CHAPTER 10. NATIONAL IMPACT ANALYSIS

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CHAPTER 10. NATIONAL IMPACT ANALYSIS

10.1 INTRODUCTION

This chapter describes the method for estimating the magnitude and net present value (NPV) of future national energy savings (NES) from candidate efficiency levels for automatic commercial ice-making (ACIM) equipment energy conservation standards. Results of the national impact analysis (NIA) described in this chapter include national energy consumption and savings, monetary value of energy savings to the nation as a result of standards, increased total installed costs to the nation as a result of standards, and the NPV of energy savings (the difference between the present monetary value of energy savings and increased total installed costs).

The U.S. Department of Energy (DOE) determined both the NPV and NES for each candidate standard level it considered for each of the 21 primary equipment classes of automatic commercial ice makers examined in this rulemaking. Sections 10.2 and 10.3 present the definitions and the inputs to NES and NPV, respectively. Section 10.4 presents the result of the NIA. DOE performed all calculations using a Microsoft Excel spreadsheet, which is available at www.eere.energy.gov/buildings/appliance_standards/ commercial_products.html. Details and instructions for using the spreadsheet are discussed in appendix 10A of this preliminary technical support document (preliminary TSD). Detailed results are available in appendix 10B of this TSD.

10.2 NATIONAL ENERGY SAVINGS

10.2.1 National Energy Savings Definition

DOE calculates annual NES for a given year as the difference between two scenarios: a base case without new energy conservation standards and a standards case with new energy conservation standards. Positive values of NES correspond to net energy savings (*i.e.*, national annual energy consumption (AEC) with standards is less than AEC in the base case).

$$NES_t = AEC_{base,t} - AEC_{standards,t}$$

Eq. 10.1

Where:

NES_t = national energy savings in the year t (quadrillion British thermal units (quads)),
$AEC_{base,t}$ = annual national energy consumption in the year t in the base case scenario (quads), and
$AEC_{standards,t}$ = annual national energy consumption in the year t in a standards case scenario (quads).

DOE calculates cumulative NES as the sum of annual NES from each year, starting with the year in which the standards that are the subject of this rulemaking become effective (2016), and through the end of the study period (2045). As discussed below, the NES also includes energy savings for equipment purchased in the final study year, and through the year in which the final year purchases are retired. Cumulative NES is explained by Eq. 10.2.

$$NES_{cum} = \sum_t NES_t$$

Eq. 10.2

DOE calculated the AEC for base-case and standards-case scenarios by multiplying the number or stock of automatic commercial ice makers (by vintage) by the unit energy consumption (UEC) (also by vintage), as shown by Eq. 10.3:

$$AEC_t = \sum_V (STOCK_V \times UEC_V) \times src_conv_t$$

Eq. 10.3

Where:

AEC_t = national annual energy consumption in the year t (quads), summed over vintages of ACIM stock,
$STOCK_V$ = stock of automatic commercial ice makers (millions of units) of vintage V surviving in the year for which DOE calculated annual energy consumption (vintages range from 1 to approximately 14 years),
UEC_V = annual unit energy consumption in kilowatt-hours (kWh) for equipment of vintage V,
src_conv_t = time-dependent conversion factor to convert from site energy to source energy (Btu/kWh), and
t = year of forecast.

The ACIM stock depends on annual shipments and equipment lifetime. DOE acknowledges that the shipment projections under the standards cases could be lower than those in the base case because the higher installed costs could cause some customers to forego or delay discretionary equipment purchases. DOE calculated an average impact factor of -0.625, -6.25 percent for a 10-percent price increase, based on an average of input received during manufacturer interviews. This information was compiled after DOE completed the work underlying this preliminary TSD. DOE will consider performing sensitivity analyses during the notice of proposed rulemaking (NOPR) stage of the rulemaking to analyze the impact of higher prices on shipment. In the executive summary of this preliminary TSD, DOE requests comment on the potential impacts on future shipments in standards-case scenarios.

10.2.2 National Energy Savings Inputs

Table 10.2.1 lists the inputs for the determination of NES.

Table 10.2.1 National Energy Saving Inputs

Input
Annual unit energy consumption (*UEC*)
Shipments
Equipment stock (*STOCKV*)
Site-to-source conversion factor (*src_conv*)

10.2.2.1 Annual Unit Energy Consumption

The annual UEC is the site energy consumed by an automatic commercial ice maker in a given year. As described in the following paragraphs, DOE forecasted annual shipment-weighted average equipment efficiencies that, in turn, enabled the determination of shipment-weighted AEC values.

Table 10.2.2 provides estimated shipment-weighted market shares, by efficiency level, for each of the equipment classes analyzed in this rulemaking. To estimate these market shares, DOE used 2010 automatic commercial ice maker shipments by equipment class developed from information provided by the industry and from published sources (see preliminary TSD chapter 3).

Table 10.2.2 Shipment-Weighted Market Shares by Efficiency Level, Base Case

Equipment Class	Market Share by Efficiency Level						
	Level 1	Level 2	Level 3	Level 4	Level 5	Level 6	Level 7
IMH-W-Small-B	50.9%	21.8%	27.3%				
IMH-W- Med -B	73.8%	26.2%					
IMH-W-Large-B	82.1%	0.0%	17.9%				
IMH-A-Small-B	59.3%	16.7%	16.7%	7.4%			
IMH-A-Large-B	68.5%	21.3%	7.9%	2.2%			
RCU-Small-B	57.1%	29.8%	1.2%	11.9%			
RCU-Large-B	55.2%	24.0%	6.3%	14.6%			
SCU-W-Small-B	37.5%	37.5%	18.8%	0.0%	6.3%		
SCU-W-Large-B	40.0%	0.0%	10.0%	20.0%	20.0%	10.0%	0.0%
SCU-A-Small-B	32.3%	48.4%	0.0%	0.0%	9.7%	9.7%	
SCU-A-Large-B	33.3%	44.4%	0.0%	5.6%	16.7%		
IMH-W-Small-C	0.0%	3.2%	6.5%	12.9%	35.5%	41.9%	
IMH-W-Large-C	0.0%	0.0%	6.3%	18.8%	75.0%		
IMH-A-Small-C	3.9%	2.0%	3.9%	5.9%	7.8%	76.5%	
IMH-A-Large-C	0.0%	0.0%	9.1%	9.1%	0.0%	0.0%	81.8%
RCU-Small-C	0.0%	13.6%	86.4%				
RCU-Large-C	0.0%	15.0%	85.0%				
SCU-W-Small-C*	NA						
SCU-W-Large-C	0.0%	0.0%	77.3%	0.0%	22.7%		
SCU-A-Small-C	0.0%	0.0%	0.0%	100.0%			
SCU-A-Large-C	0.0%	0.0%	0.0%	5.3%	5.3%	23.7%	65.8%

IMH: ice-making head; RCU: remote condenser unit; SCU: self-contained unit; A: Air cooled; W: Water cooled; B: Batch; C: Continuous

* Data available to DOE shows there are no existing SCU-Water-Small-Continuous products available, so this class is not currently defined in the models.

DOE estimated the market shares based on the number of available ice maker models of each equipment class with energy use consistent with the defined efficiency levels (*i.e.,* the model has energy use no greater than its assigned efficiency level, but not as low as the next higher efficiency level). Using the computed breakout of currently available models along with Air-Conditioning, Heating, and Refrigeration Institute (AHRI) shipment data, DOE created a shipment-weighted distribution of units by equipment class and efficiency level.

The market share for each equipment class by efficiency level is defined as the *efficiency level share*. Because DOE had no information regarding future changes in market shares among

equipment classes, DOE assumed the market share for a particular equipment class to be constant over time.

Table 10.2.3 provides the annual UEC values for each efficiency level for all 21 primary equipment classes. The annual UEC is the amount of energy used by an individual ice maker at each of the specified efficiency levels, in kWh/unit/year.

Table 10.2.3 Unit Energy Consumption by Efficiency Level

Equipment Class	Unit Energy Consumption by Efficiency Level *kWh/year*,***						
	Level 1	**Level 2**	**Level 3**	**Level 4**	**Level 5**	**Level 6**	**Level 7**
IMH-W-Small-B	3,389	3,052	2,918				
IMH-W- Med -B	7,227	6,507					
IMH-W-Large-B	10,972	9,877	9,767				
IMH-A-Small-B	4,227	3,806	3,596	3,386			
IMH-A-Large-B	8,797	7,919	7,480	7,042			
RCU-Small-B	7,930	7,218	6,743	6,625			
RCU-Large-B	13,983	12,727	11,889	11,680			
SCU-W-Small-B	1,891	1,760	1,611	1,517	1,442		
SCU-W-Large-B	4,183	3,892	3,559	3,351	3,143	3,018	2,560
SCU-A-Small-B	2,600	2,419	2,213	2,084	1,955	1,878	
SCU-A-Large-B	3,599	3,349	3,062	2,884	2,705		
IMH-W-Small-C	8,344	7,512	7,096	6,680	6,263	5,598	
IMH-W-Large-C	9,329	8,399	7,933	7,468	7,096		
IMH-A-Small-C	5,148	4,635	4,379	4,122	3,866	3,610	
IMH-A-Large-C	11,519	10,370	9,795	9,220	8,645	8,070	7,495
RCU-Small-C	8,581	7,956	7,169				
RCU-Large-C	15,078	13,979	12,594				
SCU-W-Small-C **	NA						
SCU-W-Large-C	3,471	3,350	3,143	2,933	2,850		
SCU-A-Small-C	2,600	2,419	2,213	2,136			
SCU-A-Large-C	5,387	5,012	4,583	4,314	4,046	3,778	3,456

IMH: ice-making head; RCU: remote condenser unit; SCU: self-contained unit; A: Air cooled; W: Water cooled; B: Batch; C: Continuous

* Blank cells indicate that UEC was not calculated for that efficiency level because the engineering analysis indicated that the efficiency level is not viable. NA indicates data not available.

** SCU-W-Small-C represents a viable equipment class, but DOE found no evidence of shipments within this class.

For subsequent calculations, DOE developed shipment-weighted average AEC values for the base-case efficiency distribution and for standards-case distributions. To develop standards-case distributions, DOE used the so-called "roll-up" method of aggregating shipments. In the roll-up method, when a standard is contemplated that eliminates from the market equipment below a specific efficiency level, all shipments below the candidate standard level roll up into the lowest efficiency level available under the candidate standard. For example, as Table 10.2.2 shows, in the base case, 50.9 percent of IMH-W-Small-B machines were shipped at Level 1 efficiency. If Level 1 is eliminated, those shipments would roll up into Level 2. For each equipment class, DOE used the roll-up method to calculate shipment-weighted average AEC for the efficiency distribution at each efficiency level. Table 10.2.4 shows the resulting shipment-weighted average AEC values.

Table 10.2.4 Shipment-Weighted Average Unit Energy Consumption by Efficiency Level

Equipment Class	Shipment-Weighted Average Unit Energy Consumption *kWh/year*,**						
	Level 1	Level 2	Level 3	Level 4	Level 5	Level 6	Level 7
IMH-W-Small-B	3,187	3,016	2,918				
IMH-W- Med -B	7,038	6,507					
IMH-W-Large-B	10,756	9,857	9,767				
IMH-A-Small-B	3,989	3,740	3,580	3,386			
IMH-A-Large-B	8,466	7,865	7,470	7,042			
RCU-Small-B	7,548	7,142	6,729	6,625			
RCU-Large-B	13,215	12,522	11,858	11,680			
SCU-W-Small-B	1,761	1,712	1,600	1,512	1,442		
SCU-W-Large-B	3,629	3,513	3,380	3,276	3,130	3,018	2,560
SCU-A-Small-B	2,380	2,322	2,156	2,052	1,948	1,878	
SCU-A-Large-B	3,299	3,215	2,993	2,854	2,705		
IMH-W-Small-C	6,132	6,132	6,118	6,078	5,984	5,598	
IMH-W-Large-C	7,218	7,218	7,218	7,189	7,096		
IMH-A-Small-C	3,771	3,751	3,736	3,710	3,670	3,610	
IMH-A-Large-C	7,861	7,861	7,861	7,809	7,704	7,600	7,495
RCU-Small-C	7,276	7,276	7,169				
RCU-Large-C	12,802	12,802	12,594				
SCU-W-Small-C**							
SCU-W-Large-C	3,077	3,077	3,077	2,914	2,850		
SCU-A-Small-C	2,136	2,136	2,136	2,136			
SCU-A-Large-C	3,608	3,608	3,608	3,608	3,594	3,566	3,456

IMH: ice-making head; RCU: remote condenser unit; SCU: self-contained unit; A: Air cooled; W: Water cooled; B: Batch; C: Continuous

* Blank cells indicate that UEC was not calculated for that efficiency level because the engineering analysis indicated that the efficiency level is not viable. NA indicates data not available.

** SCU-W-Small-C represents a viable equipment class, but DOE found no evidence of shipments within this class.

10.2.2.2 Shipments

DOE forecasted shipments for all years in the analysis period. These results are presented in preliminary TSD chapter 9, Shipments Analysis.

10.2.2.3 Equipment Stock

The ACIM stock in a given year is the total number of units that are in use in that year. The NES spreadsheet model keeps track of the total number of automatic commercial ice makers shipped each year. For the NES and NPV calculations in the preliminary analysis, DOE estimated that approximately 11.8 percent of the existing automatic commercial ice makers are retired in each year (based on an 8-½ -year average lifetime) and that, for units shipped in 2045, any units still remaining at the end of 2055 will be replaced.

10.2.2.4 National Annual Energy Consumption

The national AEC is the product of the annual UEC and the stocks of automatic commercial ice makers of each vintage, as shown in Eq. 10.3.

DOE initially calculated the AEC at the site (*i.e.*, electricity in kilowatt-hours consumed by the automatic commercial ice makers). DOE then calculated primary energy consumption by

applying a conversion factor to account for losses associated with the generation, transmission, and distribution of electricity.

10.2.2.5 Site-to-Source Conversion Factor

The site-to-source conversion factor is the multiplicative factor used for converting site energy consumption, expressed in kilowatt-hours, into primary or source energy consumption, expressed in Btu or quadrillion Btu (quads). The site-to-source conversion factor accounts for national average losses in electricity generation, transmission, and distribution.

At the NOPR and final rule stages of the efficiency standards rulemaking process, DOE performs a utility impact analysis. As part of the utility impact analysis, DOE uses the energy savings estimated in the NIA to model the savings using the National Energy Modeling System (NEMS) (see preliminary TSD chapter 9 for a description of NEMS). DOE then analyzes the impact on the generation equipment needed to meet projected national demand and the marginal site-to-source conversion factors arising from the generation portfolio. Because each type of residential appliance or commercial equipment has a different energy usage profile, each type will cause the electric utility grid to provide energy at times and in quantities that are unique. Thus, at the NOPR and final rule stages, DOE explicitly models the energy savings to identify this electric system-level impact. One output of this analysis is a calculated set of site-to-source conversion factors specific to the energy usage profile of the appliance/equipment.

For this preliminary analysis, DOE used annual site-to-source conversion factors specific to the commercial refrigeration usage profile, calculated from the results of detailed modeling using NEMS. Table 10.2.5 shows the conversion factors used in this analysis. DOE intends to update the NEMS model and analyze the site-to-source conversion factors at the NOPR stage of the current rulemaking, based on the results of the NIA for the efficiency standards that will be proposed at that time.

Table 10.2.5 Projected Site-to-Source Conversion Factors

Year	Site-to-Source Conversion Factor *Btu/kWh*	Year	Site-to-Source Conversion Factor *Btu/kWh*
2016	9,115	2036	9,990
2017	9,207	2037	9,990
2018	9,529	2038	9,990
2019	10,128	2039	9,990
2020	10,347	2040	9,990
2021	10,200	2041	9,990
2022	9,834	2042	9,990
2023	9,854	2043	9,990
2024	10,060	2044	9,990
2025	10,093	2045	9,990
2026	10,020	2046	9,990
2027	9,932	2047	9,990
2028	9,920	2048	9,990
2029	9,990	2049	9,990
2030	9,990	2050	9,990
2031	9,990	2051	9,990
2032	9,990	2052	9,990
2033	9,990	2053	9,990
2034	9,990	2054	9,990
2035	9,990	2055	9,990

Source: Final Rule TSD: Energy Efficiency Standards For Commercial And Industrial Equipment: Commercial Ice-Cream Freezers; Self-Contained Commercial Refrigerators, Freezers, and Refrigerator-Freezers without Doors; and Remote Condensing Commercial Refrigerators, Freezers, and Refrigerator-Freezers. Chapter 11: National Impact Analysis, and appendix H. December 31, 2008.

10.3 NET-PRESENT VALUE

10.3.1 Net-Present Value Definition

The NPV is the value in the present of a time series of costs and savings. The NPV is given by:

$$NPV = PVS - PVC$$

Eq. 10.4

Where:

PVS = present value of operating cost savings (electricity, water[a], repair, and maintenance costs), and

PVC = present value of increased total installed costs (equipment purchase price and installation cost).

DOE determined the *PVS* and *PVC* according to the following expressions:

$$PVS = \sum_t OCS_t \times DF_t$$

Eq. 10.5

[a] DOE combined water and wastewater prices into a single value.

$$PVC = \sum_t TIC_t \times DF_t$$

Eq. 10.6

Where:

OCS_t = total annual operating cost savings in the year t ($),
TIC_t = total annual installed cost increases in the year t ($),
DF_t = discount factor for the year t, and
t = year (*PVS* is summed over 2016–2055, and *PVC* is summed over 2016–2045).

DOE determined the contribution to *PVC* for each year, from the effective date of the standard (2016) to the year 2045, discounted to the year 2011. DOE determined the contribution to *PVS* for each year, from the effective date of the standard (2016) to the year when units purchased in 2045 would be retired (estimated to be 2055[b]). DOE calculated costs and savings as the difference between a standards case and a base case. DOE calculated a discount factor from the discount rate and the number of years between the "present" (*i.e.*, year to which the sum is being discounted) and the year in which the costs and savings occur. DOE calculated the NPV as the sum over time of the discounted net savings.

10.3.2 Net Present Value Inputs

Table 10.3.1 summarizes the inputs to the NPV calculation.

Table 10.3.1 Net Present Value Inputs

Input
Total annual installed cost (*TICt)*
Total annual operating cost savings (*OCSt)*
Discount factor
Present value of costs (*PVC*)
Present value of savings (*PVS*)

10.3.2.1 Total Annual Installed Cost

The increase in the total annual installed cost is equal to the annual change in the per-unit installed cost (difference between base case and standards case) multiplied by the shipments forecasted in the standards case. The total installed cost includes the manufacturer selling price, markups for wholesale and distribution chains, and installation costs. (See preliminary TSD chapter 8 for a discussion of the development of installed cost.) Table 10.3.2 shows the average total installed costs per unit for each of the equipment classes of automatic commercial ice makers by efficiency level.

[b] DOE assumes all equipment has a useful life of 8-½ years. During DOE's analyses to estimate equipment shipments and stock, equipment life was allowed to vary. This is discussed in chapter 9, in the discussion of the Weibull function. In the analysis, after 2045, DOE's models assume all purchases of equipment cease, and as equipment is retired stock goes to zero. The bulk of the stock is retired by 2052 but the retirement stretches out to 2055 at the higher end of the Weibull distribution.

Table 10.3.2 Average Total Installed Cost per Unit by Efficiency Level

Equipment Class	Average Total Installed Cost per Unit *2010$**						
	Level 1	Level 2	Level 3	Level 4	Level 5	Level 6	Level 7
IMH-W-Small-B	$4,218	$4,269	$4,279				
IMH-W- Med -B	$6,986	$7,026					
IMH-W-Large-B	$10,255	$10,274	$10,284				
IMH-A-Small-B	$4,226	$4,242	$4,265	$4,314			
IMH-A-Large-B	$6,188	$6,208	$6,332	$6,390			
RCU-Small-B	$7,287	$7,306	$7,367	$7,396			
RCU-Large-B	$12,889	$12,914	$13,018	$13,053			
SCU-W-Small-B	$4,568	$4,584	$4,611	$4,634	$4,656		
SCU-W-Large-B	$4,590	$4,606	$4,622	$4,633	$4,645	$4,659	$4,697
SCU-A-Small-B	$4,568	$4,584	$4,618	$4,640	$4,658	$4,667	
SCU-A-Large-B	$4,578	$4,605	$4,634	$4,652	$4,674		
IMH-W-Small-C	$6,949	$6,957	$6,968	$6,981	$6,992	$7,074	
IMH-W-Large-C	$7,902	$7,931	$7,947	$7,982	$8,102		
IMH-A-Small-C	$4,615	$4,648	$4,671	$4,693	$4,715	$4,874	
IMH-A-Large-C	$7,902	$7,942	$7,956	$7,971	$7,985	$8,104	$8,247
RCU-Small-C	$7,726	$7,740	$7,835				
RCU-Large-C	$11,539	$11,555	$11,704				
SCU-W-Small-C **							
SCU-W-Large-C	$4,497	$4,504	$4,516	$4,529	$4,532		
SCU-A-Small-C	$4,473	$4,511	$4,547	$4,555			
SCU-A-Large-C	$4,497	$4,497	$4,556	$4,601	$4,654	$4,713	$5,033

IMH: ice-making head; RCU: remote condenser unit; SCU: self-contained unit; A: Air cooled; W: Water cooled; B: Batch; C: Continuous

* A value of $0 indicates that there is no associated cost for this efficiency level. A blank cell indicates the engineering analysis found no further efficiency options to make the efficiency level a viable level.

** SCU-W-Small-C represents a viable equipment class, but DOE found no evidence of shipments within this class.

In prior energy conservation standards rulemakings, DOE estimated the total installed costs per unit for equipment, and then assumed that costs remain constant throughout the analysis period. This assumption is conservative because installed costs tend to decrease over time. In 2011, DOE issued a notice of data availability (NODA) titled Equipment Price Forecasting in Energy Conservation Standards Analysis. 76 FR 9696 (Feb. 22, 2011) In the NODA, DOE proposed a methodology for analyzing whether equipment prices have trended downward in real terms. The methodology examines so-called experiential learning, wherein, with ever-increasing experience with the production of a product, manufacturers are able to reduce their production costs through innovations in technology and process.

To account for increased efficiency in the automatic commercial ice maker manufacturing process over time, DOE will use a price forecast methodology based on experiential learning (see appendix 8C for more information on experiential learning). To project the manufacturer selling price of a unit, DOE will multiply the selling price for the first year of the analysis period by a coefficient specific to the year of purchase relative to the dollar year used (2010$). The coefficient will account for the effects of experiential learning.

Table 10.3.3 summarizes five learning scenarios that DOE developed. The first scenario, constant prices, is consistent with the analyses DOE historically performed. In this scenario, prices are held constant, so the learning multiplier is 1.00. The second scenario is an all-

commercial equipment price index extracted from NEMS price data. DOE developed the remaining three scenarios–the high, reference, and low learning scenarios–for this rulemaking from historical ice maker shipments and Producer Price Index data. Appendix 8C of this TSD documents the development of the price learning scenarios. For the preliminary analysis, DOE used the historically derived reference scenario. The total cost values reported in Table 10.3.2 include the effects of experiential learning. The other scenarios will be used for further sensitivity analysis in the NOPR stage. DOE requested comment on the use of experiential learning in the executive summary of this preliminary TSD.

Table 10.3.3 Experience (Price) Learning Scenarios

Year	Constant Prices	Commercial Equipment Price Index*	Historically Derived Changes		
			High Change	Reference Change	Low Change
2010	100.00%	100.00%	100.00%	100.00%	100.00%
2011	100.00%	100.26%	99.55%	99.70%	99.85%
2012	100.00%	100.34%	99.12%	99.41%	99.71%
2013	100.00%	100.76%	98.70%	99.13%	99.56%
2014	100.00%	100.73%	98.29%	98.85%	99.42%
2015	100.00%	100.29%	97.89%	98.58%	99.29%
2016	100.00%	99.95%	97.49%	98.32%	99.15%
2017	100.00%	99.30%	97.11%	98.06%	99.02%
2018	100.00%	98.60%	96.74%	97.81%	98.90%
2019	100.00%	97.85%	96.37%	97.56%	98.77%
2020	100.00%	96.98%	96.01%	97.32%	98.65%
2021	100.00%	96.00%	95.66%	97.09%	98.53%
2022	100.00%	95.04%	95.32%	96.85%	98.41%
2023	100.00%	94.06%	94.99%	96.63%	98.29%
2024	100.00%	93.10%	94.66%	96.40%	98.18%
2025	100.00%	92.12%	94.33%	96.18%	98.07%
2026	100.00%	91.17%	94.02%	95.97%	97.96%
2027	100.00%	90.00%	93.71%	95.76%	97.85%
2028	100.00%	88.88%	93.40%	95.55%	97.74%
2029	100.00%	87.74%	93.11%	95.35%	97.64%
2030	100.00%	86.63%	92.81%	95.15%	97.54%
2031	100.00%	85.39%	92.53%	94.95%	97.44%
2032	100.00%	84.27%	92.24%	94.75%	97.34%
2033	100.00%	83.08%	91.96%	94.56%	97.24%
2034	100.00%	81.89%	91.69%	94.38%	97.14%
2035	100.00%	80.64%	91.42%	94.19%	97.05%
2036	100.00%	80.64%	91.16%	94.01%	96.95%
2037	100.00%	80.64%	90.90%	93.83%	96.86%
2038	100.00%	80.64%	90.64%	93.66%	96.77%
2039	100.00%	80.64%	90.39%	93.48%	96.68%
2040	100.00%	80.64%	90.14%	93.31%	96.59%
2041	100.00%	80.64%	89.90%	93.14%	96.50%
2042	100.00%	80.64%	89.66%	92.98%	96.42%
2043	100.00%	80.64%	89.42%	92.81%	96.33%
2044	100.00%	80.64%	89.19%	92.65%	96.25%
2045	100.00%	80.64%	88.96%	92.49%	96.16%

* Price index applicable to all commercial equipment, derived from *AEO2011* data files.

DOE developed base-case and standards-case energy efficiency scenarios as discussed in section 10.2.2.1. For both the base-case and standards-case energy efficiency scenarios, DOE calculated annual shipment-weighted average efficiencies. For each annual shipment-weighted average efficiency value, DOE assigned a total installed cost, based on the shipment-weighted total installed cost for all efficiency levels. DOE based the relationship between efficiency and total installed cost for each ACIM class on the "reference change" scenario in Table 10.3.3.

Using the shipment-weighting and the data in Table 10.3.2, DOE estimated the shipment-weighted installed cost. Table 10.3.4 shows the results.

Table 10.3.4 Shipment-Weighted Average Total Installed Cost per Unit, by Efficiency Level

Equipment Class	Shipment-Weighted Average Total Installed Cost per Unit *						
	Level 1	Level 2	Level 3	Level 4	Level 5	Level 6	Level 7
IMH-W-Small-B	$4,246	$4,272	$4,279				
IMH-W- Med -B	$6,996	$7,026					
IMH-W-Large-B	$10,260	$10,276	$10,284				
IMH-A-Small-B	$4,242	$4,251	$4,268	$4,314			
IMH-A-Large-B	$6,208	$6,222	$6,334	$6,390			
RCU-Small-B	$7,307	$7,318	$7,370	$7,396			
RCU-Large-B	$12,927	$12,941	$13,023	$13,053			
SCU-W-Small-B	$4,588	$4,594	$4,614	$4,635	$4,656		
SCU-W-Large-B	$4,620	$4,626	$4,633	$4,638	$4,646	$4,659	$4,697
SCU-A-Small-B	$4,594	$4,599	$4,626	$4,644	$4,659	$4,667	
SCU-A-Large-B	$4,610	$4,619	$4,642	$4,655	$4,674		
IMH-W-Small-C	$7,022	$7,022	$7,023	$7,024	$7,027	$7,074	
IMH-W-Large-C	$8,070	$8,070	$8,070	$8,072	$8,102		
IMH-A-Small-C	$4,828	$4,829	$4,831	$4,833	$4,836	$4,874	
IMH-A-Large-C	$8,196	$8,196	$8,196	$8,197	$8,200	$8,221	$8,247
RCU-Small-C	$7,822	$7,822	$7,835				
RCU-Large-C	$11,682	$11,682	$11,704				
SCU-W-Small-C**							
SCU-W-Large-C	$4,520	$4,520	$4,520	$4,530	$4,532		
SCU-A-Small-C	$4,555	$4,555	$4,555	$4,555			
SCU-A-Large-C	$4,915	$4,915	$4,915	$4,915	$4,917	$4,924	$5,033

IMH: ice-making head; RCU: remote condenser unit; SCU: self-contained unit; A: Air cooled; W: Water cooled; B: Batch; C: Continuous

* A value of $0 indicates that there is no associated cost for this efficiency level. A blank cell indicates the engineering analysis found no further efficiency options to make the efficiency level a viable level.

** SCU-W-Small-C represents a viable equipment class, but DOE found no evidence of shipments within this class.

The results in Table 10.3.4 depend on the forecasted annual shipments by efficiency level. If a standard were set at Level 1, customers would select equipment from all of the available levels. If the standard were set at Level 2, customers would select from equipment at Level 2 or higher. As the standard levels increase, the range of available efficiency levels is reduced. The average shipment-weighted average cost depends on the equipment costs shown in Table 10.3.2 and the estimated shipments at each level.

10.3.2.2 Total Annual Operating Cost Savings

The national average annual operating cost savings equal the change in the annual operating costs (difference between base case and standards case) per unit multiplied by the stock forecasted in the standards case. The annual operating cost includes electricity, water, repair, and maintenance costs.

Annual Electricity Cost Savings. As described in preliminary TSD chapter 8, Life-Cycle Cost and Payback Period Analysis, DOE calculated annual electricity costs based on average state-level commercial electricity prices. To calculate annual energy cost savings for a particular equipment class in a given year, DOE first calculated the annual energy costs in each forecast

year at each efficiency level. To calculate annual energy costs, DOE multiplied the weighted average energy consumption at each efficiency level from Table 10.3.4 by the number of units in the equipment class in each year, and then by the sales-weighted national average electricity prices for the seven building types in chapter 8. To determine energy savings, DOE then subtracted the national energy costs at each efficiency level (Level 2 and higher) from the national energy costs at the baseline level (Level 1).

Annual Water Cost Savings. DOE used average state-level commercial water/wastewater prices to calculate water/wastewater cost savings. To calculate annual water/wastewater cost savings for a particular equipment class in a given year, DOE first calculated the annual water/wastewater costs in each forecast year at each efficiency level by multiplying the weighted average consumption at each efficiency level by the number of units in the equipment class in each year. To determine cost savings, DOE subtracted the national water costs at each efficiency level (level 2 and higher) from the national water costs at the baseline level (level 1). For the preliminary analysis, DOE did not analyze any design options that result in changes in water usage. As a result, DOE is not reporting water or water-cost savings during the preliminary analysis phase. Chapter 8 discusses in more detail the process of defining water/wastewater prices for each product class and year.

Annual Repair Costs. DOE calculated the average annual repair costs as fixed percentages of the value of the ACIM equipment (see chapter 8). Table 10.3.5 shows the average repair costs per unit for the equipment classes analyzed. The NES spreadsheet provides the capability to allow repair costs to differ by the price of the automatic commercial ice maker, and therefore by energy consumption level. For this preliminary analysis, DOE assumed the repair costs will not increase with the increases in efficiency of the equipment.

Table 10.3.5 Average Annual Repair Cost per Unit

Equipment Class	Average Annual Repair Cost *2010$*
IMH-W-Small-B	$108
IMH-W- Med -B	$178
IMH-W-Large-B	$262
IMH-A-Small-B	$108
IMH-A-Large-B	$158
RCU-Small-B	$186
RCU-Large-B	$329
SCU-W-Small-B	$117
SCU-W-Large-B	$117
SCU-A-Small-B	$117
SCU-A-Large-B	$117
IMH-W-Small-C	$178
IMH-W-Large-C	$202
IMH-A-Small-C	$118
IMH-A-Large-C	$202
RCU-Small-C	$197
RCU-Large-C	$295
SCU-W-Small-C*	NA
SCU-W-Large-C	$115
SCU-A-Small-C	$114
SCU-A-Large-C	$115

IMH: ice-making head; RCU: remote condenser unit; SCU: self-contained unit; A: Air cooled; W: Water cooled; B: Batch; C: Continuous
* NA indicates data not available. DOE was not able to identify any existing products of the SCU-W-Small-C equipment class in ice maker databases. Hence, this equipment class was not analyzed, directly or by extrapolation.

Annual Maintenance Costs. For the preliminary analysis, DOE determined average annual maintenance costs as a fixed percentage of the total installed cost, initially estimated as 3 percent of total base-case scenario installed cost. DOE also assumed that maintenance costs do not increase with efficiency level. Table 10.3.6 shows the resulting annual maintenance costs per unit by efficiency level.

Table 10.3.6 Average Annual Maintenance Cost per Unit

Equipment Class	Average Annual Maintenance Cost *2010$*
IMH-W-Small-B	$108
IMH-W- Med -B	$178
IMH-W-Large-B	$262
IMH-A-Small-B	$108
IMH-A-Large-B	$158
RCU-Small-B	$186
RCU-Large-B	$329
SCU-W-Small-B	$117
SCU-W-Large-B	$117
SCU-A-Small-B	$117
SCU-A-Large-B	$117
IMH-W-Small-C	$178
IMH-W-Large-C	$202
IMH-A-Small-C	$118
IMH-A-Large-C	$202
RCU-Small-C	$197
RCU-Large-C	$295
SCU-W-Small-C*	NA
SCU-W-Large-C	$115
SCU-A-Small-C	$114
SCU-A-Large-C	$115

IMH: ice-making head; RCU: remote condenser unit; SCU: self-contained unit; A: Air cooled; W: Water cooled; B: Batch; C: Continuous
* NA indicates data not available. DOE was not able to identify any existing products of the SCU-W-Small-C equipment class in ice maker databases. Hence, this equipment class was not analyzed, directly or by extrapolation.

10.3.2.3 Discount Factor

DOE multiplied monetary values in future years by a discount factor to determine the present value of costs and savings. The discount factor (*DF*) is:

$$DF = \frac{1}{(1+r)^{(t-t_p)}}$$

Eq. 10.7

Where:

r = discount rate,
t = year in which the cost or savings are realized, and
t_p = year in which the present value is being determined.

DOE estimated national impacts using two scenarios—a 3-percent and a 7-percent real discount rate—for the average real rate of return on private investment in the U.S. economy. DOE used these discount rates in accordance with the Office of Management and Budget (OMB) guidance to Federal agencies on the development of regulatory analysis (OMB Circular A-4, September 17, 2003), and section E, "Identifying and Measuring Benefits and Costs," therein. DOE defined the present year as 2011 for the preliminary analysis.

10.3.2.4 Present Value of Costs

The present value of increased installed costs is the annual installed cost increase in each year (*i.e.*, the difference between the standards case and base case) discounted to 2011 and summed for the time period over which DOE is considering the installation of ACIM equipment (*i.e.*, from the effective date of standards, 2016, to the year 2045).

The increase in total installed cost refers to both equipment cost and installation cost associated with the higher energy efficiency of automatic commercial ice makers purchased in the standards case compared to the base case. DOE calculated annual installed costs as the difference in total installed cost for new equipment purchased each year, multiplied by the shipments in the standards case.

10.3.2.5 Present Value of Savings

The present value of the operating cost savings is the annual operating cost savings (*i.e.*, the difference between the base case and standards case) discounted to 2011, and summed over the period from the effective date of the standard, 2016, to the time when the last unit installed in 2045 is retired from service. Savings result from decreases in total operating costs (including electricity, water, repair, and maintenance) associated with the higher energy efficiency of automatic commercial ice makers purchased in the standards case compared to the base case. Total annual operating cost savings are the savings per unit multiplied by the number of units of each vintage surviving in a particular year. Equipment consumes energy and water over its entire lifetime. For example, for units purchased in 2045, the present value of savings includes energy and water consumed after 2045 until the unit is retired from service at the end of its useful life.

10.4 NATIONAL ENERGY SAVINGS AND NET PRESENT VALUE RESULTS

DOE used the NES spreadsheet model to estimate the NES and NPV associated with various efficiency levels. Sections 10.2.2 and 10.3.2 discuss the inputs to the NES spreadsheet. The NES spreadsheet model is available at www1.eere.energy.gov/buildings/appliance_standards/commercial/automatic_ice_making_equipment.html. Appendix 10A provides details and instructions for using the model.

10.4.1 National Energy Savings and Net Present Value Input Summary

Table 10.4.1 summarizes the inputs to the NES spreadsheet model. For each input, the table provides a brief description of the data source.

Table 10.4.1 NES and NPV Inputs

Input Data	Description
Shipments	Annual shipments from shipments model (see preliminary TSD chapter 9, "Shipments Analysis").
Effective date of standard	2016
Base-case efficiencies	Distribution of base-case shipments by efficiency level.
Standards-case efficiencies	Distribution of shipments by efficiency level for each standards case. Standards case annual market shares by efficiency level remain constant over time for the base case and each standards case.
Annual energy and water consumption per unit	Annual weighted average values are a function of efficiency level (established in the engineering analysis, preliminary TSD chapter 5).
Total installed cost per unit	Annual weighted average values of installed cost are a function of efficiency level (see preliminary TSD chapter 8).
Repair cost per unit	Annual weighted average values of repair costs are constant with efficiency level (see preliminary TSD chapter 8).
Maintenance cost per linear foot	Annual weighted average values of maintenance costs are constant with efficiency level (see preliminary TSD chapter 8).
Escalation of electricity prices	2011 Energy Information Administration (EIA) *Annual Energy Outlook* (*AEO2011*) forecasts (to 2035) and extrapolation for 2036 and beyond (see preliminary TSD chapter 8).
Escalation of water prices	Historic Consumer Price Index for water-related expenditures extrapolated out to 2055.
Electricity site-to-source conversion	Conversion varies yearly and is generated by DOE's version of the EIA NEMS[1] program (a time series conversion factor; includes electric generation, transmission, and distribution losses).
Discount rate	3 and 7 percent real.
Present year	Future costs are discounted to year 2011.

10.4.2 National Energy Savings Results

The following section provides NES results for each energy consumption level considered for the 21 primary equipment classes of automatic commercial ice makers that DOE has analyzed. Results are cumulative to 2045, and are shown as primary energy savings in quads. DOE based inputs to the NES spreadsheet model on weighted average values, yielding results that are discrete point values, rather than a distribution of values as in the life-cycle cost analysis (see discussion of uncertainty in preliminary TSD chapter 8).

Table 10.4.2 shows the NES results for the efficiency levels analyzed for each equipment class of automatic commercial ice-making equipment. Table 10.4.3 and Table 10.4.4 present NES results for the efficiency levels and for each equipment class, with the quantities discounted using 7- and 3-percent discount rates, respectively.

Table 10.4.2 Cumulative National Energy Savings for Automatic Commercial Ice Makers (2016-2045)

Equipment Class	National Energy Savings by Standard Level *quads*,***					
	Level 2	Level 3	Level 4	Level 5	Level 6	Level 7
IMH-W-Small-B	0.005	0.008				
IMH-W- Med -B	0.010					
IMH-W-Large-B	0.003	0.003				
IMH-A-Small-B	0.043	0.070	0.104			
IMH-A-Large-B	0.062	0.102	0.146			
RCU-Small-B	0.014	0.028	0.032			
RCU-Large-B	0.027	0.052	0.059			
SCU-W-Small-B	0.000	0.001	0.001	0.001		
SCU-W-Large-B	0.000	0.000	0.000	0.001	0.001	0.001
SCU-A-Small-B	0.005	0.020	0.029	0.038	0.044	
SCU-A-Large-B	0.003	0.013	0.019	0.025		
IMH-W-Small-C	0.000	0.000	0.000	0.001	0.003	
IMH-W-Large-C	0.000	0.000	0.000	0.000		
IMH-A-Small-C	0.001	0.001	0.002	0.003	0.005	
IMH-A-Large-C	0.000	0.000	0.000	0.000	0.000	0.000
RCU-Small-C	0.000	0.001				
RCU-Large-C	0.000	0.001				
SCU-W-Small-C†						
SCU-W-Large-C	0.000	0.000	0.000	0.000		
SCU-A-Small-C	0.000	0.000	0.000			
SCU-A-Large-C	0.000	0.000	0.000	0.000	0.001	0.004

IMH: ice-making head; RCU: remote condenser unit; SCU: self-contained unit; A: Air cooled; W: Water cooled; B: Batch; C: Continuous

* A blank value indicates the associated efficiency level was not specified or analyzed.

** 0.000 indicates savings round to less than 0.001 quadrillion Btu.

† Data available to DOE shows there are no existing SCU-Water-Small-Continuous products available, so this class is not currently defined in the models.

Table 10.4.3 Cumulative National Energy Savings, Discounted 7 Percent (2016-2045)

Equipment Class	National Energy Savings by Standard Level *quads*,***					
	Level 2	Level 3	Level 4	Level 5	Level 6	Level 7
IMH-W-Small-B	0.001	0.002				
IMH-W- Med -B	0.002					
IMH-W-Large-B	0.001	0.001				
IMH-A-Small-B	0.011	0.018	0.026			
IMH-A-Large-B	0.015	0.025	0.036			
RCU-Small-B	0.003	0.007	0.008			
RCU-Large-B	0.007	0.013	0.015			
SCU-W-Small-B	0.000	0.000	0.000	0.000		
SCU-W-Large-B	0.000	0.000	0.000	0.000	0.000	0.000
SCU-A-Small-B	0.001	0.005	0.007	0.009	0.011	
SCU-A-Large-B	0.001	0.003	0.005	0.006		
IMH-W-Small-C	0.000	0.000	0.000	0.000	0.001	
IMH-W-Large-C	0.000	0.000	0.000	0.000		
IMH-A-Small-C	0.000	0.000	0.000	0.001	0.001	
IMH-A-Large-C	0.000	0.000	0.000	0.000	0.000	0.000
RCU-Small-C	0.000	0.000				
RCU-Large-C	0.000	0.000				
SCU-W-Small-C†						
SCU-W-Large-C	0.000	0.000	0.000	0.000		
SCU-A-Small-C	0.000	0.000	0.000			
SCU-A-Large-C	0.000	0.000	0.000	0.000	0.000	0.001

IMH: ice-making head; RCU: remote condenser unit; SCU: self-contained unit; A: Air cooled; W: Water cooled; B: Batch; C: Continuous

* A blank value indicates the associated efficiency level was not specified or analyzed.

** 0.000 indicates savings round to less than 0.001 quadrillion Btu.

† Data available to DOE shows there are no existing SCU-Water-Small-Continuous products available, so this class is not currently defined in the models.

Table 10.4.4 Cumulative National Energy Savings, Discounted 3 Percent (2016-2045)

Equipment Class	National Energy Savings by Standard Level *quads*,***					
	Level 2	Level 3	Level 4	Level 5	Level 6	Level 7
IMH-W-Small-B	0.003	0.004				
IMH-W- Med -B	0.005					
IMH-W-Large-B	0.001	0.002				
IMH-A-Small-B	0.022	0.037	0.054			
IMH-A-Large-B	0.032	0.053	0.076			
RCU-Small-B	0.007	0.015	0.017			
RCU-Large-B	0.014	0.027	0.031			
SCU-W-Small-B	0.000	0.000	0.001	0.001		
SCU-W-Large-B	0.000	0.000	0.000	0.000	0.000	0.001
SCU-A-Small-B	0.003	0.010	0.015	0.020	0.023	
SCU-A-Large-B	0.002	0.007	0.010	0.013		
IMH-W-Small-C	0.000	0.000	0.000	0.000	0.001	
IMH-W-Large-C	0.000	0.000	0.000	0.000		
IMH-A-Small-C	0.000	0.001	0.001	0.001	0.002	
IMH-A-Large-C	0.000	0.000	0.000	0.000	0.000	0.000
RCU-Small-C	0.000	0.000				
RCU-Large-C	0.000	0.000				
SCU-W-Small-C†						
SCU-W-Large-C	0.000	0.000	0.000	0.000		
SCU-A-Small-C	0.000	0.000	0.000			
SCU-A-Large-C	0.000	0.000	0.000	0.000	0.001	0.002

IMH: ice-making head; RCU: remote condenser unit; SCU: self-contained unit; A: Air cooled; W: Water cooled; B: Batch; C: Continuous

* A blank value indicates the associated efficiency level was not specified or analyzed.

** 0.000 indicates savings round to less than 0.001 quadrillion Btu.

† Data available to DOE shows there are no existing SCU-Water-Small-Continuous products available, so this class is not currently defined in the models.

10.4.3 National Water Impacts

For the preliminary analysis, DOE analyzed no design options that resulted in changes in water usage. If this changes at the NOPR and final rule phases, DOE will present national water impacts in this section of the report.

10.4.4 Annual Costs and Savings

As a prelude to providing the NPVs for each standard level in each equipment class, this section presents the annual equipment cost (or total installed cost) increases and annual operating cost savings at the national level.

Figure 10.4.1 shows the changes over time of the non-discounted annual equipment price increases and the non-discounted operating cost savings at Level 4 for an example equipment class (the small air-cooled ice-making head, batch, (IMH-A-Small-B) equipment class). The total net annual impact is the discounted value of the difference between annual installed costs and annual operating costs at a 7-percent discount rate. The figure also shows the net annual impact, which is the difference between the savings and costs for each year. The annual equipment price change is the increase in equipment price between base and standards cases for equipment purchased each year over the period 2016–2045. The annual operating savings are the savings in

operating costs for equipment purchased but not retired for each year over the time period 2016–2055. DOE determined the annual costs and savings based on the *AEO2011* reference case electricity prices.[2] The NPV is the difference between the cumulative annual discounted savings and the cumulative annual discounted costs. Appendix 10B of this TSD shows comparable figures for other efficiency levels and other equipment classes.

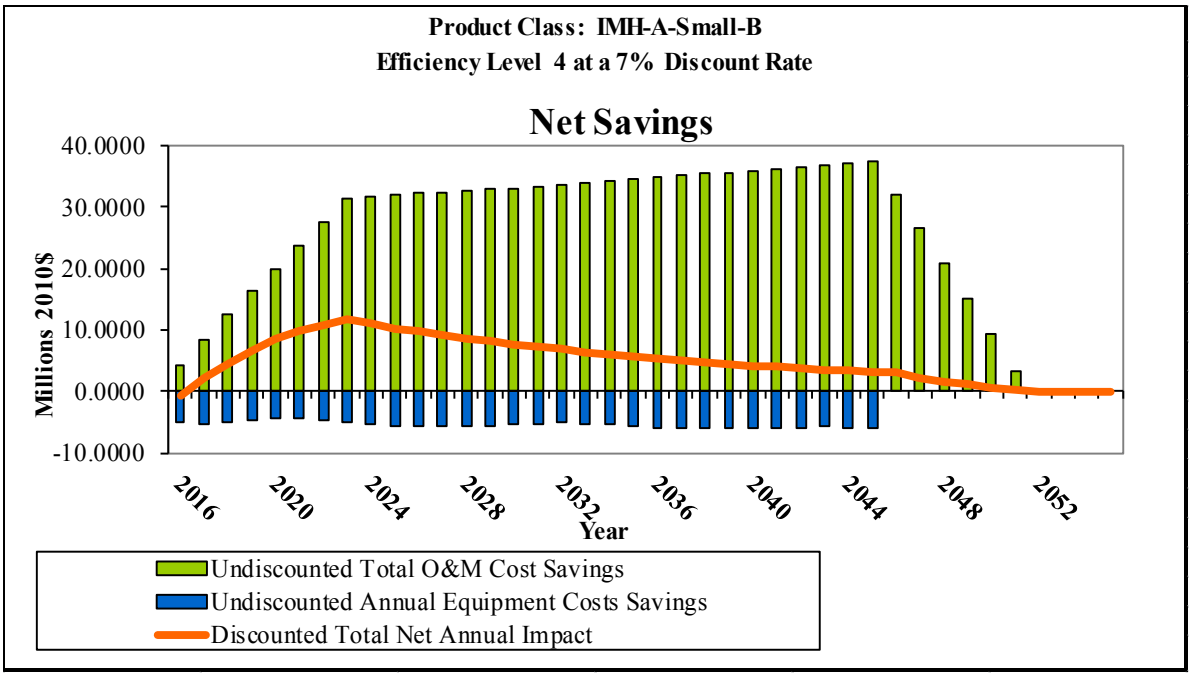

Figure 10.4.1 National Annual Costs and Savings for Efficiency Level 4

10.4.5 Net Present Value Results

The following section provides NPV results for the candidate standards levels considered for the equipment classes of automatic commercial ice makers. Results are cumulative and are shown as the discounted value of these savings. DOE based the inputs to the NES spreadsheet model on weighted average values yielding results that are discrete point values, rather than a distribution of values as in the life-cycle cost analysis (see preliminary TSD chapter 8). The present value of increased total installed costs is the total installed cost increase (*i.e.*, the difference between the standards case and base case) discounted to 2011 and summed over the time period in which DOE evaluated the impact of standards (*i.e.*, from the effective date of standards, 2016, to the year 2055).

Savings result from decreases in operating costs (including electricity, water, repair, and maintenance) associated with the higher energy efficiency of commercial refrigeration units purchased in the standards case compared to the base case. Total operating cost savings are the savings per unit, multiplied by the number of units of each vintage (*i.e.*, the year of manufacture) that remain in operation in a particular year. The operating cost includes energy and water consumed and maintenance and repair costs incurred until all units purchased during the analysis period (2016−2045) are retired from service.

Table 10.4.5 shows the NPV results for the standard levels considered for automatic commercial ice makers based on a 7-percent discount rate. DOE based all results on electricity price forecasts from the *AEO2011* reference case. Appendix 10B of this preliminary TSD provides detailed results showing the breakdown of the NPV into national equipment costs and national operating costs.

Table 10.4.5 Cumulative NPV Results Based on a 7-Percent Discount Rate

Equipment Class	Cumulative NPV at 7% *billion 2010$ ****					
	Level 2	**Level 3**	**Level 4**	**Level 5**	**Level 6**	**Level 7**
IMH-W-Small-B	0.009	0.015				
IMH-W- Med -B	0.022					
IMH-W-Large-B	0.006	0.007				
IMH-A-Small-B	0.097	0.151	0.200			
IMH-A-Large-B	0.143	0.194	0.277			
RCU-Small-B	0.032	0.059	0.064			
RCU-Large-B	0.062	0.111	0.123			
SCU-W-Small-B	0.000	0.001	0.002	0.002		
SCU-W-Large-B	0.000	0.001	0.001	0.002	0.002	0.003
SCU-A-Small-B	0.011	0.036	0.052	0.069	0.081	
SCU-A-Large-B	0.007	0.025	0.037	0.049		
IMH-W-Small-C	0.000	0.000	0.001	0.002	0.005	
IMH-W-Large-C	0.000	0.000	0.000	0.000		
IMH-A-Small-C	0.001	0.002	0.004	0.006	0.006	
IMH-A-Large-C	0.000	0.000	0.000	0.000	0.001	0.001
RCU-Small-C	0.000	0.002				
RCU-Large-C	0.000	0.001				
SCU-W-Small-C†						
SCU-W-Large-C	0.000	0.000	0.000	0.000		
SCU-A-Small-C	0.000	0.000	0.000			
SCU-A-Large-C	0.000	0.000	0.000	0.001	0.002	(0.003)

IMH: ice-making head; RCU: remote condenser unit; SCU: self-contained unit; A: Air cooled; W: Water cooled; B: Batch; C: Continuous

* A blank value indicates the associated efficiency level was not specified or analyzed.

** 0.000 indicates NPV rounds to less than $0.001 billion.

† SCU-W-Small-C represents a viable equipment class, but DOE found no evidence of shipments within this class.

Table 10.4.6 provides the NPV results based on the 3-percent discount rate and electricity price forecasts from the *AEO2011* Reference Case. Appendix 10B of this preliminary TSD provides detailed results showing the breakdown of the NPV into national equipment costs and national operating costs based on a 3-percent discount rate.

Table 10.4.6 Cumulative NPV Results Based on a 3-Percent Discount Rate

Equipment Class	Cumulative NPV at 3% *billion 2010$***					
	Level 2	**Level 3**	**Level 4**	**Level 5**	**Level 6**	**Level 7**
IMH-W-Small-B	0.019	0.032				
IMH-W-Med-B	0.046					
IMH-W-Large-B	0.013	0.014				
IMH-A-Small-B	0.205	0.322	0.431			
IMH-A-Large-B	0.302	0.420	0.598			
RCU-Small-B	0.068	0.126	0.138			
RCU-Large-B	0.132	0.237	0.263			
SCU-W-Small-B	0.001	0.003	0.004	0.005		
SCU-W-Large-B	0.001	0.002	0.002	0.003	0.004	0.007
SCU-A-Small-B	0.023	0.079	0.113	0.150	0.175	
SCU-A-Large-B	0.015	0.055	0.080	0.105		
IMH-W-Small-C	0.000	0.000	0.001	0.004	0.011	
IMH-W-Large-C	0.000	0.000	0.000	0.000		
IMH-A-Small-C	0.003	0.004	0.008	0.013	0.013	
IMH-A-Large-C	0.000	0.000	0.000	0.001	0.001	0.001
RCU-Small-C	0.000	0.003				
RCU-Large-C	0.000	0.003				
SCU-W-Small-C†						
SCU-W-Large-C	0.000	0.000	0.001	0.001		
SCU-A-Small-C	0.000	0.000	0.000			
SCU-A-Large-C	0.000	0.000	0.000	0.001	0.004	(0.003)

IMH: ice-making head; RCU: remote condenser unit; SCU: self-contained unit; A: Air cooled; W: Water cooled; B: Batch; C: Continuous

* A blank value indicates the associated efficiency level was not specified or analyzed.

** 0.000 indicates NPV rounds to less than $0.001 billion.

† SCU-W-Small-C represents a viable equipment class, but DOE found no evidence of shipments within this class.

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1. U.S. Department of Energy–Office of Energy Efficiency and Renewable Energy. Final Rule Technical Support Document (TSD). Energy Efficiency Standards for Commercial and Industrial Equipment: Commercial Ice-Cream Freezers; Self-Contained Commercial Refrigerators, Freezers, and Refrigerator-Freezers without Doors; and Remote Condensing Commercial Refrigerators, Freezers, and Refrigerator-Freezers. Chapter 11: National Impact Analysis, and Appendix H. December 31, 2008. Washington, D.C. <www1.eere.energy.gov/buildings/appliance_standards/commercial/refrigeration_equipment.html>

2. U.S. Department of Energy–Energy Information Administration. *Annual Energy Outlook 2011*. 2011. Washington D.C. DOE/EIA-0383. <www.eia.gov/forecasts/aeo/pdf/0383(2011).pdf>