EXECUTIVE SUMMARY

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EXECUTIVE SUMMARY

ES.1 OVERVIEW OF PRELIMINARY ANALYSIS ACTIVITIES

Section 6295(o)(3)(B) of 42 U.S.C. requires the U.S. Department of Energy (DOE) to establish energy conservation standards that achieve the maximum improvement in energy efficiency that is technologically feasible and economically justified. This executive summary provides an overview of the activities associated with the preliminary analysis that DOE conducted in consideration of new energy conservation standards for walk-in coolers and freezers. The executive summary describes the preliminary analysis activities and summarizes key results from DOE's analyses. Additionally, the executive summary delineates issues identified during the analyses about which DOE seeks comments from interested parties. These issues are highlighted in the public meeting presentation and are further discussed in chapter 2 of the preliminary technical support document (TSD).

Figure ES.1.1 presents a summary of the analytical components of the standards-setting process and illustrates how key results are generated. The focal point of the figure is the center column, labeled "Analyses." The columns labeled "Key Inputs" and "Key Outputs" show how the analyses fit into the process and how they relate to each other. Key inputs are the types of data and other information that the analyses require. Some key information is obtained from public databases; DOE collects other inputs from interested parties or persons having special knowledge and expertise. Key outputs are analytical results that feed directly into the standards-setting process. The issues on which DOE seeks comment from interested parties derive from the key results that are generated by the preliminary analysis. Arrows connecting analyses show the types of information that feed from one analysis to another.

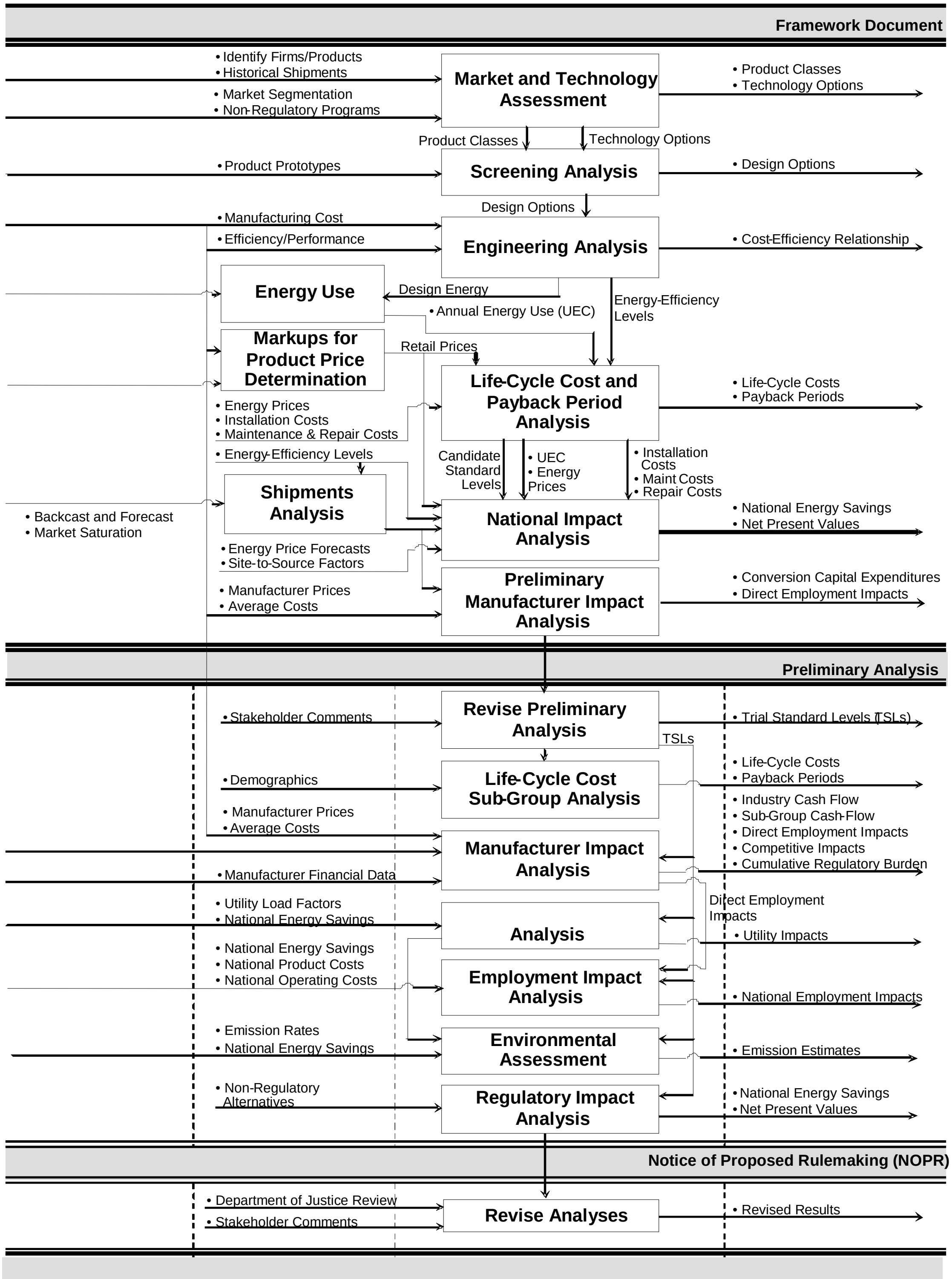

Figure ES.1.1 Flow Diagram of Analyses for the Walk-in Coolers and Walk-in Freezers Rulemaking Process

ES.2 OVERVIEW OF THE PRELIMINARY ANALYSIS AND THE TECHNICAL SUPPORT DOCUMENT

For the preliminary analysis, DOE publishes a notice of public meeting (NOPM) in the *Federal Register*, which announces the availability of the preliminary TSD, the date and place of the public meeting, and presentation materials interested parties may review before the public meeting. In addition, the NOPM highlights the major analyses DOE developed in the preliminary analysis.

The preliminary TSD describes each preliminary analysis in detail, providing detailed descriptions of inputs, sources, methodologies, and results. Chapter 2 of the preliminary TSD provides an overview of each preliminary analysis, the comments received in response to the analytical approaches DOE described in the framework document, and DOE's responses to those comments. The following chapters of the preliminary TSD address the preliminary analysis performed by DOE.

A market and technology assessment (MTA) characterizes the relevant equipment markets and technology options, including prototype designs (chapter 3 of the preliminary TSD).

A screening analysis reviews each technology option to determine whether it is technologically feasible; is practicable to manufacture, install, and service; would adversely affect equipment utility or equipment availability; or would have adverse impacts on health and safety (chapter 4 of the preliminary TSD).

An engineering analysis develops cost-efficiency relationships that show a manufacturer's cost of achieving increased efficiency. DOE uses manufacturer markups to convert manufacturer production cost (MPC) to manufacturer selling price (MSP) (chapter 5 of the preliminary TSD).

A markups analysis converts the manufacturer costs derived from the engineering analysis to consumer equipment prices (chapter 6 of the preliminary TSD).

An energy use analysis determines the annual energy use in the field of the considered equipment (chapter 7 of the preliminary TSD).

Life-cycle cost (LCC) and payback period (PBP) analyses calculate, at the consumer level, the discounted savings in operating costs throughout the estimated average life of the covered equipment, compared to any increase in the equipment's installed cost likely to result directly from the imposition of a given standard (chapter 8 of the preliminary TSD).

A shipments analysis forecasts shipments of equipment, which then are used to calculate the national impacts of standards on energy consumption, the net present value (NPV) of consumer costs and savings, and future manufacturer cash flows (chapter 9 of the preliminary TSD).

A national impact analysis (NIA) assesses the cumulative national energy savings (NES) from standards and the NPV of consumer costs and savings associated with standards at different efficiency levels (chapter 10 of the preliminary TSD).

A preliminary manufacturer impact analysis (MIA) assesses the potential impacts of energy conservation standards on manufacturers, such as effects on expenditures for capital conversion, marketing costs, shipments, and research and development costs (chapter 12 of the preliminary TSD).

The remaining chapters of the preliminary TSD address the analyses to be performed for the NOPR stage:

A life-cycle cost analysis for subgroups evaluates the effects of energy conservation standards on various national subgroups of the population (chapter 11 of the preliminary TSD).

A utility impact analysis examines impacts of energy conservation standards on the generation capacity of electric utilities (chapter 13 of the preliminary TSD).

An employment impact analysis examines the effects of energy conservation standards on national employment (chapter 14 of the preliminary TSD).

An environmental assessment examines the effects of energy conservation standards on various airborne emissions (chapter 15 of the preliminary TSD).

A regulatory impact analysis examines the national impacts of non-regulatory alternatives to mandatory energy conservation standards (chapter 16 of the preliminary TSD).

ES.3 KEY RESULTS OF THE ANALYSIS

The following sections describe in detail the key analyses DOE performed in support of the preliminary TSD.

ES.3.1 Market and Technology Assessment

When initiating an analysis of potential energy efficiency standards for commercial equipment, DOE develops information for the equipment concerned based on the present and past industry structure and market characteristics. This activity assesses industries and equipment both quantitatively and qualitatively, based on publicly available information.

When evaluating and establishing energy conservation standards, DOE generally divides covered equipment into equipment classes by the type of energy used or by capacity or other performance-related features that affect efficiency, considering such factors as utility to the consumer. Different energy conservation standards may apply to different equipment classes. (42

U.S.C. 6295(q)) Table ES.3.1 and Table ES.3.2 list the equipment classes being considered in this rulemaking.

Table ES.3.1 Equipment Classes for Walk-in Coolers and Walk-in Freezers (Envelope)

Equipment Class
Non-Display Cooler
Non-Display Freezer
Display Cooler
Display Freezer

Table ES.3.2 Equipment Classes for Walk-in Coolers and Walk-in Freezers (Refrigeration System)

Equipment Class
Dedicated Medium-Temperature Indoors
Dedicated Low-Temperature Indoors
Dedicated Medium-Temperature Outdoors
Dedicated Low-Temperature Outdoors
Unit Cooler for Multiplex System Medium Temperature
Unit Cooler for Multiplex System Low Temperature

For the walk-in coolers and freezers addressed by this rulemaking, DOE examined (1) manufacturer market share and characteristics, (2) existing regulatory and non-regulatory initiatives for improving equipment efficiency, and (3) trends in equipment characteristics and retail markets. This information provided data and resource material throughout the analysis.

DOE reviewed literature and interviewed manufacturers to develop an overall understanding of the walk-in cooler and freezer industry in the United States. Chapter 3 of the preliminary TSD describes the market analysis and resulting information.

DOE typically uses information about existing and past technology options and prototype designs to determine which technologies and combinations of technologies manufacturers use to attain higher performance levels. In consultation with interested parties, DOE develops a list of technologies to be considered.

DOE developed its list of technologies for walk-in coolers and freezers after examining various documents (e.g., trade publications, technical papers, and manufacturer literature) and consulting with manufacturers of components and systems. Because existing equipment contains many technologies for improving equipment efficiency, equipment literature and direct examination provided additional information.

ES.3.2 Screening Analysis

In the screening analysis, DOE, in consultation with interested parties, examined the technologies identified in the market and technology assessment. First, DOE removed from the list those technologies for which the energy consumption could not be adequately measured using the relevant DOE test procedure. Second, DOE evaluated the technologies using the four screening criteria: Technologies are removed from further consideration if they (1) are not technologically feasible; (2) are not practicable to manufacture, install, and service; (3) have an adverse impact on equipment utility or availability; and/or (4) have adverse impacts on health and safety. In the subsequent engineering analysis, DOE further examines the technology options that it did not remove from consideration in the screening analysis.

ES.3.3 Engineering Analysis

The engineering analysis (chapter 5 of the preliminary TSD) establishes the relationship between the cost of manufacturing walk-in coolers and freezers and their efficiency. This relationship serves as the basis for calculating costs and benefits of modified equipment designs for consumers, manufacturers, and the Nation. Chapter 5 of the preliminary TSD describes the equipment classes that DOE analyzed, the representative baseline units, the efficiency levels DOE considered, the methodology that DOE used to develop the manufacturing production cost model, and the cost-efficiency results.

ES.3.3.1 Equipment Classes Analyzed

The engineering analysis for walk-in envelopes directly analyzed the four primary walk-in envelope classes: (1) non-display coolers; (2) non-display freezers; (3) display coolers; and (4) display freezers. For all envelope equipment classes, DOE used three different class sizes (small, medium, and large) in its engineering analysis.

The engineering analysis for walk-in refrigeration systems analyzed the six primary walk-in refrigeration classes: (1) dedicated system medium-temperature indoor systems; (2) dedicated system low-temperature indoor systems; (3) dedicated system medium-temperature outdoor systems; (4) dedicated system low-temperature outdoor systems; (5) medium-temperature unit coolers connected to a Multiplex System; and (6) low-temperature unit coolers connected to a Multiplex System. Two sizes were analyzed for each refrigeration equipment class.

Table ES.3.3 and Table ES.3.4 show the class sizes for envelope and refrigeration system, respectively. Chapter 5 of the preliminary TSD includes additional details on the representative equipment classes and the cost-efficiency curves developed as part of the engineering analysis.

Table ES.3.3 Sizes Analyzed: Envelope

	Dimensions [length x width x height, ft]		
Class	**Small**	**Medium**	**Large**
Non-Display Cooler	10’ × 8’ × 7.6’	12’ × 20’ × 9.5’	25’ × 30’ × 12’
Non-Display Freezer	8’ × 6’ × 7.6’	9’ × 20’ × 9.5’	25’ × 20’ × 12’
Display Cooler	6’ × 6’ × 6.6’	10.2’ × 7’ × 7.6’	80’ × 15’ × 7.6’
Display Freezer	6’ × 6’ × 6.6’	10.2’ × 7’ × 7.6’	80’ × 15’ × 7.6’

Table ES.3.4 Sizes Analyzed: Refrigeration System

	Nominal Capacity [Btu/hour]	
Class	**Small**	**Large**
Dedicated Condensing Medium Temperature Indoor System	12,000	24,000
Dedicated Condensing Low Temperature Indoor System	6,000	12,000
Dedicated Condensing Medium Temperature Indoor System	15,000	24,000
Dedicated Condensing Low Temperature Indoor System	6,000	12,000
Multiplex Condensing Medium Temperature System	9,000	30,000
Multiplex Condensing Low Temperature System	6,000	30,000

ES.3.3.2 Manufacturing Cost Assessment

DOE estimated the manufacturing costs associated with a decrease in energy consumption for all of the equipment classes analyzed. The assessment method involved information gained during manufacturer site visits, manufacturer interviews, previous experience with similar equipment manufacturing methods and a detailed cost model that utilizes Design For Manufacture/Design For Assembly (DFM/DFA) methodology to evaluate labor costs. Using aggregated manufacturer data, DOE developed a detailed model to estimate the manufacturer production cost (MPC) at various efficiency levels. DOE obtained additional input from interested parties on the manufacturing cost model inputs. DOE also estimated the manufacturer markup and the manufacturer selling price (MSP), which includes the outbound shipping cost (the cost of shipping the equipment from the manufacturer to the distributor). DOE calculated the MSP as the product of the MPC and the manufacturer markup, plus the outbound shipping cost. Chapter 5 of the preliminary TSD includes information on the inputs used to determine the manufacturing cost, including material, labor, and overhead costs. Chapter 5 also includes information on the various components and features incorporated into designs for walk-in coolers and walk-in freezers.

DOE’s engineering analysis produced cost-energy consumption curves for the four walk-in envelope equipment classes and the six walk-in refrigeration system equipment classes. The cost-energy consumption curves are described by the energy consumption levels that DOE analyzed, and the increase in MPC and MSP required to improve baseline-energy consumption equipment to each of the considered levels. Table ES.3.5 and Table ES.3.6 present the MPC and MSP results for one example envelope and refrigeration system, respectively. Results for the remaining units analyzed can be found in Chapter 5 of the preliminary TSD.

In the remainder of this document, DOE presents complete results for these example units only. Complete results for all other units are contained in the relevant chapters of the preliminary TSD.

Table ES.3.5 MPC and MSP Estimates for a Medium Non-Display Cooler

Efficiency Levels	Manufacturer Production Cost ($)	Manufacturer Selling Price ($)
0	$ 4,164	$ 6,476
1	$ 4,527	$ 6,981
2	$ 4,561	$ 7,028
3	$ 4,576	$ 7,049
4	$ 5,330	$ 8,291
5	$ 5,498	$ 8,551
6	$ 5,750	$ 8,941
7	$ 5,896	$ 9,159
8	$ 6,339	$ 9,841
9	$ 6,782	$ 10,523
10	$ 8,782	$ 13,303
11	$ 13,381	$ 19,361
12	$ 15,961	$ 22,947
13†	$ 17,285	$ 24,788
14	$ 17,285	$ 24,788
15*	$ 17,285	$ 24,788

† The results for levels 13, 14, and 15 are identical for this and other analyses because for this analysis point, only 13 levels were analyzed. For another size in the class, there were 15 efficiency levels, so DOE maintained the data in this format for consistency.
* Max-tech efficiency level

Table ES.3.6 Manufacturer Cost Estimates for a Large Dedicated Medium-Temperature Outdoor Refrigeration System

Efficiency Levels	Manufacturer Production Cost ($)	Manufacturer Selling Price ($)
0	$ 2,689	$ 3,801
1	$ 2,725	$ 3,856
2	$ 2,999	$ 4,237
3	$ 3,190	$ 4,530
4	$ 3,390	$ 4,808
5	$ 3,690	$ 5,225
6	$ 3,833	$ 5,423
7	$ 3,869	$ 5,474
8*	$ 4,009	$ 5,669

* Max-tech efficiency level

For refrigeration systems, certain efficiency levels incorporate design options that increase the capacity of the system. Thus, an increase in the manufacturer price could be attributed to either a gain in efficiency or a gain in capacity. To distinguish the two effects, DOE divided the price by the net capacity as determined from the proposed test procedure at each efficiency level. The results for this example refrigeration system are shown in Table ES.3.7. One notable observation is that for a few efficiency levels above the baseline, the estimated costs appear to decrease. This indicates that for these efficiency levels, although the absolute price of the unit increases as shown in Table ES.3.6, the capacity also increases at a faster rate, so the price per capacity decreases. To capture this effect, DOE used the price per capacity values in the downstream analyses.

Table ES.3.7 MPC and MSP per Capacity Estimates for a Large Dedicated Medium-Temperature Outdoor Refrigeration System

Efficiency Levels	MPC per Capacity ($/(kBtu/h))	MSP per Capacity ($/(kBtu/h))
0	$ 128	$ 181
1	$ 124	$ 175
2	$ 117	$ 165
3	$ 113	$ 160
4	$ 120	$ 170
5	$ 130	$ 185
6	$ 135	$ 192
7	$ 137	$ 193
8*	$ 141	$ 199

*Max-tech efficiency level

ES.3.4 Markups to Determine Equipment Price

The markups analysis (chapter 6 of the preliminary TSD) develops appropriate markups in the distribution chain to convert the estimates of manufacturer cost derived in the engineering analysis to consumer prices. In developing markups, DOE determined the distribution channels for walk-in coolers and walk-in freezers (WICF) equipment and the markup associated with each party in the distribution channel.

The cost to the customer depends on how the customer purchases the equipment. In the framework document, DOE defined three distribution channels described below:

Manufacturer → Customer (National Account) (Channel 1)
Manufacturer → Distributor → Customer (Channel 2)
Manufacturer → Distributor → Mechanical Contractor → Customer (Channel 3)

DOE estimated markups taken by wholesalers and mechanical contractors, or alternatively, by national firms selling direct to ultimate consumer/users, along with sales taxes. Based on industry comments, the proportions of sales in each customer class were different for food sales customers (grocery and convenience stores) than for food service (restaurants). These proportions are shown in Table ES.3.8.

Table ES.3.8. Distribution Channel Shares

Dominant Market Segment	**Multiplex system**		
All	National Account	Distributor	Contractor
	85%	10%	5%
	Dedicated Equipment		
Convenience Stores (15%)	National Account	Distributor	Contractor
	30%	35%	35%
Commercial and Institutional Food Service (85%)	E-Commerce Reseller	Distributor	Contractor
	5%	80%	15%

DOE calculated separate markups for baseline products (baseline markups) and for the cost increase associated with improvements required to produce more efficient products (incremental markups).

Table ES.3.9 and Table ES.3.10 summarize the baseline markups and incremental markups developed for WICF equipment. The markups shown in this table reflect national average values for the given markup. In their inclusion in the subsequent LCC analysis, regional markup multipliers were also developed and were used to capture regional variation in mechanical contractor markups as well as state-to-state differences in sales taxes. Also in the LCC analysis, the relative shipments to new construction and to the replacement market vary by equipment class resulting in some slight differences between sales-weighted average baseline and average incremental markups by product class. For additional information, see chapter 2 of the preliminary TSD.

Table ES.3.9 Baseline Markups by Distribution Channel and Overall Weighted Average Markup, Including the Weighted Average Sales Tax Multiplier for Supermarkets

	Wholesale Distributor	Mechanical Contractor (Includes Wholesale Distributor)	National Account (Mfg Direct)	Overall Weighted Average Markup	
				Multiplex Equipment	Dedicated Equipment
Distributor(s) Markup	1.453	2.209	1.226	1.408	1.828
Sales Tax Multiplier	1.070	1.070	1.070	1.070	1.070
Overall Markup	1.555	2.364	1.311	1.506	1.955

Table ES.3.10 Incremental Markups by Distribution Channel and Overall Weighted Average Markup, Including the Weighted Average Sales Tax Multiplier

	Wholesale Distributor	Mechanical Contractor (Includes Wholesale Distributor)	National Account (Mfg Direct)	Overall Weighted Average Markup	
				Multiplex Equipment	Dedicated Equipment
Distributor(s) Markup	1.118	1.375	1.059	1.115	1.252
Sales Tax Multiplier	1.070	1.070	1.070	1.070	1.070
Overall Markup	1.196	1.471	1.133	1.193	1.340

ES.3.5 Energy Use Characterization

The energy use characterization provides the basis for developing the energy savings from using higher-efficiency WICF equipment. The energy savings results are incorporated in the LCC and other subsequent analyses. The proposed DOE test procedure for the walk-in system provides separate testing methodologies for the envelope and the refrigeration system.

For the envelope, the proposed test procedure determines the daily energy consumption of the envelope under indoor conditions using a nominal EER. For the refrigeration system, the proposed DOE test procedure provides for multiple measurements of the refrigeration capacity and energy consumption under specified test conditions. The two separate test procedures provide standardized energy efficiency metrics for the envelope and the refrigeration system which, when combined, serve as the basis for comparing the energy consumptions of different combinations of the envelope and the refrigeration system. The proposed test procedure methodology has been used to provide standardized estimates of the energy consumptions for all possible combinations of the analyzed WICF envelope design options for a given envelope product class matched with each considered design option of a given refrigeration system class. For both the envelopes and the refrigeration systems, DOE considered multiple analysis points at different equipment capacity levels in each product class. DOE uses the kWh/day rating to establish an estimate of efficiency for different combinations of equipment designs considered. Downstream analyses consider all design options of the same combinations of the envelope and the refrigeration system.

Chapter 7 of the preliminary TSD provides more details on the methods, data, and assumptions used for developing the energy consumptions of the combined systems.

Table ES.3.11 presents the average annual energy use for the example envelope class (i.e., a medium non-display cooler) at each considered energy efficiency level operating with all three refrigeration system classes at the baseline efficiency level. Table ES.3.12 presents the average annual energy usage of a cooler system consisting of the combination of the two example classes previously discussed: a medium non-display cooler and a dedicated outdoor condensing system at all efficiency levels of each. The highest energy savings potential can be observed for this system at the max-tech efficiency level.

Annual energy consumption data for all other equipment classes are provided in chapter 7 of the preliminary TSD.

Table ES.3.11 Annual Energy Consumption Estimates for a Medium Non-Display Cooler (kWh)

Type	**Non-Display Coolers (Medium)**		
Length × Width × Height (ft)	**12′ × 20′ × 9.5′**		
Refrigeration System	**Dedicated Indoor (Medium Temperature)**	**Dedicated Outdoor (Medium Temperature)**	**Multiplex (Medium Temperature)**
Envelope Efficiency Levels			
0	17,112	15,547	9,598
1	10,796	9,813	6,077
2	10,664	9,687	5,972
3	10,627	9,654	5,952
4	8,896	8,082	4,987
5	8,620	7,832	4,833
6	8,287	7,529	4,647
7	8,141	7,396	4,566
8	7,729	7,022	4,336
9	7,432	6,753	4,171
10	6,745	6,129	3,787
11	6,218	5,650	3,494
12	5,948	5,406	3,343
13	5,819	5,289	3,272
14	5,819	5,289	3,272
15*	5,819	5,289	3,272

* Max-tech efficiency level

Table ES.3.12 Annual Energy Consumption Estimates for a Medium Storage Cooler Matched with a Dedicated Medium-Temperature Outdoor System (kWh)

Type	Non-Display Cooler (Medium)/Dedicated Medium-Temperature Outdoor Systems								
Length × Width × Height (ft)	12′ × 20′ × 9.5′								
Refrigeration System Efficiency Levels	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8***
Envelope Efficiency Levels									
0	15,547	14,887	13,341	11,173	8,146	5,979	5,200	5,108	4,882
1	9,813	9,398	8,428	7,066	5,165	3,804	3,315	3,257	3,115
2	9,687	9,274	8,309	6,956	5,066	3,713	3,226	3,169	3,028
3	9,654	9,243	8,281	6,932	5,049	3,700	3,215	3,158	3,017
4	8,082	7,738	6,934	5,806	4,231	3,104	2,698	2,651	2,533
5	7,832	7,499	6,719	5,627	4,101	3,009	2,616	2,570	2,456
6	7,529	7,209	6,460	5,410	3,944	2,894	2,516	2,472	2,363
7	7,396	7,082	6,346	5,315	3,875	2,844	2,473	2,429	2,322
8	7,022	6,724	6,026	5,047	3,681	2,702	2,350	2,309	2,207
9	6,753	6,466	5,795	4,855	3,541	2,600	2,261	2,222	2,124
10	6,129	5,869	5,260	4,407	3,216	2,363	2,056	2,020	1,931
11	5,650	5,411	4,850	4,065	2,967	2,181	1,899	1,866	1,784
12	5,406	5,177	4,641	3,889	2,840	2,089	1,818	1,787	1,708
13	5,289	5,065	4,541	3,806	2,779	2,044	1,780	1,749	1,672
14	5,289	5,065	4,541	3,806	2,779	2,044	1,780	1,749	1,672
15*	5,289	5,065	4,541	3,806	2,779	2,044	1,780	1,749	1,672

* Max-tech efficiency level

ES.3.6 Life-Cycle Cost and Payback Period Analyses

New energy conservation standards for WICF equipment would result in changes in consumer operating expenses—usually a decrease—and changes in consumer price—usually an increase. DOE analyzed the net effect of revised standards on consumers by evaluating the LCC using the cost-efficiency relationship derived in the engineering analysis, as well as the energy costs derived from the energy use characterization. Inputs to the LCC calculation included the installed cost to the consumer (purchase price plus installation cost), operating costs (energy expenses, repair, and maintenance), the lifetime of the equipment, and a discount rate.

Because the installed cost of a product typically increases while operating cost typically decreases in response to new standards, there is a point in the life of products having higher-than-baseline efficiency when the cumulative net operating-cost benefit (in dollars) since the time of purchase is equal to the incremental first cost of purchasing the higher-efficiency product. The length of time required for products to reach this cost-equivalence point is known as the payback period (PBP).

DOE conducted the LCC and PBP analyses using values that reflect energy consumption in the field. DOE identified several input values for estimating the LCC, including: retail prices; energy prices; discount rates; and equipment lifetimes. DOE used EIA's energy price data to determine prices for electricity in 2009, and used projections of these energy prices from the preliminary December 2009 release of EIA's Annual Energy Outlook 2010 to estimate future energy prices. DOE developed discount rates from estimates of the finance cost for consumers and commercial businesses that purchase walk-ins.

Because the basis for the lifetime estimates in the literature for WICF equipment is uncertain, DOE used data sources to estimate the distribution of WICF lifetimes in the field. The resulting survival function, which DOE assumed has the form of a cumulative Weibull distribution, provides an average and median appliance lifetime. Table ES.3.13 shows the average and maximum lifetimes for WICF envelopes and refrigeration systems.

Table ES.3.13 Lifetimes for WICF Equipment

	Equipment Lifetimes (years)	
Parameter	**WICF Envelope**	**Refrigeration Equipment**
Average Lifetime	16	7
Maximum Lifetime	26	12

Estimating future LCC for more efficient WICF equipment is complicated because virtually no data are available on the distribution of efficiencies for current shipments of WICF envelopes and refrigeration systems. DOE's LCC analysis for this Preliminary Analysis considered the projected distribution of product efficiencies that consumers purchase under a base case (*i.e.*, the case without new energy efficiency standards) to be the least efficient units for which engineering analysis was performed. DOE refers to this distribution of product of efficiencies as a base-case efficiency distribution.

Table ES.3.14 summarizes the levels of efficiency for envelopes and dedicated refrigeration systems that result in maximum LCC savings. For each envelope and refrigeration system pair, the cell shows the maximum LCC savings and the efficiency level of envelope and refrigeration. For example, the first cell shows that LCC savings for a small non-display cooler are $7,335 per year and that this is achieved with a level 5 non-display cooler using a level 6 medium-temperature dedicated condensing indoor refrigeration system. The highest LCC savings typically occur when the efficiency levels of the envelope and refrigeration systems are nearly the same: for example, a very efficient envelope and a very inefficient refrigeration system may not pair as an LCC-maximizing system. However, in many cases, LCC is maximized at the highest possible efficiency level for the refrigeration system, but not for the envelope.

Table ES.3.14 Summary of Maximum LCC Savings for All Matched Pairs of WICF Envelopes and Refrigeration Systems

Envelope	Maximum LCC Savings ($) and Matched Efficiency Levels for Envelope and Refrigeration Unit (a,b)					
	Refrigeration System*					
	Dedicated Indoor Small	Dedicated Indoor Large	Dedicated Outdoor Small	Dedicated Outdoor Large	Multiplex System Small	Multiplex system Large
Non-Display Cooler Small	$7,335	-	$6,411	-	$2,702	-
	5,6		3,7		3,2	
Non-Display Cooler Medium	-	$13,720	-	$14,019	-	$5,288
		5,6		4,6		1,3
Non-Display Cooler Large	-	$28,369	-	$30,808	-	$10,393
		1,6		1,7		1,3
Display Cooler Small	-	$41,865	-	$41,130	-	$18,486
		5,6		5,7		4,3
Display Cooler Medium	-	$98,912	-	$96,740	-	$44,749
		6,6		6,7		5,3
Display Cooler Large	-	$552,429	-	$546,793	-	$242,378
		6,6		6,8		6,3
Non-Display Freezer Small	$27,867	-	$26,124	-	$11,071	-
	10,6		10,7		7,2	
Non-Display Freezer Medium	-	$54,842	-	$50,572	-	$20,718
		10,8		10,9		6,2
Non-Display Freezer Large	-	$102,693	-	$95,557	-	$39,312
		10,8		10,9		5,2
Display Freezer Small	-	$53,548	-	$50,779	-	$19,658
		10,6		3,7		3,2
Display Freezer Medium	-	$108,341	-	$104,054	-	$40,191
		11,7		4,7		4,2
Display Freezer Large	-	$479,751	-	$469,115	-	$146,800
		10,7		4,9		4,2

*Refrigeration system is matched to the envelope temperature regime. For example, a small non-display cooler will have a medium-temperature refrigeration system while a small non-display freezer will have a low-temperature refrigeration system.

Table ES.3.15 and Table ES.3.16 show the results of the LCC and PBP analyses, respectively, at all considered levels for the example cooler system; that is, a medium non-display cooler with a dedicated outdoor refrigeration system. Analysis results for all other systems are presented in Chapter 8 of the preliminary TSD. The results from the analysis are also graphically presented in Chapter 8 to show the range of LCC savings and PBPs for all the efficiency levels considered for each equipment class. Chapter 8 provides further details on the methods, data, and assumptions used for the LCC and PBP analyses.

In this equipment class, as for many others, the maximum LCC savings occur at a relatively high refrigeration system efficiency level (in this case 6) and a somewhat lower envelope efficiency level (in this case 4). The numbers in parentheses indicate negative LCC savings, *i.e.* efficiency levels that would not reduce life cycle costs.

Table ES.3.15 LCC Savings for a Medium Non-Display Cooler with a Large Dedicated, Medium-Temperature Outdoor Refrigeration System ($)

	Refrigeration System Efficiency Level								
Envelope Efficiency Level	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8***
0	-	922	2,871	5,215	7,659	9,037	9,450	9,452	9,403
1	8,047	8,632	9,867	11,345	12,869	13,718	13,969	13,968	13,931
2	8,013	8,596	9,823	11,293	12,808	13,651	13,901	13,900	13,864
3	8,041	8,622	9,845	11,309	12,819	13,660	13,909	13,908	13,871
4	9,117	9,605	10,631	11,857	13,116	13,814	14,019	14,018	13,985
5	9,225	9,697	10,692	11,880	13,099	13,774	13,973	13,972	13,940
6	9,276	9,731	10,688	11,830	13,001	13,648	13,839	13,837	13,806
7	9,250	9,696	10,637	11,759	12,908	13,544	13,731	13,729	13,699
8	9,104	9,529	10,422	11,487	12,578	13,179	13,356	13,355	13,325
9	8,801	9,210	10,069	11,093	12,141	12,718	12,888	12,886	12,857
10	6,846	7,217	7,998	8,927	9,876	10,397	10,550	10,548	10,521
11	1,241	1,584	2,304	3,161	4,033	4,512	4,652	4,650	4,625
12	(2,134)	(1,805)	(1,117)	(297)	537	994	1,127	1,125	1,100
13	(3,880)	(3,559)	(2,885)	(2,083)	(1,268)	(821)	(691)	(693)	(717)
14	(3,880)	(3,559)	(2,885)	(2,083)	(1,268)	(821)	(691)	(693)	(717)
15*	(3,880)	(3,559)	(2,885)	(2,083)	(1,268)	(821)	(691)	(693)	(717)

* Max-tech efficiency level

As in all equipment classes for all appliance rulemakings, the PBP in Table ES.3.16 is lower at lower efficiency levels. This is simply by design, in that DOE arranged the efficiency levels in order of ascending net costs. However, because the WICF rulemaking simultaneously examines the separate questions of envelope efficiency and refrigeration system efficiency, there are complex interactions between the two types of efficiency increases. This implies that the payback periods are not necessarily highest at the highest possible efficiency level for both types of equipment. For example, in Table ES.3.16, the highest possible payback period occurs at envelope efficiency level 15 and refrigeration efficiency level 0, rather than at envelope efficiency level 15 and refrigeration system efficiency level 8.

The PBP is calculated relative to the baseline. Therefore, the lowest possible PBP is not necessarily the most financially attractive option. This is because each level also includes the efficiency improvements of the levels below it, e.g. all technologies that are implemented in efficiency level 5 are also inclusive of technologies considered in level 2.

In this rulemaking, many of the lower efficiency levels exhibit negative payback periods. This reflects an efficiency-increasing option which simultaneously lowers operating costs and first costs. This is financially more attractive than the typical situation with efficiency improvements, which typically combine lower operating costs with increased first costs.

Table ES.3.16 PBP for a Medium Non-Display Cooler with a Large Dedicated, Medium-Temperature Outdoor Refrigeration System

Envelope Efficiency Level	PBP by Refrigeration Efficiency Level *(years)*								
	0	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8***
0	-	(2.4)	(1.9)	(1.3)	(0.4)	0.1	0.3	0.4	0.5
1	(2.0)	(2.0)	(2.0)	(1.8)	(1.4)	(1.0)	(0.9)	(0.9)	(0.8)
2	(2.0)	(2.0)	(2.0)	(1.8)	(1.4)	(1.0)	(0.9)	(0.8)	(0.7)
3	(1.9)	(2.0)	(1.9)	(1.8)	(1.3)	(1.0)	(0.9)	(0.8)	(0.7)
4	(0.6)	(0.7)	(0.8)	(0.8)	(0.6)	(0.3)	(0.3)	(0.2)	(0.2)
5	(0.4)	(0.5)	(0.6)	(0.6)	(0.4)	(0.2)	(0.1)	(0.1)	(0.0)
6	(0.0)	(0.1)	(0.3)	(0.3)	(0.1)	0.0	0.1	0.1	0.2
7	0.2	0.1	(0.1)	(0.1)	(0.0)	0.2	0.2	0.2	0.3
8	0.8	0.7	0.5	0.4	0.5	0.6	0.6	0.7	0.7
9	1.4	1.2	1.0	0.9	0.9	1.0	1.1	1.1	1.1
10	3.8	3.6	3.3	3.0	2.9	2.9	2.9	2.9	2.9
11	9.0	8.8	8.3	7.7	7.2	7.0	7.0	7.0	7.0
12	12.0	11.7	11.0	10.4	9.8	9.5	9.4	9.4	9.4
13	13.5	13.1	12.4	11.7	11.0	10.7	10.6	10.6	10.6
14	13.5	13.1	12.4	11.7	11.0	10.7	10.6	10.6	10.6
15*	13.5	13.1	12.4	11.7	11.0	10.7	10.6	10.6	10.6

* Max-tech efficiency level

ES.3.7 Shipments Analysis

For each equipment class being considered, shipment forecasts are needed to calculate the national impacts of standards on energy use, NPV, and future manufacturer cash flows. DOE’s shipments model considers shipments based on sector, market, and region. Equipment shipments to five sectors are considered: Food Sales, Convenience Stores, Commercial Food Service, Institutional Food service, and Industry (primarily Dairy). For units shipped to new construction, annual equipment shipments are equal to the number of new building units built multiplied by the equipment purchase rate, which is determined by the market share of the equipment under consideration. To estimate shipments due to replacements, the model uses sales in previous years and assumptions about the equipment lifetime, which determine how long an appliance is likely to remain in use. Shipments to “new owners” are based on historical rates of adoption. Chapter 9 of the preliminary TSD provides additional detail on the shipments analysis.

Figure ES.3.1 and Figure ES.3.2 and Table ES.3.17 and Table ES.3.18 illustrate the forecasted base-case shipments for all equipment classes included in this rulemaking.

As noted in Table ES.3.13, refrigeration systems have shorter average lifetimes than envelopes. For this reason, DOE forecasts more shipments of refrigeration systems than of envelopes, even though the installed stock of the two should be equal at any given point in time.

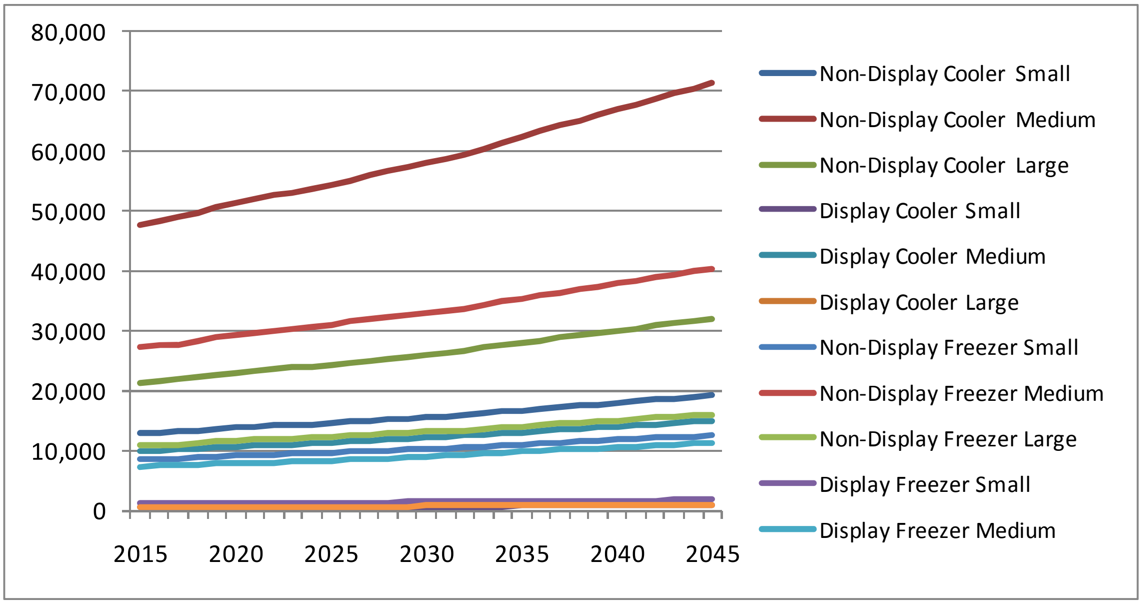

Figure ES.3.1 Projected Shipments of WICF Envelope Systems

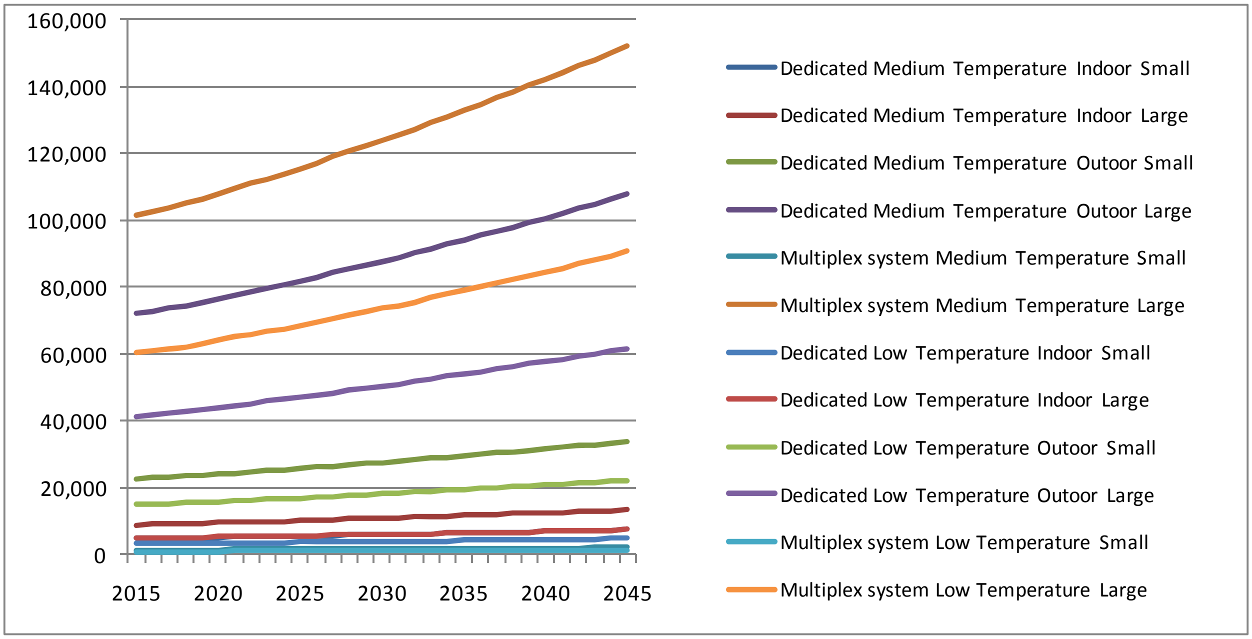

Figure ES.3.2 Projected Shipments of WICF Refrigeration Systems

Table ES.3.17 Projected Shipments of WICF Envelopes

WICF Envelopes	Year and Number Shipped						
	2015	**2020**	**2025**	**2030**	**2035**	**2040**	**2045**
Non-Display Cooler Small	12,823	13,796	14,583	15,565	16,737	17,950	19,168
Non-Display Cooler Medium	47,790	51,417	54,350	58,009	62,379	66,898	71,440
Non-Display Cooler Large	21,430	23,056	24,371	26,012	27,971	29,998	32,035
Display Cooler Small	542	585	619	663	713	767	821
Display Cooler Medium	9,909	10,688	11,319	12,126	13,039	14,013	14,996
Display Cooler Large	813	877	929	995	1,070	1,150	1,231
Non-Display Freezer Small	8,434	9,104	9,638	10,279	10,982	11,780	12,561
Non-Display Freezer Medium	27,155	29,311	31,032	33,096	35,358	37,929	40,443
Non-Display Freezer Large	10,761	11,616	12,298	13,116	14,012	15,031	16,027
Display Freezer Small	1,144	1,233	1,306	1,410	1,533	1,652	1,779
Display Freezer Medium	7,298	7,861	8,330	8,990	9,775	10,537	11,344
Display Freezer Large	572	616	653	705	766	826	889
Total	**148,673**	**160,160**	**169,428**	**180,966**	**194,336**	**208,533**	**222,735**

Table ES.3.18 Projected Shipments of WICF Refrigeration Systems

WICF Refrigeration Systems	Year and Number Shipped						
	2015	**2020**	**2025**	**2030**	**2035**	**2040**	**2045**
Dedicated Medium-Temperature Indoor Small	4,986	5,292	5,654	6,061	6,499	6,951	7,442
Dedicated Medium-Temperature Indoor Large	9,023	9,579	10,233	10,972	11,765	12,584	13,472
Dedicated Medium-Temperature Outdoor Small	22,712	24,109	25,756	27,613	29,608	31,667	33,901
Dedicated Medium-Temperature Outdoor Large	72,187	76,631	81,873	87,786	94,134	100,685	107,798
Multiplex system Medium-Temperature Small	1,458	1,547	1,653	1,772	1,900	2,033	2,176
Multiplex system Medium-Temperature Large	101,742	108,035	115,480	123,879	132,865	142,163	152,262
Dedicated Low- Temperature Indoor Small	3,293	3,498	3,733	4,002	4,280	4,571	4,884
Dedicated Low-Temperature Indoor Large	5,022	5,335	5,693	6,103	6,527	6,971	7,449
Dedicated Low-Temperature Outdoor Small	15,002	15,937	17,005	18,230	19,497	20,821	22,251
Dedicated Low-Temperature Outdoor Large	41,476	44,070	47,069	50,495	54,056	57,778	61,805
Multiplex system Low-Temperature Small	963	1,023	1,091	1,170	1,251	1,336	1,428
Multiplex system Low-Temperature Large	60,318	64,112	68,600	73,689	79,035	84,617	90,684
Total	**338,182**	**359,170**	**383,841**	**411,774**	**441,419**	**472,176**	**505,552**

ES.3.8 National Impact Analysis

The NIA estimates the following national impacts from possible candidate standard levels for WICF equipment: (1) national energy savings (NES); (2) monetary value of energy savings to consumers of the considered equipment classes due to standards; (3) increased total installed costs to consumers of the considered equipment classes due to standards; and (4) the net present value (NPV) of energy savings (difference between value of energy savings and increased total installed costs). DOE prepared an NES spreadsheet model to forecast energy savings and national consumer economic costs and savings resulting from new standards. The model uses typical national values for inputs.

A key component of DOE's estimates of NES and NPV is the trend in energy efficiency forecasted for the base case (without new standards) and each of the standards cases (with new standards). To forecast the base-case efficiency for each equipment class, DOE assumed that the least efficient level analyzed in the engineering analysis currently prevails in the marketplace. For its determination of standards-case efficiency distributions, DOE used a "roll-up" scenario to establish the distribution of efficiencies for the year that revised standards are assumed to become effective and subsequent years. DOE assumed that product efficiencies in the base case that did not meet the standard level under consideration would "roll up" to meet the new standard level in 2015. For all product classes, Chapter 10 provides additional details on this and other aspects of the NIA analysis.

ES.3.8.1 National Energy Savings

DOE calculated annual NES as the difference between national energy consumption in the base case (without new efficiency standards) and in each higher efficiency standard case. DOE estimated energy consumption and savings based on site energy and converted the electricity consumption and savings to source energy using the marginal heat rates associated with displaced power plants. DOE used the National Energy Modeling System (NEMS) to estimate the marginal heat rates. Cumulative energy savings are the sum of the annual NES, which DOE determined from 2015 through 2045.

Table ES.3.19 shows summary NES results for selected matched combinations of WICF envelopes and refrigeration systems. The selected efficiency levels in the table are those for the highest primary energy savings for which the net present value is a positive number (at a 7-percent discount rate). In many cases this corresponds to the highest efficiency levels considered for both the envelope and the refrigeration system. This is because most of the efficiency levels analyzed in this rulemaking are associated with positive net present values.

Table ES.3.19 Maximum Energy Savings for Which Net Present Value of Savings >0 at a 7-Percent Discount Rate and Corresponding WICF Envelope and Refrigeration Efficiency Levels

Envelope	Energy Savings (Quads) and Corresponding Efficiency Levels for Envelope and Refrigeration Unit (a,b)					
	Refrigeration System					
	Dedicated Indoor Small	Dedicated Indoor Large	Dedicated Outdoor Small	Dedicated Outdoor Large	Multiplex System Small	Multiplex System Large
Non-Display Cooler Small	0.021	-	0.086	-	0.003	-
	13,7		13,8		10,3	
Non-Display Cooler Medium	-	0.077	-	0.359	-	0.234
		13,7		13,8		9,3
Non-Display Cooler Large	-	-	-	0.618	-	0.165
				15,8		11,3
Display Cooler Small	-	0.004	-	0.018	-	-
		15,7		15,8		
Display Cooler Medium	-	-	-	-	-	0.556
						15,3
Display Cooler Large	-	-	-	0.421	-	-
				15,8		
Non-Display Freezer Small	0.045	-	0.192	-	0.006	-
	15,8		15,9		15,4	
Non-Display Freezer Medium	-	0.152	-	0.642	-	0.440
		15,8		15,9		15,4
Non-Display Freezer Large	-	-	-	0.781	-	0.234
				15,9		15,4
Display Freezer Small	-	-	-	0.100	-	-
				15,9		
Display Freezer Medium	-	-	-	-	-	0.462
						4,3
Display Freezer Large	-	-	-	0.514	-	-
				10,8		

Table ES.3.20 shows the national energy savings by efficiency level for the example combination of product classes, a medium non-display cooler with a large dedicated, medium-temperature outdoor refrigeration system. For other product classes, see chapter 10 of the preliminary TSD, the National Impact Analysis. The energy savings increase monotonically with efficiency level.

Table ES.3.20 National Energy Savings by Efficiency Level for Example Product Class Combination: A Medium Non-Display Cooler with a Large Dedicated, Medium-Temperature Outdoor Refrigeration System (quads)

	Refrigeration System Efficiency Level								
Envelope Efficiency Level	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
0	-	0.02	0.06	0.12	0.20	0.26	0.28	0.28	0.29
1	0.12	0.13	0.16	0.20	0.26	0.30	0.32	0.32	0.32
2	0.12	0.14	0.16	0.21	0.26	0.30	0.32	0.32	0.33
3	0.12	0.14	0.17	0.21	0.26	0.30	0.32	0.32	0.33
4	0.16	0.17	0.19	0.23	0.28	0.32	0.33	0.33	0.34
5	0.16	0.17	0.20	0.23	0.28	0.32	0.33	0.33	0.34
6	0.17	0.18	0.20	0.24	0.29	0.32	0.33	0.34	0.34
7	0.17	0.18	0.21	0.24	0.29	0.32	0.34	0.34	0.34
8	0.18	0.19	0.21	0.25	0.29	0.33	0.34	0.34	0.34
9	0.18	0.19	0.22	0.25	0.30	0.33	0.34	0.34	0.34
10	0.20	0.21	0.23	0.26	0.30	0.33	0.34	0.35	0.35
11	0.21	0.22	0.24	0.27	0.31	0.34	0.35	0.35	0.35
12	0.21	0.22	0.24	0.27	0.31	0.34	0.35	0.35	0.35
13	0.21	0.22	0.24	0.27	0.31	0.34	0.35	0.35	0.35
14	0.21	0.22	0.24	0.27	0.31	0.34	0.35	0.35	0.35
15	0.21	0.22	0.24	0.27	0.31	0.34	0.35	0.35	0.35

ES.3.8.2 Net Present Value

DOE calculated net monetary savings each year as the difference between total savings in operating costs and increases in total equipment costs in the base case and standards cases. DOE calculated savings over the life of the product. DOE used discount rates of 7 percent and 3 percent to discount future costs and savings to the present. DOE calculated NPV as the difference between the present value of operating cost savings and the present value of increased total installed costs. Selected NPV results for the example combination of product classes are shown in Table ES.3.21 for a 7 percent discount rate as the discounted value of the net savings in dollar terms. Note that these results are for the maximum level of energy savings for which net present value of savings is positive at a 7 percent discount rate, i.e. at the same efficiency levels that were presented in Table ES.3.19.

Table ES.3.21 Net Present Value of Energy Savings at Maximum Level of Energy Savings for Which Net Present Value of Savings > 0 at a 7-Percent Discount Rate and Corresponding WICF Envelope and Refrigeration Efficiency Levels

Envelope	NPV (Billion 2009$) and Corresponding Efficiency Levels for Envelope and Refrigeration Unit (a,b)					
	Refrigeration System					
	Dedicated Indoor Small	Dedicated Indoor Large	Dedicated Outdoor Small	Dedicated Outdoor Large	Multiplex System Small	Multiplex System Large
Non-Display Cooler Small	0.08	-	0.29	-	0.01	-
	13,7		13,8		10,3	
Non-Display Cooler Medium	-	0.15	-	0.90	-	0.21
		13,7		13,8		10,3
Non-Display Cooler Large	-	-	-	0.52	-	0.29
				15,8		11,3
Display Cooler Small	-	0.05	-	0.24	-	-
		15,7		15,8		
Display Cooler Medium	-	-	-	-	-	3.05
						15,3
Display Cooler Large	-	-	-	6.56	-	-
				15,8		
Non-Display Freezer Small	0.53	-	2.29	-	0.03	-
	15,8		15,9		15,4	
Non-Display Freezer Medium	-	1.52	-	6.44	-	1.22
		15,8		15,9		15,4
Non-Display Freezer Large	-	-	-	7.90	-	0.75
				15,9		15,4
Display Freezer Small	-	-	-	0.05	-	-
				15,9		
Display Freezer Medium	-	-	-	-	-	0.08
						4,3
Display Freezer Large	-	-	-	0.09	-	-
				10,8		

ES.3.9 Preliminary Manufacturer Impact Analysis

The preliminary MIA focuses on manufacturers of walk-in cooler and freezer equipment. Potential impacts include financial effects, both quantitative and qualitative, that might result from new energy conservation standards and consequently lead to changes in manufacturing practices for walk-in equipment. DOE identified potential impacts through interviews with manufacturers and other interested parties. Chapter 12 of the preliminary TSD includes details on the key issues DOE identified during the preliminary MIA.

Key issues relevant to the MIA for walk-in equipment include the following:

- Increased conversion costs;
- Impact to U.S. production and jobs;
- Cumulative regulatory burden;
- Impact to equipment utility;
- Current economic conditions;
- Equipment substitution;
- Impacts of regional standards; and
- Technical difficulty to achieve new standards

DOE conducted the preliminary MIA by first identifying equipment, methods, and practices used in the walk-in cooler and freezer industry. Next, DOE determined how energy efficiency improvements affect cost, production, and various other manufacturing metrics. Finally, DOE interviewed manufacturers for feedback.

DOE developed and distributed a questionnaire for use during the interviews. At the beginning of the interview process, DOE interviewed manufacturers and adjusted the analysis as appropriate, based on the feedback. In the interviews, DOE also examined any additional effects on competition, manufacturing capacity, direct employment, and the cumulative burden of other regulations affecting manufacturers, as well as several issues raised by individual manufacturers. Chapter 12 of the preliminary TSD provides additional details on this and other aspects of the preliminary MIA.

ES.4 ISSUES ON WHICH DOE SEEKS PUBLIC COMMENT

DOE is particularly interested in receiving comments and views of interested parties concerning the following issues:

ES.4.1 Separate Standards

DOE intends to create two separate standards for one walk-in: one standard for the refrigeration system and another standard for the envelope. The standard for the refrigeration system would be in terms of kWh/day or kWh/year, while the standard for the envelope would be in terms of energy consumption per square foot of surface area (kWh/ft^2). The refrigeration system manufacturer would be responsible for complying with the standard applicable to that system and the envelope manufacturer would be responsible for complying with the standard for the envelope. DOE has tentatively concluded that setting energy conservation standards for sub-systems or components beyond the division of the envelope and refrigeration system is unwarranted. DOE requests comment on this approach. See chapter 2, section 2.1.2.1 of the preliminary TSD.

ES.4.2 Responsibility for Compliance

DOE intends to hold the manufacturer of the envelope responsible for complying with the envelope standard, and the manufacturer of the refrigeration system responsible for complying with the refrigeration system standard. DOE believes that because of the structure of the walk-in market, it makes more sense to consider the envelope and refrigeration as separately manufactured components, rather than depart from its precedent and hold the installer or contractor responsible. However, DOE does not intend to consider sub-systems or components beyond the division of the envelope and refrigeration system. DOE requests comment on this approach. See chapter 2, section 2.1.2.2 of the preliminary TSD.

ES.4.3 Equipment Classes

Regarding WICF envelope equipment classes, DOE did not consider outdoor units as a separate envelope equipment class because the test procedure for measuring the energy performance of walk-in envelopes does not consider outdoor weather conditions. Further, typical walk-in designs for outdoor units include no additional design features that impact the energy consumption. Walk-ins are typically only modified to endure precipitation events such as rain, snow, and ice. DOE seeks comment on this assumption. DOE also seeks comment on other assumptions about both envelope and refrigeration equipment classes. See chapter 2, section 2.2.1.1, section 2.2.1.2, and section 2.2.1.3 of the preliminary TSD.

ES.4.4 Markups Analysis

DOE intends to model the WICF market and the markups analysis using multiple distribution channels. DOE requests comment on its approach and results of the markups analysis. See chapter 2, section 2.5 and chapter 6 of the preliminary TSD.

ES.4.5 Maintenance and Repair Costs

WICF refrigeration equipment is usually maintained by contractors who specialize in maintenance of both refrigeration and HVAC products. Consequently, DOE did not consider any “learning curve” related maintenance cost for the refrigeration system. For the improved technologies being proposed by DOE for the envelope (e.g., higher insulation thickness, door and sealant enhancement, active and passive infiltration reduction devices, high efficacy lighting, etc.), DOE did not find any consensus of opinion regarding “learning curve” related maintenance cost. DOE requests comment on this issue. See chapter 2, section 2.7.3 of the preliminary TSD.

ES.4.6 Manufacturer Impact

As part of the NOPR, DOE will seek further comments from manufacturers about their potential loss of market share, changes in the efficiency distribution within each industry, and the total reduction in equipment shipments at each new energy conservation standard level. DOE will then estimate the impacts on the industry quantitatively and qualitatively. DOE seeks further comment from interested parties about the impact of new standards on domestic manufacturers. See chapter 2, section 2.9 of the preliminary TSD.

ES.4.7 General Analytical Assumptions

During each stage of the preliminary analysis, DOE made one or more assumptions related to some key parameters of the analytical process on the premises that the assumed parameters reflect the actual conditions that walk-ins experience. These assumptions are described in the respective TSD chapters. DOE welcomes comments on these assumptions.