipment of 1.43 and 1.51, respectively.

One interested party commented on DOE's data sources. NEEA and NPCC recommended that, in view of the several comments DOE received on the markup analysis and ongoing restructuring and consolidation of the food retailing industry, DOE should obtain manufacturer assistance in re-crafting the markup estimates for each distribution channel. (NEEA and NPCC, No. 0059.1 at p. 9) In the NOPR analysis, DOE has revised many of its estimates of the shares of individual channels based on comments received from interested parties. Given their general reliability, in estimating the markup multipliers in specific distribution channels, DOE uses data from trade associations and economic census data from the U.S. Census Bureau. The NOPR analysis relies on the most recently available data to derive the markup multipliers.

Table IV-12 shows the overall weighted average baseline and incremental markups for sales of refrigeration systems and envelope components. Chapter 6 and appendix 6A of the TSD provide complete details of the methodology and data used in the estimation of the markup multipliers.

Table IV-12 Overall Markup Multipliers for All Equipment Classes

Equipment Class	Markup Multipliers	
	Baseline	Incremental
DC.M.I*	1.51	1.19
DC.L.I*		
DC.M.O*	1.51	1.19
DC.L.O*		
MC.M	1.43	1.25
MC.L		
SP.M	1.16	1.09
SP.L		
DD.M	1.41	1.29
DD.L		
PD.M	1.16	1.09
PD.L		
FD.M	1.16	1.09
FD.L		

*For DC refrigeration systems, markups apply to both capacity ranges.

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E. Energy Use Analysis

The energy use analysis estimates the annual energy consumption of refrigeration systems serving walk-ins and the energy consumption that can be directly ascribed to the selected components of the WICF envelopes. These estimates are used in the subsequent LCC and PBP analyses (chapter 8 of the TSD) and NIA (chapter 10 of the TSD).

In the preliminary analysis, DOE estimated the annual energy consumption for a complete theoretical walk-in consisting of an envelope and a matched refrigeration system, each at a specific efficiency level, using a set of assumptions for product loading, duty cycle, and other associated conditions. In the NOPR, DOE is proposing energy consumption standards separately for the refrigeration systems and a selected set of envelope components: panels, non-display doors, and display doors. Consequently, DOE revised the methodology for estimating the annual energy consumption to reflect the new approach.

A key change from the preliminary analysis methodology for estimating the annual energy consumption is that in the NOPR analysis, DOE is no longer matching the refrigeration systems to specific envelope sizes. The estimates for the annual energy consumption of each analyzed representative refrigeration system (see section IV.C.2) were reached by assuming that (1) the refrigeration system is sized such that it follows a specific daily duty cycle for a given number of hours per day at full rated capacity, and (2) the refrigeration systems produce no additional refrigeration effect for the remaining period of the 24-hour cycle. These assumptions are consistent with the present industry practice for sizing refrigeration systems. This methodology assumes that the refrigeration system is paired with an envelope that generates a load profile such that the rated hourly capacity of the paired refrigeration system, operated for the given number of run hours per day, produces adequate refrigeration effect to meet the daily refrigeration load of the envelope with a safety margin to meet contingency situations. Thus, the annual energy consumption estimates for the refrigeration system depends on the methodology adopted for sizing, the implied assumptions and the extent of oversizing. The sizing methodology adopted in this NOPR analysis is further discussed later in this section.

For the envelopes, the estimates of product and infiltration loads are no longer used in estimating energy consumption in the analysis because these factors are not intended to be mitigated by any of the component standards. DOE calculated only the transmission loads across the envelope components under test procedure conditions and combined that with the annual energy efficiency ratio (AEER) to arrive at the annual refrigeration energy consumption associated with the specific component. AEER is a ratio of the net amount of heat removed from the envelope in Btu by the refrigeration system and the annual energy consumed in watt-hours using bin temperature data specified in AHRI 1250-2009 to calculate AWEF. The annual electricity consumption attributable to any envelope component is the sum of the direct electrical energy consumed by electrically-powered sub-components (e.g., lights and anti-sweat heaters) and the refrigeration energy, which is computed by dividing the transmission heat load traceable to the envelope component by the AEER metric, where the AEER metric represents the efficiency of the refrigeration system with which the envelope is paired.

In the preliminary analysis, DOE estimated aggregate refrigeration loads of three sizes of complete WICF envelopes in each of the four envelope classes (i.e., storage and display coolers and freezers.) In the NOPR, given the component-level approach, DOE estimated the annual energy consumption per unit of the specific envelope components by calculating the transmission load of the component over 24 hours under the test procedure conditions, and then calculating the annual refrigeration energy consumption attributed to that component by applying an appropriate AEER value.

1. Sizing Methodology for the Refrigeration System

In the preliminary analysis, DOE calculated the required size of the refrigeration system for a given envelope by assuming that the rated capacity of the refrigeration system would be adequate to meet the refrigeration load of a walk-in cooler or freezer during the high-load condition. The load profile of WICF equipment that DOE used broadly followed the load profile assumptions of the industry test procedure for refrigeration systems—AHRI 1250-2009, Standard for Performance Rating of Walk-In Coolers and Freezers ("AHRI 1250-2009"). As noted earlier, that protocol was incorporated into DOE's test procedure. 76 FR 33631 (June 9, 2011).

As a result, the DOE test procedure incorporates an assumption that, during a 24-hour period, a WICF refrigeration system experiences a high-load period of 8 hours corresponding to frequent door openings, product loading events, and other design load factors, and a low-load period for the remaining 16 hours, corresponding to a minimum load resulting from conduction, internal heat gains from non-refrigeration equipment, and steady-state infiltration across the envelope surfaces. During the high-load period, the ratio of the envelope load to the net refrigeration system capacity is 70 percent for coolers and 80 percent for freezers. During the low-load period, the ratio of the envelope load to the net refrigeration system capacity is 10 percent for coolers and 40 percent for freezers. The relevant load equations correspond to a duty cycle for refrigeration systems, where the system runs at full design point refrigeration capacity for 7.2 hours per day for coolers and 12.8 hours per day for freezers. Specific equations to vary load based on the outdoor ambient temperature are also specified.

DOE received several comments on its duty cycle assumptions in the preliminary analysis. American Panel pointed out that the average envelope load hourly distributions for low and high loads used by DOE in the preliminary analysis represented a light loading condition and should be reversed, implying that a typical refrigeration system would experience 16 hours of high load and 8 hours of low load per day, rather than DOE’s assumptions of 8 hours and 16 hours for high and low load, respectively. (American Panel, Public Meeting Transcript, No. 0045 at p. 212) For the restaurant market segment in particular, American Panel noted that the high-load and low-load periods would both typically be 12 hours each. (American Panel, No. 0048.1 at p. 8) American Panel also commented that its own heat load calculations use 18 hours of maximum refrigeration system run time for the freezers and noted that this is the industry standard. (American Panel, No. 0048.1 at p. 3) Manitowoc and Heatcraft, however, agreed with DOE’s assumptions of the hourly load distributions for the high-load and low-load periods, which are consistent with AHRI 1250-2009. (Manitowoc, Public Meeting Transcript, No. 0045 at p. 215; Heatcraft, Public Meeting Transcript, No. 0045 at p. 213) NEEA and NPCC noted that the duty cycle assumptions for the energy use analysis were credible and did not recommend any changes to this part of the analysis. (NEEA and NPCC, No. 0059.1 at p. 10) AHRI also commented that the assumptions made by DOE to calculate the duty cycle are acceptable for the analysis. (AHRI, No. 0055.1 at p. 3) Manitowoc noted that the envelope load assumptions are not supported with measurements from real life walk-in monitoring but are based on conservative sizing practices followed by the industry to ensure that even in worst-case situations, the walk-in will maintain the necessary temperature. (Manitowoc, No. 0056.1 at p. 3)

In light of the comments received from American Panel on current industry sizing practices, and Manitowoc's comment that actual duty cycles differ from the AHRI test procedure conditions, DOE tentatively concludes that the duty cycle assumptions of AHRI 1250-2009 should not be used for the sizing purposes because they may not represent the average conditions for WICF refrigeration systems for all applications under all conditions. DOE recognizes that test conditions are often designed to effectively compare the performance of equipment with different features under the same conditions.

For the energy use analysis, DOE revisited the duty cycle issue and found that the current industry practice for sizing the refrigeration system is based on providing a 10 percent safety margin multiplier to the calculated aggregate refrigeration load over a 24-hour daily cycle and assuming a nominal run time of 16 hours for coolers and 18 hours for freezers for sizing the refrigeration system. DOE's key assumption in the preliminary analysis of equating the refrigeration capacity to the high-box load is not practiced in the industry and DOE has made no attempt to model the peak load. The nominal run time varies only in special situations—such as when freezers use hot gas defrost or when the temperature of the evaporator coil is higher than 32 °F. Consequently, DOE adopted the industry practice described above for calculating the energy use and load characterization.

In this NOPR, DOE proposes a nominal run time of 16 hours per day for coolers and 18 hours per day for freezers to calculate the capacity of a "perfectly" sized refrigeration system. A fixed oversize factor is then applied to this size to calculate the actual runtime. With the oversize factor applied, DOE assumes that the runtime of the refrigeration system is 13.3 hours per day for coolers and 15 hours per day for freezers at full design point capacity. The reference outside ambient temperatures for the design point capacity conform to the AHRI 1250-2009 conditions incorporated into the DOE test procedure and are 95 °F and 90 °F for refrigeration systems with outdoor and indoor condensers, respectively.

DOE notes that the AHRI assumptions for high-load and low-load conditions were supported by some interested parties and acknowledges that the distribution of high-load and low-load hour assumptions could be relevant to the equipment energy consumption. DOE has observed, however, that the high-load situation is not taken into account by the industry in its standard sizing methods and would not represent current industry practices. Thus, for the NOPR analysis, DOE has revised its sizing methodology to be consistent with its understanding of the current industry practice. DOE requests comment on the sizing methodology.

2. Oversize Factors

American Panel commented that DOE's preliminary analysis assumptions regarding duty cycle and sizing conflicted with the prevalent practice in the industry, which resulted in considerable oversizing of the refrigeration systems when paired with a given envelope. Oversizing leads to higher first cost estimates for the refrigeration equipment and distorts the LCC and PBP results because the energy savings are not commensurate with the first costs. American Panel further commented that because the refrigeration systems examined as part of the preliminary analysis are poorly matched to the envelopes, no meaningful conclusion can be drawn from the accompanying LCC, PBP, and NIA results. (American Panel, No. 0048.1 at p. 8 and p. 11) Regarding the annual energy calculations presented in chapter 7 of the TSD, American Panel did not believe that DOE properly matched the refrigeration systems and envelopes—which yielded an estimated 8 hours or less of runtime per day. In its view, this preliminary estimate is incorrect. (American Panel, No. 0048.1 at p. 9) American Panel also submitted additional documentation demonstrating its own methodology for matching the selected refrigeration system capacity to the estimated heat load of a walk-in expressed in Btu/h. (American Panel, No. 0048.1 at p. 9) DOE investigated further and found that the load calculation manuals and sizing software of several refrigeration system manufacturers supported American Panel's recommendation on the approach to sizing.

As stated previously, DOE observed that the typical and widespread industry practice for sizing the refrigeration system is to calculate the daily heat load on the basis of a 24-hour cycle and divide by 16 hours of runtime for coolers and 18 hours of runtime for freezers. DOE also found that it is customary in the industry to allow for a 10 percent safety margin to the aggregate 24-hour load resulting in 10 percent oversizing of the refrigeration system.

In the preliminary analysis, DOE considered a scaled mismatch factor in addition to the oversizing related to its duty cycle assumptions. DOE recognized that an exact match for the calculated refrigeration capacity may not be available for the refrigeration systems available in the market because most refrigeration systems are mass-produced in discrete capacities. The capacity of the best matched refrigeration system is likely to be the nearest higher capacity refrigeration system available. This consideration led DOE to develop a scaled mismatch factor that could be as high as 33 percent for the smaller refrigeration system sizes, and was scaled down for the larger sized units. In the preliminary analysis, DOE applied this mismatch oversizing factor to the required refrigeration capacity at the high-load condition to determine the required capacity of the refrigeration system to be paired with a given envelope.

DOE received multiple comments regarding the mismatch factor. Manitowoc pointed out that the mismatch factors used by DOE in the preliminary analysis are high. DOE assumed that compressors are available only in capacity increments of

6000 Btu/h but Manitowoc noted that compressors are available at capacity increments of 2000 Btu/h and 1500 Btu/h for medium- and low-temperature systems, respectively. (Manitowoc, No. 0056.1 at p. 3; Manitowoc, Public Meeting Transcript, No. 0045 at p. 220 and p. 222) American Panel pointed out that the maximum mismatch factor could be 15 percent. (American Panel, Public Meeting Transcript, No. 0045 at p. 220) Heatcraft stated that DOE's assumption that the sizes of refrigeration systems available in the market are at 0.5-ton intervals is not applicable for larger sized systems. For sizes from 5–10 horsepower, the compressors are available in 2.5-horsepower intervals, and for sizes from 10–30 horsepower, compressors are available in 5-horsepower intervals. (Heatcraft, No. 0069.1 at p. 2)

Based on these comments, DOE recalculated the mismatch factor because compressors for the lower capacity units are available at smaller size increments than what DOE assumed in the preliminary analysis. DOE also agrees with Manitowoc that for larger sizes, the size increments of available capacities are higher than size increments available for the lower capacities. DOE further noted as part of the revised analysis that under current industry practice, if the exact calculated size of the refrigeration system with a 10 percent safety margin is not available in the market, the user may choose the closest matching size even if it has a lower capacity, allowing the daily runtimes to be somewhat higher than their intended values. The designer would recalculate the revised runtime with the available lower capacity and compare it with the target runtime of 16 hours for coolers and 18 hours for freezers and, if this value falls within acceptable limits, then the chosen size of the refrigeration system is accepted and there is no mismatch oversizing.

DOE further examined the data of available capacities in published catalogs of several manufacturers and noted that the range of available capacities depends on compressor type and manufacturer. Furthermore, because smaller capacity increments are available for units in the lower capacity range and larger capacity increments are available for units in the higher capacity range, the mismatch factor is generally uniform over the range of equipment sizes. For the NOPR, DOE tentatively concluded from these data that a scaled mismatch factor linked to the target capacity of the unit may not be applicable, but that the basic need to account for discrete capacities available in the market is still valid. To this end, DOE is now applying a uniform average mismatch factor of 10 percent over the entire capacity range of refrigeration systems.

3. Product Load

The NOPR analysis does not include an explicitly modeled product load to determine the annual energy consumption. Instead, the annual energy consumption estimates for the refrigeration systems are based on industry practice duty cycle assumptions. This approach does not require any explicit modeling of the product load. However, for the shipment analysis of refrigeration systems, DOE expressed annual shipments and stocks in terms of installed refrigeration capacity (Btu/h). The shipments of the refrigeration system were linked to the shipments of envelopes, which required DOE to estimate the required refrigeration capacity for the units shipped. DOE included several assumptions about product loads in these calculations. These assumptions are discussed in the relevant section on shipment (Section IV.G of this NOPR).

4. Other Issues

DOE received one comment on the issue of the interaction of building air-conditioning systems with WICF systems installed within them. Ingersoll Rand stated that envelope improvements may not lead to significant energy savings because the load on the refrigeration systems of the WICF unit would be replaced by the load on the building air-conditioning system. DOE did not account for the difference in overall energy use that could be directly attributed to the improvement of envelope components on the whole building cooling load and, correspondingly, any space-cooling energy impacts. At the same time, any envelope component improvements may also result in a decrease in the use of heating energy within the buildings. This impact on building heating and cooling loads would only occur for WICF units located indoors. The relative cooling-energy-use penalty to heating-energy-use benefit is a function of the climate of the region in which the building is located, the building type and size, and the placement of the WICF units within the building. The relative monetary benefits are also a function of the relative heating and cooling fuel costs. The quantification of the relative benefits impact would have required an extensive analysis of building climate-control performance, which is both unnecessary and outside the scope framed by Congress.

For the refrigeration systems, DOE calculated the annual energy consumption for all six classes of refrigeration systems at various capacity points with all available compressor options and at all efficiency levels for which results of engineering analysis were available. The annual energy consumption results were used as inputs to the LCC and PBP analyses. Based on the results of the LCC analysis, DOE selected the most cost-efficient combination of compressors and other components at a given AWEF level for a specific capacity point. Fourteen efficiency options were selected from the entire range of available AWEF values for each capacity point analyzed. To simplify further analysis, however, DOE chose two points from a set of four or five capacity points in each of the four dedicated condensing equipment classes, and one for each of the two multiplex condensing equipment classes. DOE used the shipment data to derive a shipment weighted AEER value for each TSL option for the refrigeration system. For the envelope components, DOE estimated the associated refrigeration energy at each of the TSL options and each level of efficiency of the components. The units of analysis were the unit area for the panels and each whole door for the doors. DOE added the direct electrical energy consumed for each of the doors at different efficiency levels to the refrigeration energy to arrive at the total annual energy consumption. The annual energy consumption results for the components were used as inputs to the LCC and PBP analyses for the components. Chapter 7 of the TSD shows the annual average energy consumption estimates by equipment class and efficiency level for both the refrigeration system and the components.

F. Life-Cycle Cost and Payback Period Analyses

DOE conducts LCC and PBP analyses to evaluate the economic impacts of potential energy conservation standards for walk-ins on individual consumers—that is, buyers of the equipment. As stated previously, DOE adopted a component-based approach for developing performance standards for walk-in coolers and freezers. Consequently, the LCC and PBP analyses were conducted separately for the refrigeration system and the envelope components: panels, non-display doors, and display doors.

The LCC is defined as the total consumer expense over the life of a product, consisting of purchase, installation, and operating costs (expenses for energy use, maintenance, and repair). To calculate the operating costs, DOE discounts future operating costs to the time of purchase and sums them over the lifetime of the product. The PBP is defined as the estimated number of years it takes consumers to recover the increased purchase cost (including installation) of a more efficient product. The increased purchase cost is derived from the higher first cost of complying with the higher energy conservation standard. DOE calculates the PBP by dividing the increase in purchase cost (normally higher) by the change in the average annual operating cost (normally lower) that results from the standard.

NEEA and NPCC suggested that, when estimating equipment lifetimes, DOE should consider both the economic and physical lifetimes of WICF equipment.

(NEEA and NPCC, No. 0559.1 at p. 11) The physical lifetime refers to the duration before the equipment fails or is replaced, whereas the economic lifetime refers to the duration before the walk-in cooler and freezer equipment is taken out of service because the owner is no longer in business. In its energy conservation standards rulemakings, DOE does not typically consider the change of ownership of a distressed property due to business failure or insolvency of the first owner. The underlying assumption in this approach is that the higher efficiency equipment would continue to serve over its physical lifetime irrespective of ownership changes. Interested parties commented, however, that, in the case of walk-ins, the economic lifetime could be significantly lower. Owners at high risk of business failure or insolvency would be less likely to buy higher efficiency equipment because they likely would not see the long-term life cycle benefits of energy savings.

In response to these comments, DOE attempted to include alternative Weibull probability distributions in the NOPR analysis to capture the effects of a reduced economic lifetime of WICF equipment for small restaurants, but due to the increased complexity resulting from the component-level approach and lack of data on reduced lifetimes on account of change of ownership of walk-in equipment, DOE did not incorporate a shorter restaurant sector economic lifetime in the NOPR life cycle cost model. In many, if not most, cases when there is a change in ownership, equipment is not disassembled, but is sold “as is.”

For any given efficiency level, DOE measures the PBP and the change in LCC relative to the base-case equipment efficiency levels. The base-case estimate reflects the market without new or amended energy conservation standards. For walk-ins, the base-case estimate assumes that newly manufactured walk-in equipment complies with the existing EPCA requirements and either equals or exceeds the efficiency levels achievable by EPCA-compliant equipment. Inputs to the economic analyses include the total installed operating, maintenance, and repair costs.

Inputs to the calculation of total installed cost include the cost of the product—which consists of manufacturer costs, manufacturer markups, distribution channel markups, and sales taxes—and installation costs. Inputs to the calculation of operating expenses include annual energy consumption, energy prices and price projections, repair and maintenance costs, product lifetimes, discount rates, and the year that compliance with standards is required. DOE created probability distributions for product lifetime inputs to account for their uncertainty and variability.

DOE developed refrigeration and envelope component spreadsheet models used for calculating the LCC and PBP. Chapter 8 of the TSD and its appendices provide details on the refrigeration and envelope subcomponent spreadsheet models and on all the inputs to the LCC and PBP analyses.

Table IV-13 summarizes DOE’s approach and data used to derive inputs to the LCC and PBP calculations for both the preliminary TSD and the changes made for today’s NOPR. The subsections that follow discuss the initial inputs and methods and the changes DOE made for the NOPR.

For refrigeration systems, DOE analyzed all possible compressor technology options available for a given capacity of the refrigeration system. From the results of the individual compressor technology LCC analysis, DOE developed LCC savings plots in which the LCC savings over the LCC cost at the lowest total installed price option was plotted against the refrigeration system efficiency metric (AWEF). The LCC savings plots for the individual compressor technologies were superimposed into a single plot. A full range of optimal technology options were obtained by choosing the compressor technology available from the suite of available technologies that can reach a given efficiency level with the highest calculated LCC savings. The series of technology choices over the entire range of AWEF values from baseline to the highest achievable efficiency level obtained in this manner comprise the optimal path in developing higher efficiency equipment.

Table IV-13 Summary of Inputs and Methods in the LCC and PBP Analysis*

Inputs	Preliminary Analysis	Changes for the NOPR
Installed Costs		
Equipment Cost	Derived by multiplying manufacturer cost by manufacturer and retailer markups and sales tax, as appropriate.	Included factor for estimating price trends due to manufacturer experience.
Installation Costs	Based on RS Means Mechanical Cost Data 2009. Assumed no change with efficiency level.	Based on RS Means Mechanical Cost Data 2012. Assumed no change with efficiency level.
Operating Costs		
Annual Energy Use	DOE calculated the average annual energy use for each WICF envelope class matched with outdoor condenser systems using a load profile described in AHRI 1250-2009 (8 hours of high load and 16 hours of low load per day).	Daily load profile of the refrigeration system revised to 13.3 hours runtime per day for coolers and 15 hours for freezers, at full rated capacity and at outside air temperatures corresponding to the reference rating temperatures.
Energy Prices	EIA (Energy Information Administration). Form EIA-861 for 2006.	Source for Commercial and Industrial Retail Prices of Electricity: Form EIA-826 Database Monthly Electric Utility Sales and Revenue Data (EIA-826 Sales and Revenue Spreadsheets). www.eia.doe.gov/cneaf/electricity/page/eia826.html. Accessed September 30, 2012.
Energy Price Trends	Forecasted using AEO2009 price forecasts.	Forecasts updated using AEO2013.
Repair and Maintenance Costs	Annualized repair and maintenance costs of the combined system were derived from RS Means 2009 walk-in cooler and freezer maintenance data. Doors and refrigeration systems were replaced during the lifetime.	Revised to RS Means 2012 walk-in cooler and freezer maintenance data and maintenance data; maintenance and repair costs for the refrigeration system and the envelope components were individually estimated.
Present Value of Operating Cost Savings		
Equipment Lifetime	Based on manufacturer interviews. Variability: characterized using Weibull probability distributions.	Revised to reflect stakeholder comments.
Discount Rates	Based on the 2009 commercial refrigeration equipment final rule (72 FR 1092); vary across commercial building types.	Based on Damodaran Online, October 2012.
Compliance Date	2015	2017.

* References for the data sources mentioned in this table are provided in the sections following the table or in chapter 8 of the TSD.

1. Equipment Cost

To calculate consumer equipment costs, DOE multiplied the MSPs from the engineering analysis by the supply-chain markups described above (along with sales taxes). DOE used different markups for baseline products and higher efficiency products because, as discussed previously, DOE applies an incremental markup to the MSP increase associated with higher-efficiency products.

On February 22, 2011, DOE published a notice of data availability (NODA, 76 FR 9696) stating that DOE may consider improving its regulatory analysis by addressing equipment price trends. Consistent with the NODA, DOE examined historical producer price indices (PPI) for refrigeration equipment in general and found both positive and negative short-term real price trends. Over the historical long term DOE found slightly negative time real price trends. Therefore, DOE assumes in its price forecasts for this NOPR that the real prices of refrigeration equipment decrease slightly over time. DOE performed a sensitivity analysis of the NPV results for refrigeration equipment to the observed range of uncertainty in this long term price trend. DOE projected the price of the panels and doors using constant real 2012$ prices (See chapter 8 and chapter 10 of the TSD). DOE is aware that there have been significant changes in both the regulatory environment and equipment technologies during this period that create analytical challenges for estimating longer-term product price trends from the product-specific PPI data. DOE performed price trend sensitivity calculations to examine the dependence of the analysis results on different analytical assumptions. A more detailed discussion of price trend modeling and calculations is provided in Appendix 8D of the TSD. DOE invites comment on methods to improve its equipment price forecasting, as well as any data supporting alternate methods.

2. Installation Cost

Installation cost includes labor, overhead, and any miscellaneous materials and parts needed to install the equipment. For the preliminary analysis, DOE derived baseline installation costs for walk-in coolers and freezers from data in RS Means Mechanical Cost Data 2009.

DOE estimated installation costs separately for panels, non-display doors, and display doors. Installation costs for panels were calculated per square foot of area while installation costs for non-display doors were calculated per door. Display door installation costs were omitted and assumed to be included in the panel installation costs for display walk-ins. DOE assumed that display doors are either installed by the assembler or manufacturer of the walk-in unit, and the installation costs for the display doors are included in the "mark-up" amounts for the OEM channel.

For the NOPR analysis, DOE included refrigeration system component installation costs based on RS Means Mechanical Cost Data 2012. Refrigeration system installation costs included separate installation costs for the condensing unit and unit cooler. American Panel commented that these units are installed simultaneously by the same installation crew and quoted as a combined price. (American Panel, Public Meeting Transcript, No. 0045 at p. 246 and No. 0048.1 at p. 9) RS Means 2012 provides these installation costs separately, although the installation activities may be performed by the same crew. DOE proposes to be consistent with the approach of the cost data source because this approach permits one to estimate the installation costs of many combinations of unit coolers and condensing units.

In the preliminary analysis, DOE did not distinguish between installation costs for indoor and outdoor systems. Manitowoc stated that indoor and outdoor systems would likely incur different installation costs. (Manitowoc, Public Meeting Transcript, No. 0045 at p. 245) Installation cost differences between indoor and outdoor condensing units were not reported in the RS Means data because the costs shown are based only on unit capacity. DOE assumed that the installation costs reported in the RS Means data are based on a weighted average of outdoor and indoor units—accordingly, DOE used identical installation costs for indoor and outdoor condensing units.

3. Annual Energy Consumption

To estimate the annual energy consumption, DOE assumed that the installed refrigeration capacity is 20 percent larger than the refrigeration load calculated in the sizing methodology. The prevailing industry practice is to recommend that the rated capacity for refrigeration equipment selection includes a 10 percent “safety factor”. DOE chose to use a somewhat higher oversizing factor to account for the differences between the sizes calculated, using load estimation software programs, and the discrete sizes available in the market (that is, the mismatch factor). To determine annual energy consumption, DOE calculated, using the industry practice described above, that a refrigeration system with the selected oversizing factor would be required to run 13.3 hours per day for coolers and 15 hours per day for freezers at full rated capacity at the reference outside air temperatures to meet the aggregate refrigeration load of the paired walk-in envelope. These time periods were determined from DOE's sizing methodology, as discussed in section IV.E.1. DOE used reference temperatures of 90 °F and 95 °F for indoor and outdoor condensing refrigeration systems, respectively, which is consistent with the standard rating conditions incorporated by DOE from AHRI 1250-2009.

4. Energy Prices

DOE calculated average commercial electricity prices using Form EIA-826 Database Monthly Electric Utility Sales and Revenue Data (EIA-826 Sales and Revenue Spreadsheets) (www.eia.doe.gov/cneaf/electricity/page/eia826.html; accessed September 30, 2012). DOE calculated an average national commercial price by (1) estimating an average commercial price for each utility by dividing the commercial revenues by commercial sales; and (2) weighting each utility by the number of commercial consumers it served in that state, across the nation. For the preliminary TSD, DOE used the electricity price data from 2009. DOE updated the NOPR analysis using 2012 data.

5. Energy Price Projections

To estimate energy prices in future years for the preliminary TSD, DOE multiplied the average state energy prices described above by the forecast of annual average commercial energy price indices developed in the Reference Case from AEO2013, which forecasted prices through 2040.[17] AHRI supported DOE's approach for estimating current and future energy prices. (AHRI, No. 0055.1 at p. 3) DOE did not change its general approach, but today's NOPR analysis updates the initial energy price forecasts using AEO2013, which has an end year of 2035.[18] To estimate the price trends after 2035, DOE used the average annual rate of change in prices from 2026 to 2035.

6. Maintenance and Repair Costs

DOE calculated both maintenance and repair costs for the analysis. Maintenance costs are associated with maintaining the equipment operation, whereas repair costs are associated with repairing or replacing components that have failed in the refrigeration system and the envelope (i.e. panels and doors). In the preliminary analysis, DOE considered only general maintenance costs (e.g., checking and maintaining refrigerant charge levels, checking settings, and cleaning heat exchanger coils) and lighting maintenance activities. The NOPR analysis applies the same lighting maintenance assumptions for display doors with lights as DOE previously applied during the preliminary analysis phases. The remaining data on general maintenance for an entire walk-in were apportioned between the refrigeration system and the envelope doors. Based on the descriptions of maintenance activities in the RS

[17] The spreadsheet tool that DOE used to conduct the LCC and PBP analyses allows user0s 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.
[18] U.S. Energy Information Administration. Annual Energy Outlook 2013. May 2013. U.S. Energy Information Administration: Washington, DC.

Means 2012 Facilities Maintenance and Repair Cost Data (available on CD-ROM) and manufacturer interviews, DOE assumed that the general maintenance associated with the panels is minimal and did not include any maintenance costs for panels in its analysis. RS Means 2012 data provided general maintenance costs for display and storage walk-ins.

In response to this approach, American Panel suggested that DOE contact the Commercial Food Equipment Service Association (CFESA) to obtain additional maintenance and repair information. (American Panel, No. 0048.1 at p. 8) At American Panel's recommendation, DOE contacted CFESA, who explained that they did not have the information requested.

Of the total annual maintenance costs for a walk-in unit, which ranges from $170–$262, DOE assumed $150 would be spent on the refrigeration system and the rest would be spent on the display and passage doors of the envelope. DOE made this assumption as part of its preliminary analyses based on comments and research that pointed to this value as the likely amount that would need to be expended to cover refrigeration system-related costs. Maintenance costs were assumed to be the same across small, medium, and large door sizes in the case of both non-display doors and display doors. (DOE derived the envelope-related costs as the difference between the total maintenance costs for a walk-in and the assumed maintenance costs for the refrigeration system.) As stated previously, annual maintenance costs for the envelope wall and floor panels were assumed to be negligible and were not considered.

Interested parties commented on maintenance costs associated with refrigerant leakage and refrigerant charge. Emerson stated that DOE's estimated maintenance costs should account for higher refrigerant costs due to higher leakage rates and other issues in systems with higher refrigerant charge. (Emerson, Public Meeting Transcript, No. 0045 at p. 238) However, Emerson also commented that higher refrigerant costs could lead to the use of refrigerant leakage-reduction devices that offset the increased repair costs due to higher refrigerant charge and loss. (Emerson, Public Meeting Transcript, No. 0045 at p. 239) DOE did not receive any data for refrigeration maintenance costs, but based on the comments from Emerson, DOE assumes as part of the NOPR analysis that the $150 maintenance cost for a refrigeration system would include expenses related to refrigerant charge maintenance costs. DOE seeks data from interested parties on refrigerant charge maintenance costs applicable to walk-ins.

Other interested parties commented on potential climate change legislation. AHRI suggested that DOE study the impact of climate change legislation on the future availability and price of HFC refrigerants. (AHRI, No. 0055.1 at p. 3) Emerson also said that any future cap-and-trade bill would increase refrigerant costs significantly. (Emerson, Public Meeting Transcript, No. 0045 at p. 238) NEEA and NPCC suggested that refrigerant leakage and climate change responses should be evaluated in a manner that seeks to reduce refrigerant leakage rather than focusing solely on managing refrigerant replacement costs, particularly since maintenance costs are rising. (NEEA and NPCC, No. 0059.1 at p. 10) DOE acknowledges the concerns of interested parties regarding the effect of climate change legislation on refrigerant leakage and refrigerant costs. DOE does not speculate on pending legislation, which is outside the scope of this rulemaking.

DOE also updated its methodology for determining repair costs for the NOPR in response to earlier comments. In the preliminary analysis, DOE assumed that both the unit cooler and the condensing unit of the refrigeration system are replaced when the refrigeration system fails. Master-Bilt commented that repairing a failed refrigeration system typically would require replacement of the compressors, not the entire system, and that approximately five percent of refrigeration systems would require a compressor replacement during a 10-year span. (Master-Bilt, Public Meeting Transcript, No. 0045 at p. 287) American Panel agreed and noted that, when a refrigeration system fails the entire refrigeration system is not typically replaced; rather, only compressors or fan motors are replaced. (American Panel, Public Meeting Transcript, No. 0045 at p. 11) After carefully considering these comments, DOE assumed for the NOPR analysis that 5 percent of systems require compressor replacement and 10 and 15 percent of systems require fan motor replacement for evaporators and condensers, respectively, over the lifetime of the system. Aftermarket prices for fan motors and compressors were obtained from data collected during the engineering analysis and multiplied by a trade channel markup. DOE estimated installation costs using the RS Means

Mechanical Cost Data 2012 and calculated the total repair cost per occasion of replacement. DOE then calculated the annualized repair costs by multiplying the discounted total replacement cost per occasion by the replacement lifetime percentage.

Under this approach, the NOPR analysis factored repair costs for lighting repairs pertaining to the lighting of the display doors. Data from the RS Means Electrical Cost Data 2012 were used to obtain the labor installation cost for lighting replacements. For refrigeration systems, DOE observed that estimated repair costs often increased with increasing efficiency levels, particularly for higher-efficiency compressors and fan motors.

In the preliminary analysis, DOE assumed that annualized maintenance and repair costs were constant across all efficiency levels. Manitowoc and Master-Bilt stated that maintenance and repair cost increases across efficiency levels should not be negligible because more efficient equipment is more complex and may have design options that lead to the incorporation of additional or more expensive parts, which would cost more to maintain and replace. (Manitowoc, Public Meeting Transcript, No. 0045 at p. 241; Master-Bilt, No. 0046.1 at p. 1) Heatcraft agreed that maintenance and repair costs may increase with higher efficiency levels, stating that more efficient equipment would incur higher maintenance and repair costs because higher efficiency evaporator and condenser coils are larger and heavier, making them more difficult and costly to maintain. (Heatcraft, No. 0069.1 at p. 1) AHRI stated that larger evaporator and condenser coils require more refrigerant and concluded that the maintenance and cost repair differences across efficiency levels are evident. (AHRI, No. 0055.1 at p. 3 and 4) NEEA and NPCC stated, however, that there are no data available to support the contention that the complexity of electronics systems used in the controls of higher efficiency equipment leads to higher maintenance costs. (NEEA and NPCC, No. 0059.1 at p. 10)

In the NOPR analysis, DOE considered these comments and examined whether each design option would have higher maintenance and repair costs associated with it. As stated earlier, DOE agreed with comments made by Master-Bilt and American Panel on repair costs and found that certain design options that entail substitution of either evaporator and condenser fan motors or higher efficiency compressors would likely incur higher maintenance and repair costs because of the higher cost of these components. The NOPR analysis accounts for these observations. In summary, DOE believes that repair costs will increase with efficiency level whereas all non-lighting maintenance costs will not increase with efficiency level.

7. Product Lifetime

In the preliminary analysis, DOE estimated an average product lifetime of 15 years for envelopes and 7 years for refrigeration systems. The NOPR analysis alters this approach by estimating lifetimes for the individual components analyzed, instead of the entire envelope. DOE estimated an average lifetime of 15 years for panels and

14 years for display and non-display doors. DOE also revised the average refrigeration system lifetime to 12 years. Weibull distributions were derived around average lifetime estimates to obtain specific failure rates at each year of equipment life. See chapter 8 of the NOPR TSD for further details on the method and sources DOE used to develop product lifetimes.

8. Discount Rates

In calculating LCC, DOE applies discount rates to estimate the present value of future operating costs. DOE did not have sufficient information in preparing its preliminary analysis to derive discount rates for walk-ins. Instead, DOE used discount rates from the 2009 commercial refrigeration equipment final rule as a surrogate to approximate the rates that would apply to walk-ins. 72 FR at 1123 (January 9, 2009). For the NOPR, DOE derived the discount rates for the walk-in cooler and freezer equipment analysis by estimating the cost of capital for a large number of companies similar to those that could purchase walk-in cooler and freezer 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. Average discount rates (real) in these updated analyses by service building type are as follows:

- Grocery: 3.7 percent

- Food service: 3.9 percent
- Convenience Store: 5.0 percent
- Restaurant: 6.2 percent
- Other Food Service: 3.8 percent

DOE estimated the cost of equity financing by using the Capital Asset Pricing Model (CAPM).[19] 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.

See chapter 8 of the TSD for further details on the development of commercial discount rates.

9. Compliance Date of Standards

EPCA prescribes that DOE establish performance-based standards for walk-ins by 2012. (42 U.S.C. 6313(f)(4)(A)) The standards apply to equipment manufactured beginning on the date 3 years after the final rule is published unless DOE determines, by rule, that a 3-year period is inadequate, in which case DOE may

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

extend the compliance date for that standard by an additional 2 years. (42 U.S.C. 6314(f)(4)(B)) In the absence of any information indicating that 3 years is inadequate, DOE proposes a compliance date for the standards of 2017. Therefore, DOE calculated the LCC and PBP for walk-in coolers and freezers under the assumption that compliant equipment would be purchased in the year when compliance with the new standard is required–2017. DOE seeks comments and information on the adequacy of the 3-year compliance date.

10. Base-Case and Standards-Case Efficiency Distributions

To accurately estimate the share of consumers who would likely be impacted by a standard at a particular efficiency level, DOE's LCC analysis considers the projected distribution of product efficiencies that consumers purchase under the base case (i.e., the case without new energy efficiency standards). DOE refers to this distribution of product efficiencies as a base-case efficiency distribution. DOE examined the range of standard and optional equipment features offered by manufacturers. For refrigeration systems, DOE estimated that 75 percent of the equipment sold under the base case would be at DOE's assumed baseline level—that is, the equipment would comply with the existing standards in EPCA, but have no additional features that improve efficiency. The remaining 25 percent of equipment would have features that would increase its efficiency. While manufacturers could have many options, DOE assumed that the average efficiency level of this equipment would correspond to the efficiency level achieved by the baseline equipment with the first design option in the sequence of design options in the engineering analysis ordered by their relative cost-effectiveness. DOE estimated that for panels and non-display doors, 100 percent of the equipment sold under the base case would consist of equipment at DOE's assumed baseline level—that is, minimally compliant with EPCA. For cooler display doors, DOE assumed that 25 percent of the current shipments are minimally compliant with EISA and the remaining 75 percent are higher-efficiency (45 percent are assumed to have LED lighting, corresponding to the first efficiency level above the baseline in the engineering analysis, and 30 percent are assumed to have LED lighting plus anti-sweat heater wire controls, corresponding to the second efficiency level above the baseline). For freezer display doors, DOE assumed that 80 percent of the shipments would be minimally compliant with EPCA and the remaining 20 percent have LED lighting, corresponding to the first efficiency level above the baseline. (See Section IV.C and chapter 5 of the TSD for a discussion of the efficiency levels and design options in the engineering analysis). The current analysis assumes that all consumers purchase only the minimally compliant equipment from 2017 on, when the walk-in cooler and freezer standard is in effect. DOE requests comment on the distribution of product efficiencies in the absence of standards, particularly with respect to the magnitude of market penetration of any specific higher-efficiency technologies. For further information on DOE's estimate of base-case efficiency distributions, see chapter 8 of the TSD.

11. Inputs to Payback Period Analysis

The payback period is the number of years that it takes the consumer to recover the additional installed cost of more efficient products, compared to baseline products, through energy cost savings. The simple payback period does not account for changes in operating expense over time or the time value of money. Payback periods that exceed the life of the product mean that the increased total installed cost is not recovered in reduced operating expenses (based on the first year's estimated operating cost).

The inputs to the PBP calculation are the total installed costs to the consumer 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 discount rates are not used.

Interested parties raised several concerns regarding the LCC and PBP analyses. American Panel commented that the LCC and PBP presented in the preliminary analysis may be inaccurate because the refrigeration systems were not properly matched to the walk-in envelope, and the refrigeration system would be oversized for food safety and have a shorter run time. American Panel recommended that DOE select the refrigeration system capacity based on the heat load of the envelope size to achieve realistic LCC and PBP results. (American Panel, No. 0048.1 at p. 8) To account for this possibility, the current analysis now assumes that the refrigeration system is oversized by 20 percent over the aggregate refrigeration load of the walk-in unit.

American Panel submitted several comments relating to PBP issues for specific market segments. During the public meeting, American Panel commented that small business owners, such as non-chain restaurants or independent food service operators, generally attempt to avoid higher first costs due to the uncertainty of business success, while food service franchisees can afford to consider a longer term view of future savings. (American Panel, Public Meeting Transcript, No. 0045 at p. 252) American Panel cited data from the National Restaurant Association indicating that approximately 70 percent of all restaurants and 90 percent of small restaurants that open in the same building as a previously failed business fail in the first year due to insufficient up-front capital. American Panel predicted from these data that increased equipment costs resulting from new energy standards would have a serious negative impact on the small business restaurant owner, especially during the first year of restaurant operation, and that these entities would be able to sustain equipment efficiency improvements with a payback period of only 1 year or less. (American Panel, No. 0048.1 at p. 10) Owners and operators of franchised restaurant chains could afford to consider a longer payback period (e.g., 2 years or more). (American Panel, Public Meeting Transcript, No. 0045 at p. 254)

DOE will continue to use the standard LCC and PBP methods to convey the economic impacts of energy efficiency standards on walk-ins. DOE recognizes the particular PBP considerations of various market segments, however, including small businesses and independent restaurants. In preparing this NOPR, DOE examined the "business lifetime" (also referred to as the "economic lifetime"), which is an issue prevalent in the restaurant market sector. According to submitted comments, the economic lifetime of WICF equipment used in certain businesses may significantly differ from the operational lifetime. This issue could potentially impact the LCC and NIA analyses and is further discussed in section IV.G.1.b of this document. The walk-in lifetime details are also discussed in chapter 8 of the TSD.

12. Rebuttable-Presumption Payback Period

As noted above, EPCA, as amended, 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 that complies with an energy conservation standard level will be less than three times the value of the consumer's first-year energy (and, as applicable, water) savings derived as a result of the standard, as calculated under the test procedure in place for that standard. (42 U.S.C. 6295(o)(2)(B)(iii)) For each considered efficiency level, DOE determined the value of the first year's energy savings by calculating the quantity of those savings in accordance with the applicable DOE test procedure, and multiplying that amount by the average energy price forecast for the year in which compliance with the new standard would be required.

American Panel commented that the 3-year PBP established in EPCA should be decreased to 1 or 1.5 years at the most. (American Panel, No. 0048.1 at p. 11) DOE acknowledges the economic impacts on small businesses resulting from implementing energy efficiency standards but has maintained the 3-year PBP guideline as an initial step for determining economic justification, consistent with 42 U.S.C. 6295(o). However, DOE routinely conducts a full economic analysis that considers the full range of impacts to the consumer, manufacturer, nation, and environment and will consider other applicable criteria in determining whether a proposed standard is economically justified, including impacts on small businesses. For the results of DOE's detailed analysis of economic impacts on commercial customers and manufacturers, see sections V.B.1 and V.B.2.

For the NOPR analysis, DOE calculated a rebuttable presumption payback period at each TSL for WICF equipment. Rather than using distributions for input values, DOE used discrete values and, as required by EPCA, based the calculation on the assumptions in the DOE WICF test procedure. As a result, DOE calculated a single rebuttable presumption payback value, rather than a distribution of payback periods. Table IV-14 and Table IV-15 show the rebuttable presumption payback periods at TSL 4 for refrigeration systems and envelope components, respectively.

Table IV-14 WICF Refrigeration Systems Rebuttable Payback Period at TSL 4

Equipment Class	Compressor Type Analyzed	Rebuttable Payback Period
DC.M.I, < 9,000	SEM	4.7
DC.M.I, ≥ 9,000	SCR	1.8
DC.M.O, < 9,000	SEM	3.9
DC.M.O, ≥ 9,000	SCR	3.1
DC.L.I, < 9,000	SCR	2.1
DC.L.I, ≥ 9,000	SCR	2.3
DC.L.O, < 9,000	SCR	1.7
DC.L.O, ≥ 9,000	SCR	3.1
MC.M	-	0.8
MC.L	-	0.7

Table IV-15 WICF Envelope Components Rebuttable Payback Period at TSL 4

Equipment Class	Equipment Size	Rebuttable Payback Period

SP.M	Small	5.3
	Medium	5.2
	Large	5.1
SP.L	Small	3.1
	Medium	3.8
	Large	4.1
FP.L	Small	3.8
	Medium	4.6
	Large	5.1
DD.M	Small	2.5
	Medium	2.2
	Large	1.9
DD.L	Small	N/A
	Medium	N/A
	Large	0.4
PD.M	Small	6.2
	Medium	6.1
	Large	6.0
PD.L	Small	4.7
	Medium	4.7
	Large	4.6
FD.M	Small	6.0
	Medium	6.0
	Large	5.9
FD.L	Small	3.5
	Medium	2.4
	Large	2.4

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

G. National Impact Analysis – National Energy Savings and Net Present Value

The NIA assesses the national energy savings (NES) and the net present value (NPV) of total consumer costs and savings that would be expected to result from the new energy conservation standards. ("Consumer" in this context refers to customers of the product being regulated.) The NES and NPV are analyzed at specific efficiency levels separately for the refrigeration systems and components of the envelope (panels, non-display doors, and display doors). 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 energy use and LCC analyses. For the NOPR analysis, DOE forecasted the energy savings, operating cost savings, product costs, and NPV of consumer benefits for products sold from 2017 through 2073 -- the year in which the last standards -- compliant equipment shipped during the 30-year analysis period beginning in 2017 operates.

DOE evaluates the impacts of the new standards by comparing base-case projections with standards-case projections. The base-case projections characterize energy use and consumer costs for each equipment class in the absence of any new energy conservation standards. DOE compares these projections with projections characterizing the market for each equipment class if DOE adopted the new standard at specific energy efficiency levels (that is, the TSLs or standards cases) for that equipment class. For the base case forecast, DOE considered a mix of two levels of efficiency for the refrigeration systems and a single efficiency level for the components, except for cooler display doors as noted in Table IV-16. For the standards cases, DOE considered a “roll-up” scenario in which DOE assumes that product efficiencies that do not meet the standard level under consideration would roll-up to meet the new 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 consumer costs and savings from each TSL. The NOPR TSD and other documentation that DOE provides during the rulemaking helps explain the models and how to use them and also allow interested parties to review DOE’s analyses. 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 higher and lower energy price trends compared to the Reference case, as well as higher and lower commercial building starts, which result in higher and lower walk-in shipments to new commercial buildings. NIA results based on these cases are presented in appendix 10E of the NOPR TSD.

Table IV-16 summarizes the inputs and key assumptions DOE used for both the preliminary analysis and NOPR with respect to the NIA analysis. Discussion of these inputs and changes follows the table. See chapter 10 of the NOPR TSD for further details.

Table IV-16 Summary of Inputs and Key Assumptions for the National Impact Analysis

Inputs	Preliminary Analysis	Changes for the NOPR Analysis
Shipments	Annual shipments from the shipments model for complete walk-in units.	Annual shipments from the shipments model calculated separately for refrigeration systems and components.
Compliance Date of Standard	2015	2017
Base-Case Forecasted Efficiencies	No efficiency distributions assumed for the base case and the current baseline level was assumed to represent the market for the forecasted shipments of complete walk-in systems.	Refrigeration systems: For EISA* shipments, 75 percent of shipments are assumed to be at the baseline and 25 percent of shipments are assumed to be equivalent to the first efficiency level in the engineering analysis. Panels and non-display doors: For EISA shipments, 100 percent of shipments are assumed to be at the baseline. Display doors: For EISA shipments, 25 percent of cooler display doors are assumed to be at the baseline and 75 percent are higher-efficiency (45 percent with LED lighting and 30 percent with LED lighting and lighting controls); and 80 percent of freezer doors are assumed to be at the baseline and 20 percent are higher-efficiency (with LED lighting).
Standards-Case Forecasted Efficiencies	No efficiency distributions assumed for the standards case. A single efficiency level was assumed to represent the market for the forecasted shipments of complete walk-in systems.	No efficiency distributions assumed for standards compliant shipments. Shipped efficiencies for the forecasted shipments of refrigeration systems and components are represented by a roll up to the minimum standard level being analyzed.
Annual Energy Consumption per Unit	DOE calculated the average annual energy use for each WICF envelope class matched with outdoor condenser systems using a load profile described in AHRI 1250-2009 (8 hours of high load and 16 hours of low load per day).	DOE changed the daily load profile of the refrigeration system to 13.3 hours runtime per day for coolers and 15 hours for freezers, at full rated capacity corresponding to the reference rating outside air temperatures.
Total Installed Cost per Unit	Manufacturer's selling price is estimated from Engineering Analysis. Installation costs are based on RS Means Mechanical Cost Data 2009. Assumed no change with efficiency level.	Updated to RS Means Mechanical Cost Data 2012.
Annual Energy Cost per Unit	Annual Energy consumption per unit was multiplied by the Annual energy cost. Costs were discounted and summed over the analysis period for the net present value calculations.	No change.

Repair and Maintenance Cost per Unit	Annualized repair and maintenance costs of the combined system were derived from RS Means 2009 walk-in cooler and freezer maintenance data. Doors and refrigeration systems could be replaced during the lifetime of the envelope.	Updated to RS Means 2012 walk-in cooler and freezer repair and maintenance data; repair and maintenance costs for the refrigeration system and the envelope components were estimated separately.
Energy Prices	Forecasted using AEO2009 price forecasts.	Updated to AEO2013 forecasts.
Energy Site-to-Source Conversion Factor	Varies yearly and is generated by NEMS-BT (2009); applied from 2014 through 2045.	Updated to modified NEMS-BT** (2012), and applied from 2017 through 2073.
Discount Rate	3% and 7% real.	No change.
Present Year	Future expenses discounted to 2010.	Future expenses discounted to 2013

*EISA 2007 amended EPCA to establish prescriptive standards for walk-in coolers and freezers manufactured on or after January 1, 2009. EISA shipments refer to the shipments complying with these prescriptive standards. This is in contrast to pre-EISA shipments, which would refer to shipments before 2009 when there was no Federal energy efficiency standard in place.
**Site-to-source factors modified by Lawrence Berkley National Laboratories.

American Panel noted that the NIA results in the preliminary analysis were not meaningful because the refrigeration system capacities were not properly matched to the walk-in envelope. As stated earlier in the LCC and PBP sections, American Panel contended that DOE should select the refrigeration system capacity based on the envelope heat load to make the economic analyses realistic. (American Panel, No. 0048.1 at p. 11) In the NOPR, DOE conducted the NIA analysis for the refrigeration systems and the selected envelope components independent of each other and then combined the results to arrive at the trial standard levels. This approach did not directly pair the walk-in units with the matched capacity refrigeration system because minor inconsistencies in the matching of individual units could have large effects on the overall NIA results, as noted by American Panel. Rather, the NOPR analysis involved combining the results in the aggregate to arrive at a more accurate estimate of overall energy savings across the range of covered equipment.

1. Shipments

Forecasts of product shipments are used to calculate the national impacts of standards on energy use, NPV, and future manufacturer cash flows. DOE developed shipment forecasts for refrigeration systems and envelope components based on an analysis of growth trends of specific building types housing the walk-in units. In DOE's shipments model, shipments of walk-in units and their components are driven by new purchases and stock replacements due to failures. The envelope component model and refrigeration system shipments model take an accounting approach, tracking market shares of each equipment class and the vintage of units in the existing stock. Stock accounting uses product shipments as inputs to estimate the age distribution of in-service product stocks for all years. The age distribution of in-service product stocks is a key input to calculations of both the NES and NPV because operating costs for any year depend on the age distribution of the stock. DOE also considers the impacts on shipments from changes in product purchase price and operating cost associated with higher energy efficiency levels.

American Panel, NEEA and NPCC suggested that DOE contact the National Association of Food Equipment Manufacturers (NAFEM) and major refrigeration system manufacturers such as Heatcraft and Russell to obtain shipment information. (American Panel, Public Meeting Transcript, No. 0045 at pp. 274–275; NEEA and NPCC, Public Meeting Transcript, No. 0045 at p. 281) DOE contacted NAFEM, which provided DOE with copies of that organization's "Size and Shape of the Industry" reports. These reports contain data on the annual sales of walk-in units in the food service sector for 2002–2010. DOE analyzed the data received from NAFEM and also obtained other data from manufacturer interviews and other sources. DOE used these data to develop equipment class size share distributions, and are documented in the current shipment models.

a. Share of Shipments and Stock Across Equipment Classes

In response to the shipments analysis results in the preliminary analysis, DOE received several comments regarding the share of shipments and stock across equipment classes, dedicated condensing and multiplex systems, indoor and outdoor systems, cooler and freezer envelopes, and envelope sizes.

In the preliminary analysis, DOE estimated that 46 percent of the existing stock of walk-in systems is served by multiplex systems. American Panel commented that the ratio between multiplex to dedicated condensing refrigeration systems was too high and stated that, historically, 68 percent of their sales are for dedicated condensing refrigeration systems. American Panel suggested that DOE's estimate of the share of stocks of dedicated condensing refrigeration systems should be 70 percent. (American Panel, Public Meeting Transcript, No. 0045 at pp. 192 and 275; American Panel, No. 0048.1 at p. 4) Heatcraft supported this observation by stating that multiplex medium temperature refrigeration system stock share should be only 15 percent. (Heatcraft, Public Meeting Transcript, No. 0045 at p. 269)

DOE considered these comments and re-examined its analyses in developing its revised analysis for the NOPR. As part of this revised analysis, DOE developed a shipment model that provided the key inputs required by the shipment models for the envelope components and refrigeration systems. Based on this shipment analysis, DOE estimated that dedicated condensing units account for approximately 70 percent of the refrigeration market and the remaining 30 percent consists of unit coolers connected to multiplex condensing systems. DOE estimated that medium temperature unit coolers connected to multiplex systems account for about 25 percent of the shipments and stock. Regarding American Panel's comment on the relative shares of stock between the multiplex and the dedicated condensing refrigeration systems shown in the preliminary TSD (Table 3.2.8), DOE noted that Table 3.2.8 addressed shipments and not refrigeration system stock data. (American Panel, Public Meeting Transcript, No. 0045 at p. 269)

DOE received two comments regarding the stock share for outdoor and indoor dedicated condensing refrigeration systems. Heatcraft stated that a 30 percent share for outdoor dedicated condensing refrigeration systems was a reasonable assumption for DOE's economic analyses. (Heatcraft, Public Meeting Transcript, No. 0045 at p. 268) Manitowoc stated that the share of indoor dedicated condensing refrigeration systems should be higher than predicted, approximately 10 percent. (Manitowoc, Public Meeting Transcript, No. 0045 at p. 274) DOE considered these comments in light of other available data and estimated for the NOPR analysis that approximately 66 percent and 3 percent of the shipments and stocks of the refrigeration systems are accounted for by the outdoor and indoor dedicated condensing refrigeration systems, respectively.

Regarding the relative shares of stock or shipment between walk-in coolers and freezers, American Panel commented that DOE's estimates of 70 percent and 30 percent shares for cooler and freezer envelopes, respectively, were reasonable. (American Panel, Public Meeting Transcript, No. 0045 at p. 275) DOE has slightly adjusted these estimates in the NOPR shipment model to 71 percent (coolers) and 29 percent (freezers) based on updated calculations and data.

NEEA and NPCC stated that DOE correctly apportioned walk-ins by business type in the preliminary analysis, but noted that significant market shifts are taking place in the grocery and convenience store sectors. (NEEA and NPCC, No. 0059.1 at p. 11) NEEA and NPCC did not elaborate on the significance or nature of the market shifts. American Panel stated that DOE's estimate of twice as many large walk-in coolers as small walk-in coolers seemed inaccurate, and stated it would provide data. (American Panel, Public Meeting Transcript, No. 0045 at p. 293) American Panel then submitted a written comment with its own historical shipment data showing that walk-in cooler and freezer shipments for small, medium, and large units are 40 percent, 56 percent, and 4 percent, respectively, which differs significantly from DOE's estimates of 14 percent, 58 percent, and 28 percent for small, medium, and large units, respectively, in the preliminary analysis. (American Panel, No. 0048.1 at p. 11) In the NOPR analysis, DOE adjusted its estimates based in part on American

Panel's feedback. For the NOPR, DOE estimated that size distributions of stocks and shipments of walk-in units are 52 percent, 40 percent, and 8 percent for small, medium, and large, respectively.

b. Lifetimes and Replacement Rates

As discussed in the previous section on LCC and PBP analyses, the preliminary analysis assumed an envelope lifetime of approximately 15 years. American Panel agreed with DOE's 15-year lifetime estimate for the envelopes. (American Panel, Public Meeting Transcript, No. 0045 at p. 283) Kysor mentioned that the envelope lifetime could vary depending on the traffic within it. For example, an 8- to 10-year envelope lifetime can be expected if pallet jack or forklifts are used in the walk-in, while a longer envelope lifetime is likely if activity is limited to foot traffic or lighter hand trucks. (Kysor, Public Meeting Transcript, No. 0045 at p. 287) Master-Bilt suggested that most envelopes have a 20-year lifetime. (Master-Bilt, No. 0046.1 at p. 1) American Panel concurred with the 5 percent replacement rate for walk-in cooler and freezer envelopes, which corresponds to a 20-year lifetime. (American Panel, No. 0048.1 at p. 11) AHRI commented that based on its own experience, it believes envelope wall and floor panels tend to have a longer lifetime—12 to 25 years would be typical—but provided no data in support of this view. (AHRI, No. 0055.1 at p. 4) Hill Phoenix noted that failure of envelope components is usually evident by visual inspection, and panels would not usually fail from condensation or ice formation in the insulation. (Hill Phoenix, No. 0066.1 at p. 3) Given that most of these comments provided only anecdotal evidence and not supporting data, DOE continues to assume a 15-year average lifetime for panels in the current analysis.

DOE assumed the typical lifetime of envelope doors to be 5 years in the preliminary analysis. American Panel commented that the door replacement rate of 5 years is not supported by its in-house data, which show a door replacement rate of 5 percent, with the door lasting throughout the walk-in cooler and freezer envelope lifetime. (American Panel, No. 0048.1 at p. 9) In addition, American Panel stated that the number of replacement non-display doors represented 5 percent of their annual door shipments, which is inconsistent with the assumption that doors only last 5 years. (American Panel, Public Meeting Transcript, No. 0045 at p. 14 and p. 284) In light of these comments on the door replacement rates, DOE has revised its assumptions of door lifetimes to more closely match envelope lifetimes. The NOPR shipment model assumes an average lifetime of approximately 14 years for both display and non-display doors.

For refrigeration systems, DOE assumed an average lifetime of 7 years in the preliminary analysis. Master-Bilt stated that refrigeration system lifetimes were comparable to the envelope lifetime of approximately 20 years—it estimated that refrigeration system lifetimes would be about 80–100 percent of envelope lifetimes. (Master-Bilt, Public Meeting Transcript, No. 0045 at p. 287) Master-Bilt also stated that a 15 percent replacement rate for the refrigeration systems, which corresponds to a lifetime of 7 years, is too high, and actual replacement rates should be only half as much. (Master-Bilt, No. 0046.1 at p. 1) AHRI stated that a typical mechanical equipment lifetime is between 8 and 12 years. (AHRI, No. 0055.1 at p. 4) Master-Bilt also mentioned that the economy has reduced the frequency at which walk-in coolers and freezers are completely replaced with new equipment because of the high cost. Instead, existing equipment is often being refurbished with users typically replacing only one or a few individual components. (Master-Bilt, No. 0046.1 at p. 1) Master-Bilt also stated that doors are the most commonly repaired or replaced envelope component, while the most common replacement part for a refrigeration system is the compressor. It noted that only 5 percent of refrigeration systems require replacement compressors over a 10-year span. (Master-Bilt, Public Meeting Transcript, No. 0045 at p. 287) American Panel agreed that the entire refrigeration system is not typically replaced and only a compressor or fan motor is replaced when the system fails. Consequently, American Panel disagreed with the 15 percent average replacement rate used in the preliminary analysis for the refrigeration systems and suggested DOE use a refrigeration system replacement rate of 10 percent. (American Panel, No. 0048.1 at p. 11) In view of the comments received from interested parties, DOE revised its assumption of the average lifetime of the refrigeration system to 12 years, corresponding to a replacement rate of about 8 percent.

In the preliminary analysis, DOE assumed a higher replacement rate for refrigeration systems than for envelopes. American Panel commented that DOE's estimated shipment ratio of 3 to 1 between refrigeration systems and envelopes was too high and that a more appropriate shipment ratio between refrigeration systems and envelopes would be about 1.3 to 1. (American Panel, Public Meeting Transcript, No. 0045 at p. 192 and No. 0048.1 at p. 4) As explained, in the NOPR shipment model, the refrigeration system lifetime has been revised downward from 15 to 12 years. (DOE has retained the 15-year lifetime for envelopes.) In the revised shipment model, refrigeration system replacements account for about 30–41 percent of all refrigeration system shipments. While this estimate exceeds the suggested shipment ratio of 1.3, DOE believes that the average lifetimes of walk-in envelopes and refrigeration systems, which are based on manufacturer interviews and stakeholder comments, are reasonable.

NEEA and NPCC stated that economic lifetimes are different from physical lifetimes and suggested that DOE use both economic and physical lifetimes depending on the building type in which the walk-in cooler and freezer resides. (NEEA and NPCC, No. 0059.1 at p. 11) The physical lifetime refers to the duration before the equipment fails or is replaced, whereas the economic lifetime refers to the duration before the walk-in cooler and freezer equipment is taken out of service because the owner is no longer in business. In the event of an economic lifetime failure, however, a WICF would likely not leave the national stock, but would instead be sold to a third party, which would represent a transfer of goods and would not impact WICF shipments or stock at a national level. For a more detailed discussion of economic lifetimes see life-cycle cost discussion in section IV.F.7.

c. Growth Rates

The preliminary analysis used a shipments growth rate of approximately 2 percent. Several interested parties commented on this assumption. American Panel agreed with DOE's assumption that walk-in growth will match growth seen in building stock square footage. (American Panel, No. 0048.1 at p. 11) Others stated that the preliminary analysis shipment growth rate was overestimated. AHRI, NEEA and NPCC predicted that the walk-in market would be flat and any growth would be less than 1 percent. (AHRI, No. 0055.1 at p. 4; NEEA and NPCC, Public Meeting Transcript, No. 0045 at p. 292) Master-Bilt, NEEA and NPCC stated that the shipment analysis should use a maximum growth rate of 1 percent. (Master-Bilt, No. 0046.1 at p.1; NEEA and NPCC, Public Meeting Transcript, No. 0045 at p. 292) One stakeholder stated that its business has grown annually at a simple rate of 10 percent, although it added that this may not be representative and may have been driven by gaining market share from other manufacturers. (American Panel, Public Meeting Transcript, No. 0045 at pp. 290–291) American Panel suggested that NAFEM may provide walk-in growth rates across industry. American Panel observed that shipments grow about 7 percent in normal financial times; however, they can decline 10 percent per year during a recession. In particular, the restaurant sector business has dropped by 60 percent while walk-in cooler and freezer business in the school sector has grown. (American Panel, No. 0048.1 at p. 11) Considering these stakeholder comments, DOE modeled its growth rate projections for the NOPR analysis using the commercial building floor space growth rates from the AEO 2013 NEMS-BT model.

d. Other Issues

DOE developed a core shipment model for estimating the annual shipments and stocks of complete WICFs that formed the basis for the shipment analysis of refrigeration systems and envelope components. DOE expressed annual shipments and stocks of refrigeration systems in terms of installed refrigeration capacity (Btu/h) which required DOE to estimate the required refrigeration capacity for the WICF units shipped. As part of the process, product loads were estimated for different envelope sizes and types.

In the preliminary analysis, product load estimates were central to the annual energy consumption projections and were presented in the same context. American Panel stated that while the product-specific heat and product pull-down temperature values used in the preliminary analysis were correct, it disagreed with the product-loading values assumed for various types of equipment. American Panel suggested that the product-loading estimates should be 2 pounds per cubic foot for small coolers and 1 pound per cubic foot for medium and large coolers (not 4 and 2 respectively, as DOE had assumed), and 1 pound per cubic foot for small, medium, and large freezers (not 1 for small freezers and 0.5 for medium and large freezers, as DOE had assumed). (American Panel, Public Meeting Transcript, No. 0045 at p. 209) Master-Bilt stated that it is difficult to have product load assumptions that are valid for all applications and DOE should explicitly state that the product load assumptions currently used are valid only for specific situations but may not necessarily be representative of all applications. (Master-Bilt, No. 0046.1 at p. 1)

DOE agrees with Master-Bilt's observation that it is difficult to make assumptions on product load that are valid for all sizes and all applications. DOE revisited the issue and concluded that the loading ratios indicated by American Panel could be representative of the food service segment of the market, which accounts for about 35 percent of the aggregate installed refrigeration capacity for the walk-ins. From the available product brochures and indicated product loads for different sizes of WICF equipment, DOE believes that the loading ratios used for the other market segments are closer to ratios used in the preliminary analysis. Consequently, DOE did not change the loading ratios for the NOPR analysis.

2. Forecasted Efficiency in the Base Case and Standards Cases

A key component of the NIA is the trend in energy efficiency forecasted for the base and standards cases. Using data collected from manufacturers and an analysis of market information, DOE developed a base-case energy efficiency distribution (which yields a shipment-weighted average efficiency) for each of the considered equipment classes for the first year of the forecast period. To project the efficiency trend over the entire forecast period, DOE considered the current market distribution and recent trends. For envelope components, all base case shipments are assumed to have only a single EPCA-compliant efficiency level except for display doors. For cooler display doors, shipments would be a mix of 25 percent EPCA-compliant equipment and 75 percent higher efficiency equipment. For freezer display doors, shipments would be a mix of 80 percent EPCA-compliant equipment and 20 percent higher efficiency equipment. For refrigeration systems, DOE assumed, based on manufacturer interviews, that in the absence of standards (the base case), shipments would be a mix of 75 percent EPCA-compliant equipment and 25 percent higher efficiency equipment. For both refrigeration systems and envelope components, DOE assumed no improvement of energy efficiency in the base case and held the base-case energy efficiency distribution constant throughout the forecast period. DOE requests comment on this assumption.

To estimate efficiency trends in the standards cases, DOE has used a “roll-up” scenario in its standards rulemakings. The roll-up scenario represents a standards case in which all product efficiencies in the base case that do not meet the standard would roll up to meet the new standard level. Consumers in the base case who purchase walk-in equipment above the standard level are not affected as they are assumed to continue to purchase the same equipment. The roll-up scenario characterizes consumers primarily driven by the first-cost of the analyzed products and characterizes the efficiency trends currently found in the market.

In summary, under the roll-up scenario DOE assumes: (1) product efficiencies in the base case that do not meet the standard level under consideration would “roll-up” to meet the new standard level and (2) product efficiencies above the standard level under consideration would not be affected.

3. National Energy Savings

For each year in the forecast period, DOE calculates the NES for each standard level by multiplying the stock of equipment affected by the energy conservation standards by the per-unit annual energy savings. DOE typically considers the impact of a rebound effect, introduced in the energy-use analysis, in its calculation of national energy savings 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 assumed a rebound factor of one, or no effect, because walk-ins must cool their contents at all times and it is not possible for consumers to operate them more frequently. For a further discussion of the rebound effect, see chapter 10 of the TSD. DOE seeks comment on the assumption that there is no rebound effect associated with these products.

To estimate the national energy savings expected from appliance standards, DOE uses a multiplicative factor to convert site energy consumption (at the home or commercial building) into primary or source energy consumption (the energy required to convert and deliver the site energy). These conversion factors account for the energy used at power plants to generate electricity and losses in transmission and distribution, as well as for natural gas losses from pipeline leakage and energy used for pumping. For electricity, the conversion factors vary over time due to projected changes in generation sources (that is, the power plant types projected to provide electricity to the country). The factors that DOE developed are marginal values, which represent the response of the system to an incremental decrease in consumption associated with appliance standards.

In the preliminary analysis, DOE used annual site-to-source conversion factors based on the version of NEMS that corresponds to AEO2009. For this NOPR, DOE updated its conversion factors based on the U.S. energy sector model NEMS-BT corresponding to AEO2013.

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.[20]

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

4. Net Present Value of Consumer Benefit

The inputs for determining the NPV of the total costs and benefits experienced by walk-in equipment consumers are: (1) total annual installed cost; (2) total annual savings in operating costs; and (3) a discount factor. DOE calculates net savings each year as the difference between the base case and each standards case in total savings in operating costs and total increases in installed costs. DOE calculates operating cost savings over the life of each product shipped during the forecast period.

DOE multiplies the net savings in future years by a discount factor to determine their present value. For the preliminary analysis, DOE estimated the NPV of appliance consumer benefits using both a 3 percent and a 7 percent real discount rate. 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. NEEA and NPCC urged DOE to focus on the 3-

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

percent discount rate as the primary basis for the analyses because the issues largely pertain to the aggregate costs and benefits accruing to society at large. (NEEA and NPCC, No. 0059.1 at p. 12) DOE uses these discount rates in accordance with guidance provided by the Office of Management and Budget (OMB) to Federal agencies on the development of regulatory analysis.[21] Therefore, for today's NOPR, DOE continued to estimate the NPV of appliance consumer benefits using both a 3 percent and a 7 percent real discount rate as directed by OMB.

5. Benefits from Effects of Standards on Energy Prices

The reduction in electricity consumption associated with new standards for walk-ins could reduce the electricity prices charged to consumers in all sectors of the economy and thereby reduce their electricity expenditures. In chapter 2 of the preliminary 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 consumers associated with new or amended standards for walk-ins.

For this rule, DOE used NEMS-BT to assess the impacts of the reduced need for new electric power plants and infrastructure projected to result from standards. In NEMS-BT, changes in power generation infrastructure affect utility revenue requirements, which in turn affect

[21] OMB Circular A-4 (Sept. 17, 2003), section E, "Identifying and Measuring Benefits and Costs." Available at: www.whitehouse.gov/omb/memoranda/m03-21.html.

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 entities involved in electricity supply, particularly power plant providers and fuel suppliers. Given the uncertainty about the extent to which the benefits for electricity users from reduced electricity prices would be a transfer from those involved in electricity supply to electricity users, DOE continues to investigate the extent to which electricity price changes projected to result from standards represent a net gain to society.

H. Consumer Subgroup Analysis

In analyzing the potential impact of new or amended standards on commercial consumers, DOE evaluates the impact on identifiable groups (i.e., subgroups) of consumers, such as different types of businesses that may be disproportionately affected by an energy conservation standard. DOE gathered data for all business types identified in the analysis: grocery stores; convenience stores (including specialty food stores); convenience stores without gasoline stations; and restaurants that purchase their own walk-in coolers or freezers.

Comments submitted by American Panel and Manitowoc recommended that DOE consider non-chain restaurants independently of chain restaurants. (American Panel, Public Meeting Transcript, No. 0045 at p. 252; Manitowoc, Public Meeting Transcript, No. 0045 at p. 254) Further comments by American Panel suggested that small restaurants are more vulnerable to potential economic consequences of an efficiency standard. (American Panel, No. 0048.1 at p. 10) DOE agrees with these comments and believes that its current models accurately represent chain restaurants because data used to characterize the restaurant business type is dominated by multi-establishment chain restaurants. Hence, small, non-chain restaurants are included in the subgroup analysis.

After reviewing the data and submitted comments (see TSD chapter 11 for more details), DOE identified small restaurant owners because this subgroup likely includes owners of high-cost walk-in coolers and freezers, has the highest capital costs of all subgroups, and potentially experiences the shortest equipment economic lifetimes. These conditions make it likely that this subgroup will have the lowest life-cycle cost savings of any major consumer group.

DOE estimated the impact on the identified consumer subgroup using the LCC spreadsheet model. The standard LCC and PBP analyses (described in section IV.F) include various types of businesses that own and use walk-in coolers and freezers. The LCC spreadsheet model allows for the identification of one or more subgroups of businesses, which can then be analyzed by sampling only each subgroup. The results of DOE’s LCC subgroup analysis are summarized in section V.B and described in detail in chapter 11 of the TSD.

I. Manufacturer Impact Analysis

1. Overview

DOE performed an MIA to estimate the financial impact of energy conservation standards on manufacturers of walk-in equipment and to calculate the impact of such standards on employment and manufacturing capacity. Manufacturers of panels, doors, and refrigeration, as well as manufacturers of completed walk-ins, were considered in the analysis.

The MIA has both quantitative and qualitative aspects. The quantitative portion of the MIA primarily relies on the Government Regulatory Impact Model (GRIM), an industry cash-flow model customized for 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 industry net present value (INPV). Different sets of assumptions (markup scenarios) will produce different results. The qualitative portion of the MIA addresses factors such as product characteristics and industry and market trends. Chapter 12 of the NOPR TSD describes the complete MIA.

DOE conducted the MIA for this rulemaking in three phases. In Phase 1 of the MIA, DOE prepared a profile of the walk-in cooler and freezer industry, which includes a top-down cost analysis of manufacturers that DOE 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 Securities and Exchange Commission (SEC) 10–K filings, Moody's company data reports, corporate annual reports, the U.S. Census Bureau's Economic Census, and Dun and Bradstreet reports.

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

In Phase 3 of the MIA, DOE conducted 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.I.4 for a description of the key issues manufacturers raised during the interviews.

Phase 3 also includes an evaluation of sub-groups of manufacturers that may be disproportionately impacted by 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. Thus, during Phase 3, DOE analyzed small manufacturers as a subgroup.

The Small Business Administration (SBA) defines a small business for North American Industry Classification System (NAICS) 333415 “Air-Conditioning and Warm Air Heating Equipment and Commercial and Industrial Refrigeration Equipment Manufacturing” as having 750 employees or fewer. During its research, DOE identified multiple companies that manufacture products covered by this rulemaking and qualify as a small business under the SBA definition. The small businesses were further sub-divided into small manufacturers of panels, doors, and refrigeration equipment to better understand the impacts of the rulemaking on those entities. The small business subgroup is discussed in sections V.B.2.d and VI.B of today’s notice and in Chapter 12 of the NOPR TSD.

2. Government Regulatory Impact Model Analysis

As discussed previously, DOE uses the GRIM to quantify the changes in cash flow that result in a higher or lower industry value from new standards. The GRIM analysis uses a discounted cash-flow methodology that incorporates manufacturer costs, markups, shipments, and industry financial information as inputs. The GRIM models changes in costs, distribution of shipments, investments, and manufacturer margins that could result from new energy conservation standards. The GRIM spreadsheet uses the inputs to arrive at a series of annual cash flows beginning in 2013 (the base year of the analysis) and continuing to 2046. DOE calculated INPVs by summing the stream of annual discounted cash flows during these periods. DOE applied discount rates derived from industry financials and then modified them according to feedback during manufacturer interviews. Discount rates ranging from 9.4 to 10.5 percent were used depending on the component being manufactured.

The GRIM calculates cash flows using standard accounting principles and compares changes in INPV between the base case and each TSL (the standards case). Essentially, the difference in INPV between the base case and a standards case represents the financial impact of the new standard on manufacturers. Additional details about the GRIM, the discount rate, and other financial parameters can be found in chapter 12 of the TSD.

DOE typically presents its estimates of industry impacts by grouping the major equipment classes served by the same manufacturers. For the WICF industry, DOE groups results by panels, doors, and refrigeration systems.

a. Government Regulatory Impact Model Key Inputs

i. Manufacturer Production Costs

Manufacturing a higher-efficiency product is typically more expensive than manufacturing a baseline product due to the use of more expensive components and larger quantities of raw materials. The changes in the manufacturer production cost (MPC) of the analyzed products can affect 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 TSD. In addition, DOE used information from its teardown analysis, described in section IV.C.3.a, to disaggregate the MPCs into material, labor, and overhead costs. To calculate the MPCs for products above the baseline, DOE added the incremental material, labor, and overhead costs from the engineering cost-efficiency curves to the baseline MPCs. These cost breakdowns and product mark-ups were validated with manufacturers during manufacturer interviews.

ii. Shipments Forecast

The GRIM estimates manufacturer revenues based on total unit shipment forecasts and the distribution of shipments by equipment class. For the base-case analysis, the GRIM uses the NIA base-case shipment forecasts from 2013, the base year for the MIA analysis, to 2046, the last year of the analysis period.

For the standards case shipment forecast, the GRIM uses the NIA standards case shipment forecasts. The NIA assumes zero elasticity in demand as explained in section 9.3.1 in chapter 9 of the TSD. Therefore, the total number of shipments per year in the standards case is equal to the total shipments per year in the base case. DOE assumes a new efficiency distribution in the standards case, however, based on the energy conservation standard. DOE assumed that product efficiencies in the base case that did not meet the standard under consideration would “roll up” to meet the new standard in the standard year.

iii. Product and Capital Conversion Costs

New energy conservation standards will cause manufacturers to incur conversion costs to bring product designs into compliance. DOE evaluated the level of conversion-related capital expenditures needed to comply with each efficiency level in each equipment class. For the purpose of 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, and marketing focused on making product designs comply with the new energy conservation standards. Capital conversion costs are investments in property, plant, and equipment to adapt or change existing production facilities so that new equipment designs can be fabricated and assembled.

To evaluate the level of capital conversion expenditures manufacturers would likely incur to comply with energy conservation standards, DOE used the 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 sections IV.C.2 and IV.C.3.

DOE assessed the product conversion costs at each level by integrating data from quantitative and qualitative sources. DOE considered feedback from multiple manufacturers at each efficiency level to determine conversion costs such as R&D

expenditures and certification costs. Manufacturer numbers 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 the standard. The investment figures used in the GRIM can be found in section V.B.2.a of today's notice. For additional information on the estimated product conversion and capital conversion costs, see chapter 12 of the TSD.

b. Government Regulatory Impact Model Scenarios

i. 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 non-production cost markups to the MPCs estimated in the engineering analysis for each equipment class and efficiency level. 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 new energy conservation standards: (1) a preservation of gross margin percentage and (2) a preservation of operating profit. These scenarios lead to different markups values which, when applied to the input 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. DOE assumed the non-production cost markup—which includes SG&A expenses, research and development expenses, interest, and profit—to be 1.32 for panels, 1.50 for solid doors, 1.62 for display doors, and 1.35 for refrigeration. These markups are consistent with the ones DOE assumed in the engineering analysis. Manufacturers have indicated that it is optimistic to assume that, as manufacturer production costs increase in response to an energy conservation standard, manufacturers would be able to maintain the same gross margin percentage markup. Therefore, DOE assumes that this scenario represents a high bound to industry profitability under an energy conservation standard.

In the preservation of operating profit scenario, manufacturer markups are set so that operating profit one year after the compliance date of the new energy conservation standards is the same as in the base case. Under this scenario, as the cost of production and the cost of sales rise, 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 maintain only its operating profit in absolute dollars after the standard. Operating margin in percentage terms is reduced between the base case and standards case.

3. Discussion of Comments

Interested parties commented on the assumptions and results of the preliminary analysis, particularly on the cumulative regulatory burden, inventory levels, and scope of the manufacturer impact analysis.

a. Cumulative Regulatory Burden

AHRI stated that DOE must take into account the impact of new regulations that California is working on as part of Title 20 that will establish new prescriptive design requirements for walk-in coolers and freezers in 2011. (AHRI, Public Meeting Transcript, No. 0045 at p. 5)

DOE reviewed California Code of Regulations Title 20, Section 1605, which establishes walk-in requirements for insulation levels, motor types, and use of automatic door-closers. The latest set of regulations, published in the 2010 Appliance Efficiency Regulations and effective 2011, includes design standards required for all walk-ins manufactured on or after January 1, 2009. These state regulations are identical to Federal regulations that are set forth in EPCA (see 42 U.S.C. 6313(f)), and that are already in place. As a practical matter, the Federal regulations mirror those that the State of California had previously prescribed. As a result there was no incremental cost differential between the Federal standards promulgated in 2007 and California standards. The energy conservation standards that DOE is considering in this standards rulemaking are more stringent than the already-prescribed levels.

AHRI also expressed concern over California regulations to limit greenhouse gas emissions, in particular the California Air Resources Board (CARB) provisions to reduce the use of high global warming potential refrigerants, such as hydrofluorocarbons (HFCs). (AHRI, Public Meeting Transcript, No. 0045 at p. 5)

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. 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. According to EPCA, walk-in coolers and freezers are enclosed storage spaces that can be walked into and have a total chilled storage area of less than 3,000 square feet. (42 U.S.C. 6311(20) (defining the term "walk-in cooler; walk-in freezer")) Due to this size limit, it is unlikely that a walk-in refrigeration system will contain over 50 pounds of refrigerant, making application of the CARB provisions unlikely.[22]

b. Inventory Levels

In the preliminary analysis, DOE determined from U.S. Census data that the end-of-year inventory for the air-conditioning and warm air heating equipment and commercial and industrial refrigeration equipment manufacturing industry (NAICS

[22] DOE estimates that walk-ins meeting the statutory definition would likely use between 5 and 40 pounds of refrigerant, below the threshold established under the California regulations.

code 333415) was approximately 10 percent of shipment value from 2002 to 2007 (U.S. Census Bureau Annual Survey of Manufacturers) and presented these data in Table 12.3.3 of chapter 12 in the preliminary TSD. American Panel expressed concerns that the inventory percentages shown in Table 12.3.3 of chapter 12 in the Preliminary TSD are inaccurate and noted that their end-of-year inventory value has been only 2.5 percent of annual shipment value on average. (American Panel, No. 0048.1 at p. 11) The U.S. Census percentages represent values for the air-conditioning and warm-air heating equipment and commercial and industrial refrigeration equipment manufacturing industry, which includes a wide range of products and companies. DOE agrees that the U.S. Census figures may not necessarily be representative of inventory levels for specific walk-in cooler and freezer manufacturers. The figure is used to characterize the industry and is not a component of any quantitative analysis. DOE has factored American Panel's inventory number into its qualitative understanding of the walk-in industry.

c. Manufacturer Subgroup Analysis

AHRI suggested that DOE should enlarge the scope of the manufacturer impact analysis to examine the impact of the rulemaking on all manufacturers of different equipment classes—including panel, door, and refrigeration system manufacturers. (AHRI, Public Meeting Transcript, No. 0045 at p. 4)

To better reflect the structure of the rulemaking, DOE has expanded its analysis of manufacturers to include the impact of the rulemaking on key component suppliers, including panel manufacturers, door manufacturers, and refrigeration system manufacturers. Additionally, small manufacturers of panels, doors, and refrigeration systems are considered as separate sub-groups in the MIA.

4. Manufacturer Interviews

As part of the MIA, DOE discussed potential impacts of standards with eight panel manufacturers, six door manufacturers, and three refrigeration systems manufacturers. In the interviews, DOE asked manufacturers to describe their major concerns about this rulemaking. The following sections discuss manufacturers' most significant concerns.

a. Cost of testing

All door, panel, and refrigeration manufacturers expressed concern regarding the cost of testing. The majority of walk-ins sold are not standard combinations of box sizes, refrigeration components, and doors. Almost every walk-in unit is tailored to meet consumer specifications. According to manufacturers, DOE-mandated testing of every configuration sold is not realistic and could become a financial burden that would negatively impact manufacturers' profitability.

The cost of compliance testing includes the engineering support necessary to design and run tests, the cost of the units tested, and the cost of third-party testing support. Some manufacturers indicated that it may be necessary to set up new test labs to deal with compliance requirements. Beyond DOE compliance testing, energy conservation standards may lead to product redesigns that require new certifications, such as Underwriters Laboratories (UL) fire safety, NSF 2 food service, and NSF 7 commercial refrigerator and freezer standards compliance.

Multiple door, panel, and refrigeration manufacturers expressed concern that these compliance and certification testing costs may lead to less customization in the industry. As an example, one door manufacturer was concerned that walk-in manufacturers would offer fewer door choices and partner with fewer door companies to reduce testing burden. As another example, a manufacturer that produces only unit coolers indicated that the need to certify the complete refrigeration system would force them to leave the WICF market. As the unit cooler supplier, the manufacturer does not have the ability to certify the entire system because they do not supply the condensing unit portion of the system. Today, the manufacturer's consumers pair the unit coolers with condensing units from other suppliers to assemble a walk-in refrigeration system. The manufacturer speculated that, in a regulated environment, their consumers would switch from buying refrigeration components from manufacturers of unit coolers to buying complete systems with matched unit coolers and condensing units from larger competitors that build complete systems rather than components. Their customers would make this change to avoid the test burden on refrigeration systems. Other manufacturers mentioned that the cost of testing could ultimately lead to conditions in which small panel manufacturers would be forced out of the market.

Finally, walk-in manufacturers were concerned about pricing and availability of third-party testing. Several walk-in manufacturers noted that it is unclear whether a sufficient number of qualified third parties exist to carry out the performance testing mandated by DOE for the entire industry. One manufacturer was concerned that an insufficient number of test facilities would lead to higher testing costs and delays in achieving compliance.

b. Enforcement and Compliance

All of the interviewed manufacturers expressed concern that an energy conservation standard rulemaking could result in unfair competition if the standard is not properly enforced. Interviewed manufacturers claimed that numerous manufacturers, particularly small one-to-two person operations, are not currently complying with the existing walk-in regulations in EPCA, which took effect January 1, 2009. The manufacturers explained that smaller operations often have an incentive to be non-compliant. By using materials that do not comply with existing regulations, the non-compliant manufacturers maintain a price advantage over compliant manufacturers.

Manufacturers emphasized the need to have well-defined compliance responsibilities. WICF units can be manufactured and delivered as per standard by the manufacturer, but the end user may decide to remove some of the efficiency features, such as strip curtains. Additionally, the quality of installation at the client site is often a factor that manufacturers cannot control because field assembly is managed by contractors. Manufacturers also noted that, for some installations, the contractors purchase the walk-in envelope and refrigeration equipment from separate suppliers, making it impossible for the equipment manufacturers to determine the efficiency of the installed product. Multiple manufacturers requested clarification to better understand which party bears responsibility for ensuring field-assembled walk-ins meet federal standards.

In this NOPR, DOE discusses issues surrounding compliance and enforcement. In particular, DOE proposes that each component manufacturer would be responsible for certifying to DOE that the components they manufacture comply with the standards. DOE believes that the component-based approach provides for effective certification and enforcement of any standards while ensuring that the walk-in industry has sufficient flexibility to meet the applicable standards. For more details on DOE's proposed approach, see section III.D.

c. Profitability Impacts

Walk-in manufacturers discussed how new energy conservation standards could affect profit levels. Manufacturers considered the walk-in industry to be a low margin-business. Price competition can be very aggressive, particularly for large orders and for name-brand client accounts. Manufacturers stated that low margins leave little room for the added costs that energy conservation standards could impose. Manufacturers noted that they will have to absorb the additional costs or pass the costs onto the consumer.

Specifically, manufacturers emphasized their concerns about the impact of thicker panels, thicker doors, and more efficient refrigeration on profitability. Thicker panels require more material and longer processing times. The end result could be a reduction in factory throughput coupled with increased cost. Additionally, manufacturers noted that thicker panels are heavier, which leads to higher shipping costs. Similar concerns exist for solid doors. To achieve higher refrigeration efficiencies, manufacturers would have to purchase larger coils, more efficient compressors, and more expensive control systems. All these components increase the cost of goods sold for the completed walk-in.

Manufacturers speculated that passing all these costs onto their customers would lead to lower-volume orders, as consumers with set budgets would not be able to purchase as many walk-ins (in the case of chain stores) or as much walk-in space (in the case of individual operations) for the same dollar amount. Alternatively, absorbing these costs would significantly reduce profit margins.

In the manufacturer impact analysis, DOE has examined the impacts of standards on manufacturers' profit margins. For the results of DOE's analysis, see section V.B.2.a.

d. Excessive Conversion Cost

According to panel manufacturers, a new energy conservation standard that requires increased levels of thickness could result in high conversion costs. Much of the existing production equipment is designed to produce panels 3.5–5 inches thick. Panels that are 6 or more inches thick are less common in the industry. Any standard that results in the market moving to 5-inch thick panels would require some conversion cost as factories that use foam-in-place technology must accommodate increased curing times. Manufacturers indicated that the conversion costs could range from $100,000 to $500,000, depending on the manufacturer’s existing equipment. Any standard that requires 6-inch thick panels would involve significant additional investment by most manufacturers. At this level of thickness, manufacturers estimate conversion costs would range from $200,000 to $1 million. Any standard that requires 7-inch thick panels would require all manufacturers to reevaluate their manufacturing process. Conversion costs would range from $1.5 million to $4 million. Based on manufacturer statements, any standard that moved the industry to 6-inch thick panels would likely put some of the top 10 panel manufacturers out of business.

DOE considers conversion costs in the manufacturer impact analysis. For details on DOE’s findings, see section V.B.2.a.

e. Disproportionate Impact on Small Businesses

Most interviewed manufacturers noted that new energy conservation standards could have a disproportionate impact on small businesses as compared to larger businesses. The cost of testing, the potential increase in materials, and the potential need to obtain financing are the factors that could affect small business manufacturers producing refrigeration systems, panels, and doors more severely.

Manufacturers voiced concerns regarding the cost of both compliance testing and certification testing (e.g., UL and NSF certifications) on small businesses. According to manufacturers, the price tag for testing is likely to be similar for both small and large companies due to the high level of product customization in the industry. For small businesses, the cost will spread across smaller sales volumes, making recuperation of the testing investment more difficult. Some manufacturers thought that compliance testing costs alone could force small manufacturers to exit the industry.

Additionally, small manufacturers indicated that they face a significant price disadvantage for foaming agents (used for insulation) and components due to their small purchasing quantities when compared to large manufacturers. Any standard that requires small manufacturers to use more foam or more expensive components will exacerbate the pricing gap. Given the price-sensitive nature and low margin of the industry, the small envelope manufacturers were concerned that requiring thicker panels provided a competitive advantage to large manufacturers that could obtain foaming agents at a lower price based on order quantities that are of larger magnitude.

Several interviewed manufacturers expressed concern that the current tightness in financial markets and reduced economic activity could negatively impact their ability to obtain the financing necessary to cover compliance costs, particularly for small business operations, which generally have greater difficulty obtaining financing.

DOE has examined the impact on small manufacturers in its manufacturer sub-group analysis and regulatory flexibility analysis. For the results of these analyses, see sections V.B.2.d and VI.B.

f. Refrigerant Phase-Out

Interviewed manufacturers noted the impacts of mandated changes in blowing agents and refrigerants. Currently, walk-in manufacturers use HFC-404 and HFC-134a refrigerants. While HFC-404 is used exclusively as a refrigerant, HFC-134a is used as both a refrigerant and a blowing agent in the walk-in manufacturing industry.

Several manufacturers expressed concern about the impact of a potential phase-down or phase-out of HFCs. The concern is acute because manufacturers stated that there is no clear alternative or substitute to HFCs for the industry. Without a clear replacement, manufacturers are concerned that any phase-out would create a period of uncertainty as the industry identifies suitable alternatives and then redesigns both products and processes around the replacement. In the manufacturers' experience, past phase-outs have led to more expensive and less efficient refrigerant replacements.

Panel manufacturers expressed concern that conversion to a new blowing agent would be costly as they would have to go through a transition period in which foam would need to be reformulated. Production processes and facilities would need to adapt to the new foam blend. Manufactures stated that previous , replacement blowing agents have been more expensive and have presented challenges to the production process because of different flow characteristics from the agents they replace. They also noted that blowing agent substitutes have led to foam blends with lower R-value, providing less insulation. Panel manufacturers were concerned that lower insulation effectiveness results in thicker panels needed to meet a standard, which leads to increased production cost and lower profit margins.

Refrigeration system manufacturers expressed that an HFC phase-out would be costly as it would require redesign of all products. Some manufacturers stated that an HFC phase-out would force them to use flammable refrigerants. Manufacturers noted that some alternative refrigerants may require substantially larger systems to achieve the same levels of performance.

As discussed in section IV.A.2.b, DOE has only considered HFC refrigerants in the analysis. DOE did not consider whether foam blowing agents would cost more, less or stay the same and DOE understands there is a range of non-HFC foam blowing used already in these applications.

J. Employment Impact Analysis

Employment impacts are one factor DOE considers in selecting an efficiency standard. Employment impacts include direct and indirect impacts. Direct employment impacts are any changes that affect employment of WICF manufacturers. Indirect impacts are those employment changes in the larger economy that occur because of the shift in expenditures and capital investment caused by the purchase and operation of more efficient walk-ins. The MIA results in section V.B.2.b of this notice and chapter 12 of the TSD address only the direct employment impacts on walk-in manufacturers. Chapter 13 of the TSD provides further information about other, primarily indirect, employment impacts discussed in this section.

Indirect employment impacts from WICF standards consist of the net jobs created or eliminated in the national economy, excluding the manufacturing sector being regulated, as a consequence of (1) reduced spending by end-users on electricity, which could potentially be offset by the increased spending on maintenance and repair of higher efficiency equipment); (2) reduced spending on new energy supply by the utility industry; (3) increased spending on the purchase price of new walk-in coolers and freezers; and (4) the effects of those three factors throughout the economy. DOE expects the net monetary savings from 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 a personal-computer based, economic analysis model that characterizes the interconnections among 188 sectors of the economy as national input/output structural matrices using data from the U.S. Department of Commerce's 1997 Benchmark U.S. input-output table. The ImSET model estimates changes in employment, industry output, and wage income in the overall U.S. economy resulting from changes in expenditures in various sectors of the economy. DOE estimated changes in expenditures using the NIA model. ImSET then estimated the net national indirect employment impacts efficiency standards would have on employment by sector.

The ImSET input/output model suggests that the proposed standards could increase the net demand for labor in the economy, and the gains would most likely be very small relative to total national employment. For more details on the employment impact analysis and its results, see chapter 13 of the TSD and section IV.J of this notice.

K. 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 14 of the TSD.

L. Emissions Analysis

In the emissions analysis, DOE estimates the reduction in power sector emissions of carbon dioxide (CO_2), nitrogen oxides (NO_x), sulfur dioxide (SO_2), and mercury (Hg) from potential energy conservation standards for walk-in coolers and freezers . 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)), 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 15 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, 2011.

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 and the District of Columbia (D.C.). SO_2 emissions from 28 eastern states and D.C. were also limited under the Clean Air Interstate Rule (CAIR; 70 FR 25162 (May 12, 2005)), which created an allowance-based trading program that operates along with the Title IV program. CAIR was remanded to the U.S. Environmental Protection Agency (EPA) by the U.S. Court of Appeals for the District of Columbia Circuit 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 August 21, 2012, the D.C. 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.

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 an 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.

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).[23] 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. AEO 2013 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 CSAPR, 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.

CSAPR established a cap on NO_x emissions in 28 eastern States and the District of Columbia. Energy conservation standards are expected to have

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[23] On July 20, 2012, EPA announced a partial stay, for a limited duration, of the effectiveness of national new source emission standards for hazardous air pollutants from coal- and oil-fired electric utility steam generating units.
http://www.epa.gov/airquality/powerplanttoxics/pdfs/20120727staynotice.pdf

little effect on NO_x emissions in those States covered by CSAPR 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 reduction using emissions factors based on AEO 2013, which incorporates the MATS.

M. Monetizing Carbon Dioxide and Other Emissions Impacts

As part of the development of this amended rule, DOE considered the estimated monetary benefits likely to result 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 similar to the calculation of the NPV of consumer benefit, DOE considered the reduced emissions expected to result over the lifetime of products 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 rulemaking.

For today's NOPR, DOE is relying on a set of values for the social cost of carbon (SCC) that was developed by an interagency process. A summary of the basis for these values is provided below, and a more detailed description of the methodologies used is provided as an appendix to chapter 16 of the 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[24] points out that any assessment will suffer from uncertainty, speculation, and lack of information about (1) future emissions of greenhouse gases, (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

[24] National Research Council. Hidden Costs of Energy: Unpriced Consequences of Energy Production and Use. National Academies Press: Washington, DC (2009).

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 carbon dioxide 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 carbon dioxide 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 carbon dioxide 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.[25] 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.[26] 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

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[25] 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.

[26] See, *Average Fuel Economy Standards, Passenger Cars and Light Trucks, Model Years 2011-2015,* 73 FR 24352 (May 2, 2008) (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: http://www.nhtsa.gov/fuel-economy)

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 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. Specifically, 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 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 estimated for 2010 grow in real terms over time, as depicted in Table IV-17. 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,[27] although preference is given to consideration of the global benefits of reducing CO_2 emissions. Table IV-17 presents the values in the 2010 interagency group report,[28] which is reproduced in appendix 16-A of the NOPR TSD.

Table IV-17 Annual SCC Values from 2010 Interagency Report, 2010–2050 (in 2007 dollars per metric ton)

	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.[29] Table IV-18 shows the updated

[27] 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.

[28] 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. http://www.whitehouse.gov/sites/default/files/omb/inforeg/for-agencies/Social-Cost-of-Carbon-for-RIA.pdf.

[29] 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.

sets of SCC estimates in five year increments from 2010 to 2050. The full set of annual SCC estimates between 2010 and 2050 is reported in appendix 16-A of the NOPR 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-18 Annual SCC Values from 2013 Interagency Update, 2010–2050 (in 2007 dollars per metric ton CO2)

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 National Research Council report mentioned above points out that there is tension between the

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http://www.whitehouse.gov/sites/default/files/omb/inforeg/social_cost_of_carbon_for_ria_2013_update.pdf 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.

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 cases specified, the values used for emissions in 2015 were $12.9, $40.8, $62.2, and $117 per metric ton avoided (values expressed in 2012$). 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 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 the CAIR. 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 $4809 per ton in 2012$).[30] In accordance with OMB guidance, [31] DOE calculated the 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 SO_2 and Hg emissions in energy conservation standards rulemakings. It has not included monetization in the current analysis.

V. Analytical Results

A. Trial Standard Levels

As discussed in section III.B, DOE is proposing to set separate performance standards for the refrigeration system and for the envelope's doors and panels. The

[30] 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.
[31] OMB, Circular A-4: Regulatory Analysis (Sept. 17, 2003).

manufacturers of these components would be required to comply with the applicable performance standards. For a fully assembled WICF unit in service, the aggregate energy consumption would depend on the individual efficiency levels of both the refrigeration system and the components of the envelope.

The refrigeration system removes heat from the interior of the envelope and accounts for most of the walk-in's energy consumption. However, the refrigeration system and envelope interact with each other and affect each other's energy performance. On the one hand, because the envelope components reduce the transmission of heat from the exterior to the interior of the walk-in, the energy savings benefit for any efficiency improvement for these envelope components depends on the efficiency level of the refrigeration system. Thus, any potential standard level for the refrigeration system would affect the energy that could be saved through standards for the envelope components. On the other hand, the economics of higher-efficiency refrigeration systems depend on the refrigeration load profile of the WICF unit as a whole, which is partially impacted by the envelope components.

To accurately characterize the total benefits and burdens for each of its proposed standard levels, DOE developed TSLs that each consist of a combination of standard levels for both the refrigeration system and the set of envelope components that comprise a walk-in. In other words, each TSL DOE proposes in this NOPR consists of a standard for refrigeration systems, a standard for panels, a standard for non-display doors, and a standard for display doors.

1. Trial Standard Level Selection Process

The paragraphs that follow describe how DOE selected the TSLs. First, DOE selected seven potential levels for refrigeration systems by performing LCC and NIA analyses for refrigeration systems. Second, DOE selected four levels for the envelope components by performing LCC and NIA analyses for the envelope components paired with each of the seven selected refrigeration system levels alone. Third, DOE chose six composite TSLs from the combinations of the seven potential levels for the refrigeration systems and the four potential levels for the envelope components. This process accounts for the fact that, as described above, the choice of refrigeration efficiency level affects the energy savings and NPV of the envelope component levels. These steps are described below.

In selecting potential levels for the refrigeration systems, DOE focused on certain capacity points in the range it considered in the engineering analysis. (For a list of all points considered in the engineering analysis, see section IV.C.1.b.) In selecting the refrigeration capacity points for further analysis, DOE chose capacities with the highest relative shares of shipments in each equipment class. The proposed standard levels for each equipment class were then based on the analyzed capacities in each capacity range. The cost-efficiency tradeoff for the design options is similar over the range of sizes analyzed in the engineering analysis.

Table V-1 Refrigeration Equipment Class Capacities

Equipment Class	Analyzed Capacities (kBtu/hr)
DC.M.I, < 9,000	6
DC.M.I, ≥ 9,000	18
DC.M.O, < 9,000	6
DC.M.O, ≥ 9,000	18,54
DC.L.I, < 9,000	6
DC.L.I, ≥ 9,000	9
DC.L.O, < 9,000	6
DC.L.O, ≥ 9,000	9,54
MC.M	9
MC.L	9

DOE enumerated seven potential levels for each of the refrigeration system classes. Each analyzed capacity point in any refrigeration system class has between 3 and 13 efficiency levels, each corresponding to an added applicable design option (described in section IV.C). DOE also analyzed three competing compressor technologies for each dedicated condensing refrigeration system class. These compressor technologies are: hermetic reciprocating, semi-hermetic, and scroll.

At a given efficiency level, the compressor with the best life-cycle cost result was selected to represent the equipment at that efficiency level. From the set of possible efficiency levels for a given class, DOE selected seven for further analysis. For analyzed equipment having less than seven engineering design options (e.g., in the multiplex refrigeration system classes), the same efficiency level appeared more than once in the suite of seven efficiency levels. Five of the seven refrigeration system levels were based on their relative energy saving potential. The other two were based on maximizing the national net present value ("Max NPV"), and on achieving the maximum energy savings that is possible using all of the compressor technologies ("All Compressors").

DOE decided to include an all-compressors criterion for the refrigeration systems in response to stakeholder comments that DOE did not consider all types of compressors in the preliminary analysis (these comments were discussed in sections IV.C.4.b and IV.C.5.b). In particular, interested parties noted that the choice of compressor could affect the potential energy savings, but that it was inappropriate to treat compressor choice as a design option because not all compressor types are available at all capacities for all types of equipment. In response to these comments, DOE developed performance curves in the engineering analysis for refrigeration systems with each compressor type independently—identifying the maximum efficiency level for systems with each compressor type. The highest refrigeration system efficiency level that could be obtained by any compressor type for a given capacity unit was identified. In its set of TSL options, DOE included a highest efficiency level for the refrigeration systems at which all compressor technologies can compete ("All Compressors"). See chapter 10 of the TSD for further details on DOE's process for selecting potential TSLs.

After the seven potential efficiency levels for each refrigeration system class were selected as described above, DOE proceeded with the LCC and NIA analysis of the envelope components (panels and doors). DOE conducted the LCC and NIA analyses on the envelope components by pairing them with each of the seven refrigeration system efficiency levels. Each panel and door class has between five and nine potential efficiency levels, each corresponding to an engineering design option applicable to that class (described in section IV.C). These LCC and NPV results represent the entire range of the economic benefits to the consumer at various combinations of efficiency levels of the refrigeration systems and the envelope components. The pairing of refrigeration system efficiency levels with the efficiency levels of envelope component classes is discussed in detail in chapter 10 of the TSD.

DOE selected envelope component levels for further analysis based on the following criteria: maximum NPV, maximum NES with positive NPV, and Max Tech. DOE also considered a fourth criterion: maximum NES with positive NPV for display doors only, and no new standard for panels and non-display doors. DOE considered this level because it observed that, due to the nature of the panel and non-display door industry, any standard could have a large effect on small panel and door manufacturers. This effect is described in detail in chapter 12 of the TSD, Manufacturer Impact Analysis.

Finally, DOE chose six composite TSLs by selecting from the combinations of the seven potential levels for the refrigeration systems and the four potential levels for the envelope components. The composite TSLs and criteria for each one are shown in Table V-2.

Table V-2 Criteria Description for the Composite TSLs

	Refrigeration System Criteria			
Component Criteria	**All Compressors**	**Max NPV**	**Max NES with NPV>0***	**Max Tech**
Display Doors Only		**2**: All display doors only at NPV> 0		
Maximum NPV	**1**: All compressors, max NPV	**4**: Maximum NPV for both refrigeration system and components		
Maximum NES with NPV>0	**3**: All compressors, NPV>0		**5**: Max NES with NPV>0 for both Refrigeration system and Components	
Max –Tech				**6**: Max-tech for both Refrigeration system and Components

* Not counted as a separate efficiency level for the refrigeration system, as it corresponds to the Max Tech level in the current analysis

In Table V-2, the column headings identify the criteria for the TSL option for the refrigeration system and the row headings identify the criteria for the TSL option for the envelope components. The intersection of the row and the column define the respective choices for the composite TSL. The composite TSLs are numbered from 1 to 6 in order of least to most energy savings.

DOE describes each TSL, from highest to lowest energy savings, as follows. TSL 6 is the max-tech level for each equipment class for all components. TSL 5 represents the maximum efficiency level of the refrigeration system equipment classes with a positive NPV at a 7-percent discount rate, combined with the maximum efficiency level with a positive NPV at a 7-percent discount rate for each envelope component (panel, non-display door, or display door). TSL 4 corresponds to the efficiency level with the maximum NPV for refrigeration system classes and the efficiency level with the maximum NPV for envelope component classes. TSL 3 is the highest efficiency level for refrigeration systems at which all compressor technologies can compete, combined with the maximum efficiency level with a positive NPV at a 7-percent discount rate for each envelope component. TSL 2 is the efficiency level with the maximum NPV at a 7-percent discount rate for refrigeration systems, combined with the efficiency level with a maximum NPV at a 7-percent discount rate for display doors only, and does not include a new energy standard for panels and non-display doors. DOE is considering TSL 2 because a standard for panels and non-display doors may be unduly burdensome to a large number of small business manufacturers (see sections V.B.2.d and VI.B for further discussion of the impact of the rule on small manufacturers). TSL 1 is the highest efficiency level for refrigeration systems at which all compressor technologies can compete, combined with the efficiency level with the maximum NPV at a 7-percent discount rate for each envelope component when the components are combined with the selected refrigeration efficiency level. For more details on the criteria for the proposed TSLs, see chapter 10 of the TSD.

2. Trial Standard Level Equations

For panels and doors, DOE expresses the TSLs in terms of a normalization metric. For panels, the normalization metric is the ratio of the edge area to the core area. The TSLs are expressed in terms of polynomial equations that establish maximum U-factor limits in the form of:

$$\text{U - factor} = \text{A} \times \left(\frac{\text{Edge Area}}{\text{Core Area}} \right)^2 + \text{B} \times \left(\frac{\text{Edge Area}}{\text{Core Area}} \right) + \text{C}$$

The form of the equation allows the efficiency requirements to be determined for panels of any dimension within an equipment class. Coefficients A, B, and C were uniquely derived for each equipment class by plotting the U-factor of each representative size in an equipment class versus the edge area to core area ratio of the representative size and modeling the relationship as a polynomial equation. The core and edge areas for both floor and structural panels are defined in the walk-in cooler and freezer test procedure final rule. 76 FR at 33632 (June 9, 2011).

For display and non-display doors, respectively, the normalization metric is the surface area of the door. The TSLs are expressed in terms of linear equations that establish maximum daily energy consumption (MEC) limits in the form of:

$$\text{MEC} = \text{D} \times (\text{Surface Area}) + \text{E}$$

Coefficients D and E were uniquely derived for each equipment class by plotting the energy consumption at a given performance level versus the surface area of the door and determining the slope of the relationship, D, and the offset, E, where the offset represents the theoretical energy consumption of a door with no surface area (the offset is necessary because not all energy-consuming components of the door scale directly with surface area). The surface area is defined in the walk-in cooler and freezer test procedure final rule. 76 FR at 33632.

For refrigeration systems, the proposed TSLs are expressed as a minimum efficiency level (AWEF) that the system must meet. For dedicated condensing systems, DOE calculated the AWEF differently for small and large classes based DOE's expectation that small sized equipment may have difficulty meeting the same efficiency standard as large equipment (see section IV.A.3.b for details). Specifically, DOE observed that higher-capacity equipment tended to be more efficient because of the availability of scroll compressors above a certain capacity. DOE expressed the AWEF for large capacity dedicated condensing systems as a single value corresponding to the AWEF of the lowest capacity system analyzed in the large capacity class. DOE expressed the AWEF for the small capacity dedicated condensing systems as a linear equation normalized to the system gross capacity, where the equation was based on the AWEFs for the smallest two capacities analyzed but adjusted such that the equation would be continuous with the standard level for the large capacity class at the boundary capacity point between the classes (i.e., 9,000 Btu/h). DOE calculated a single minimum efficiency for each class of multiplex condensing systems because DOE found that equipment capacity did not have a significant effect on the efficiency of the equipment. See appendix 10D of the TSD for further details on how the AWEF values were calculated. DOE requests comment on the AWEF equations and the methodology for determining them. In particular, DOE asks interested parties to submit data on how the efficiency of typical refrigeration systems varies by capacity. Based on comments and additional data DOE receives on the NOPR, DOE may consider other methods of calculating the minimum AWEF associated with the TSLs for each equipment class.

The following tables present the equations and AWEFs for all TSLs under consideration. Table V-3, Table V-4, Table V-5, Table V-6, Table V-7, and Table V-8 show the standards equations for structural cooler panels, structural freezer panels, freezer floor panels, display doors, non-display passage doors, and non-display freight doors, respectively. Table V-9 shows the AWEFs for refrigeration systems and indicates that the equations and AWEFs for a particular class of equipment may be the same across more than one TSL. This occurs when the criteria for two different TSLs are satisfied by the same efficiency level for a particular component. For example, for all refrigeration classes the max-tech level has a positive NPV; thus, the efficiency level with the maximum energy savings with positive NPV (TSL 5) is the same as the efficiency level corresponding to max-tech (TSL 6).

Table V-3 Equations for All Structural Cooler Panel TSLs

TSL	Equations for Maximum U-Factor (Btu/h-ft^2-°F)
Baseline	$-0.10\times\left(\frac{A_{\text{nf edge}}}{A_{\text{nf core}}}\right)^2+0.19\times\left(\frac{A_{\text{nf edge}}}{A_{\text{nf core}}}\right)+0.042$
TSL 1	$-0.012\times\left(\frac{A_{\text{nf edge}}}{A_{\text{nf core}}}\right)^2+0.024\times\left(\frac{A_{\text{nf edge}}}{A_{\text{nf core}}}\right)+0.041$
TSL 2	$-0.10\times\left(\frac{A_{\text{nf edge}}}{A_{\text{nf core}}}\right)^2+0.19\times\left(\frac{A_{\text{nf edge}}}{A_{\text{nf core}}}\right)+0.042$
TSL 3	$-0.010\times\left(\frac{A_{\text{nf edge}}}{A_{\text{nf core}}}\right)^2+0.021\times\left(\frac{A_{\text{nf edge}}}{A_{\text{nf core}}}\right)+0.036$
TSL 4	$-0.017\times\left(\frac{A_{\text{nf edge}}}{A_{\text{nf core}}}\right)^2+0.024\times\left(\frac{A_{\text{nf edge}}}{A_{\text{nf core}}}\right)+0.041$
TSL 5	$-0.010\times\left(\frac{A_{\text{nf edge}}}{A_{\text{nf core}}}\right)^2+0.021\times\left(\frac{A_{\text{nf edge}}}{A_{\text{nf core}}}\right)+0.036$
TSL 6	0.011

Table V-4 Equations for All Structural Freezer Panel TSLs

TSL	Equations for Maximum U-Factor (Btu/h-ft^2-°F)
Baseline	$-0.088\times\left(\frac{A_{\text{nf edge}}}{A_{\text{nf core}}}\right)^2+0.17\times\left(\frac{A_{\text{nf edge}}}{A_{\text{nf core}}}\right)+0.037$
TSL 1	$-0.0083\times\left(\frac{A_{\text{nf edge}}}{A_{\text{nf core}}}\right)^2+0.017\times\left(\frac{A_{\text{nf edge}}}{A_{\text{nf core}}}\right)+0.029$
TSL 2	$-0.088\times\left(\frac{A_{\text{nf edge}}}{A_{\text{nf core}}}\right)^2+0.17\times\left(\frac{A_{\text{nf edge}}}{A_{\text{nf core}}}\right)+0.037$
TSL 3	0.024
TSL 4	$-0.0083\times\left(\frac{A_{\text{nf edge}}}{A_{\text{nf core}}}\right)^2+0.017\times\left(\frac{A_{\text{nf edge}}}{A_{\text{nf core}}}\right)+0.029$
TSL 5	0.024
TSL 6	0.011

Table V-5 Equations for All Freezer Floor Panel TSLs

TSL	Equations for Maximum U-Factor (Btu/h-ft^2-°F)
Baseline	$-0.098\times\left(\frac{A_{\text{fp edge}}}{A_{\text{fp core}}}\right)^2+0.18\times\left(\frac{A_{\text{fp edge}}}{A_{\text{fp core}}}\right)+0.042$
TSL 1	$-0.0091\times\left(\frac{A_{\text{fp edge}}}{A_{\text{fp core}}}\right)^2+0.018\times\left(\frac{A_{\text{fp edge}}}{A_{\text{fp core}}}\right)+0.033$
TSL 2	$-0.098\times\left(\frac{A_{\text{fp edge}}}{A_{\text{fp core}}}\right)^2+0.18\times\left(\frac{A_{\text{fp edge}}}{A_{\text{fp core}}}\right)+0.042$
TSL 3	$-0.0064\times\left(\frac{A_{\text{fp edge}}}{A_{\text{fp core}}}\right)^2+0.013\times\left(\frac{A_{\text{fp edge}}}{A_{\text{fp core}}}\right)+0.023$
TSL 4	$-0.0091\times\left(\frac{A_{\text{fp edge}}}{A_{\text{fp core}}}\right)^2+0.018\times\left(\frac{A_{\text{fp edge}}}{A_{\text{fp core}}}\right)+0.033$
TSL 5	$-0.0064\times\left(\frac{A_{\text{fp edge}}}{A_{\text{fp core}}}\right)^2+0.013\times\left(\frac{A_{\text{fp edge}}}{A_{\text{fp core}}}\right)+0.023$
TSL 6	$-0.021\times\left(\frac{A_{\text{fp edge}}}{A_{\text{fp core}}}\right)^2+0.041\times\left(\frac{A_{\text{fp edge}}}{A_{\text{fp core}}}\right)+0.011$

Table V-6 Equations for All Display Door TSLs

TSL	Equations for Maximum Energy Consumption (kWh/day)	
	DD.M	DD.L
Baseline	$0.14\times A_{dd}+0.82$	$0.36\times A_{dd}+0.88$
TSL 1	$0.049\times A_{dd}+0.39$	$0.33\times A_{dd}+0.38$
TSL 2	$0.049\times A_{dd}+0.39$	$0.33\times A_{dd}+0.38$
TSL 3	$0.049\times A_{dd}+0.39$	$0.06\times A_{dd}+3.8$
TSL 4	$0.049\times A_{dd}+0.39$	$0.33\times A_{dd}+0.38$
TSL 5	$0.049\times A_{dd}+0.39$	$0.33\times A_{dd}+0.38$
TSL 6	$0.0080\times A_{dd}+0.29$	$0.11\times A_{dd}+0.32$

Table V-7 Equations for All Passage Door TSLs

TSL	Equations for Maximum Energy Consumption (kWh/day)	
	PD.M	PD.L
Baseline	$0.0040\times A_{nd}+0.24$	$0.141\times A_{nd}+4.81$
TSL 1	$0.0032\times A_{nd}+0.22$	$0.138\times A_{nd}+4.04$
TSL 2	$0.0040\times A_{nd}+0.24$	$0.141\times A_{nd}+4.81$
TSL 3	$0.0032\times A_{nd}+0.22$	$0.135\times A_{nd}+3.91$
TSL 4	$0.0032\times A_{nd}+0.22$	$0.138\times A_{nd}+4.04$
TSL 5	$0.0032\times A_{nd}+0.22$	$0.135\times A_{nd}+3.91$
TSL 6	$0.00093\times A_{nd}+0.0083$	$0.131\times A_{nd}+3.88$

Table V-8 Equations for All Freight Door TSLs

TSL	Equations for Maximum Energy Consumption (kWh/day)	
	FD.M	FD.L
Baseline	$0.0078\times A_{nd}+0.11$	$0.12\times A_{nd}+5.6$
TSL 1	$0.0073\times A_{nd}+0.082$	$0.11\times A_{nd}+5.3$
TSL 2	$0.0078\times A_{nd}+0.11$	$0.12\times A_{nd}+5.6$
TSL 3	$0.0073\times A_{nd}+0.082$	$0.10\times A_{nd}+5.2$
TSL 4	$0.0073\times A_{nd}+0.082$	$0.11\times A_{nd}+5.4$
TSL 5	$0.0073\times A_{nd}+0.082$	$0.10\times A_{nd}+5.2$
TSL 6	$0.00092\times A_{nd}+0.13$	$0.094\times A_{nd}+5.2$

Table V-9 AWEFs for All Refrigeration System TSLs

Equipment Class	Equations for Minimum AWEF (Btu/W-h)			
	Baseline	TSLs 1 and 3	TSLs 2 and 4	TSLs 5 and 6
DC.M.I, < 9,000	$2.47\times10^{-4}\times Q+2.30$	$4.37\times10^{-4}\times Q+2.26$	$2.63\times10^{-4}\times Q+4.53$	$2.63\times10^{-4}\times Q+4.53$
DC.M.I, ≥ 9,000	4.52	6.19	6.90	6.90
DC.M.O, < 9,000	$2.50\times10^{-4}\times Q+2.66$	$6.10\times10^{-4}\times Q+3.57$	$1.34\times10^{-3}\times Q+0.12$	$9.23\times10^{-4}\times Q+3.90$
DC.M.O, ≥ 9,000	4.91	9.06	12.21	12.21
DC.L.I, < 9,000	$1.43\times10^{-4}\times Q+1.48$	$1.10\times10^{-4}\times Q+2.16$	$1.93\times10^{-4}\times Q+1.89$	$1.93\times10^{-4}\times Q+1.93$
DC.L.I, ≥ 9,000	2.77	3.15	3.63	3.67
DC.L.O, < 9,000	$1.70\times10^{-4}\times Q+1.38$	$2.43\times10^{-4}\times Q+2.16$	$5.70\times10^{-4}\times Q+1.02$	$4.53\times10^{-4}\times Q+2.17$
DC.L.O, ≥ 9,000	2.91	4.35	6.15	6.25
MC.M	6.80	10.82	10.74	10.82
MC.L	4.66	5.91	5.53	5.91

B. Economic Justification and Energy Savings

1. Economic Impacts on Commercial Customers

a. Life-Cycle Cost and Payback Period

Consumers affected by new or amended standards usually incur higher purchase prices and experience lower operating costs. DOE evaluates these impacts on individual consumers by calculating changes in LCC and the PBP associated with the TSLs. Using the approach described in section IV.F, DOE calculated the LCC impacts and PBPs for the efficiency levels considered in this NOPR. Inputs used for calculating the LCC include total installed costs (i.e., equipment price plus installation costs), annual energy savings, and average electricity costs by consumer, energy price trends, repair costs, maintenance costs, equipment lifetime, and consumer discount rates. DOE based the LCC and PBP analyses on energy consumption under conditions of actual product use. DOE created distributions of values for some inputs, with probabilities attached to each value, to account for their uncertainty and variability. DOE used probability distributions to characterize equipment lifetime, discount rates, sales taxes and several other inputs to the LCC model.

The computer model DOE uses to calculate the LCC and PBP, which incorporates Crystal Ball (a commercially available software program), relies on a Monte Carlo simulation to incorporate uncertainty and variability into the analysis. The Monte Carlo simulations randomly sample input values from the probability distributions of the input variables and calculate the LCC and PBP from these. Details of the spreadsheet model, and of all the inputs to the LCC and PBP analyses, are contained in TSD chapter 8 and its appendices.

DOE's LCC and PBP analysis results for each refrigeration system are reported in Table V-10 through Table IV-14 at each TSL for the representative sizes of walk-in refrigeration systems in each equipment class. Each table includes the installed cost, total LCC, average LCC savings, the median payback period, and also the percentage of customers who will experience a benefit, cost, or no change under a proposed standard by performing a Monte Carlo analysis. DOE noted that for all classes of refrigeration systems, consumer LCCs were positive up through TSL 6, which corresponds to the maximum technologically feasible level (max-tech) refrigeration level. The median PBP values vary between 2–6 years for the dedicated condensing unit (DC) classes and were less than 1 year for the multiplex classes for all TSLs for medium temperature systems and for TSL2 and TSL 4 for low temperature systems. The median PBP exceeded 2 year only for the other TSLs considered. DOE also noted that higher benefits are experienced by users of larger capacity systems than by the smaller capacity systems. The LCC savings and PBP for all the sizes analyzed by DOE are shown in TSD chapter 8.

DOE's LCC and PBP analysis results for all envelope component equipment classes at each TSL are reported in Table V-15 through Table V-17. DOE analyzed three sizes (small, medium and large) in each component equipment class. Results for the components of different sizes in the equipment class are averaged on the basis of their shipment weights and reported in these tables. LCC and PBP results for all sizes may be found in chapter 8 of the TSD. Table V-10 through Table V-17 show that for all the components, LCC savings are significantly negative and payback periods are very high at the max-tech level (TSL 6).

Table V-10 Summary LCC and PBP Results for Medium Temperature Dedicated Condensing Refrigeration Systems – Outdoor Condenser

Trial Standard Level	Life-Cycle Cost (2012$)			Life-Cycle Cost Savings (2012$)				Payback Period (years)
	Installed Cost	Discounted Operating Cost	LCC	Average Savings	% of Consumers that Experience			Median
					Net Cost	No Impact	Net Benefit	
Baseline	4,368	7,363	11,731					
TSL1	4,891	5,791	10,682	1,048	0	0	100	1.3
TSL2	5,387	4,766	10,153	1,577	0	0	100	2.5
TSL3	4,992	5,622	10,614	1,117	0	0	100	1.8
TSL4	5,286	4,936	10,222	1,509	0	0	100	2.0
TSL5	5,532	4,591	10,123	1,608	1	0	99	3.0
TSL6	5,532	4,591	10,123	1,608	1	0	99	3.0

Table V-11 Summary LCC and PBP Results for Medium-Temperature Dedicated Condensing Refrigeration Systems – Indoor Condenser

Trial Standard Level	Life-Cycle Cost (2012$)			Life-Cycle Cost Savings (2012$)				Payback Period (years)
	Installed Cost	Discounted Operating Cost	LCC	Average Savings	% of Consumers that Experience			Median
					Net Cost	No Impact	Net Benefit	
Baseline	4,033	7,746	11,779					
TSL1	4,501	6,998	11,499	280	1	0	99	3.2
TSL2	4,931	6,238	11,169	611	4	0	96	4.4
TSL3	4,501	6,998	11,499	280	1	0	99	3.2
TSL4	4,931	6,238	11,169	611	4	0	96	4.4
TSL5	4,931	6,238	11,169	611	4	0	96	4.4
TSL6	4,931	6,238	11,169	611	4	0	96	4.4

Table V-12 Summary of LCC and PBP Results for Low-Temperature Dedicated-Condensing Refrigeration Systems – Outdoor Condenser

Trial Standard Level	Life-Cycle Cost (2012$)			Life-Cycle Cost Savings (2012$)				Payback Period (years)
	Installed Cost	Discounted Operating Cost	LCC	Average Savings	% of Consumers that Experience: Net Cost	No Impact	Net Benefit	Median
Baseline	4,093	10,471	14,564					
TSL1	4,673	8,564	13,236	1,328	5	0	95	1.2
TSL2	5,377	6,791	12,168	2,001	5	0	95	2.3
TSL3	4,673	8,564	13,236	1,328	5	0	95	1.2
TSL4	5,377	6,791	12,168	2,001	5	0	95	2.3
TSL5	5,591	6,584	12,175	1,994	5	0	95	2.8
TSL6	5,591	6,584	12,175	1,994	5	0	95	2.8

Table V-13 Summary of LCC and PBP Results for Low-Temperature Dedicated-Condensing Refrigeration Systems – Indoor Condenser

Trial Standard Level	Life-Cycle Cost (2012$)			Life-Cycle Cost Savings (2012$)				Payback Period (years)
	Installed Cost	Discounted Operating Cost	LCC	Average Savings	% of Consumers that Experience			Median
					Net Cost	No Impact	Net Benefit	
Baseline	4,161	13,051	17,212					
TSL1	4,688	12,019	16,707	505	0	0	100	2.8
TSL2	5,187	11,018	16,205	1,117	0	0	100	2.7
TSL3	4,688	12,019	16,707	505	0	0	100	2.8
TSL4	5,187	11,018	16,205	1,117	0	0	100	2.7
TSL5	5,272	10,970	16,242	1,080	0	0	100	3.1
TSL6	5,272	10,970	16,242	1,080	0	0	100	3.1

Table V-14 Summary LCC and PBP Results for Medium- and Low-Temperature Multiplex Refrigeration Systems (Unit Coolers Only)

Trial Standard Level	Efficiency Level	Life-Cycle Cost (2012$)			Life-Cycle Cost Savings (2012$)				Payback Period (years)
		Installed Cost	Discounted Operating Cost	LCC	Average Savings	% of Consumers that Experience			Median
						Net Cost	No Impact	Net Benefit	
Medium Temperature Multiplex									
	Baseline	1,583	6,143	7,726					
TSL1	EL2	2,251	3,759	6,010	1,715	0	0	100	0.6
TSL2	EL2	2,231	3,771	6,002	1,724	0	0	100	0.5
TSL3	EL2	2,251	3,759	6,010	1,715	0	0	100	0.6
TSL4	EL2	2,231	3,771	6,002	1,724	0	0	100	0.5
TSL5	EL3	2,251	3,759	6,010	1,715	0	0	100	0.6
TSL6	EL3	2,251	3,759	6,010	1,715	0	0	100	0.6
Low Temperature Multiplex									
	Baseline	1,583	10,295	11,878					
TSL1	EL2	2,776	7,252	10,028	1,849	0	0	100	2.5
TSL2	EL2	2,231	7,585	9,817	2,061	0	0	100	0.4
TSL3	EL2	2,776	7,252	10,028	1,849	0	0	100	2.5
TSL4	EL2	2,231	7,585	9,817	2,061	0	0	100	0.4
TSL5	EL5	2,776	7,252	10,028	1,849	0	0	100	2.5
TSL6	EL5	2,776	7,252	10,028	1,849	0	0	100	2.5

Table V-15 Summary LCC and PBP Results for Structural and Floor Panels (Weighted Across All Sizes)

Trial Standard Level	Life-Cycle Cost (2012$)			Life-Cycle Cost Savings (2012$)				Payback Period (years)
	Installed Cost	Discounted Operating Cost	LCC	Average Savings	% of Consumers that Experience			Median
					Net Cost	No Impact	Net Benefit	
Medium Temperature Structural Panel								
Baseline	1,007	97	1,104					
TSL1	1,007	97	1,104	16	14	0	86	3.8
TSL2	977	119	1,095	0	0	100	0	0.0
TSL3	1,043	85	1,128	-9	75	0	25	6.8
TSL4	1,007	80	1,088	8	34	0	66	4.5
TSL5	1,043	65	1,109	-22	93	0	7	9.0
TSL6	3,206	19	3,225	-2,139	100	0	0	146.4
Low Temperature Structural Panel								
Baseline	1,122	278	1,400					
TSL1	1,122	278	1,400	122	2	0	98	2.9
TSL2	1,010	399	1,410	0	0	100	0	0.0
TSL3	1,373	215	1,588	-66	79	0	21	7.4
TSL4	1,122	216	1,338	72	7	0	93	3.6
TSL5	1,373	161	1,533	-140	94	0	6	10.0
TSL6	3,208	76	3,284	-1,890	100	0	0	43.0
Low Temperature Floor Panel								
Baseline	1,202	243	1,445					
TSL1	1,202	243	1,445	66	6	0	94	3.5
TSL2	1,103	318	1,421	0	0	100	0	0.0
TSL3	1,348	166	1,515	-4	62	0	38	6.0
TSL4	1,202	189	1,390	30	28	0	72	4.5
TSL5	1,348	124	1,473	-65	88	0	12	8.0
TSL6	2,982	79	3,061	-1,653	100	0	0	48.7

Table V-16 Summary LCC and PBP Results for Display Doors (Weighted Across All Sizes)

Trial Standard Level	Life-Cycle Cost (2012$)			Life-Cycle Cost Savings (2012$)				Payback Period (years)
	Installed Cost	Discounted Operating Cost	LCC	Average Savings	% of Consumers that Experience			Median
					Net Cost	No Impact	Net Benefit	
Medium Temperature Display Door								
Baseline	1,100	530	1,630					
TSL1	1,205	186	1,391	239	0	0	100	2.1
TSL2	1,205	180	1,385	228	0	0	100	2.2
TSL3	1,205	186	1,391	239	0	0	100	2.1
TSL4	1,205	180	1,385	228	0	0	100	2.2
TSL5	1,205	177	1,382	222	0	0	100	2.2
TSL6	4,182	73	4,255	-2,650	100	0	0	37.6
Low Temperature Display Door								
Baseline	1,594	1,412	3,006					
TSL1	1,756	1,033	2,789	217	0	0	100	N/A
TSL2	1,756	954	2,710	200	0	0	100	N/A
TSL3	2,046	972	3,019	-12	64	0	36	6.0
TSL4	1,756	954	2,710	200	0	0	100	N/A
TSL5	1,756	942	2,698	198	0	0	100	N/A
TSL6	4,242	371	4,613	-1,717	100	0	0	18.5

Table V-17 Summary LCC and PBP Results for Non-Display Doors (Weighted Across All Sizes)

Trial Standard Level	Life-Cycle Cost (2012$)			Life-Cycle Cost Savings (2012$)				Payback Period (years)
	Installed Cost	Discounted Operating Cost	LCC	Average Savings	% of Consumers that Experience			Median
					Net Cost	No Impact	Net Benefit	
Medium Temperature Passage Door								
Baseline	691	89	780					
TSL1	691	89	780	2	27	0	73	4.5
TSL2	683	91	774	0	0	100	0	0.0
TSL3	691	89	780	2	27	0	73	4.5
TSL4	691	83	774	0	52	0	48	5.5
TSL5	691	80	772	0	64	0	36	6.0
TSL6	1,637	19	1,655	-884	100	0	0	78.7
Low Temperature Passage Door								
Baseline	1,070	2,205	3,274					
TSL1	1,070	2,205	3,274	74	14	0	86	4.3
TSL2	880	2,261	3,142	0	0	100	0	0.0
TSL3	1,226	2,138	3,364	-16	66	0	34	6.2
TSL4	1,070	2,020	3,090	52	27	0	73	4.7
TSL5	1,226	1,937	3,163	-52	75	0	25	7.0
TSL6	1,863	1,913	3,776	-665	100	0	0	18.3
Medium Temperature Freight Door								
Baseline	1,277	147	1,424					
TSL1	1,277	143	1,420	3	25	0	75	4.5
TSL2	1,265	144	1,409	0	0	100	0	0.0
TSL3	1,277	143	1,420	3	25	0	75	4.5
TSL4	1,277	131	1,408	1	50	0	50	5.4
TSL5	1,277	126	1,403	0	62	0	38	5.9
TSL6	2,511	49	2,560	-1,157	100	0	0	81.5
Low Temperature Freight Door								
Baseline	1,670	3,424	5,094					
TSL1	1,670	3,424	5,094	152	6	0	94	3.8
TSL2	1,426	3,491	4,917	0	0	100	0	0.0
TSL3	1,914	3,305	5,219	28	56	0	44	5.8
TSL4	1,543	3,237	4,780	136	1	0	99	2.9
TSL5	1,914	2,987	4,901	-32	69	0	31	6.5
TSL6	3,273	2,932	6,205	-1,337	100	0	0	21.7

b. Life-Cycle Cost Subgroup Analysis

Using the LCC spreadsheet model, DOE estimated the impact of increased WICF efficiency standards at each TSL on the following consumer subgroup: small restaurants that purchase their own walk-in units. These restaurants are typically identified by the Small Business Administration as restaurants with annual receipts of $10 million or less.[32] The small restaurant subgroup was analyzed because in the "food service and drinking places" business class in the 2007 Census,[33] almost 60 percent of employment and sales can be attributed to small restaurants and more than 78 percent of these establishments are considered small businesses. Furthermore, DOE received comments suggesting small restaurant owners could be particularly vulnerable to potential negative consequences of higher efficiency standards and potentially face shorter equipment lifetimes. DOE's LCC analysis shows that restaurants had among the highest financing costs (based on weighted average cost of capital of entities using walk-in coolers and freezers). Therefore, this group was expected to have the least LCC savings and longest PBP of any identifiable consumer group.

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[32] Small Business Administration. "Table of Small business Size Standards." SBA.gov. http://www.sba.gov/content/guide-size-standards. Accessed July 2011

[33] U.S. CENSUS. 2007. U.S. Census Bureau American Fact Finder, 2002 Economic Census-Sector 44: Retail Trade: Subject Series–Estab & Firm Size: Single Unit and Multiunit Firms for the United States: 2007, Washington, D.C., Accessed July 2011. http://www.census.gov/econ/census07/www/data_release_schedule/whats_been_released.html#44.

DOE estimated the LCC and PBP for the small restaurants subgroup. Table V-18 and Table V-19 show the LCC savings for refrigeration systems and envelope component equipment, respectively, which meet the proposed energy conservation standards for the small restaurant subgroup. Table V-20 and Table V-21 show the corresponding PBPs (in years) for this subgroup.

For example, DOE's analysis shows that at TSL 4, structural cooler panels for small restaurants have lower LCC savings and longer payback periods than other business types; however, LCC savings values are still positive for this subgroup at this TSL for panels. In addition, payback periods are typically increased by less than 10 percent compared with the walk-in market as a whole. For a more detailed discussion on the LCC subgroup analysis and its results, see chapter 11 of the TSD.

Table V-18 Life-Cycle Cost Savings for WICF Refrigeration Systems (2012$)

Equipment Class	Business	TSL1	TSL2	TSL3	TSL4	TSL5	TSL6
DC.M.I.006	Small Business	$67.25	$352.58	$67.25	$352.58	$352.58	$352.58
	All Business Types	$70.30	$370.28	$70.30	$370.28	$370.28	$370.28
DC.M.I.018	Small Business	$1,294.98	$1,762.74	$1,294.98	$1,762.74	$1,762.74	$1,762.74
	All Business Types	$1,350.45	$1,837.93	$1,350.45	$1,837.93	$1,837.93	$1,837.93
DC.M.O.006	Small Business	$567.37	$718.28	$567.37	$718.28	$784.16	$784.16
	All Business Types	$589.85	$748.02	$748.02	$589.85	$818.57	$818.57
DC.M.O.018	Small Business	$1,749.53	$2,761.13	$1,749.53	$2,761.13	$2,761.13	$2,761.13
	All Business Types	$1,817.33	$2,874.34	$1,817.33	$2,874.34	$2,874.34	$2,874.34
DC.M.O.054	Small Business	$12,021.21	$12,566.27	$12,021.21	$12,566.27	$12,566.27	$12,566.27
	All Business Types	$12,493.74	$13,068.28	$12,493.74	$13,068.28	$13,068.28	$13,068.28
DC.L.I.006	Small Business	$754.45	$1,073.48	$754.45	$1,073.48	$1,035.60	$1,035.60
	All Business Types	$788.39	$1,120.12	$788.39	$1,120.12	$1,081.45	$1,081.45
DC.L.I.009	Small Business	$136.23	$1,031.11	$136.23	$1,031.11	$1,031.11	$1,031.11
	All Business Types	$142.04	$1,112.07	$142.04	$1,112.07	$1,077.14	$1,077.14
DC.L.O.006	Small Business	$1,764.83	$1,747.88	$1,764.83	$1,747.88	$1,773.85	$1,773.85
	All Business Types	$1,833.48	$1,814.48	$1,833.48	$1,814.48	$1,843.63	$1,843.63
DC.L.O.009	Small Business	$1,022.91	$2,218.75	$1,022.91	$2,218.75	$2,184.74	$2,184.74
	All Business Types	$1,059.59	$2,307.72	$1,059.59	$2,307.72	$2,273.00	$2,273.00
DC.L.O.054	Small Business	$13,619.19	$14,061.17	$13,619.19	$14,061.17	$13,231.20	$13,231.20
	All Business Types	$14,125.72	$14,590.39	$14,125.72	$14,590.39	$13,760.51	$13,760.51

*Multiplex refrigeration systems are not typically used in small restaurants.

Table V-19 Life-Cycle Cost Savings for WICF Envelope Components (Panels and Doors) (2012$)

Equip. Class	Business	TSL1	TSL2	TSL3	TSL4	TSL5	TSL6
SP.M	Small Business	$12.65	-	($8.05)	$6.20	($16.17)	($2,141.42)
	All Business Types	$15.55	-	($8.98)	$7.63	($22.44)	($2,138.75)
SP.L	Small Business	$109.66	-	($75.54)	$67.73	($92.45)	($1,901.81)
	All Business Types	$121.93	-	($65.50)	$71.61	($139.77)	($1,890.34)
FP.L	Small Business	$58.43	-	($12.64)	$26.98	($52.29)	($1,661.22)
	All Business Types	$65.59	-	($4.45)	$30.28	($64.89)	($1,652.86)
DD.M	Small Business	$225.18	$214.71	$225.17	$214.71	$209.52	($2,660.23)
	All Business Types	$238.77	$227.69	$238.77	$227.69	$222.46	($2,650.38)
DD.L	Small Business	$210.44	$193.37	($11.78)	$193.37	$191.01	($1,739.58)
	All Business Types	$217.30	$200.08	($12.17)	$200.08	$197.59	($1,716.84)
PD.M	Small Business	$1.80	-	$1.80	$0.11	($0.88)	($886.46)
	All Business Types	$2.13	-	$2.13	$0.32	($0.30)	($883.91)
PD.L	Small Business	$64.25	-	($37.17)	$42.91	($65.11)	($677.42)
	All Business Types	$73.75	-	($15.74)	$51.91	($51.65)	($664.59)
FD.M	Small Business	$2.96	-	$2.96	$0.35	($6.14)	($1,160.14)
	All Business Types	$3.46	-	$3.46	$0.70	($0.24)	($1,156.91)
FD.L	Small Business	$137.63	-	$13.37	$126.39	($58.05)	($1,357.39)
	All Business Types	$152.18	-	$27.62	$136.42	($32.13)	($1,337.03)

Note: Dashes represent components at baseline efficiency and therefore do not have a payback period. Numbers in parentheses indicate negative values.

Table V-20 Payback Period for WICF Refrigeration Systems (Years)

Equipment	Business	TSL1	TSL2	TSL3	TSL4	TSL5	TSL6
DC.M.I.006	Small Business	3.63	5.20	3.63	5.20	5.20	5.46
	All Business Types	3.40	4.88	3.40	4.88	4.88	4.88
DC.M.I.018	Small Business	2.31	2.28	2.31	2.28	2.28	2.28
	All Business Types	2.17	2.14	2.17	2.14	2.14	2.14
DC.M.O.006	Small Business	2.20	3.35	5.52	0.02	4.46	4.46
	All Business Types	2.11	3.21	3.21	2.11	4.30	4.30
DC.M.O.018	Small Business	1.02	2.64	1.02	2.64	2.64	2.64
	All Business Types	0.98	2.54	0.98	2.54	2.54	2.54
DC.M.O.054	Small Business	1.02	1.79	1.02	1.79	1.79	1.79
	All Business Types	0.98	1.74	0.98	1.74	1.74	1.74
DC.L.I.006	Small Business	3.52	2.74	3.52	2.74	3.16	3.16
	All Business Types	3.32	2.58	3.32	2.58	2.98	2.98
DC.L.I.009	Small Business	2.19	2.22	2.19	2.22	3.35	3.35
	All Business Types	2.07	2.78	2.07	2.78	3.16	3.16
DC.L.O.006	Small Business	2.10	1.77	2.10	1.77	2.88	2.88
	All Business Types	2.03	1.72	2.03	1.72	2.80	2.80
DC.L.O.009	Small Business	0.76	2.93	0.76	2.93	3.12	3.12
	All Business Types	0.74	2.84	0.74	2.84	3.02	3.02
DC.L.O.054	Small Business	0.50	0.63	0.50	0.63	3.23	3.23
	All Business Types	0.48	0.61	0.48	0.61	3.15	3.15

*Multiplex refrigeration systems are not typically used in small restaurants.

Table V-21 Payback Period for WICF Envelope Components (Panels and Doors) (Years)

Equipment	Business	TSL1	TSL2	TSL3	TSL4	TSL5	TSL6
SP.M	Small Business	3.77	-	6.77	4.46	8.92	146.06
	All Business Types	3.81	-	6.80	4.49	8.95	146.40
SP,L	Small Business	2.82	-	7.33	3.60	9.86	42.58
	All Business Types	2.85	-	7.43	3.63	9.95	42.97
FP.L	Small Business	3.47	-	5.88	4.42	7.92	48.28
	All Business Types	3.50	-	5.96	4.46	7.99	48.69
DD.M	Small Business	2.10	2.17	2.10	2.17	2.21	37.28
	All Business Types	2.13	2.19	2.13	2.19	2.22	37.56
DD.L	Small Business	N/A	N/A	6.20	N/A	N/A	18.91
	All Business Types	N/A	N/A	6.01	N/A	N/A	18.48
PD.M	Small Business	4.52	-	4.52	5.48	6.01	78.77
	All Business Types	4.54	-	4.54	5.51	6.03	78.73
PD.L	Small Business	4.26	-	6.22	4.70	7.02	18.26
	All Business Types	4.27	-	6.23	4.69	7.02	18.31
FD.M	Small Business	4.44	-	4.44	5.38	5.90	81.55
	All Business Types	4.46	-	4.46	5.41	5.92	81.51
FD.L	Small Business	3.76	-	5.76	2.92	6.54	21.62
	All Business Types	3.76	-	5.77	2.92	6.54	21.70

Note: Dashes represent components at baseline efficiency and therefore do not have a payback period.

2. Economic Impacts on Manufacturers

DOE performed a manufacturer impact analysis (MIA) to estimate the impact of new energy conservation standards on manufacturers of walk-in cooler and freezer refrigeration, panels, and doors. The section below describes the expected impacts on manufacturers at each considered TSL. Chapter 12 of the TSD explains the analysis in further detail.

a. Industry Cash-Flow Analysis Results

Table V-22 through Table V-24 depict the financial impacts on manufacturers and the conversion costs DOE estimates manufacturers would incur at each TSL. The financial impacts on manufacturers are represented by changes in industry net present value (INPV).

The impact of energy efficiency standards were analyzed under two markup scenarios: (1) the preservation of gross margin percentage and (2) the preservation of operating profit. As discussed in section IV.I.2.b, DOE considered the preservation of gross margin percentage scenario by applying a uniform “gross margin percentage” markup across all efficiency levels. As production cost increases with efficiency, this scenario implies that the absolute dollar markup will increase. DOE assumed the nonproduction cost markup—which includes SG&A expenses; research and development expenses; interest; and profit to be 1.32 for panels, 1.50 for solid doors, 1.62 for display doors, and 1.35 for refrigeration. These markups are consistent with the ones DOE assumed in the engineering analysis and the base case of the GRIM.

Manufacturers have indicated that it is optimistic to assume that as their production costs increase in response to an efficiency standard, they would be able to maintain the same gross margin percentage markup. Therefore, DOE assumes that this scenario represents a high bound to industry profitability under an energy-conservation standard.

The preservation of earnings before interest and taxes (EBIT) scenario reflects manufacturer concerns about their inability to maintain their margins as manufacturing production costs increase to reach more-stringent efficiency levels. In this scenario, while manufacturers make the necessary investments required to convert their facilities to produce new standards-compliant equipment, operating profit does not change in absolute dollars and decreases as a percentage of revenue.

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 standards case that result 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 a comparison of free cash flow between the base case and the standards case at each TSL in the year before new standards take effect.

Table V-22 through Table V-24 show the MIA results for each TSL using the markup scenarios described above for WICF panel, door and refrigeration manufacturers, respectively:

Table V-22 Manufacturer Impact Analysis Results for WICF Panels

	Units	Base Case	Trial Standard Level					
			1	**2**	**3**	**4**	**5**	**6**
INPV	2012 $M	207.3	182.2 to 195.8	207.3 to 207.3	144.1 to 177.0	182.2 to 195.8	144.1 to 177.0	-212.9 to 441.9
Change in INPV	2012 $M	-	-25.0 to -11.5	0.0 to 0.0	-63.1 to -30.2	-25.0 to -11.5	-63.1 to -30.2	-420.2 to 234.7
	%	-	-12.1 to -5.6	0.0 to 0.0	-30.5 to -14.6	-12.1 to -5.6	-30.5 to -14.6	-202.7 to 113.2
Free Cash Flow (FCF) (2016)	2012 $M	18.4	10.7	18.4	-3.4	10.7	-3.4	-54.6
Change in FCF (2016)	2012 $M	-	-7.7	0.0	-21.8	-7.7	-21.8	-73.0
	%	-	-41.6	0.0	-118.7	-41.6	-118.7	-396.9
Conversion Costs	2012 $M	-	21	0	58	21	58	195

Table V-23 Manufacturer Impact Analysis Results for WICF Doors

	Units	Base Case	Trial Standard Level					
			1	**2**	**3**	**4**	**5**	**6**
INPV	2012 $M	454.6	437.6 to 470.7	446.2 to 470.2	428.2 to 467.8	437.8 to 470.6	427.3 to 466.4	260.8 to 1145.1
Change in INPV	2012 $M	-	-17.0 to 16.1	-8.4 to 15.6	-26.4 to 13.2	-16.8 to 16.0	-27.3 to 11.8	-193.8 to 690.5
	%	-	-3.7 to 3.5	-1.8 to 3.4	-5.8 to 2.9	-3.7 to 3.5	-6.0 to 2.6	-42.6 to 151.9
FCF (2016)	2012 $M	36.1	34.1	36.1	30.4	34.1	30.5	0.6
Change in FCF (2016)	2012 $M	-	-2.07	0.00	-5.7	-2.1	-5.7	-35.6
	%	-	-5.7	0.0	-15.8	-5.7	-15.7	-98.5
Conversion Costs	2012 $M	-	6	0.0	15	6	15	92

Table V-24 Manufacturer Impact Analysis Results for WICF Refrigeration Systems

	Units	Base Case	Trial Standard Level					
			1	2	3	4	5	6
INPV	2012 $M	189.1	170.9 to 183.3	153.6 to 184.8	170.9 to 183.3	153.6 to 184.8	145.8 to 188.3	145.8 to 188.3
Change in INPV	2012 $M	-	-18.3 to -5.9	-35.5 to -4.4	-18.3 to -5.9	-35.5 to -4.4	-43.3 to -0.8	-43.3 to -0.8
	%	-	-9.7 to -3.1	-18.8 to -2.3	-9.7 to -3.1	-18.8 to -2.3	-22.9 to -0.4	-22.9 to -0.4
FCF (2016)	2012 $M	16.3	11.7	9.1	11.7	9.1	8.0	8.0
Change in FCF (2016)	2012 $M	-	-4.6	-7.2	-4.6	-7.2	-8.3	-8.3
	%	-	-28.2	-44.0	-28.2	-44.0	-51.0	-51.0
Conversion Costs	2012 $M	-	15	24	15	24	28	28

Walk-in Cooler and Freezer Panel MIA Results

At TSL 1, DOE models the impacts on panel INPV to be negative under both mark-up scenarios. The change in panel INPV ranges from -$25.0 million to -$11.5 million, or a change in INPV of -12.1 percent to -5.6 percent. At this level, panel industry free cash flow[34] is estimated to decrease by as much as $7.7 million, or 41.6 percent compared to the base-case value of $18.4 million in 2016, the year before the compliance date. The primary driver of the drop in INPV is the standard for low-temperature side panels, which goes up to EL 2. At EL 2, manufacturers would likely use 5-inch thick side panels for low-temperature applications to meet the panel standard. At this level, DOE estimates conversion costs to be $21 million for the industry.

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[34] Free cash flow (FCF) is a metric commonly used in financial valuation. DOE calculates this value by adding back depreciation to net operating profit after tax and subtracting increases in working capital and capital expenditures.

At TSL 2, the standard for all panel equipment classes are set to the baseline efficiency. As a result, there are no changes to INPV, no changes in industry free cash flow, and no conversion costs.

At TSL 3, DOE estimates impacts on panel INPV to range from -$63.1 million to -$30.2 million, or a change in INPV of -30.5 percent to -14.6 percent. At this level, panel industry free cash flow is estimated to decrease by as much as $21.8 million, or 118.7% compared to the base-case value of $18.4 million in the year before the compliance date. The large percentage drop in cash flow in the GRIM indicates that conversion costs are high relative to the size of the industry and relative to annual operating profits. Conversion costs are expected to total $58 million. The conversion costs are driven by the need for 6-inch panels for both low temperature floor and side panels, as described in section 12.4.8 of the TSD. During manufacturer interviews, some panel manufacturers stated they would evaluate leaving the industry rather than make the required investments to meet the standard.

At TSL 4, the standard for all panel equipment classes are identical to those at TSL 1.

DOE estimates TSL 5 impacts on panel INPV to be range from -$63.1 million to -$30.2 million, or a change in INPV of -30.5 percent to -14.6 percent. At this level, panel industry free cash flow is estimated to decrease by as much as $21.8 million, or 118.7 percent compared to the base-case value of $18.4 million in the year before the compliance date. At this TSL, conversion costs total $58 million for the industry. These conversion costs are based on DOE's analysis indicating that industry would likely adopt 6-inch side floor panels to meet the standard. As in TSL 3, some panel manufacturers would likely leave the industry at this level of burden.

TSL 6 represents the use of max-tech design options for all equipment classes. DOE estimates impacts on panel INPV to be range from -$420.2 million to $234.7 million, or a change in INPV of -202.7 percent to 113.2 percent. At this level, panel industry free cash flow is estimated to decrease by as much as $73.0 million, or 396.9 percent compared to the base-case value of $18.4 million in the year before the compliance date. Impacts at the most negative end of the range would likely force many manufacturers out of the industry.

Walk-in Cooler and Freezer Door MIA Results

For TSL 1, DOE models the change in INPV for doors to range from -$17.0 million to $16.1 million, or a change in INPV of -3.7 percent to 3.5 percent. At this standard level, door industry free cash flow is estimated to decrease by as much as $2.1 million, or 5.7 percent compared to the base case value of $36.1 million in the year before the compliance date. DOE expects solid door manufacturers to pursue design options that reduce the loss of heat through door frames and through embedded windows. Changes to door frame design may require new tooling. Total conversion costs for the door industry are expected to reach $6 million.

At TSL 2, DOE estimates the impacts on door INPV to range from -$8.4 million to $15.6 million, or a change in INPV of -1.8 percent to 3.4 percent. At this level, door industry free cash flow is estimated to decrease by a negligible amount in the year before the compliance year. Furthermore, there are minimal conversion costs. To meet the standard, display door manufacturers would need to replace existing lighting with LEDs and reduce anti-sweat wire energy consumption. For solid door manufacturers, the standard is set at the baseline. Total conversion costs are expected to total $0.1 million for the industry. These costs are primarily product conversion costs associated incorporating heater wire controls and updating marketing literature.

For TSL 3, DOE estimates the change in door INPV to range from -$26.4 million to $13.2 million, or a change in INPV of -5.8 percent to 2.9 percent. At this level, door industry free cash flow is estimated to decrease by as much as $5.7 million, or 15.8 percent compared to the base-case value of $36.1 million in the year before the compliance date. At this level, display doors would need to incorporate lighting sensors. Solid doors for low temperature walk-ins would likely need to be redesigned to 6-inches of thickness. The additional production equipment and the cost of product redesigns drive conversion costs up to $15 million, more than double the conversion costs at TSL 1 and TSL 2. This conversion cost number assumes that manufacturers that produce both panels and solid doors would use the same foaming equipment and presses to produce both products since DOE models panel manufacturers also going to 6-inch side panels for low temperature applications at

TSL 3. Manufacturers that exclusively produce freight doors and passage doors will not be able to spread their investment over as many equipment classes.

For TSL 4, DOE estimates impacts on door INPV to range from -$16.8 million to $16.0 million, or a change in INPV of -3.7 percent to 3.5 percent. At this considered level, door industry free cash flow is estimated to decrease by as much as $2.1 million, or 5.7 percent compared to the base-case value of $36.1 million in the year before the compliance date. The standard levels for doors at TSL 4 are nearly identical to the standard levels at TSL 2, except that the standard is one efficiency level lower for the low temperature freight door equipment class. As mentioned above, DOE expects display door manufacturers to pursue design changes that do not require new manufacturing equipment. Manufacturers are expected to use LEDs in display doors and reduce anti-sweat wire energy consumption for medium temperature applications. DOE expects solid door manufacturers to pursue design options that reduce the loss of heat through door frames and through embedded windows. Changes to door frame design may require new tooling. Total conversion costs are expected to reach $6 million for the industry.

For TSL 5, DOE estimates impacts on door INPV to range from -$27.3 million to $11.8 million, or a change in INPV of -6.0 percent to 2.6 percent, at TSL 5. At this level, door industry free cash flow is estimated to decrease by as much as $5.7 million, or 15.7 percent compared to the base-case value of $36.1 million in the year before the compliance date. This standard level for doors at TSL 5 is nearly identical to the standard levels at TSL 3. Total conversion costs are expected to reach $15 million.

For TSL 6, DOE estimates impacts on door INPV to range from -$193.8 million to $690.5 million, or a change in INPV of -42.6 percent to 151.9 percent. At this level, door industry free cash flow is estimated to decrease by as much $35.6 million, or 98.5 percent compared to the base-case value of $36.1 million in the year before the compliance date. Conversion costs would total $92 million. At this level, some door manufacturers would likely choose to leave the industry rather than make the necessary investments to comply with standards.

Walk-in Cooler and Freezer Refrigeration MIA Results

At TSL 1, DOE estimates impacts on refrigeration INPV to range from -$18.3 million to -$5.9 million, or a change in INPV of -9.7 percent to -3.1 percent. At this level, refrigeration industry free cash flow is estimated to decrease by as much as $4.6 million, or 28.2 percent compared to the base-case value of $16.3 million in 2016, the year before the compliance year. For dedicated condensing, medium temperature, indoor refrigeration systems, DOE's engineering analysis indicates that manufacturers would need to incorporate multiple design options to achieve this standard. The design options would likely include variable speed evaporator fan motors and larger condensing coils. For dedicated condensing, low temperature, indoor refrigeration systems, manufacturers may need to further include improved condenser fan, improved evaporator fan blades, and electronically commutated motors. For dedicated condensing, medium temperature, outdoor refrigeration systems, design options necessary to meet TSL 1 would include variable speed evaporator fan motors, improved condenser fan blades, electronically commutated condenser fan motors, and improved evaporator fan blades. For dedicated condensing, low temperature, outdoor refrigeration systems, additional design options required to meet the trial standard level include ambient sub-cooling, variable speed condenser fans, and defrost control strategies. For multiplex refrigeration, manufacturers would need to evaluate design improvements, such as variable speed evaporator fan motors, improved fan blade designs, defrost control, and hot gas defrost. Integration of these design options across equipment classes will require extensive engineering investments. As a result, conversion costs total $15 million for the industry.

At TSL 2, DOE estimates impacts on refrigeration INPV to range from -$35.5 million to -$4.4 million, or a change in INPV of -18.8 percent to -2.3 percent. At this level, refrigeration industry free cash flow is estimated to decrease by as much as $7.2 million, or 44.0 percent compared to the base-case value of $16.3 million in the year before the compliance date. From TSL 1 to TSL 2, standards increase for most equipment classes. For dedicated condensing, medium temperature, indoor systems, a manufacturer would need to consider including electronically commutated condenser fan motors, improved condenser fan blades, and improved evaporator fan blades. For dedicated condensing, medium temperature, outdoor systems, the most cost effective options include using ambient subcooling, variable speed condenser fan motors, and floating head pressure with electronic expansion valves. For dedicated condensing, low temperature, outdoor systems, manufacturers will need to consider incorporating improved evaporator fan blades, larger condenser coils, and floating head pressure with electronic expansion valves. The range of changes does not require significant amounts of new production equipment, but could require substantial development and engineering time. DOE estimates the WICF refrigeration industry's conversion costs to increase to $24 million.

At TSL 3, the standards and the impacts on the walk-in refrigeration industry are identical to those at TSL 1.

At TSL 4, the standards and the impacts on the walk-in refrigeration industry are identical to those at TSL 2.

TSL 5 and TSL 6 represent max-tech for WICF refrigeration systems. DOE estimates impacts on refrigeration INPV to range from -$43.3 million to -$0.8 million, or a change in INPV of -22.9 percent to -0.4 percent. At this level, refrigeration industry free cash flow is estimated to decrease by as much as $8.3 million, or 51.0 percent compared to the base-case value of $16.3 million in the year before the compliance year. DOE's engineering analysis indicates that manufacturers would need to incorporate design changes beyond those for TSL 4 and TSL 3 to achieve this standard. Additional design changes for dedicated condensing, low temperature, indoor and outdoor refrigeration would include defrost controls. For multiplex units, the standard levels at TSL 5 and 6 are identical to those at TSL 1. Total conversion costs are expected to reach $28 million for the industry.

b. Impacts on Direct Employment

Methodology

To quantitatively assess the impacts of 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, 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 multiplied by 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. To further establish a lower bound to negative impacts on employment, DOE reviewed design options, conversion costs, and market share information to determine the maximum number of manufacturers that would leave the industry at each TSL.

In evaluating the impact of energy efficiency standards on employment, DOE performed separate analyses on all three walk-in component manufacturer industries: panels, doors and refrigeration systems.

Using the GRIM, DOE estimates in the absence of new energy conservation standards, there would be 3,482 domestic production workers for walk-in panels, 1,187domestic production workers for walk-in doors, and 346 domestic production workers for walk-in refrigeration systems in 2017.

Table V-25, Table V-26, and Table V-27 show the range of the impacts of potential new energy conservation standards on U.S. production workers in the panel, door, and refrigeration system markets, respectively. Additional detail on the analysis of direct employment can be found in chapter 12 of the TSD.

Table V-25 Potential Changes in the Total Number of Domestic Production Workers in 2017 for Panels

TSL	1	2	3	4	5	6
Potential Changes in Domestic Production Workers 2017 (from a base case employment of 3,462)	-435 to 134	0	-871 to 490	-435 to 134	-871 to 490	-1741 to 3,243

Table V-26 Potential Changes in the Total Number of Domestic Production Workers in 2017 for Doors

TSL	1	2	3	4	5	6
Potential Changes in Domestic Production Workers 2017 (from a base case employment of 1,187)	-60 to 149	0 to 97	-120 to 196	-60 to 146	-120 to 192	-349 to 2,409

Table V-27 Potential Changes in the Total Number of Domestic Production Workers in 2017 for Refrigeration Systems

TSL	1	2	3	4	5	6
Potential Changes in Domestic Production Workers 2017 (from a base case employment of 346)	0 to 31	-88 to 74	0 to 31	-88 to 74	-116 to 99	-116 to 99

The employment impacts shown in Table V-25 through Table V-27 represent the potential production employment changes that could result following the compliance date of new energy conservation standards. 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 represents the maximum decrease to the total number of U.S. production workers in the industry due to manufacturers leaving the industry. However, in the long-run, DOE would expect the manufacturers that do not leave the industry to add employees to cover lost capacity and to meet market demand.

The employment impacts shown are independent of the employment impacts from the broader U.S. economy, which are documented in the Employment Impact Analysis, chapter 13 of the TSD.

c. Impacts on Manufacturing Capacity

Panels

Manufacturers indicated that design options that necessitate thicker panels could lead to longer production times for panels. In general, every additional inch of foam increases panel cure times by roughly 20 minutes. DOE understands from manufacturer interviews, however, that the industry is not currently operating at full capacity. Given this fact, and the number of manufacturers able to produce panels above the baseline today, an increase in thickness at lower panel standards – that is, a standard that is based on 4-inch or 5-inch panels – is not likely to lead to product shortages in the industry. However, a standard that necessitates 6-inch panels for any of the panel equipment classes would require manufacturers to add equipment to maintain throughput due to longer curing times or to purchase all new tooling to enable production if the manufacturer's current equipment cannot accommodate 6-inch panels. These conversion costs are discussed further in chapter 12 of the TSD.

Doors

Display door manufacturers did not identify any design options which would lead to capacity constraints. However, manufacturers commented on differences between the two types of low-emittance coatings analyzed: hard low emittance coating ("hard-coat"), the baseline option, and soft low emittance coating ("soft-coat"), the corresponding design option. Hard-coat is applied to the glass pane at high temperatures during the formation of the pane and is extremely durable, while soft-coat is applied in a separate step after the glass pane is formed and is less durable than hard low emittance coating but has better performance characteristics. Manufacturers indicated that soft-coat is significantly more difficult to work with and may require new conveyor equipment. As manufacturers adjust to working with soft-coat, longer lead times may occur.

The production of solid doors is very similar to the production of panels and faces the same capacity challenges as panels. As indicated in the panel discussion above, DOE does not anticipate capacity constraints at a standard that moves manufacturers to 5 inches of thickness.

Refrigeration

DOE did not identify any significant capacity constraints for the design options being evaluated for this rulemaking. For most refrigeration manufacturers, the walk-in market makes up a relatively small percentage of their overall revenues. Additionally, most of the design options being evaluated are available as product options today. As a result, the industry should not experience capacity constraints directly resulting from an energy conservation standard.

d. Impacts on Small Manufacturer Sub-Group

As discussed in section IV.I.1, using average cost assumptions to develop an industry cash-flow estimate may not be adequate for assessing differential impacts among manufacturer sub-groups. Small manufacturers, niche equipment manufacturers, and manufacturers exhibiting a cost structure substantially different from the industry average could be affected disproportionately. DOE used the results of the industry characterization to group manufacturers exhibiting similar characteristics. Consequently, DOE analyzes small manufacturers as a sub-group.

DOE evaluated the impact of new energy conservation standards on small manufacturers, specifically ones defined as “small businesses” by the SBA. 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 2 refrigeration system manufacturers, 42 panel manufacturers, and 5 door manufacturers in the WICF industry that are small businesses. DOE describes the differential impacts on these small businesses in today's notice at section VI.B, Review Under the Regulatory Flexibility Act.

Section VI.B concludes that larger manufacturers could have a competitive advantage in multiple component markets due to their size, engineering and testing resources, and ability to access capital. Additionally, in some market segments, larger manufacturers have significantly higher production volumes over which to spread costs. In particular, DOE's analysis shows that this rule could drive consolidation in the walk-in cooler and freezer panel industry. While DOE cannot certify that today's rule would not have a significant economic impact on a substantial number of small manufacturers, DOE has considered these potential impacts and sought to mitigate any such impacts in choosing the TSL proposed in today's rule. For example, DOE specifically considered TSL 2, which would not raise the efficiency requirement on panel manufacturers above the base case level in order to minimize impacts on panel manufacturers. . In addition to the range of TSLs considered, alternatives to the proposed rule that were considered include the following policy alternatives: (1) no new regulatory action, (2) commercial consumer rebates, and (3) commercial consumer tax credits. Chapter 17 of the TSD associated with this proposed rule includes a report referred to in Section VI.A in the preamble as the regulatory impact analysis (RIA). The energy savings of these regulatory alternatives are one to two orders of magnitude smaller than those expected from the standard levels under consideration. The range of economic impacts of these regulatory alternatives is an order of magnitude smaller than the range of impacts expected from the standard levels under consideration. For a complete discussion of the impacts on small businesses, see section VI.B and chapter 12 of the TSD.

e. Cumulative Regulatory Burden

While any one regulation may not impose a significant burden on manufacturers, the combined effects of several impending regulations may have serious consequences for some manufacturers, groups of manufacturers, or an entire industry. Assessing the impact of a single regulation may overlook this cumulative regulatory burden. Multiple regulations affecting the same manufacturer can strain profits and can 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 and equipment efficiency.

For the cumulative regulatory burden analysis, DOE looks at other regulations that could affect walk in cooler and freezer manufacturers that will take effect approximately 3 years before or after the compliance date of new energy conservation standards for these products. In addition to the new energy conservation regulations on walk-ins, several other Federal regulations apply to these products and other equipment produced by the same manufacturers. While the cumulative regulatory burden focuses on the impacts on manufacturers of other Federal requirements, DOE also describes a number of other regulations in section VI.B because it recognizes that these regulations also impact the products covered by this rulemaking.

Companies that produce a wide range of regulated products may be faced with more capital and product development expenditures than competitors with a narrower scope of products. Regulatory burdens can prompt companies to exit the market or reduce their product offerings, potentially reducing competition. Smaller companies in particular can be affected by regulatory costs since these companies have lower sales volumes over which they can amortize the costs of meeting new regulations. DOE discusses below the regulatory burdens manufacturers could experience, mainly, DOE regulations for other products or equipment produced by walk-in manufacturers and other Federal requirements including the United States Clean Air Act, the Energy Independence and Security Act of 2007. While this analysis focuses on the impacts on manufacturers of other Federal requirements, in this section DOE also describes a number of other regulations that could also impact the WICF equipment covered by this rulemaking: potential climate change and greenhouse gas legislation, State conservation standards, and food safety regulations. DOE discusses these and other requirements, and includes the full details of the cumulative regulatory burden, in chapter 12 of the NOPR TSD.

DOE Regulations for Other Products Produced by Walk-In Cooler and Freezer Manufacturers

In addition to the new energy conservation standards on walk in cooler and freezer equipment, several other Federal regulations apply to other products produced by the same manufacturers. DOE recognizes that each regulation can significantly affect a manufacturer's financial operations. Multiple regulations affecting the same manufacturer can strain manufacturers' profits and possibly cause an exit from the market. DOE is conducting an energy conservation standard rulemaking for commercial refrigeration equipment. In its Notice of Proposed Rulemaking for commercial refrigeration equipment, DOE initially estimated conversion costs for the CRE industry to total $87.5 million. Conversion costs are one-time expenses the industry will bear between the announcement date of the standard and the effective date of the standard.

Federal Clean Air Act

The Clean Air Act defines the EPA's responsibilities for protecting and improving the nation's air quality and the stratospheric ozone layer. The most significant of these additional regulations is the EPA-mandated phase-out of hydrochlorofluorocarbons (HCFCs). The Act requires that, on a quarterly basis, any person who produced, imported, or exported certain substances, including HCFC refrigerants, report the amount produced, imported and exported. Additionally—effective January 1, 2015—selling, manufacturing, and using any such substance is banned unless such substance (1) has been used, recovered, and recycled; (2) is used and entirely consumed in the production of other chemicals; or (3) is used as a refrigerant in appliances manufactured prior to January 1, 2020. Finally, production phase-outs will continue until January 1, 2030 when such production will be illegal. These bans could trigger design changes to natural or low global warming potential refrigerants and could impact the insulation used in products covered by this rulemaking.

State Conservation Standards

Since 2004, the State of California has had established energy standards for walk-in coolers and freezers. California's Code of Regulations (Title 20, Section 1605) prescribe requirements for insulation levels, motor types, and use of automatic door-closers used for WICF applications. These requirements have since been amended and mirror those standards that Congress prescribed as part of EISA 2007. Other States, notably, Connecticut, Maryland, and Oregon, have recently established energy efficiency standards for walk-ins that are also identical to the ones contained in EPCA. These standards would not be preempted until any Federal standards that DOE may adopt take effect. See 42 U.S.C. 6316(h)(2). Once DOE's standards are finalized, all other State standards that are in effect would be pre-empted. As a result, these State standards do not pose any regulatory burden above that which has already been established in EPCA.

Food Safety Standards

Manufacturers expressed concern regarding Federal, State, and local food safety regulations. A walk-in must perform to the standards set by NSF, state, country, and city health regulations. There is general concern among manufacturers about conflicting regulation scenarios as new energy conservation standards may potentially prevent or make it more difficult for them to comply with food safety regulations.

3. National Impact Analysis

a. Amount and Significance of Energy Savings

To estimate the national energy savings attributable to the TSLs under consideration, DOE compared the energy consumption of the refrigeration systems under the base case to their anticipated energy consumption under each TSL. Because all the TSLs except TSL 6 combine high efficiency refrigeration systems with envelope components having small efficiency gains over the baseline levels, DOE projected that the additional impact from higher efficiency levels for envelope components on the capacity of refrigeration systems sold for each system, and subsequently on the aggregate shipped capacity, would not significantly impact the energy savings estimate for each TSL. Consequently, DOE calculated the baseline energy consumption and the energy savings for higher efficiency refrigeration systems independent of the envelope component efficiency level at the TSLs considered. DOE did, however, estimate this reduction in capacity from improved envelope component efficiency on an aggregate basis at each TSL and accounted for the economic benefit in the calculation of the national net present value for each TSL as discussed in section V.3.b.

By contrast, the energy savings benefits for the envelope components are influenced directly by the efficiency of the refrigeration system. Because of this, the energy savings for the envelope levels are calculated such that both the baseline and the higher efficiency envelope components are paired with the refrigeration system at the efficiency level corresponding to the specific TSL.

Table V-28 through Table V-30 present DOE's forecasts of the national primary energy savings for each TSL of the refrigeration systems and selected envelope components, and the combination of refrigeration systems and envelope components. In addition Table V-30 shows the FFC energy savings for each TSL. These forecasts were calculated using the approach described in section IV.G. Chapter 10 of the NOPR TSD presents tables that also show the magnitude of the energy savings.

Table V-28 WICF Refrigeration Systems: Cumulative National Energy Savings in Quads (Primary Energy Savings)

Equipment Class	Trial Standard Levels			
	1,3	2,4	5	6
DC.M.I*	0.024	0.041	0.041	0.041
DC.M.O*	1.825	2.446	2.524	2.524
DC.L.I*	0.009	0.016	0.017	0.017
DC.L.O*	0.768	1.162	1.256	1.256
MC.M	0.378	0.376	0.378	0.378
MC.L	0.099	0.084	0.099	0.099

*For DC refrigeration systems, results include both capacity ranges.

Table V-29 Component Equipment Class: Cumulative National Energy Savings in Quads (Primary Energy Savings)

Equipment Class	Trial Standard Levels					
	1	2	3	4	5	6
SP.M	0.259	0.000	0.324	0.221	0.273	0.553
SP.L	0.447	0.000	0.564	0.380	0.447	0.619
FP.L	0.048	0.000	0.069	0.040	0.055	0.069
DD.M	0.405	0.394	0.405	0.394	0.394	0.620
DD.L	0.021	0.020	0.029	0.020	0.020	0.095
PD.M	0.009	0.000	0.009	0.007	0.007	0.073
PD.L	0.113	0.000	0.141	0.106	0.128	0.140
FD.M	0.000	0.000	0.000	0.000	0.000	0.004
FD.L	0.010	0.000	0.013	0.007	0.012	0.013

Table V-30 Refrigeration Systems and Components Combined: Cumulative National Primary and Full-Fuel Cycle Energy Savings in Quads

Application	Trial Standard Levels					
	1	2	3	4	5	6
Medium Temperature	2.900	3.257	2.965	3.486	3.617	4.193
Low Temperature	1.515	1.283	1.692	1.816	2.032	2.308
Primary Energy Savings Total	4.415	4.540	4.658	5.302	5.649	6.501
Upstream Energy Savings	0.072	0.074	0.076	0.086	0.092	0.106
FFC Total	4.487	4.614	4.734	5.388	5.741	6.607

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. 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 walk-in coolers and freezers. Thus, this information is presented for informational purposes only and is not indicative of any change in DOE's analytical methodology. The NES of estimated primary energy savings results based on a 9-year analytical period are presented in Table V-31 through Table V-33. The impacts are counted over the lifetime of products purchased in 2017–2025.

Table V-31 WICF Refrigeration Systems: Cumulative National Primary Energy Savings in Quads for Units Sold in 2017-2025

Equipment Class	Trial Standard Levels			
	1,3	2,4	5	6
DC.M.I*	0.007	0.012	0.012	0.012
DC.M.O*	0.547	0.733	0.756	0.756
DC.L.I*	0.003	0.005	0.005	0.005
DC.L.O*	0.230	0.348	0.376	0.376
MC.M	0.113	0.113	0.113	0.113
MC.L	0.030	0.025	0.030	0.030

*For DC refrigeration systems, results include multiple capacity ranges.

Table V-32 Component Equipment Class: Cumulative National Primary Energy Savings in Quads for Units Sold in 2017-2025 (Primary Energy Savings)

Equipment Class	Trial Standard Levels					
	1	2	3	4	5	6
SP.M	0.063	0.000	0.079	0.054	0.066	0.134
SP.L	0.108	0.000	0.137	0.092	0.108	0.150
FP.L	0.012	0.000	0.017	0.010	0.013	0.017
DD.M	0.123	0.119	0.123	0.119	0.119	0.188
DD.L	0.006	0.006	0.009	0.006	0.006	0.029
PD.M	0.003	0.000	0.003	0.002	0.002	0.021
PD.L	0.033	0.000	0.041	0.031	0.037	0.041
FD.M	0.000	0.000	0.000	0.000	0.000	0.001
FD.L	0.002	0.000	0.003	0.002	0.003	0.003

Table V-33 Refrigeration Systems and Components Combined: Cumulative National Primary and Full-Fuel Cycle Energy Savings in Quads for Units Sold in 2017-2025

Application	Trial Standard Levels					
	1	2	3	4	5	6
Medium Temperature	0.855	0.977	0.871	1.033	1.069	1.226
Low Temperature	0.425	0.384	0.470	0.519	0.579	0.651
Primary Energy Savings Total	1.280	1.361	1.341	1.552	1.648	1.877
Upstream Energy Savings	0.021	0.022	0.022	0.025	0.027	0.031
FFC Total	1.301	1.383	1.363	1.577	1.675	1.908

b. Net Present Value of Consumer Costs and Benefits

DOE estimated the cumulative NPV to the nation of the total costs and savings for consumers that would result from particular composite standard levels for the refrigeration systems and components. 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, since 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 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-34 through Table V-39 show the consumer NPV results for each of the TSLs DOE considered for the combination of refrigeration systems and envelope components, using both a 7-percent and a 3-percent discount rate. In each case, the impacts cover the lifetime of products purchased in 2017-2046. For a particular TSL combination, improving component efficiency should result in reduced refrigeration load on the paired refrigeration system and consequently, the refrigeration system can be downsized, resulting in additional consumer benefits. In estimating the "first cost benefits," DOE made several assumptions and has shown the results only in the summary table. For a discussion of these assumptions, see chapter 10 of the TSD.

Table V-34 WICF Refrigeration Systems: Net Present Value in Millions (2012$) at a 7-percent Discount Rate for Units Sold in 2017-2046

Equipment Classes	Trial Standard Levels			
	1,3	**2,4**	**5**	**6**
DC.M.I*	38	52	52	52
DC.M.O*	3,417	3,943	3,937	3,937
DC.L.I*	12	19	19	19
DC.L.O*	1,488	1,995	1,913	1,913
MC.M	835	843	835	835
MC.L	161	189	161	161

*For DC refrigeration systems, results include both capacity ranges.

Table V-35 Envelope Component Equipment Classes: Net Present Value in Millions (2012$) at a 7-percent Discount Rate for Units Sold in 2017-2046

Equipment Class	Trial Standard Levels					
	1	2	3	4	5	6
SP.M	289	0	121	207	11	-17,715
SP.L	662	0	269	520	21	-4,298
FP.L	63	0	52	48	22	-578
DD.M	571	545	571	545	543	-11,200
DD.L	54	51	0	51	50	-395
PD.M	4	0	4	1	1	-1,764
PD.L	106	0	38	88	6	-513
FD.M	0	0	0	0	0	-106
FD.L	10	0	5	9	2	-59

Table V-36 Refrigeration Systems and Components Combined: Net Present Value in Millions (2012$) at a 7-percent Discount Rate for Units Sold in 2017-2046

Application	Trial Standard Levels					
	1	2	3	4	5	6
Medium Temperature						
Combined NPV	5,155	5,384	4,987	5,592	5,380	-25,961
First cost benefits	6	3	18	34	45	153
Sub-Total	5,161	5,386	5,004	5,627	5,425	-25,809
Low Temperature						
Combined NPV	2,555	2,255	2,025	2,919	2,193	-3,751
First cost benefits	49	0	89	96	246	344
Sub-Total	2,604	2,255	2,114	3,015	2,438	-3,408
Total – All	7,765	7,641	7,118	8,642	7,864	-29,217

Table V-37 WICF Refrigeration Systems: Net Present Value in Millions (2012$) at a 3-percent Discount Rate for Units Sold in 2017-2046

Equipment Class	Trial Standard Levels			
	1,3	2,4	5	6
DC.M.I*	107	159	159	159
DC.M.O*	9,161	11,047	11,147	11,147
DC.L.I*	36	61	60	60
DC.L.O*	3,951	5,483	5,455	5,455
MC.M	2,143	2,157	2,143	2,143
MC.L	450	483	450	450

*For DC refrigeration systems, results include both capacity ranges.

Table V-38 Envelope Component Equipment Classes: Net Present Value in Millions (2012$) at a 3-percent Discount Rate for Units Sold in 2017-2046

Equipment Class	Trial Standard Levels					
	1	2	3	4	5	6
SP.M	990	0	779	770	484	-32,834
SP.L	2,151	0	1,468	1,694	797	-7,144
FP.L	219	0	216	167	134	-985
DD.M	1,667	1,602	1,667	1,602	1,597	-20,987
DD.L	135	128	41	128	126	-640
PD.M	21	0	21	13	12	-3,329
PD.L	364	0	270	319	189	-803
FD.M	1	0	1	1	1	-200
FD.L	36	0	31	32	23	-92

Table V-39 Refrigeration Systems and Components Combined: Net Present Value in Millions (2012$) at a 3-percent Discount Rate for Units Sold in 2017-2046

Application	Trial Standard Levels					
	1	2	3	4	5	6
Medium Temperature						
Combined NPV	14,091	14,965	13,880	15,748	15,543	-43,901
First cost benefits	12	5	34	66	87	294
Sub-Total	14,102	14,970	13,914	15,814	15,630	-43,607
Low Temperature						
Combined NPV	7,191	6,155	6,464	8,297	7,234	-3,700
First cost benefits	94	0	172	185	473	663
Sub-Total	7,285	6,155	6,636	8,482	7,707	-3,037
Total - All	21,387	21,125	20,550	24,296	23,337	-46,644

The NPV results based on the aforementioned 9-year analytical period are presented in Table V-40 through Table V-45. 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-40 WICF Refrigeration Systems: Net Present Value in Millions (2012$) at a 7-percent Discount Rate for Units Sold in 2017-2025

Equipment Classes	Trial Standard Levels			
	1,3	**2, 4**	**5**	**6**
DC.M.I*	21	30	30	30
DC.M.O*	1,864	2,175	2,178	2,178
DC.L.I*	7	11	11	11
DC.L.O*	810	1,095	1,060	1,060
MC.M	451	455	451	451
MC.L	89	102	89	89

*For DC refrigeration systems, results include both capacity ranges.

Table V-41 Envelope Component Equipment Classes: Net Present Value in Millions (2012$) at a 7-percent Discount Rate for Units Sold in 2017-2025

Equipment Class	Trial Standard Levels					
	1	**2**	**3**	**4**	**5**	**6**
SP.M	128	0	35	89	-17	-9,275
SP.L	306	0	92	238	-27	-2,293
FP.L	29	0	21	21	6	-307
DD.M	326	312	326	312	311	-5,473
DD.L	29	28	3	28	27	-186
PD.M	3	0	3	1	1	-870
PD.L	62	0	30	53	13	-244
FD.M	0	0	0	0	0	-53
FD.L	5	0	2	4	0	-30

Table V-42 Refrigeration Systems and Components Combined: Net Present Value in Millions (2012$) at a 7-percent Discount Rate for Units Sold in 2017-2025

Application	Trial Standard Levels					
	1	**2**	**3**	**4**	**5**	**6**
Medium Temperature						
Combined NPV	2,883	3,061	2,791	3,156	3,153	-12,843
First cost benefits	3	1	9	17	23	77
Sub-Total	2,886	3,062	2,800	3,174	3,176	-12,766
Low Temperature						
Combined NPV	1,322	1,125	1,045	1,479	1,416	-1,829
First cost benefits	23	0	42	33	124	174
Sub-Total	1,345	1,125	1,087	1,512	1,540	-1,655
Total - All	4,230	4,188	3,887	4,686	4,716	-14,421

Table V-43 WICF Refrigeration Systems: Net Present Value in Millions (2012$) at a 3-percent Discount Rate for Units Sold in 2017-2025

Equipment Class	Trial Standard Levels			
	1,3	**2,4**	**5**	**6**
DC.M.I*	42	63	63	63
DC.M.O*	3,564	4,330	4,377	4,377
DC.L.I*	14	24	24	24
DC.L.O*	1,535	2,143	2,145	2,145
MC.M	828	832	828	828
MC.L	177	187	177	177

*For DC refrigeration systems, results include both capacity ranges.

Table V-44 Envelope Component Equipment Classes: Net Present Value in Millions (2012$) at a 3-percent Discount Rate for Units Sold in 2017-2025

Equipment Class	Trial Standard Levels					
	1	**2**	**3**	**4**	**5**	**6**
SP.M	296	0	197	224	101	-12,538
SP.L	651	0	385	503	167	-2,879
FP.L	64	0	61	48	34	-392
DD.M	675	650	675	650	648	-7,204
DD.L	52	50	21	50	49	-203
PD.M	9	0	9	6	5	-1,161
PD.L	147	0	118	129	87	-261
FD.M	0	0	0	0	0	-71
FD.L	11	0	8	10	6	-35

Table V-45 Refrigeration Systems and Components Combined: Net Present Value in Millions (2012$) at a 3-percent Discount Rate for Units Sold in 2017-2025

Application	Trial Standard Levels					
	1	**2**	**3**	**4**	**5**	**6**
Medium Temperature						
Combined NPV	5,414	5,875	5,315	6,106	6,022	-15,707
First cost benefits	4	2	12	24	32	107
Sub-Total	5,418	5,877	5,328	6,130	6,054	-15,600
Low Temperature						
Combined NPV	2,624	2,403	2,319	3,092	2,688	-1,425
First cost benefits	34	0	62	67	172	240
Sub-Total	2,658	2,403	2,382	3,159	2,859	-1,185
Total - All	8,076	8,281	7,709	9,289	8,913	-16,785

c. Employment Impacts

Besides the direct impacts on manufacturing employment discussed in section V.B.2.b, DOE develops general estimates of the indirect employment impacts of proposed standards on the economy. As discussed above, DOE expects energy conservation standards for walk-ins to reduce energy bills for commercial consumers, 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 WICF 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 standards. These impacts may affect a variety of businesses not directly involved in the decision to make, operate, or pay the utility bills for walk-ins. 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 Bureau of Labor Statistics (BLS) data (as described in section IV.J; see chapter 13 of the TSD for more details).

In this input/output model, the dollars saved on utility bills from more efficient walk-in equipment are centered in economic sectors that create more jobs than are lost in the electric utility industry when spending is shifted from electricity to other products and services. Thus, the proposed walk-in energy conservation standards 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 indicates the quality of jobs lost or gained. As shown in Table V-46, DOE estimates that net indirect employment impacts from a proposed WICF standard are small relative to the national economy.

Table V-46 Net Change in Jobs from Indirect Employment Effects Under WICF TSLs

Year	Trial Standard Level	Net National Change in Jobs (Thousands)		
		Envelope Components	Refrigeration Systems	Total
2017	1	0.2	0.5	0.7
	2	0.1	0.7	0.8
	3	0.2	0.5	0.7
	4	0.2	0.7	0.9
	5	0.2	0.8	1.0
	6	0.3	0.8	1.1
2021	1	0.8	2.5	3.4
	2	0.3	3.4	3.7
	3	1.0	2.5	3.5
	4	0.8	3.4	4.2
	5	0.9	3.6	4.4
	6	1.4	3.6	5.0

4. Impact on Utility or Performance of Equipment

In performing the engineering analysis, DOE generally considers design options that would not lessen the utility or performance of the individual classes of equipment. See 42 U.S.C. 6295(o)(2)(B)(i)(IV). As presented in the screening analysis (chapter 4 of the TSD), DOE eliminates design options that reduce the utility of the equipment from consideration. For this notice, DOE tentatively concludes that none of the efficiency levels proposed for walk-in cooler and freezer equipment would be likely to reduce the utility or performance of the equipment.

5. Impact of Any Lessening of Competition

DOE has also considered any lessening of competition that is likely to result from amended standards. The Attorney General determines the impact, if any, of any lessening of competition likely to result from a proposed standard, and transmits such determination to the Secretary, together with an analysis of the nature and extent of such impact. (42 U.S.C. 6295(o)(2)(B)(i)(V) and (ii))

To assist the Attorney General in making such determination, DOE will provide DOJ with copies of this NOPR and the TSD for review. DOE will consider DOJ's comments on the proposed rule in preparing the final rule, and DOE will publish and respond to DOJ's comments in that document.

DOE also notes that during MIA interviews, domestic manufacturers indicated that foreign manufacturers do not generally enter the walk-in market and have not done so for the past several years; however, some walk-in equipment may be manufactured in Mexico or Canada. Manufacturers also stated that consolidation has occurred among walk-in manufacturers in recent years, due largely to the competitive nature of the industry and the recently enacted standards established by Congress. DOE believes that these trends will continue in this market regardless of the proposed standard levels chosen, but could accelerate if higher standard levels are set.

DOE does not believe that the proposed standards would result in domestic firms moving their production facilities outside the United States. The vast majority of walk-ins sold in the United States are manufactured in the United States, in large part because walk-in equipment is generally bulky, making it difficult and expensive to ship internationally. Manufacturers generally indicated during interviews that they would modify their existing facilities to comply with the amended energy conservation standards that DOE develops.

6. Need of the Nation to Conserve Energy

An improvement in the energy efficiency of the products subject to today's rule 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 TSD.

Energy savings from amended standards for WICF equipment classes covered in today's NOPR could also produce environmental benefits in the form of reduced emissions of air pollutants and greenhouse gases associated with electricity production. Table V-47 provides DOE's estimate of cumulative emissions reductions projected to result from the TSLs considered in this rulemaking. The table includes both power sector emissions and upstream emissions. The upstream emissions were calculated using the multipliers discussed in section IV.G. DOE reports annual CO_2, NO_X, and Hg emissions reductions for each TSL in chapter 15 of the NOPR TSD. As discussed in section IV.J, DOE did not include NO_X emissions reduction from power plants in States subject to CAIR, because an energy conservation standard would not affect the overall level of NO_X emissions in those States due to the emissions caps mandated by CSAPR.

Table V-47 Cumulative Emissions Reduction for WICF TSLs for Equipment Purchased in 2017-2046

	TSL					
	1	**2**	**3**	**4**	**5**	**6**
Power Sector and Site Emissions*						
CO_2 (million metric tons)	234.32	240.95	246.75	281.35	299.79	345.05
NO_X (thousand tons)	178.96	183.22	188.62	214.60	228.76	263.66
Hg (tons)	0.52	0.53	0.54	0.62	0.66	0.76
N_2O (thousand tons)	5.22	5.33	5.51	6.26	6.67	7.70
CH_4 (thousand tons)	29.18	29.98	30.74	35.03	37.33	42.98
SO_2 (thousand tons)	313.03	322.01	329.61	375.89	400.52	460.93
Upstream Emissions						
CO_2 (million metric tons)	13.87	14.27	14.61	16.66	17.75	20.43
NO_X (thousand tons)	190.90	196.36	201.02	229.24	244.26	281.10
Hg (tons)	0.01	0.01	0.01	0.01	0.01	0.01
N_2O (thousand tons)	0.14	0.14	0.15	0.17	0.18	0.21
CH_4 (thousand tons)	1,159.66	1,192.72	1,221.16	1,392.52	1,483.77	1,707.59
SO_2 (thousand tons)	2.97	3.06	3.13	3.57	3.80	4.38
Total Emissions						
CO_2 (million metric tons)	248.19	255.22	261.36	298.01	317.54	365.48
NO_X (thousand tons)	369.85	379.58	389.64	443.84	473.02	544.76
Hg (tons)	0.52	0.54	0.55	0.63	0.67	0.77
N_2O (thousand tons)	5.36	5.48	5.65	6.43	6.85	7.90
CH_4 (thousand tons)	1,188.84	1,222.70	1,251.90	1,427.56	1,521.10	1,750.57
SO_2 (thousand tons)	316.00	325.06	332.74	379.46	404.32	465.31

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.M.1, 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 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. The values for later years are higher due to increasing damages as the magnitude of climate change increases.

Table V-48 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 16 of the NOPR TSD.

Table V-48 Cumulative Emissions Reduction for WICF TSLs (2017 through 2073)

TSL	SCC Case*			
	5% discount rate, average*	3% discount rate, average*	2.5% discount rate, average*	3% discount rate, 95th percentile*
	Million 2012$			
Primary Energy Emissions				
1	1,477.1	7,031.6	11,276.4	21,608.4
2	1,532.4	7,269.9	11,648.3	22,334.5
3	1,552.5	7,396.3	11,863.3	22,730.2
4	1,777.9	8,455.6	13,556.7	25,982.3
5	1,892.8	9,004.8	14,438.5	27,670.6
6	2,173.0	10,348.6	16,597.3	31,802.7
Upstream Emissions				
1	86.8	415.1	665.9	1,277.0
2	90.0	429.1	687.8	1,319.6
3	91.2	436.7	700.6	1,343.3
4	104.4	499.1	800.6	1,535.4
5	111.2	531.6	852.7	1,635.2
6	127.7	610.9	980.2	1,879.4
Total Emissions				
1	1,563.8	7,446.7	11,942.3	22,885.4
2	1,622.4	7,698.9	12,336.1	23,654.1
3	1,643.7	7,832.9	12,563.9	24,073.6
4	1,882.4	8,954.8	14,357.3	27,517.7
5	2,003.9	9,536.4	15,291.2	29,305.8
6	2,300.7	10,959.5	17,577.5	33,682.1

* 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 and Hg emissions reductions anticipated to result from amended ballast standards. Table V-49 presents the present value of cumulative NO_X emissions reductions for each TSL calculated using the average dollar-per-ton values at 7-percent and 3-percent discount rates.

Table V-49 Cumulative Present Value of NO_X Emissions Reduction for WICF TSLs (2017 through 2073)

TSL	3% discount rate	7% discount rate
	Million 2012$	
Power Sector Emissions		
1	219.7	96.3
2	227.7	101.0
3	231.0	100.9
4	264.4	116.2
5	281.5	123.6
6	323.3	141.4
Upstream Emissions		
1	240.1	105.4
2	249.4	110.5
3	252.3	110.5
4	289.1	127.2
5	307.7	135.3
6	353.1	154.8
Total Emissions		
1	459.8	201.6
2	477.1	211.4
3	483.3	211.4
4	553.5	243.5
5	589.2	258.9
6	676.5	296.3

Note: Present value of NOX emissions calculated with at $2,639 per ton.

The NPV of the monetized benefits associated with emissions reductions can be viewed as a complement to the NPV of the consumer savings calculated for each TSL considered in this NOPR.

Table V-50 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 columns of each table correspond to the four scenarios for the valuation of CO_2 emission reductions discussed above.

Table V-50 WICF 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	23.03	29.29	33.79	45.11
2	22.83	29.30	33.94	45.65
3	22.28	28.87	33.60	45.50
4	26.28	33.80	39.21	52.82
5	25.45	33.46	39.22	53.72
6	-44.22	-35.01	-28.39	-11.73
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	9.36	15.41	19.91	31.02
2	9.30	15.55	20.19	31.68
3	8.80	15.16	19.89	31.58
4	10.57	17.84	23.24	36.60
5	9.91	17.66	23.41	37.64
6	-26.86	-17.96	-11.34	5.01

Note: Low Value corresponds to \$468 per ton of NOX emissions. Medium Value corresponds to \$2,639 per ton of NOX emissions. High Value corresponds to \$4,809 per ton of NOX emissions.
* These label values represent the global SCC in 2015, in 2012\$. The present values have been calculated with scenario-consistent discount rates.

Although adding the value of consumer savings to the values of emission reductions provides a valuable perspective, the following should be considered: (1) the national consumer savings are domestic U.S. consumer monetary savings found in market transactions, while the values of emissions reductions are based on estimates of marginal social costs, which, in the case of CO_2, are based on a global value; and (2) the assessments of consumer savings and emission-related benefits are performed with different computer models, leading to different timeframes for analysis. For walk-ins, the present value of national consumer savings is measured for the period in which units shipped (2017–2046) continue to operate. However, the time frames of the benefits associated with the emission reductions differ. For example, the value of CO_2 emissions reductions reflects the present value of all future climate-related impacts due to emitting a ton of CO_2 in that year, out to 2300.

Chapter 15 of the NOPR TSD presents calculations of the combined NPV, including benefits from emissions reductions for each TSL.

7. Other Factors

Consistent with EPCA, DOE examined whether other factors might be relevant in determining whether the proposed standards are economically justified. See generally 42 U.S.C. 6295(o)(2)(B)(i)(VII). DOE identified none other than those discussed above.

DOE prepared a regulatory impact analysis (RIA) for this rulemaking, which is contained in the TSD. The RIA is subject to review by the Office of Information and Regulatory Affairs (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 quantitative 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 walk-in 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 analyzed these alternatives with reference to the particular market dynamics of the WICF industry.

DOE identified the following major policy alternatives for achieving increased WICF efficiency:

- No new regulatory action
- Commercial consumer tax credits
- Commercial consumer 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 consumers to voluntarily purchase at least some higher efficient at any of the trial standard levels

(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 TSD, Regulatory Impact Analysis, for further details.)

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

Commercial consumer tax credits. Consumer tax credits are considered a viable non-regulatory market transformation program. From a consumer 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 consumer to taxpayers as a whole. DOE, therefore, assumed that equipment costs in the consumer tax credits scenario were identical to the NIA base case.

Commercial consumer rebates. Consumer rebates cover a portion of the difference in incremental product price between products meeting baseline efficiency levels and those meeting higher efficiency levels, resulting in a higher percentage of consumers purchasing more efficient models and decreased aggregated energy use compared to the base case. Although a rebate program would reduce the total installed cost to the consumer, 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 consumer to taxpayers as a whole. Consequently, DOE assumed that equipment costs in the rebates scenario were identical to the NIA base case.

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 such 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 purchases would have very limited impact on improving the overall market efficiency of WICF equipment because they are a negligible part of the total. In the case of replacement incentives, several policy options exist to promote early replacement, including a direct national program of consumer incentives, incentives paid to utilities to promote an early replacement program, 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.

C. Proposed Standard

“When considering proposed standards, the new or amended energy conservation standard that DOE adopts for any type (or class) of walk-in coolers and freezers shall be designed to achieve the maximum improvement in energy efficiency that the Secretary of Energy determines is technologically feasible and economically justified. (42 U.S.C. 6313(f)(4)(A)) In determining whether a standard is economically justified, the Secretary must determine whether the benefits of the standard exceed its burdens to the greatest extent practicable, considering the seven statutory factors discussed previously. (42 U.S.C. 6295(o)(2)(B)(i) and 6316(a)) The new or amended standard must also “result in significant conservation of energy.” (42 U.S.C. 6295(o)(3)(B) and 6316(a))

DOE considered the impacts of 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 remainder of this section. DOE bases its discussion of each TSL on quantitative analytical results such as national energy savings, net present value (discounted at 3 and 7 percent), emissions reductions, industry net present value, life-cycle cost, and consumers' 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.

DOE has included a table below that presents 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. Section V.B presents the estimated impacts of each TSL on commercial customers and manufacturers, and subgroups thereof, as well as the Nation.

Table V-51 Summary of Results for WICF Refrigeration Systems and Envelope Components , TSLs 1-6

Category	TSL 1	TSL 2	TSL 3	TSL 4	TSL5	TSL6
National Full-Fuel Cycle Energy Savings (quads)						
Total-All	4.49	4.61	4.73	5.39	5.74	6.61
NPV of Consumer Benefits (2012$ billion)						
3% discount rate	21.4	21.1	20.6	24.3	23.3	-46.6
7% discount rate	7.8	7.6	7.1	8.6	7.9	-29.2
Industry Impacts						
Change in Industry NPV (2012$ million)	-60 to -1	-44 to 11	-108 to -23	-77 to 0	-134 to -19	-657 to 924
Change in Industry NPV (%)	-7 to 0	-5 to 1	-13 to -3	-9 to 0	-16 to -2	-77 to 109
Cumulative Emissions Reduction						
CO_2 (MMt)	248.2	255.2	261.4	298.0	317.5	365.5
NO_X (kt)	369.9	379.6	389.6	443.8	473.0	544.8
Hg (t)	0.5	0.5	0.6	0.6	0.7	0.8
SO_2 (kt)	316.0	325.1	332.7	379.5	404.3	465.3
N_2O (kt)	5.4	5.5	5.7	6.4	6.9	7.90
N_2O (kt CO_2 eq)@	1,600.0	1,634.5	1,687.2	1,917.5	2,044.5	2,357.9
CH_4 (kt)	1,188.84	1,222.70	1,251.90	1,427.56	1,521.10	1,750.57
CH_4 (kt CO_2 eq)@	29,720.25	30,566.82	31,296.66	35,688.0	38,026.65	43,763.14
Value of Cumulative Emissions Reduction*						
CO_2 (2012$ billion)*	1.56 to 22.89	1.62 to 23.65	1.64 to 24.07	1.88 to 27.52	2.00 to 29.31	2.41 to 33.68
NO_X – 3% discount rate (2012$ million)	460	477	483	553	589	676
NO_X – 7% discount rate (2012$ million)	202	211	211	243	259	296
LCC Savings (2012$) **						
Refrigeration Systems						
DC.M.I***	280	611	280	611	611	611
DC.M.O***	1,048	1,577	1,117	1,509	1,608	1,608
DC.L.I***	505	1,117	505	1,117	1,080	1,080
DC.L.O***	1,328	2,001	1,328	2,001	1,994	1,994
MC.M	1,715	1,724	1,715	1,724	1,715	1,715
MC.L	1,849	2,061	1,849	2,061	1,849	1,849
Envelope Components						
SP.M	16	0	-9	8	-22	-2,139
SP.L	122	0	-66	72	-140	-1,890
FP.L	66	0	-4	30	-65	-1,653
DD.M	239	228	239	228	222	-2,650
DD.L	217	200	-12	200	198	-1,717
PD.M	2	0	2	0	0	-884
PD.L	74	0	-16	52	-52	-665
FD.M	3	0	3	1	0	-1,157

Category	TSL 1	TSL 2	TSL 3	TSL 4	TSL5	TSL6
FD.L	152	0	28	136	-32	-1,337
PBP (years) [†]						
Refrigeration Systems						
DC.M.I***	3.2	4.4	3.2	4.4	4.4	4.4
DC.M.O***	1.3	2.5	1.8	2.0	3.0	3.0
DC.L.I***	2.8	2.7	2.8	2.7	3.1	3.1
DC.L.O***	1.2	2.3	1.2	2.3	2.8	2.8
MC.M	0.6	0.5	0.6	0.5	0.6	0.6
MC.L	2.5	0.4	2.5	0.4	2.5	2.5
Envelope Components						
SP.M	3.8	N/A	6.8	4.5	9.0	146.4
SP.L	2.9	N/A	7.4	3.6	10.0	43.0
FP.L	3.5	N/A	6.0	4.5	8.0	48.7
DD.M	2.1	2.2	2.1	2.2	2.2	37.6
DD.L	N/A	N/A	6.0	N/A	N/A	18.5
PD.M	4.5	N/A	4.5	5.5	6.0	78.7
PD.L	4.3	N/A	6.2	4.7	7.0	18.3
FD.M	4.5	N/A	4.5	5.4	5.9	81.5
FD.L	3.8	N/A	5.8	2.9	6.5	21.7
Distribution of Consumer LCC Impacts						
All Medium and Low Temperature Refrigeration Systems						
Net Cost (%)	0	0	0	0	1	1
No Impact (%)	0	0	0	0	0	0
Net Benefit (%)	100	100	100	100	99	99
All Medium and Low Temperature Panels						
Net Cost (%)	11	0	76	28	93	100
No Impact (%)	0	100	0	0	0	0
Net Benefit (%)	89	0	24	72	7	0
All Medium and Low Temperature Display Doors						
Net Cost (%)	0	0	4	0	0	100
No Impact (%)	0	0	0	0	0	0
Net Benefit (%)	100	100	96	100	100	0
All Medium and Low Temperature Passage Doors						
Net Cost (%)	23	0	39	45	67	100
No Impact (%)	0	100	0	0	0	0
Net Benefit (%)	77	0	61	55	33	0
All Medium and Low Temperature Freight Doors						
Net Cost (%)	16	0	39	28	65	100
No Impact (%)	0	100	0	0	0	0
Net Benefit (%)	84	0	61	72	35	0

* Range of the economic value of CO_2 reductions is based on estimates of the global benefit of reduced CO_2 emissions.
** For LCCs, DOE did not consider variability of input parameters and used fixed input values. For the panels the unit of analysis is 100 ft^2, for other items it is a single unit of a refrigeration system or a door.
***For DC refrigeration systems, results include both capacity ranges.
[†] For PBPs, DOE did not consider variability of input parameters and used fixed input values.
[@] CO2eq is the quantity of CO2 that would have the same global warming potential (GWP)

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 accelerating or altering investments in energy saving equipment. (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, it may be rational for consumers to trade off these types of investments at a higher than expected rate between current consumption and uncertain future energy cost savings. Some studies suggest that this seeming undervaluation may be explained in certain circumstances by differences between tested and actual energy savings, or by uncertainty and irreversibility of energy investments. There may also be "hidden" welfare losses to customers if newer energy efficient equipment is an imperfect substitute for the less efficient equipment it replaces. In the abstract, it may be difficult to say how a welfare gain from correcting potential under-investment in energy conservation compares in magnitude to the potential welfare losses associated with no longer purchasing equipment or switching to an imperfect substitute, both of which still exist in this framework.

While DOE is not prepared at present to provide a fully quantifiable framework for estimating the benefits and costs of changes in consumer purchase decisions due to an 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.[35] 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 how to more fully assess the potential impact of energy conservation standards on consumer choice and how to quantify this impact in its regulatory analysis in future rulemakings. In particular, DOE requests comment on whether there are features or attributes of the more energy efficient walk-in coolers and walk-in freezers that manufacturers would produce to meet the standards in this proposed rule that might affect the welfare, positively or negatively, of consumers who purchase WICFs.

First, DOE considered TSL 6, the max tech level for WICF refrigeration systems and the covered envelope components combined together. TSL 6 would save

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[35] Alan Sanstad, Notes on the Economics of Household Energy Consumption and Technology Choice. Lawrence Berkeley National Laboratory. 2010. http://www1.eere.energy.gov/buildings/appliance_standards/pdfs/consumer_ee_theory.pdf

an estimated 6.61 quads of energy through 2073, an amount DOE considers significant. For the Nation as a whole, DOE projects that TSL 6 would have a negative NPV for consumers, i.e., result in increased costs of $29.2 billion, using a discount rate of 7 percent. The emissions reductions at TSL 6 are 365.5 MMt of CO_2, up to 545 kt of NO_x, 465 kt of SO_2, and up to 0.8 tons of Hg. These reductions are valued from $2.41 to $33.68 billion for CO_2. For NOx the emissions reductions are valued at $296 million at a discount rate of 7 percent.

At TSL 6, DOE projects that consumers of WICF envelope components will experience an increase in LCC, ranging from $665 (low temperature passage door) to $2,650 (medium temperature display door) compared to the baseline. For refrigeration systems, however, DOE estimates that consumers would experience a decrease in LCC ranging from $611 to $1,994.

At TSL 6, manufacturers 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 $657 million to an increase of $924 million based on DOE's manufacturer mark-up scenarios. The upper bound of $924 million is considered an optimistic scenario by manufacturers because it assumes manufacturers can fully pass on substantial increases in product costs. DOE recognizes the risk of large negative impacts on industry if manufacturers' expectations concerning reduced profit margins are realized. TSL 6 could reduce the walk-in refrigeration, panel, and door INPV by up to 77 percent, if the most negative impacts are realized.

After carefully considering the analysis and weighing the benefits and burdens of TSL 6, DOE finds that the benefits to the Nation of TSL 6 (i.e., energy savings and emissions reductions (including environmental and monetary benefits)) are small compared to the burdens (i.e., a decrease of $29.2 billion in NPV and a decrease of 77 percent in INPV). Because the burdens of TSL 6 far outweigh the benefits, TSL 6 is not economically justified. Therefore, DOE is not proposing to adopt TSL 6.

DOE then considered TSL 5, which combines refrigeration systems and envelope components at the highest efficiency level for each that would generate positive NPV to the Nation. TSL 5 would likely save an estimated 5.74 quads of energy through 2073, an amount DOE considers significant. For the Nation as a whole, DOE projects that TSL 5 would result in a net increase of $7.9 billion in NPV, using a discount rate of 7 percent. The estimated emissions reductions at TSL 5 are 317.5 MMt of CO_2, up to 473 kt of NO_x, 404 kt of $SO_{2,}$ and up to 0.7 tons of Hg. These reductions are valued from $2.00 to $29.31 billion for CO_2. For NOx the emissions reductions are valued at $259 million at a discount rate of 7 percent.

At TSL 5, DOE projects that the customers of WICF equipment will experience an increase in LCC for panels and low temperature passage and freight doors and either unchanged or decreased LCC for display doors and medium temperature passage and freight doors. For the refrigeration systems, DOE estimates that the consumers would experience a decrease in LCC ranging from $611 to $1,994.

At TSL 5, the projected change in INPV ranges from a decrease of $134 million to a decrease of $19 million. At TSL 5, DOE recognizes the risk of negative impacts if manufacturers' expectations concerning reduced profit margins are realized. If the negative end of the range of impacts is reached as DOE expects, TSL 5 could result in a net loss of 16 percent in INPV to the walk-in cooler and freezer industry. Additionally, DOE is concerned about TSL 5 causing disproportionate burdens on small business panel manufacturers, as explained in the Regulatory Flexibility analysis in section VI.B.4.

After carefully considering the analysis and weighing the benefits and burdens of TSL 5, DOE finds that the benefits to the Nation at TSL 5 (i.e., energy savings and emissions reductions (including environmental and monetary benefits)) are too low compared to the burdens (i.e., a decrease of 16 percent in INPV for the walk-in cooler and freezer industry with disproportionate impacts on the panel industry). Because the burdens of TSL 5 outweigh the benefits, TSL 5 is not economically justified. Therefore, DOE is not proposing TSL 5.

Next, DOE considered TSL 4, which combines the refrigeration systems at the maximum NPV level with the envelope components also at the maximum NPV level.

TSL 4 would likely save an estimated 5.39 quads of energy through 2073, an amount DOE considers significant. For the Nation as a whole, DOE projects that TSL 4 would result in a net increase of $8.6 billion in NPV, using a discount rate of 7 percent. The estimated emissions reductions at TSL 4 are 298 MMt of CO_2, up to 444 kt of NO_x, 379.5 kt of SO_2, and up to 0.6 tons of Hg. These reductions are valued from $1.88 to $27.52 billion for CO_2. For NOx the emissions savings are valued at $243 million at a discount rate of 7 percent.

At TSL 4, DOE projects that consumers of WICF equipment will experience a decrease of LCC for all equipment classes. At TSL 4, the projected change in INPV ranges from a decrease of $77 million to an increase of $0.01 million. At TSL 4, DOE recognizes the risk of negative impacts if manufacturers' expectations concerning reduced profit margins are realized. If the negative end of the range of impacts is reached as DOE expects, TSL 4 could result in a net loss of 9 percent of INPV to walk-in manufacturers.

After carefully considering the analysis and weighing the benefits and burdens of TSL 4, DOE tentatively believes that setting levels for both the refrigeration system and envelope components at TSL 4 represents the maximum improvement in energy efficiency that DOE's analysis projects to be technologically feasible and economically justified. TSL 4 is technologically feasible because the technologies required to achieve these levels are already in existence. TSL 4 is economically justified because the benefits to the Nation (i.e., increased energy savings of 5.39 quads, emissions reductions including environmental and monetary benefits of, for example, 298 MMt of carbon dioxide emissions reduction with an associated value of up to $27.52 billion at a discount rate of 3 percent, and an increase of $8.6 billion in NPV) outweigh the costs (i.e., a decrease of 9 percent in INPV).

Therefore, DOE has tentatively decided to propose the adoption of energy conservation standards at TSL 4 for WICF refrigeration systems and the considered envelope components. DOE may re-examine this level depending on the nature of the information it receives during the comment period and make adjustments to 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 walk-in cooler and freezer 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 walk-in coolers and freezers that are not captured by the users of such equipment. These benefits include externalities related to environmental protection that are not reflected in energy prices, such as reduced emissions of greenhouse gases.

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 a regulatory impact analysis (RIA) on today's rule and that the Office of Information and Regulatory Affairs (OIRA) in the Office of Management and Budget (OMB) review this rule. DOE presented to OIRA for review the proposed 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 technical support document for this rulemaking.

DOE has also reviewed this proposed regulation pursuant to Executive Order 13563, issued on January 18, 2011 (76 FR 3281, Jan. 21, 2011). EO 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, the Office of Information and Regulatory Affairs 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 an initial regulatory flexibility analysis (IRFA) for any rule that by law must be proposed for public comment, unless the agency certifies that the rule, if promulgated, will not have a significant economic impact on a substantial number of small entities. As required by Executive Order 13272, "Proper Consideration of Small Entities in Agency Rulemaking," 67 FR 53461 (August. 16, 2002), DOE published procedures and policies on February 19, 2003 to ensure that the potential impacts of its rules on small entities are properly considered during the rulemaking process. 68 FR 7990. DOE has made its procedures and policies available on the Office of the General Counsel's website (http://energy.gov/gc/office-general-counsel).

For manufacturers of walk-in coolers and freezers, the Small Business Administration (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 North American Industry Classification System (NAICS) code and industry description and are available at http://www.sba.gov/idc/groups/public/documents/sba_homepage/serv_sstd_tablepdf.pdf . Walk-in cooler and freezer 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 fewer for an entity to be considered as a small business for this category.

DOE determined that it could not certify that the proposed rule, if promulgated, would not have a significant effect on a substantial number of small entities that manufacture WICF panels and doors. Therefore, DOE has prepared an IRFA (sections VI.B.1 through VI.B.6 below) for this rulemaking. The IRFA describes potential impacts on small businesses associated with walk-in cooler and freezer energy conservation standards.

1. Reasons for the Proposed Rule

Title III of the Energy Policy and Conservation Act of 1975, as amended, (EPCA or the Act) sets forth a variety of provisions designed to improve energy efficiency. Part B of Title III (42 U.S.C. 6291–6309) provides for the Energy Conservation Program for Consumer Products Other Than Automobiles. The National Energy Conservation Policy Act (NECPA), Public Law 95–619, amended EPCA to add Part C of Title III, which established an energy conservation program for certain industrial equipment. (42 U.S.C. 6311– 6317) (For purposes of codification in Title 42 of the U.S. Code, these parts were subsequently redesignated as Parts A and A–1, respectively, for editorial reasons.) Section 312 of the Energy Independence and Security Act of 2007 (EISA 2007) further amended EPCA by adding certain equipment to this energy conservation program, including walk-in coolers and walk-in freezers (collectively ‘‘walk-in equipment’’ or ‘‘walk-ins’’), which are the subject of this rulemaking. (42 U.S.C. 6311(1), (20), 6313(f) and 6314(a)(9)) The proposed rule would establish energy conservation standards for walk-in coolers and walk-in freezers.

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

EPCA provides that DOE must publish performance-based standards for walk-in coolers and walk-in freezers that achieve the maximum improvement in energy that is technologically feasible and economically justified. (42 U.S.C. 6313(f)(4)(A)) However, in general, DOE may not adopt any standard that would not result in the significant conservation of energy. (42 U.S.C. 6295(o)(3)) (Regarding provisions contained only in the consumer products section of the U.S. Code, DOE is proposing to apply those provisions to walk-in coolers and walk-in freezers in the same manner.) Moreover, DOE may not prescribe a standard: (1) for certain products, including walk-in coolers and freezers, 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)) In deciding whether a proposed standard is economically justified, DOE must determine whether the benefits of the standard exceed its burdens after receiving comments on the proposed standard. (42 U.S.C. 6295(o)(2)(B)(i)) To determine whether economic justification exists, DOE reviews comments received and conducts analysis to determine whether DOE must make this determination, and by considering, to the greatest extent practicable, the seven factors set forth in 42 U.S.C.6295(o)(2)(B) (see section II of this preamble).

EPCA also states that the Secretary may not prescribe 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), 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)) Further information concerning the background of this rulemaking is provided in chapter 1 of the TSD.

3. Description and Estimated Number of Small Entities Regulated

DOE used available public information and information from confidential interviews to identify potential small manufacturers. DOE's research involved industry trade association membership directories (including AHRI and NAFEM), the NSF Section 7 certification database, individual company websites, and marketing research tools (e.g., Dun and Bradstreet reports) to create a list of companies that manufacture or sell walk-in cooler or freezer panels, doors, and refrigeration systems 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 previous DOE public meetings. DOE reviewed the 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 WICF equipment. DOE screened out companies that did not offer products covered by this rulemaking, did not meet the definition of a ‘‘small business,’’ or are foreign owned and operated.

Based on this information, DOE identified 52 panel manufacturers and found 42 of the identified panel manufacturers to be small businesses. As part of the MIA interviews, the Department interviewed nine panel manufacturers, including three small business operations. During MIA interviews, multiple manufacturers claimed that there are "hundreds of two-man garage-based operations" that produce WICF panels in small quantities. They asserted that these small manufacturers do not typically comply with EISA 2007 standards and do not obtain UL or NSF certifications for their equipment. DOE was not able to identify these small businesses and did not consider them in its analysis. Based on the purported number of small panel manufacturers and the potential scope of the impact (as described in section VI.B.4 below), DOE could not certify that the proposed standards would not have a significant impact on a substantial number of small businesses with respect to the panel industry.

DOE identified 59 walk-in door manufacturers. Fifty-five of those produce solid doors and four produce display doors. Of the fifty-five solid door manufacturers, fifty-two produce panels as their primary business and are considered in the category of panel manufacturers above. The remaining three solid door manufacturers are all considered to be small businesses. Of the four display door manufacturers, two are considered small businesses. Therefore, of the seven manufacturers that exclusively produce WICF doors (three producing solid doors and four producing display doors), DOE determined that five are small businesses. As part of the MIA interviews, the Department interviewed six door manufacturers, including four small business operations. Based on the large proportion of small door manufacturers in the door market and the potential scope of the impact (as described in section VI.B.4 below), DOE could not certify that the proposed standards would not have a significant impact on a large number of small businesses with respect to the door industry.

DOE identified nine refrigeration system manufacturers in the WICF industry. Based on publicly available information, two of the manufacturers are small businesses. One small business focuses on large warehouse refrigeration systems, which are outside the scope of this rulemaking. However, at its smallest capacity, this company's units can be sold to the walk-in market. The other small business specializes in building evaporators and unit coolers for a range of refrigeration applications, including the walk-in market. As part of the MIA interviews, the Department interviewed five refrigeration manufacturers, including the two small business operations. Both small businesses expressed concern that the rulemaking would negatively impact their businesses and one small business indicated it would exit the walk-in industry as a result of any standard that would directly impact walk-in refrigeration system energy efficiency. However, due to the small number of small businesses that manufacture WICF refrigeration systems and the fact that only one of two focuses on WICF refrigeration as a key market segment and constitutes a very small share of the overall walk-in market, DOE certifies that the proposed standards would not have a significant impact on a substantial number of small businesses with respect to the refrigeration equipment industry.

4. Description and Estimate of Compliance Requirements

Given the significant role of small businesses in the walk-in panel and walk-in door industries, DOE provides a detailed analysis of the impacts of the proposed standard on these industries below.

Panels

In the walk-in industry, panel manufacturers typically use the same production lines to manufacture all three equipment classes (SP.M, SP.L, and FP.L). The equipment class with the most stringent standard drives conversion costs. The design options considered include reducing heat loss through the panel frame (typically by using high density polyurethane framing materials or by moving to a frameless design), increasing the thickness of panels, and incorporating vacuum-insulated technology.

Small manufacturers tend to be at a disadvantage when adapting to a new standard requiring fixed cost investments. Small manufacturers may have greater difficulty obtaining credit or may obtain less favorable terms than larger competitors when capital expenditures are necessary to meet the standard. Additionally, product testing costs stemming from the energy conservation standard tend to be fixed and do not scale with sales volume. As a result, these product conversion costs would be the same in absolute terms for small and large panel manufacturers. The small businesses would have to recoup these over smaller sales volumes, leading to higher per unit costs and potentially putting them at a pricing disadvantage. The projected conversion cost impacts on panel manufacturers are shown in Table VI-1 and Table VI-2 below.

Table VI-1 Impacts of Conversion Costs on a Small Panel Manufacturer

	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 Operating Income
TSL 1	565%	122%	9%	242%
TSL 2	0%	0%	0%	0%
TSL 3	1695%	230%	26%	669%
TSL 4	565%	122%	9%	242%
TSL 5	1695%	230%	26%	669%
TSL 6	5461%	995%	87%	2262%

Table VI-2 Impacts of Conversion Costs on a Large Panel Manufacturer

	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 Operating Income
TSL 1	22%	5%	0%	9%
TSL 2	0%	0%	0%	0%
TSL 3	66%	9%	1%	26%
TSL 4	22%	5%	0%	9%
TSL 5	66%	9%	1%	26%
TSL 6	213%	39%	3%	88%

At the proposed standard (TSL 4), the engineering analysis suggests that manufacturers would shift to high density rails for all products to achieve the minimum U-factors. The capital conversion costs would be 565% of the typical annual capital expenditures for a small manufacturer while only 22% of the typical annual capital expenditures for a large manufacturer. The product conversion costs would be 122% of the typical small manufacturer's annual R&D budget and only 5% of the typical large manufacturer's annual R&D budget.

In addition to these conversion cost impacts, small manufacturers typically have a significant price disadvantage for raw materials, such as foaming agents. Any standard that requires small manufacturers to use more insulation or add a different foam formulation for high density rails will accentuate the difference in material costs for large manufacturers versus small manufacturers.

Based on the large number of small panel manufacturers and the potential scope of the impact (as described in section VI.B.2 below), DOE could not certify that the proposed standards would not have a significant impact on a substantial number of small businesses with respect to the panel industry.

Doors

For the walk-in door industry, DOE identified seven small manufacturers that produce doors as their primary product, as described in section VI.B.4. Three companies produce solid doors and four companies produce display doors.

In the solid door market, all three manufacturers of customized passage doors and freight doors are small. The potential impacts on these three manufacturers are illustrated in Table VI-3.

Table VI-3 Impacts of Conversion Costs on a Small Solid Door Manufacturer

	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 Operating Income
TSL 1	52%	47%	2%	25%
TSL 2	0%	0%	0%	0%
TSL 3	626%	47%	5%	63%
TSL 4	157%	47%	2%	25%
TSL 5	626%	47%	5%	63%
TSL 6	4086%	142%	27%	369%

At the proposed standard (TSL 4), the engineering analysis suggests that manufacturers would shift to high density frames to achieve the minimum energy consumption for all solid doors. Additionally, for low-temperature passage doors, manufacturers would need to incorporate enhanced windows to reduce heat transmission; manufacturers of low-temperature freight doors would need to add controls to minimize anti-sweat heater energy usage. The capital conversion costs would be 157% of the typical annual capital expenditures for a small manufacturer and the product conversion costs would be 47% of the typical manufacturer's annual R&D budget.

In the display door market, two of the four manufacturers are small. If conversion costs for display door manufacturers were large, the small manufacturers could be at a disadvantage due to the fixed investments necessary for capital conversion and product conversion costs. However, as illustrated in Table VI-4, conversion costs for display door manufacturers are negligible for most TSLs. This is because the considered design options primarily consist of component swaps and component additions. To make these design changes, no costly equipment or tooling is necessary. As a result, the conversion costs do not cause small businesses to be at a significant disadvantage relative to larger businesses when adapting to the proposed standard.

Table VI-4 Impacts of Conversion Costs on a Small Display Door Manufacturer

	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 Operating Income
TSL 1	0%	2%	0%	0%
TSL 2	0%	2%	0%	0%
TSL 3	0%	2%	0%	0%
TSL 4	0%	2%	0%	0%
TSL 5	0%	2%	0%	0%
TSL 6	501%	19%	3%	20%

Table VI-5 Impacts of Conversion Costs on a Large Display Door Manufacturer

	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 Operating Income
TSL 1	0%	0%	0%	0%
TSL 2	0%	0%	0%	0%
TSL 3	0%	0%	0%	0%
TSL 4	0%	0%	0%	0%
TSL 5	0%	0%	0%	0%
TSL 6	88%	3%	0%	4%

At the proposed standard (TSL 4), the engineering analysis suggests that manufacturers would need to purchase more efficient components, such as LED lights, and incorporate anti-sweat heater controllers. There are no anticipated capital conversion costs, and product conversion costs appear to be manageable for both small and large businesses door manufacturers.

Based on the number of small door manufacturers and the potential scope of the impact on solid door manufacturers, DOE could not certify that the proposed standards would not have a significant impact on a significant number of small businesses with respect to the walk-in door industry.

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

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

6. Significant Alternatives to the Proposed Rule

The primary alternatives to the proposed rule considered by DOE are the other TSLs besides the one being considered today, proposed TSL 4. DOE explicitly considered the role of small businesses 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, including small manufacturers, of walk-in refrigeration, panels, and doors. In particular, DOE considered the increase in conversion costs and potential negative impacts on small businesses that occurred between TSL 4 and TSL 5 for the solid door and panel industries, which have a significant number of small businesses. As another alternative to the proposed standard, DOE also considered lower TSLs; in particular, TSL 1, which does not set standards for panels and non-display doors. Chapter 12 of the TSD contains additional information about the impact of this rulemaking on manufacturers.

In addition to the other TSLs considered, alternatives to the proposed rule include the following policy alternatives: (1) no new regulatory action, (2) commercial consumer rebates, and (3) commercial consumer tax credits. Chapter 17 of the TSD associated with this proposed rule includes a report referred to in Section VI.A in the preamble as the regulatory impact analysis (RIA). The energy savings of these regulatory alternatives are one to two orders of magnitude smaller than those expected from the standard levels under consideration. The range of economic impacts of these regulatory alternatives is an order of magnitude smaller than the range of impacts expected from the standard levels under consideration.

C. Review Under the Paperwork Reduction Act

Manufacturers of walk-in coolers and freezers 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 walk-in coolers and freezers, 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 walk-in coolers and freezers. 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

DOE has prepared a draft environmental assessment (EA) of the impacts of the proposed rule pursuant to the National Environmental Policy Act of 1969 (42 U.S.C. 4321 et seq.), the regulations of the Council on Environmental Quality (40 CFR parts 1500–1508), and DOE's regulations for compliance with the National Environmental Policy Act of 1969 (10 CFR part 1021). This assessment includes an examination of the potential effects of emission reductions likely to result from the rule in the context of global climate change, as well as other types of environmental impacts. The draft EA has been incorporated into the NOPR TSD as chapter 15. Before issuing a final rule for walk-in coolers and freezers, DOE will consider public comments and, as appropriate, determine whether to issue a finding of no significant impact (FONSI) as part of a final EA or to prepare an environmental impact statement (EIS) for this rulemaking.

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. See 42 U.S.C. 6316(h)(1)(A)(2), 42 U.S.C. 6316(h)(2)(B), and 42 U.S.C. 6316(h)(3). 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. Pub. L. 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 walk-in cooler and freezer 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 walk-in coolers and freezers, 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 the NOPR and the "Regulatory Impact Analysis" section of the TSD for this proposed rule respond to those requirements.

Under section 205 of UMRA, the Department is obligated to identify and consider a reasonable number of regulatory alternatives before promulgating a rule for which a written statement under section 202 is required. 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. 6313(f)(4)(A), today's proposed rule would establish energy conservation standards for walk-in coolers and walk-in freezers 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 energy conservation standards for walk-in coolers and freezers, 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.

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 or projects. The "Energy Conservation Standards Rulemaking Peer Review Report" dated February 2007 has been disseminated and is available at the following website: 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. Persons 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 website at: http://www1.eere.energy.gov/buildings/appliance_standards/rulemaking.aspx/ruleid/30. 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 webpage 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 website will waive any CBI claims for the information submitted. For information on submitting CBI, see the Confidential Business Information section.

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 or 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 or 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 that 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. Component Level Standards

In this NOPR, DOE proposes to set separate standards for the panels, display doors, non-display doors, and refrigeration system of a walk-in, but is not proposing to establish an overall performance standard for the envelope or for the walk-in as a whole. DOE requests that interested parties submit comments about this approach. See section III.A for further details.

2. Market Performance Data

As part of the market assessment, DOE collects information that provides an overall picture of the market for the walk-in coolers and freezers. DOE's analysis of market data uses catalogue and performance data to determine the number of products on the market at varying efficiency levels. However, WICF equipment has not previously been rated for efficiency by manufacturers, nor has an efficiency metric been established for the equipment. DOE requests that interested parties submit market performance data to help inform DOE's analysis. See section IV.A for further details.

3. Definitions

In this NOPR, DOE proposes to amend the existing definition of display door and to add definitions of passage door and freight door, as follows.

DOE proposes to amend the existing definition of display door to include all doors that are composed of 50 percent or more glass or another transparent material. This amendment is intended to classify passage doors that are mostly composed of glass as display doors because the utility and construction of glass passage doors more closely resemble that of a display door. DOE proposes the following amended definition of display door: "Display door means a door that – (1) is designed for product display; or (2) has 50 percent or more of its surface area composed of glass or another transparent material." The amended definition would affect both the test procedure (by potentially subjecting a broader range of equipment to testing) and the energy conservation standards. DOE requests comment on the proposed definition of display door.

DOE is also proposing a definition for passage doors in order to differentiate passage doors from freight doors. Passage doors are mostly intended for the passage of people and small machines such as hand carts. DOE proposes the following definition of passage door: "Passage door means a door that is used as a means of access for people and is less than 4 feet wide and 8 feet tall." DOE requests comment on the proposed definition of passage door.

Freight doors tend to be larger than passage doors and are typically used to allow machines, such as forklifts, into walk-ins. DOE is proposing a definition of "freight door" to distinguish it from a passage door. DOE proposes the following definition of freight door: "Freight door means a door that is not a passage door and is equal to or larger than 4 feet wide and 8 feet tall." DOE requests comment on the proposed definition of freight door.

See section IV.A.1 for further information on the definitions.

4. Equipment Included in the Rulemaking

DOE proposes not to include certain types of equipment in the rulemaking analysis. DOE identified three types of panels used in the walk-in industry: display panels, floor panels, and non-floor panels. Based on its research, DOE determined that display panels, typically found in beer caves (walk-ins used for the display and storage of beer or other alcoholic beverages often found in a supermarket) make up a small percentage of all panels currently present in the market. Therefore, because of the extremely limited energy savings potential currently projected to result from amending the requirements that these panels must meet, DOE is not proposing standards for walk-in display panels in this NOPR. Also, DOE is declining to set a performance-based standard for walk-in cooler floor panels. All other types of panels, freezer floor and non-floor, will be subject to a performance standard. DOE requests comment on this approach and requests market data to better understand the market share of display panels and walk-in cooler floor panels.

DOE also proposes not to include blast freezer refrigeration systems, which are designed to quickly freeze food and then store it at a holding temperature, in this rulemaking analysis. DOE received comments regarding the performance difference and the higher energy consumption of blast freezers as compared to storage freezers. DOE questions whether blast freezer refrigeration systems would be less efficient than storage freezers and seeks information regarding whether blast freezers would face difficulty in complying with DOE's proposed standards. Furthermore, if blast freezers cannot comply with those proposed standards, DOE requests test procedure data confirming the same. See section IV.A.2 for details.

5. Type of Refrigerant Analyzed

DOE based its analysis on refrigeration equipment using R404A, a hydrofluorocarbon (HFC) refrigerant, as it is widely used in the walk-ins industry. DOE received comments supporting the use of HFC refrigerants, but also suggested considering refrigerants with lower global warming potential (GWP) due to the shift in the marketplace toward these products. 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. DOE requests comment on the extent of current use or future availability of lower GWP refrigerants and asks manufacturers and chemical producers to submit data related to the ability of equipment (existing or redesigned) using HFC alternative refrigerants to meet the proposed standard. See section IV.A.2.b for further details. DOE also requests data and evidence to support estimates of the cost of any incremental technology or equipment redesign that may be needed in order to compensate for any energy efficiency losses associated with the use of alternative refrigerants to meet the standards proposed in this notice.

6. Refrigeration Classes

DOE has proposed separate classes for dedicated condensing refrigeration systems and unit coolers connected to multiplex condensing systems. However, DOE does not propose to create separate classes for dedicated packaged systems (where the unit cooler and condensing unit are integrated into a single piece of equipment) and dedicated split systems (where the unit cooler and condensing unit are separate pieces of equipment connected by refrigerant piping). Due to the small market share of packaged systems, DOE proposes to base the standard for dedicated condensing systems on an analysis of split systems. DOE requests comment on its proposal not to consider dedicated packaged systems and dedicated split systems as separate classes, and specifically asks whether this proposal would unfairly disadvantage any manufacturers.

In addition, DOE proposes one standard level for high-capacity equipment and another for low-capacity equipment within the dedicated condensing category (because the compressor is covered only for DC systems). High- and low-capacity equipment would thus also be considered different equipment classes, with the classes divided at a threshold of 9,000 Btu/h. DOE requests comment on this proposal, particularly the capacity threshold between high- and low-capacity equipment.

See section IV.A.3.b for details about the refrigeration system equipment classes.

7. Cycle Efficiency

DOE considered design options manufacturers could use to improve cycle efficiency; for example, economizer cooling. In the screening analysis, DOE screened out economizer cooling based on utility to the consumer, one of the four screening criteria. Specifically, economizer cooling is not effective in areas of the country where the temperature does not drop below a walk-in's temperature. DOE did not identify any other options to improve cycle efficiency beyond what was already considered. However, DOE realizes that there may be other methods and designs manufacturers could use to improve cycle efficiency and requests specific recommendations on such methods and designs, as well as how they could be incorporated into the analysis of standard levels. See section IV.B.2.b for details.

8. Envelope Representative Sizes

DOE used three different panel sizes to represent the variation in panels within each equipment class. DOE determined the sizes based on market research and calculated the impact of size on the test metric, U-factor. DOE requests comment on the representative sizes used in the analysis and whether other sizes should be considered.

Similar to panels, DOE used three different sizes to represent the differences in doors within each class for walk-in display and non-display doors. The sizes of the doors were determined by market research, and can be found in section IV.C.1.a for display and non-display doors. DOE requests comment on the representative equipment sizes analyzed in the proposed analysis. See section IV.C.1.a for further details.

9. Performance Data for Envelope Components

DOE's engineering model separately analyzes panels, display doors, and non-display doors. The models estimate the performance of the baseline equipment and levels of performance above the baseline associated with specific design options that are added cumulatively to the baseline equipment. Results for performance of all components can be found in appendix 5A of the TSD. DOE requests comment on the performance data and requests any data manufacturers can provide about the performance of panels, display doors, or non-display doors and their design options. See section IV.A for further details.

10. Refrigeration Metric

The refrigeration energy model calculates the annual energy consumption and the Annual Walk-in Energy Factor (AWEF) of walk-in coolers and freezers at various performance levels using a design option approach. AWEF is the ratio of the total heat, not included in the heat generated by the operation of the refrigeration system, removed, in Btu, from a walk-in box during a one-year period of usage to the total energy input of refrigeration systems, in watt-hours, during the same period. DOE proposes using AWEF as the metric to set standards for the refrigeration system and requests comment on this proposal. See section IV.C.2.a for further details.

11. Manufacturing Markups

DOE calculated the manufacturer's selling price of the walk-in cooler and freezer equipment by multiplying the manufacturer's production cost by a markup and adding the equipment's shipping cost. The markup affects the manufacturer's selling price, which is a critical input to the downstream economic analyses. DOE calculated an average markup for panels to be 32 percent, for display doors to be 50 percent, for non-display doors to be 62 percent, and for refrigeration to be 35 percent. DOE requests comment on the proposed markups. See section IV.C.3.d for further details.

12. Envelope Component Shipping Prices

DOE has found through its research that most panel, display door, and non-display door manufacturers use less than truck load freight to ship their respective components. DOE also found that typically none of the manufacturers mark up the shipments for profit, and instead include the cost of shipping as part of the price quote. DOE has conducted its analysis accordingly and requests comment on the shipping prices found in chapter 5 of the NOPR TSD. See section IV.C.3.e for further details.

13. Panel and Door Baseline Assumptions

In the NOPR analysis, DOE used wood framing members as the baseline framing material in panels. DOE's analysis assumes the typical wood frame completely borders the insulation and is 1.5 inches wide. DOE requests comment on its baseline specifications for walk-in panels, specifically the assumptions about framing material and framing dimensions.

DOE assumed that the baseline non-display doors are constructed in a similar manner to baseline panels. Baseline non-display doors consist of wood framing materials 1.5 inches wide that completely border foamed-in-place polyurethane insulation. For non-display doors, DOE also proposes to include a 2.25 ft^2 window that conforms to the standards set by EPCA on all non-display passage doors regardless of the passage door's size. DOE analyzed two different size windows for non-display freight doors. DOE assumed that a small freight door has a 2.25 ft^2 window and that both medium and large freight doors have 4 ft^2 windows. DOE requests comment on the baseline specifications for non-display doors, specifically on the size of the windows included in the baseline door.

DOE made several assumptions about baseline display doors in its analysis. First it assumed that baseline display cooler doors are composed of two panes of glass with argon gas fill and hard coat low-e coating. Second, DOE assumed that the baseline cooler display door requires 2.9 W/ft^2 of anti-sweat heater wire and does not have a heater wire controller. Baseline display freezer doors in DOE's analysis are composed of three panes of glass, argon gas, and soft coat low-e coating. Third, DOE assumed that baseline freezer doors use 15.23 W/ft^2 of anti-sweat heater wire power and require an anti-sweat heater wire controller. Finally, DOE assumed that each baseline door is associated with one fluorescent light with an electronic ballast, and that a door shorter than 6.5 feet has a 5-foot fluorescent bulb and a door equal to or taller than 6.5 feet has a 6-foot fluorescent bulb. DOE requests comment on the baseline assumptions for display cooler and freezer doors. In particular, DOE requests data illustrating the energy or power consumption of anti-sweat heaters found on cooler and freezer display doors.

See section IV.C.4.a for further details on the baseline assumptions.

14. Condensing Unit and Unit Cooler Components

In its analysis of baseline equipment, DOE included all necessary components of the refrigeration system that came from the manufacturer. However, DOE has tentatively decided against including components in its engineering analysis that are not specifically part of the unit cooler or condensing unit; for example, refrigerant piping connecting a unit cooler to a multiplex condensing system. DOE assumes that these are not included in the manufacturer's selling price of the equipment, and would be supplied by the contractor upon installation. DOE requests comment on this assumption. See section IV.C.4.b for further details.

15. Refrigeration Temperature Difference Assumption

In determining appropriate temperature set points, DOE considered information from various sources in formulating its assumptions: comments, research, and confidential and non-confidential discussions with manufacturers and other parties. DOE notes that the ambient temperature specified in the test procedure is 90 or 95 degrees for indoor and outdoor condensing units, respectively. Given that the system must maintain a reasonable temperature difference (TD) between the SCT and the ambient temperature, the SCT during the test procedure would be higher than the 90-–95 degree assumption recommended. Even though the set point during actual use may be lower, equipment is rated—and evaluated for meeting the standard—at the test procedure rating points. DOE requests comment on this assumption, particularly whether the TDs for baseline and higher efficiency equipment are appropriate. See section IV.C.4.b for further details.

16. Panel Design Options

In the proposed engineering analysis for walk-in panels, DOE included design options that increase the baseline insulation thickness, change the baseline insulation material from foam-in-place polyurethane to a hybrid of polyurethane and VIP, change the baseline framing material from wood to high-density polyurethane, and eliminate a non-floor-panel's framing material. DOE proposes that floor panels must retain some type of framing material, and that high-density polyurethane framing materials found in a panel have the same dimensions as the wood framing materials. DOE requests comment on the design options for panels, including the specifications for high-density polyurethane framing materials, manufacturer conversion costs for increasing the baseline panel thickness, and any estimated changes in repair, maintenance, or installation costs. DOE also requests comment on the technological feasibility of the panel options analyzed and whether the design options selected would cause any lessening of the utility or the performance of the walk-ins. See section IV.C.5.a for further details.

17. Display and Non-Display Door Design Options

The design options that DOE proposes for display doors include improved glass packs, anti-sweat heater controls for cooler doors, LED lighting, and lighting sensors. DOE does not propose anti-sweat heater controls for freezer display doors because baseline freezer doors are required to have a controller due to the amount of power consumed by the anti-sweat heater wire. DOE requests comment on the proposed design options, specifically any heat transfer data for the improved glass packs detailed in chapter 5 of the TSD.

The design options that DOE proposes for non-display doors include increased insulation thickness, changing the insulation material from baseline to a hybrid of polyurethane and VIP, changing the baseline framing material from wood to high-density polyurethane, improving the window's glass pack, and adding an anti-sweat heater wire controller to the door. DOE requests comment on the proposed design options for non-display doors, and specifically requests comment on the manufacturer conversion investments required to update product designs and manufacturing lines in order to product compliant products; information regarding any changes in repair, maintenance, or installation costs of the window improvements detailed in chapter 5 of the TSD. DOE also requests comment on the technological feasibility of the panel options analyzed and whether the design options selected would cause any lessening of the utility or the performance of the walk-ins.

See section IV.C.5.a and chapter 5 of the TSD for further details on the display and non-display door design options.

18. Refrigeration System Design Options

DOE is proposing to include the use of improved condenser coils as a design option, wherein the condenser coil increases by a certain percentage from its original size. After performing analytical calculations, DOE tentatively believes that increasing the coil size of the condenser would not require an increase in the coil size of the evaporator. However, DOE requests comment on this assumption, particularly from manufacturers that currently utilize larger condenser coils.

DOE is proposing to use high-efficiency condenser fan motors as a design option, and it is critical to accurately estimate the input power due to the energy savings associated with this option. DOE calculated the input power from the efficiency ratings provided. However, DOE received comments that this approach may not provide an accurate method to measure input power and requests feedback on how it should determine input power.

DOE also considered a design option which modulates or adjusts the speed of the evaporator fans when the compressor is off. DOE is aware of the potential effects of evaporator fan control on food safety but has tentatively concluded that the controls it analyzed are limited (to 50 percent fan cycling or 50 percent fan speed when the compressor is off) such that food temperatures could be adequately maintained in either control case. DOE requests comment from interested parties as to whether food temperatures would be adequately maintained in the specific control cases it has analyzed, and, if not, what would be an appropriate control strategy. DOE particularly requests any data interested parties can provide to show the relationship between fan controls and food temperatures. DOE also seeks information on whether other components may be necessary to ensure food temperatures would be adequately maintained, such as extra thermostats located in certain areas of the walk-in.

DOE has adjusted its analysis of the floating head pressure design option after taking commenters' recommendations into account. DOE included components and analytical changes with respect to fan power, temperature differences, and SCT in response to stakeholder comments. DOE requests comment on its revised assumptions and implementation of this option, particularly regarding the cost to implement various floating head pressure control schemes and the energy savings that would be achieved. DOE requests comment on the technological feasibility of the panel options analyzed and whether the design options selected would cause any lessening of the utility or the performance of the walk-ins. DOE also requests information on any changes in repair, maintenance, or installation costs associated with the technologies needed to meet the proposed standards.

See section IV.C.5.b and chapter 5 of the TSD for further details on the refrigeration system design options.

19. Relative Equipment Sizing

In the Energy Use Analysis, DOE calculates the expected energy consumption of the covered equipment, as installed. To do so, DOE makes certain assumptions about the relative sizing of refrigeration systems with envelopes, which determines how often the compressor runs during a day, which in turn affects the energy use of the equipment. For the NOPR analysis, DOE assumed that the runtime of the refrigeration system is 13.3 hours per day for coolers and 15 hours per day for freezers at full design point capacity and requests comment on this assumption. See section IV.E.1 for further details.

20. Equipment Price Trends

DOE assumes in its price forecasts for this NOPR that the real prices of walk-in cooler and freezer equipment decrease slightly over time. DOE performed price trends sensitivity calculations to examine the dependence of the analysis results on different analytical assumptions. DOE invites comment on methods to improve its equipment price forecasting, as well as any data supporting alternate methods. For more details, see section IV.F.1.

21. Refrigerant Charge Maintenance Costs

DOE received comments on maintenance costs associated with refrigerant leakage and refrigerant charge and assumed a certain maintenance cost for the refrigeration system. DOE requests that interested parties submit data on refrigerant charge maintenance costs. See section IV.F.6 for further details.

22. Compliance Date of Standards

DOE's proposed standards will apply to products that are manufactured beginning on the date 3 years after the final rule is published 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. 6314(f)(4)(B)) 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. See section IV.F.9 for details.

23. Base-Case Efficiency Distributions

To accurately estimate the share of consumers who would likely be impacted by a standard at a particular efficiency level, DOE's LCC analysis considers the projected distribution of product efficiencies that consumers purchase under the base case (i.e., the case without new energy efficiency standards) DOE examined the range of standard and optional equipment features offered by refrigeration manufacturers and estimated that for refrigeration systems, 75 percent of the equipment sold under the base case would be at DOE's assumed baseline level—that is, the equipment would comply with the existing standards in EPCA, but have no additional features that improve efficiency. The remaining 25 percent of equipment would have features that would increase its efficiency to a level commensurate with the first design option in each equipment class. For envelope components, all base case shipments are assumed to have only a single EPCA-compliant efficiency level except for cooler display doors. For cooler display doors, shipments in the base case would be a mix of 80 percent EPCA-compliant equipment and 20 percent higher efficiency equipment. For both refrigeration systems and envelope components, DOE assumed that the base-case energy efficiency distribution would remain constant throughout the forecast period. DOE requests comment on its assumptions about base-case efficiency distributions. See sections IV.F.10 and IV.G.2 for details.

24. Trial Standard Level Equations

In this NOPR, DOE proposes standard levels for different classes of refrigeration systems. DOE expressed the AWEF for large capacity dedicated condensing systems as a single value and expressed the AWEF for the small capacity dedicated condensing systems as a linear equation normalized to the system gross capacity. DOE calculated a single minimum AWEF for each class of multiplex condensing systems. The methodology DOE used to develop the AWEF values and equations is detailed in appendix 10D of the TSD. DOE requests comment on the AWEF equations and the methodology for determining them. In particular, DOE asks interested parties to submit data on how the efficiency of typical refrigeration systems varies by capacity. Based on comments and additional data DOE receives on the NOPR, DOE may consider other methods of calculating the minimum AWEF associated with the TSLs for each equipment class. See section V.A.2 for details.

25. Proposed Standard

In this NOPR, DOE proposes TSL 4 as the energy conservation standard for equipment covered under this rulemaking. DOE proposes this standard because it tentatively believes that it represents the maximum improvement in energy efficiency that is technologically feasible and economically justified, and that the benefits outweigh the burdens. For a full description of the benefits and burdens of TSL 4, see section V.C.

We seek comment, information and data on whether other combinations of standards for refrigeration units, panels, or doors can improve energy efficiency that is technologically feasible and economically justified, taking into consideration effects on the manufacturers and the end users of walk-in coolers and freezers.

26. Product Attributes

DOE requests comment on whether there are features or attributes of the more energy efficient walk-in coolers and freezers that manufacturers would produce to meet the standards in this proposed rule that might lessen the utility or performance of these products in current uses (i.e., restaurants, food service providers, grocery stores and convenience stores). An example of such an effect might be that grocers or restaurant operators would change where, how, how much and for how long food items would be stored or whether thicker panels would detrimentally reduce the refrigerated area of a walk-in making higher efficiency panels less desirable. DOE requests comment specifically on how any such effects should be weighed in the choice of standards for these walk-in coolers and freezers for the final rule.

27. Impact of Amended Standards on Future Shipments

DOE welcomes stakeholder input and estimates on the effect of amended standards on future walk-in cooler and freezer shipments. We are seeking information on what factors drive the demand for walk-in coolers and freezers and whether those factors are likely to remain unchanged in the relevant analytic time period of 30 years. For example, a commenter submitted that 70 percent of all restaurants and 90 percent of all small restaurants fail due to insufficient up-front capital. In light of this information, are there better ways and data to project future shipments of walk-in coolers and freezers than the current method which is based on the number of buildings projected to house walk-in coolers and freezers? DOE also welcomes input and data on the demand elasticity estimates used in the analysis.

28. 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 quality 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.

29. Analytic Timeline

For this rulemaking, DOE analyzed the effects of this proposal assuming that the walk-in coolers and freezers would be available to purchase starting 2017 until 2047 and includes the useful life of the last unit sold, extending the analysis to 2073. DOE also undertook a sensitivity analysis using nine rather than 30 years of product shipments. The choice of a 30-year period 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.

In particular, given that walk-in coolers and freezers are largely used by the food service industry, convenience stores and small grocers, we are seeking information on whether the turnover rates in the food service industry, convenience stores and small grocers affects the useful life of walk-in coolers and freezers.

30. Markets for Used Walk-In Coolers and Freezers

DOE is seeking information on whether there is a significant market for used walk-in coolers and freezers. Given the high turnover rate of food service industry (e.g., a commenter noted 70 to 90 percent failure rates for restaurants), we are seeking to understand whether it is reasonable to assume that the useful life of the refrigeration system would be 12 years and other components 15 years due to active used equipment markets.

31. 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 walk-in coolers and freezers. DOE notes that the small businesses could be disproportionately affected by this standard because of the cost of testing, potential increase in materials and potential difficulty in obtaining financing. DOE seeks comment and, in particular, data, in its efforts to quantify the impacts of this rulemaking on small business manufacturers.

32. Rebound Effect

DOE assumed a rebound factor of one, or no effect, because walk-ins must cool their contents at all times and it is not possible for consumers to operate them more frequently. A rebound effect occurs when users operate higher efficiency equipment more frequently and/or for longer durations, thus offsetting estimated energy savings. DOE seeks comment on this assumption and whether other factors should be considered in the rebound effect, such as a decision to buy a larger system due to increased lifetime costs savings, or money saved in electricity bills with more efficient walk-in coolers and freezers being used for other electricity consuming activities.

33. 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 CO2 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.

34. 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.

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, Imports, Intergovernmental relations, 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 431.302 is amended by revising the definition for "Display Door" and adding, in alphabetical order, definitions for "Freight Door" and "Passage Door" to read as follows:

§431.302 Definitions concerning walk-in coolers and freezers.

* * * * *

Display door means a door that:

(1) Is designed for product display; or

(2) Has 75 percent or more of its surface area composed of glass or another transparent material.

* * * * *

Freight door means a door that is not a display door and is equal to or larger than 4 feet wide and 8 feet tall.

* * * * *

Passage door means a door that is not a freight or display door.

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*   *   *   *   *

3. In §431.304, revise paragraph (a) to read as follows:

§431.304 Uniform test method for the measurement of energy consumption of walk-in coolers and walk-in freezers.

(a) Scope. This section provides test procedures for measuring, pursuant to EPCA, the energy consumption of walk-in coolers and walk-in freezers.

*   *   *   *   *

4. In §431.306, revise paragraph (a)(3), and add paragraphs (c), (d), (e), and (f) to read as follows:

§431.306 Energy conservation standards and their effective dates.

(a) * * *

(3) Contain wall, ceiling, and door insulation of at least R-25 for coolers and R-32 for freezers, except that this paragraph shall not apply to:

(i) Glazed portions of doors not to structural members and

(ii) A walk-in cooler or walk-in freezer component if the component manufacturer has demonstrated to the satisfaction of the Secretary in a manner consistent with applicable requirements that the component reduces energy consumption at least as much as if such insulation requirements of subparagraph (a)(3) were to apply.

(b) * * * * *

(c) *Walk-in cooler and freezer panels.*

Class Descriptor	Class	Equations for Maximum U-Factor (Btu/h-ft^2-°F)*
Structural Panel, Medium Temperature**	SP.M	$-0.012 \times \left(\frac{A_{\text{nf edge}}}{A_{\text{nf core}}}\right)^2 + 0.024 \times \left(\frac{A_{\text{nf edge}}}{A_{\text{nf core}}}\right) + 0.041$
Structural Panel, Low Temperature	SP.L	$-0.0083 \times \left(\frac{A_{\text{nf edge}}}{A_{\text{nf core}}}\right)^2 + 0.017 \times \left(\frac{A_{\text{nf edge}}}{A_{\text{nf core}}}\right) + 0.029$
Floor Panel, Low Temperature	FP.L	$-0.0091 \times \left(\frac{A_{\text{fp edge}}}{A_{\text{fp core}}}\right)^2 + 0.018 \times \left(\frac{A_{\text{fp edge}}}{A_{\text{fp core}}}\right) + 0.033$

*$A_{\text{nf edge}}$ and $A_{\text{nf core}}$ represent the edge and core surface area of the structural panel, respectively. $A_{\text{fp edge}}$ and $A_{\text{fp core}}$ represent the edge and core surface area of the floor panel, respectively.
** A structural panel is a panel that is not used to construct a walk-in's floor. This includes, but is not limited to, ceiling panels and wall panels.

(d) *Walk-in cooler and freezer display doors.*

Class Descriptor	Class	Equations for Maximum Energy Consumption (kWh/day)*
Display Door, Medium Temperature	DD.M	$0.049 \times A_{dd} + 0.39$
Display Door, Low Temperature	DD.L	$0.33 \times A_{dd} + 0.38$

*A_{dd} represents the surface area of the display door.

(e) *Walk-in cooler and freezer non-display doors.*

Class Descriptor	**Class**	**Equations for Maximum Energy Consumption (kWh/day)***
Passage Door, Medium Temperature	PD.M	$0.0032 \times A_{nd} + 0.22$
Passage Door, Low Temperature	PD.L	$0.14 \times A_{nd} + 4.0$
Freight Door, Medium Temperature	FD.M	$0.0073 \times A_{nd} + 0.082$
Freight Door, Low Temperature	FD.L	$0.11 \times A_{nd} + 5.4$

*A_{nd} represents the surface area of the non-display door.

(f) *Walk-in cooler and freezer refrigeration systems.*

Class Descriptor	**Class**	**Equations for Minimum AWEF (Btu/W-h)***
Dedicated Condensing, Medium Temperature, Indoor System, < 9,000 Btu/h Capacity	DC.M.I, < 9,000	$2.63 \times 10^{-4} \times Q + 4.53$
Dedicated Condensing, Medium Temperature, Indoor System, ≥ 9,000 Btu/h Capacity	DC.M.I, ≥ 9,000	6.90
Dedicated Condensing, Medium Temperature, Outdoor System, < 9,000 Btu/h Capacity	DC.M.O, < 9,000	$1.34 \times 10^{-3} \times Q + 0.12$
Dedicated Condensing, Medium Temperature, Outdoor System, ≥ 9,000 Btu/h Capacity	DC.M.O, ≥ 9,000	12.21
Dedicated Condensing, Low Temperature, Indoor System, < 9,000 Btu/h Capacity	DC.L.I, < 9,000	$1.93 \times 10^{-4} \times Q + 1.89$
Dedicated Condensing, Low Temperature, Indoor System, ≥ 9,000 Btu/h Capacity	DC.L.I, ≥ 9,000	3.63
Dedicated Condensing, Low Temperature, Outdoor System, < 9,000 Btu/h Capacity	DC.L.O, < 9,000	$5.70 \times 10^{-4} \times Q + 1.02$
Dedicated Condensing, Low Temperature, Outdoor System, ≥ 9,000 Btu/h Capacity	DC.L.O, ≥ 9,000	6.15
Multiplex Condensing, Medium Temperature	MC.M	10.74
Multiplex Condensing, Low Temperature	MC.L	5.53

*Q represents the system gross capacity as calculated by the procedures set forth in AHRI 1250.