DEPARTMENT OF ENERGY

10 CFR Part 431

[Docket Number EERE–2010–BT–STD–0037]

RIN 1904–AC39

Energy Conservation Program: Energy Conservation Standards for Automatic Commercial Ice Makers

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

ACTION: Notice of proposed rulemaking and public meeting.

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

DATES: DOE will accept comments, data, and information regarding this notice of proposed rulemaking (NOPR) before and after the public meeting, but no later than May 16, 2014. See section VII, ''Public Participation,'' for details.

DOE will hold a public meeting on Monday, April 14, 2014, from 9 a.m. to 4 p.m., in Washington, DC. The meeting will also be broadcast as a webinar. See section VII, ''Public Participation,'' for webinar registration information, participant instructions, and information about the capabilities available to webinar participants.

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

Any comments submitted must identify the NOPR for Energy Conservation Standards for Automatic Commercial Ice Makers and provide docket number EERE–2010–BT–STD–0037 and/or regulatory information number (RIN) 1904–AC39. Comments may be submitted using any of the following methods:

1. *Federal eRulemaking Portal: www.regulations.gov*. Follow the instructions for submitting comments.
2. *Email: ACIM-2010-STD-0037@ee.doe.gov*. Include the docket number and/or RIN in the subject line of the message.
3. *Mail:* Ms. Brenda Edwards, U.S. Department of Energy, Building Technologies Program, Mailstop EE–2J, 1000 Independence Avenue SW., Washington, DC 20585–0121. If possible, please submit all items on a CD. It is not necessary to include printed copies.
4. *Hand Delivery/Courier:* Ms. Brenda Edwards, U.S. Department of Energy, Building Technologies Program, 950 L'Enfant Plaza SW., Suite 600, Washington, DC 20024. Telephone: (202) 586–2945. If possible, please submit all items on a CD, in which case it is not necessary to include printed copies.

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

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

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

The link to the docket Web page is the following: *www.regulations.gov/#!docketBrowser;rpp=25;po=0;D=EERE-2010-BT-STD-0037*. This Web page will contain a link to the docket for this proposed rule on the regulations.gov site. The regulations.gov Web page will contain simple instructions on how to access all documents, including public comments, in the docket. See section VII for further information on how to submit comments through *www.regulations.gov*.

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

FOR FURTHER INFORMATION CONTACT: Mr. John Cymbalsky, U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, Building Technologies Program, EE–2B, 1000 Independence Avenue SW., Washington, DC 20585–0121. Telephone: (202) 287–1692. Email: *automatic_commercial_ice_makers@ee.doe.gov*.

Mr. Ari Altman, U.S. Department of Energy, Office of the General Counsel, GC–71, 1000 Independence Avenue SW., Washington, DC 20585–0121. Telephone: (202) 287–6307. Email: *Ari.Altman@hq.doe.gov*.

SUPPLEMENTARY INFORMATION:

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I. Summary of the Proposed Rule

Title III, Part C[1] of the Energy Policy and Conservation Act of 1975 (EPCA or the Act), Public Law 94–163 (42 U.S.C. 6311–6317, as codified), established the Energy Conservation Program for Certain Industrial Equipment, a program covering certain industrial equipment,[2] which includes the focus of this proposed rule: automatic commercial ice makers.

Pursuant to EPCA, any new or amended energy conservation standard that DOE prescribes for the covered

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

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

equipment, such as automatic commercial ice makers, shall be designed to achieve the maximum improvement in energy efficiency that is technologically feasible and economically justified and would result in significant conservation of energy. (42 U.S.C. 6295(o)(2)(A) and (3)(B); 6313(d)(4))

In accordance with these and other statutory criteria discussed in this proposed rule, DOE proposes amended conservation standards for automatic commercial ice makers,[3] and new standards for covered equipment not yet subject to energy conservation standards. The proposed standards, which consist of maximum allowable energy usage values per 100 lb of ice production, are shown in Table I.1 and Table I.2. Standards shown on Table I.1 for batch type ice makers represent an amendment to existing standards set for cube type ice makers by EPCA in 42 U.S.C. 6313(d)(1). Table I.1 also shows new standards for cube type ice makers with expanded harvest capacities up to 4,000 pounds of ice per 24 hour period (lb ice/24 hours) and an explicit coverage of other types of batch machines, such as tube type ice makers. Table I.2 provides proposed standards for continuous type ice-making machines, which are not covered by DOE's existing standards. The proposed standards include, for applicable equipment classes, maximum condenser water usage values in gallons per 100 lb of ice production. If adopted, the proposed standards would apply to all equipment manufactured in, or imported into, the United States, beginning 3 years after the publication date of the final rule. (42 U.S.C. 6313(d)(2)(B)(i) and (3)(C)(i))

TABLE I.1—PROPOSED ENERGY CONSERVATION STANDARDS FOR BATCH TYPE AUTOMATIC COMMERCIAL ICE MAKERS

Equipment type	Type of cooling	Rated harvest rate *lb ice/24 hours*	Maximum energy use *kilowatt-hours (kWh)/100 lb ice* *	Maximum condenser water use *gal/100 lb ice* **
Ice-Making Head	Water	<500	5.84–0.0041H	200–0.022H
		≥500 and <1,436	3.88–0.0002H	200–0.022H
		≥1,436 and <2,500	3.6	200–0.022H
		≥2,500 and <4,000	3.6	145
Ice-Making Head	Air	<450	7.70–0.0065H	NA
		≥450 and <875	5.17–0.0008H	NA
		≥875 and <2,210	4.5	
		≥2,210 and <2,500	6.89–0.0011H	NA
		≥ 2,500 and <4,000	4.1	
Remote Condensing (but not remote compressor)	Air	<1,000	7.52–0.0032H	NA
	Air	≥1,000 and <4,000	4.3	NA
Remote Condensing and Remote Compressor	Air	<934	7.52–0.0032H	NA
	Air	≥934 and <4,000	4.5	NA
Self-Contained	Water	<200	8.55–0.0143H	191–0.0315H
		≥200 and <2,500	5.7	191–0.0315H
		≥2,500 and <4,000	5.7	112
Self-Contained	Air	<175	12.6–0.0328H	NA
		≥175 and <4,000	6.9	NA

* H = rated harvest rate in pounds per 24 hours, indicating the water or energy use for a given rated harvest rate. Source: 42 U.S.C. 6313(d).
** Water use is for the condenser only and does not include potable water used to make ice.

TABLE I.2—PROPOSED ENERGY CONSERVATION STANDARDS FOR CONTINUOUS TYPE AUTOMATIC COMMERCIAL ICE MAKERS

Equipment type	Type of cooling	Rated harvest rate *lb ice/24 hours*	Maximum energy use *kWh/100 lb ice* *	Maximum condenser water use *gal/100 lb ice* **
Ice-Making Head	Water	<900	6.08–0.0025H	160–0.0176H
		≥900 and <2,500	3.8	160–0.0176H
		≥2,500 and <4,000	3.8	116
Ice-Making Head	Air	<700	9.24–0.0061H	NA
		≥700 and <4,000	5.0	NA
Remote Condensing (but not remote compressor)	Air	<850	7.5–0.0034H	NA
		≥850 and <4,000	4.6	NA
Remote Condensing and Remote Compressor	Air	<850	7.65–0.0034H	NA
		≥850 and <4,000	4.8	NA
Self-Contained	Water	<900	7.28–0.0027H	153–0.0252H
		≥900 and <2,500	4.9	153–0.0252H
		≥2,500 and <4,000	4.9	90
Self-Contained	Air	<700	9.2–0.0050H	NA

[3] EPCA as amended by the Energy Policy Act of 2005 (EPACT 2005) established maximum energy use and maximum condenser water use standards for cube type automatic commercial ice makers with harvest capacities between 50 and 2,500 lb/24 hours. In this rulemaking, DOE proposes amending the legislated energy use standards for these automatic commercial ice maker types. DOE did not, however, consider amendment to the existing condenser water use standards for equipment with existing condenser water standards. In the preliminary TSD, DOE indicated that the ice maker standards primarily focus on energy use, and that DOE is not bound by EPCA to evaluate reductions in the condenser water use in automatic commercial ice makers, and may in fact consider increases in condenser water use, if this is a cost-effective way to improve energy efficiency. Section 0 of today's NOPR contains more information on DOE's analysis of condenser water use.

TABLE I.2—PROPOSED ENERGY CONSERVATION STANDARDS FOR CONTINUOUS TYPE AUTOMATIC COMMERCIAL ICE MAKERS—Continued

Equipment type	Type of cooling	Rated harvest rate *lb ice/24 hours*	Maximum energy use *kWh/100 lb ice* *	Maximum condenser water use *gal/100 lb ice* **
		≥700 and <4,000	5.7	NA

* H = rated harvest rate in pounds per 24 hours, indicating the water or energy use for a given rated harvest rate. Source: 42 U.S.C. 6313(d).
** Water use is for the condenser only and does not include potable water used to make ice.

A. Benefits and Costs to Customers

Table I.3 presents DOE's evaluation of the economic impacts of the proposed standards on customers of automatic commercial ice makers, as measured by the average life-cycle cost (LCC) savings [4] and the median payback period (PBP).[5] The average LCC savings are positive for all equipment classes under the standards proposed by DOE.

TABLE I.3—IMPACTS OF PROPOSED STANDARDS ON CUSTOMERS OF AUTOMATIC COMMERCIAL ICE MAKERS

Equipment class *	Average LCC savings *2012$*	Median PBP *years*
IMH–W–Small–B	328	2.27
IMH–W–Med–B	587	0.85
IMH–W–Large–B **	833	0.69
IMH–W–Large–B–1	701	0.72
IMH–W–Large–B–2	1,260	0.58
IMH–A–Small–B	396	1.42
IMH–A–Large–B **	1,127	0.84
IMH–A–Large–B–1	1,168	0.82
IMH–A–Large–B–2	908	0.94
RCU–Large–B **	983	0.65
RCU–Large–B–1	963	0.62
RCU–Large–B–2	1,277	1.00
SCU–W–Large–B	694	1.00
SCU–A–Small–B	396	1.56
SCU–A–Large–B	502	1.49
IMH–A–Small–C	391	0.97
IMH–A–Large–C	1,026	0.69
SCU–A–Small–C	146	1.85

* Abbreviations are: IMH is ice-making head; RCU is remote condensing unit; SCU is self-contained unit; W is water-cooled; A is air-cooled; Small refers to the lowest harvest category; Med refers to the Medium category (water-cooled IMH only); RCU with and without remote compressor were modeled as one group. For three large batch categories, a machine at the low end of the harvest range (B–1) and a machine at the higher end (B–2) were modeled. Values are shown only for equipment classes that have significant volume of shipments and, therefore, were directly analyzed. See chapter 5 of the NOPR technical support document, ''Engineering Analysis,'' for a detailed discussion of equipment classes analyzed.
** LCC savings and PBP results for these classes are weighted averages of the typical units modeled for the large classes, using weights provided in TSD chapter 7.

B. Impact on Manufacturers

The industry net present value (INPV) is the sum of the discounted cash flows to the industry from the present year (2013) through the end of the analysis period (2047). Using a real discount rate of 9.2 percent, DOE estimates that the INPV for manufacturers of automatic commercial ice makers is $101.8 million in 2012$. Under the proposed standards, DOE expects that manufacturers may lose up to 23.5 percent of their INPV, or approximately $23.9 million. Based on DOE's interviews with the manufacturers of automatic commercial ice makers, DOE does not expect any plant closings or significant loss of employment.

C. National Benefits

DOE's analyses indicate that the proposed standards for automatic commercial ice makers would save a significant amount of energy. The lifetime savings for equipment purchased in the 30-year period that begins in the year of compliance with amended and new standards (2018–2047) [6] amount to 0.286 quadrillion British thermal units (quads) of cumulative energy.

The cumulative national net present value (NPV) of total customer savings of the proposed standards for automatic commercial ice makers in 2012$ ranges from $0.791 billion (at a 7-percent

[4] Life-cycle cost of automatic commercial ice makers is the cost to customers of owning and operating the equipment over the entire life of the equipment. Life-cycle cost savings are the reductions in the life-cycle costs due to the amended energy conservation standards when compared to the life-cycle costs of the equipment in the absence of the amended energy conservation standards.

[5] Payback period refers to the amount of time (in years) it takes customers to recover the increased installed cost of equipment associated with new or amended standards through savings in operating costs.

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

discount rate) to $1.751 billion (at a 3-percent discount rate [7]). This NPV expresses the estimated total value of future operating cost savings minus the estimated increased installed costs for equipment purchased in the period from 2018–2047, discounted to 2013.

In addition, the proposed standards are expected to have significant environmental benefits. The energy savings would result in cumulative emission reductions of 14.6 million metric tons (MMt) [8] of carbon dioxide (CO_2), 8.7 thousand tons of nitrogen oxides (NO_X), 0.3 thousand tons of nitrous oxide (N_2O), 75.8 thousand tons of methane (CH_4) and 0.02 tons of mercury (Hg),[9] and 21 thousand tons of sulfur dioxide (SO_2) based on energy savings from equipment purchased over the period from 2018–2047.[10]

The value of the CO_2 reductions is calculated using a range of values per metric ton of CO_2 (otherwise known as the Social Cost of Carbon, or SCC) developed and recently updated by an interagency process.[11] The derivation of the SCC value is discussed in section IV.L. DOE estimates the net present monetary value of the CO_2 emissions reduction is between $0.102 and $1.426 billion, expressed in 2012$ and discounted to 2013. DOE also estimates the net present monetary value of the NO_X emissions reduction, expressed in 2012$ and discounted to 2013, is between $0.54 and $5.53 million at a 7-percent discount rate, and between $1.71 and $17.56 million at a 3-percent discount rate.[12]

Table I.4 summarizes the national economic costs and benefits expected to result from today's proposed standards for automatic commercial ice makers.

TABLE I.4—SUMMARY OF NATIONAL ECONOMIC BENEFITS AND COSTS OF PROPOSED AUTOMATIC COMMERCIAL ICE MAKER CONSERVATION STANDARDS

Category	Present value *million 2012$*	Discount rate (percent)
Benefits		
Operating Cost Savings	982	7
	2,114	3
CO_2 Reduction Monetized Value ($11.8/t case) *	102	5
CO_2 Reduction Monetized Value ($39.7/t case) *	463	3
CO_2 Reduction Monetized Value ($61.2/t case) *	733	2.5
CO_2 Reduction Monetized Value ($117/t case) *	1,426	3
NO_X Reduction Monetized Value ($2,639/t case) **	3	7
	10	3
Total Benefits †, ††	1,448	7
	2,587	3
Costs		
Incremental Installed Costs	191	7
	364	3
Net Benefits		
Including CO_2 and NO_X Reduction Monetized Value	1,257	7
	2,223	3

* The CO_2 values represent global monetized values of the SCC, in 2012$, in year 2015 under several scenarios of the updated SCC values. The values of $11.8, $39.7, and $61.2 per metric ton (t) are the averages of SCC distributions calculated using 5-percent, 3-percent, and 2.5-percent discount rates, respectively. The value of $117.0/t represents the 95th percentile of the SCC distribution calculated using a 3-percent discount rate. The SCC time series used by DOE incorporate an escalation factor.

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

† Total Benefits for both the 3-percent and the 7-percent cases are derived using the series corresponding to SCC value of $39.7/t.

†† DOE estimates reductions in sulfur dioxide, mercury, methane and nitrous oxide emissions, but is not currently monetizing these reductions. Thus, these impacts are excluded from the total benefits.

The benefits and costs of today's proposed standards, for automatic commercial ice makers sold in 2018–2047, can also be expressed in terms of annualized values. The annualized monetary values are the sum of (1) the annualized national economic value of the benefits from the operation of equipment that meets the proposed standards (consisting primarily of operating cost savings from using less energy and water, minus increases in equipment installed cost, which is another way of representing customer NPV); and (2) the annualized monetary value of the benefits of emission reductions, including CO_2 emission reductions.[13]

[7] These discount rates are used in accordance with the Office of Management and Budget (OMB) guidance to Federal agencies on the development of regulatory analysis (OMB Circular A–4, September 17, 2003), and section E, ''Identifying and Measuring Benefits and Costs,'' therein. Further details are provided in section 0.

[8] A metric ton is equivalent to 1.1 U.S. short tons. Results for NO_X, Hg, and SO_2 are presented in short tons.

[9] DOE calculates emissions reductions relative to the *Annual Energy Outlook 2013* (*AEO2013*) Reference Case, which generally represents current legislation and environmental regulations for which implementing regulations were available as of December 31, 2012.

[10] DOE also estimated CO_2 and CO_2 equivalent (CO_2eq) emissions that occur through 2030 (CO_2eq includes greenhouse gases such as CH_4 and N_2O). The estimated emissions reductions through 2030 are 5.8 million metric tons CO_2, 576 thousand tons CO_2eq for CH_4, and 25 thousand tons CO_2eq for N_2O.

[11] *http://www.whitehouse.gov/sites/default/files/omb/assets/inforeg/technical-update-social-cost-of-carbon-for-regulator-impact-analysis.pdf.*

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

[13] DOE used a two-step calculation process to convert the time-series of costs and benefits into annualized values. First, DOE calculated a present value in 2013, the year used for discounting the NPV of total consumer costs and savings, for the time-series of costs and benefits using discount rates of 3 and 7 percent for all costs and benefits except for the value of CO_2 reductions. For the latter, DOE used a range of discount rates, as shown in Table I.5. From the present value, DOE then calculated the fixed annual payment over a 30-year period (2018 through 2047) that yields the same

Although combining the values of operating savings and CO_2 emission reductions provides a useful perspective, two issues should be considered. First, the national operating savings are domestic U.S. customer monetary savings that occur as a result of market transactions, while the value of CO_2 reductions is based on a global value. Second, the assessments of operating cost savings and CO_2 savings are performed with different methods that use different time frames for analysis. The national operating cost savings is measured over the lifetimes of automatic commercial ice makers shipped from 2018 to 2047. The SCC values, on the other hand, reflect the present value of some future climate-related impacts resulting from the emission of 1 ton of CO_2 in each year. These impacts continue well beyond 2100.

Estimates of annualized benefits and costs of the proposed standards are shown in Table I.5. (All monetary values below are expressed in 2012$.) Table I.5 shows the primary, low net benefits, and high net benefits scenarios. The primary estimate is the estimate in which the operating cost savings were calculated using the *Annual Energy Outlook 2013* (*AEO2013*) Reference Case forecast of future electricity prices. The low net benefits estimate and the high net benefits estimate are based on the low and high electricity price scenarios from the *AEO2013* forecast, respectively.[14] Using a 7-percent discount rate for benefits and costs, the cost in the primary estimate of the standards proposed in this rule is $20 million per year in increased equipment costs. (Note that DOE used a 3-percent discount rate along with the corresponding SCC series value of $39.7/ton in 2012$ to calculate the monetized value of CO_2 emissions reductions.) The annualized benefits are $104 million per year in reduced equipment operating costs, $27 million in CO_2 reductions, and $0.32 million in reduced NO_X emissions. In this case, the annualized net benefit amounts to $110 million. At a 3-percent discount rate for all benefits and costs, the cost in the primary estimate of the amended standards proposed in this notice is $21 million per year in increased equipment costs. The benefits are $121 million per year in reduced operating costs, $27 million in CO_2 reductions, and $0.55 million in reduced NO_X emissions. In this case, the net benefit amounts to $128 million per year.

DOE also calculated the low net benefits and high net benefits estimates by calculating the operating cost savings and shipments at the *AEO2013* low economic growth case and high economic growth case scenarios, respectively. The low and high benefits for incremental installed costs were derived using the low and high price learning scenarios. The net benefits and costs for low and high net benefits estimates were calculated in the same manner as the primary estimate by using the corresponding values of operating cost savings and incremental installed costs.

TABLE I.5—ANNUALIZED BENEFITS AND COSTS OF PROPOSED STANDARDS FOR AUTOMATIC COMMERCIAL ICE MAKERS

	Discount rate (percent)	Primary estimate * *million 2012$*	Low net benefits estimate * *million 2012$*	High net benefits estimate * *million 2012$*
Benefits				
Operating Cost Savings	7	104	98	112
	3	121	113	132
CO_2 Reduction Monetized Value ($11.8/t case) **	5	8	8	8
CO_2 Reduction Monetized Value ($39.7/t case) **	3	27	26	27
CO_2 Reduction Monetized Value ($61.2/t case) **	2.5	39	38	40
CO_2 Reduction Monetized Value ($117/t case) **	3	82	80	84
NO_X Reduction Monetized Value (at $2,639/t case) **	7	0.32	0.31	0.33
	3	0.55	0.53	0.58
Total Benefits (Operating Cost Savings, CO_2 Reduction and NO_X Reduction) †	7	131	124	139
	3	149	139	160
Costs				
Total Incremental Installed Costs	7	20	21	20
	3	21	22	20
Net Benefits Less Costs				
Total Benefits Less Incremental Costs	7	110	103	120
	3	128	118	140

* The primary, low, and high estimates utilize forecasts of energy prices from the *AEO2013* Reference Case, Low Economic Growth Case, and High Economic Growth Case, respectively.

** The CO_2 values represent global monetized values of the SCC, in 2012$, in 2015 under several scenarios of the updated SCC values. The values of $11.8, $39.7, and $61.2 per ton are the averages of SCC distributions calculated using 5-percent, 3-percent, and 2.5-percent discount rates, respectively. The value of $117.0 per ton represents the 95th percentile of the SCC distribution calculated using a 3-percent discount rate. See section IV.L for details. For $NO_{X,}$ an average value ($2,639) of the low ($468) and high ($4,809) values was used.

† Total monetary benefits for both the 3-percent and 7-percent cases utilize the central estimate of social cost of NO_X and CO_2 emissions calculated at a 3-percent discount rate (averaged across three integrated assessment models) , which is equal to $39.7/ton (in 2012$).

present value. The fixed annual payment is the annualized value. Although DOE calculated annualized values, this does not imply that the time-series of cost and benefits from which the annualized values were determined is a steady stream of payments.

[14] The *AEO2013* scenarios used are the ''High Economics'' and ''Low Economics'' scenarios.

DOE has tentatively concluded that the proposed standards represent the maximum improvement in energy efficiency that is technologically feasible and economically justified, and would result in significant conservation of energy (42 U.S.C. 6295(o)(2)(B) and 6313(d)(4)) DOE further notes that technologies used to achieve these standard levels are already commercially available for the equipment classes covered by this notice. Based on the analyses described above, DOE has tentatively concluded that the benefits of the proposed standards to the Nation (energy savings, positive NPV of customer benefits, customer LCC savings, and emission reductions) would outweigh the burdens (loss of INPV for manufacturers and LCC increases for some customers).

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

II. Introduction

The following section briefly discusses the statutory authority underlying this proposal, as well as some of the relevant historical background related to the establishment of standards for automatic commercial ice makers.

A. Authority

Title III, Part C of EPCA,[15] Public Law 94–163 (42 U.S.C. 6311–6317, as codified), established the Energy Conservation Program for Certain Industrial Equipment, a program covering certain industrial equipment, which includes the subject of this rulemaking: Automatic commercial ice makers.[16]

EPCA prescribed energy conservation standards for automatic commercial ice makers that produce cube type ice with capacities between 50 and 2,500 lb ice/24 hours. (42 U.S.C. 6313(d)(1)) EPCA requires DOE to review these standards and determine, by January 1, 2015, whether amending the applicable standards is technically feasible and economically justified. (42 U.S.C. 6313(d)(3)(A)) If amended standards are technically feasible and economically justified, DOE must issue a final rule by the same date. (42 U.S.C. 6313(d)(3)(B)) Additionally, EPCA granted DOE the authority to conduct rulemakings to establish new standards for automatic commercial ice makers not covered by 42 U.S.C. 6313(d)(1)), and DOE is using that authority in this rulemaking. (42 U.S.C. 6313(d)(2)(A))

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

DOE must follow specific statutory criteria for prescribing amended standards for covered equipment. As indicated above, any amended standard for covered equipment must be designed to achieve the maximum improvement in energy efficiency that is technologically feasible and economically justified. (42 U.S.C. 6295(o)(2)(A) and 6313(d)(4)) Furthermore, DOE may not adopt any standard that would not result in the significant conservation of energy. (42 U.S.C. 6295(o)(3) and 6313(d)(4)) DOE also may not prescribe a standard: (1) For certain industrial equipment, including automatic commercial ice makers, if no test procedure has been established for the product; or (2) if DOE determines by rule that the proposed standard is not technologically feasible or economically justified. (42 U.S.C. 6295(o)(3)(A)–(B) and 6313(d)(4)) In deciding whether a proposed standard is economically justified, DOE must determine whether the benefits of the standard exceed its burdens. (42 U.S.C. 6295(o)(2)(B)(i) and 6313(d)(4)) DOE must make this determination after receiving comments on the proposed standard, and by considering, to the greatest extent practicable, the following seven factors:

1. The economic impact of the standard on manufacturers and consumers of the equipment subject to the standard;
2. The savings in operating costs throughout the estimated average life of the covered equipment in the type (or class) compared to any increase in the price, initial charges, or maintenance expenses for the covered equipment that are likely to result from the imposition of the standard;
3. The total projected amount of energy, or as applicable, water, savings likely to result directly from the imposition of the standard;
4. Any lessening of the utility or the performance of the covered equipment likely to result from the imposition of the standard;
5. The impact of any lessening of competition, as determined in writing by the U.S. Attorney General (Attorney General), that is likely to result from the imposition of the standard;
6. The need for national energy and water conservation; and
7. Other factors the Secretary of Energy (Secretary) considers relevant. (42 U.S.C. 6295(o)(2)(B)(i)(I)–(VII) and 6313(d)(4))

EPCA, as codified, also contains what is known as an ''anti-backsliding'' provision, which prevents the Secretary from prescribing any amended standard that either increases the maximum allowable energy use or decreases the minimum required energy efficiency of covered equipment. (42 U.S.C. 6295(o)(1) and 6313(d)(4)) Also, the Secretary may not prescribe an amended or new standard if interested persons have established by a preponderance of the evidence that the standard is likely to result in the unavailability in the United States of any covered product type (or class) of performance characteristics (including reliability), features, sizes, capacities, and volumes that are substantially the same as those generally available in the United States. (42 U.S.C. 6295(o)(4) and 6313(d)(4))

Further, EPCA, as codified, establishes a rebuttable presumption that a standard is economically justified

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

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

if the Secretary finds that the additional cost to the consumer of purchasing a product complying with an energy conservation standard level will be less than three times the value of the energy savings during the first year that the consumer will receive as a result of the standard, as calculated under the applicable test procedure. (*See* 42 U.S.C. 6295(o)(2)(B)(iii) and 6313(d)(4)) Section III.E.2 presents additional discussion about rebuttable presumption payback period (RPBP).

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

Federal energy conservation requirements generally supersede State laws or regulations concerning energy conservation testing, labeling, and standards. (42 U.S.C. 6297(a)–(c) and 6316(f)) DOE may, however, grant waivers of Federal preemption for particular State laws or regulations, in accordance with the procedures and other provisions set forth under 42 U.S.C. 6297(d) and 6316(f).

DOE has also reviewed this regulation pursuant to Executive Order 13563, issued on January 18, 2011. 76 FR 3821 (Jan. 21, 2011). Executive Order 13563 is supplemental to and explicitly reaffirms the principles, structures, and definitions governing regulatory review established in Executive Order 12866. 58 FR 51735 (Oct. 4, 1993). To the extent permitted by law, agencies are required by Executive Order 13563 to: (1) Propose or adopt a regulation only upon a reasoned determination that its benefits justify its costs (recognizing that some benefits and costs are difficult to quantify); (2) tailor regulations to impose the least burden on society, consistent with obtaining regulatory objectives, taking into account, among other things, and to the extent practicable, the costs of cumulative regulations; (3) select, in choosing among alternative regulatory approaches, those approaches that maximize net benefits (including potential economic, environmental, public health and safety, and other advantages; distributive impacts; and equity); (4) to the extent feasible, specify performance objectives, rather than specifying the behavior or manner of compliance that regulated entities must adopt; and (5) identify and assess available alternatives to direct regulation, including providing economic incentives to encourage the desired behavior, such as user fees or marketable permits, or providing information upon which choices can be made by the public. 76 FR 3821 (Jan. 21, 2011).

DOE emphasizes as well that Executive Order 13563 requires agencies to use the best available techniques to quantify anticipated present and future benefits and costs as accurately as possible. In its guidance, the Office of Information and Regulatory Affairs (OIRA) has emphasized that such techniques may include identifying changing future compliance costs that might result from technological innovation or anticipated behavioral changes. 76 FR 3821 (Jan. 21, 2011). For the reasons stated in the preamble, DOE believes that this NOPR is consistent with these principles, including the requirement that, to the extent permitted by law, benefits justify costs and that net benefits are maximized.

Consistent with Executive Order 13563, and the range of impacts analyzed in this rulemaking, the standards proposed herein by DOE achieves maximum net benefits.

B. Background

1. Current Standards

In a final rule published on October 18, 2005, DOE adopted the energy conservation standards and water conservation standards prescribed by EPCA in 42 U.S.C. 6313(d)(1) for certain automatic commercial ice makers manufactured on or after January 1, 2010. 70 FR at 60407, 60415–16. These standards consist of maximum energy use and maximum condenser water use to produce 100 pounds of ice for automatic commercial ice makers with harvest rates between 50 and 2,500 lb ice/24 hours. These standards appear at 10 CFR part 431, subpart H, Automatic Commercial Ice Makers. Table II.1 presents DOE's current energy conservation standards for automatic commercial ice makers.

TABLE II.1—AUTOMATIC COMMERCIAL ICE MAKERS STANDARDS PRESCRIBED BY EPCA—COMPLIANCE REQUIRED BEGINNING ON JANUARY 1, 2010

Equipment type	Type of cooling	Harvest rate *lb ice/24 hours*	Maximum energy use *kWh/100 lb ice*	Maximum condenser water use * *gal/100 lb ice*
Ice-Making Head	Water	<500	7.8–0.0055H **	200–0.022H.**
		≥500 and <1,436	5.58–0.0011H	200–0.022H.
		≥1,436	4.0	200–0.022H.
	Air	<450	10.26–0.0086H	Not Applicable.
		≥450	6.89–0.0011H	Not Applicable.
Remote Condensing (but not remote compressor)	Air	<1,000	8.85–0.0038H	Not Applicable.
		≥1,000	5.10	Not Applicable.
Remote Condensing and Remote Compressor	Air	<934	8.85–0.0038H	Not Applicable.
		≥934	5.30	Not Applicable.
Self-Contained	Water	<200	11.4–0.019H	191–0.0315H.
		≥200	7.60	191–0.0315H.
	Air	<175	18.0–0.0469H	Not Applicable.
		≥175	9.80	Not Applicable.

Source: 42 U.S.C. 6313(d).
* Water use is for the condenser only and does not include potable water used to make ice.

** H = harvest rate in pounds per 24 hours, indicating the water or energy use for a given harvest rate.

2. History of Standards Rulemaking for Automatic Commercial Ice Makers

As stated above, EPCA prescribes energy conservation standards and water conservation standards for certain cube type automatic commercial ice makers with harvest rates between 50 and 2,500 lb ice/24 hours: Self-contained ice makers and ice-making heads (IMHs) using air or water for cooling and ice makers with remote condensing with or without a remote compressor. Compliance with these standards was required as of January 1, 2010. (42 U.S.C. 6313(d)(1)) DOE adopted these standards and placed them under 10 CFR part 431, subpart H, Automatic Commercial Ice Makers.

In addition, EPCA requires DOE to conduct a rulemaking to determine whether to amend the standards established under 42 U.S.C. 6313(d)(1), and if DOE determines that amendment is warranted, DOE must also issue a final rule establishing such amended standards by January 1, 2015. (42 U.S.C. 6313(d)(3)(A))

Furthermore, EPCA granted DOE authority to set standards for additional types of automatic commercial ice makers that are not covered in 42 U.S.C. 6313(d)(1). (42 U.S.C. 6313(d)(2)(A)) While not enumerated in EPCA, additional types of automatic commercial ice makers DOE identified as candidates for standards to be established in this rulemaking include flake and nugget, as well as batch type ice makers that are not included in the EPCA definition of cube type ice makers.

To satisfy its requirement to conduct a rulemaking, DOE initiated the current rulemaking on November 4, 2010 by publishing on its Web site its ''Rulemaking Framework for Automatic Commercial Ice Makers.'' (The Framework document is available at: *www.regulations.gov/#!documentDetail;D=EERE-2010-BT-STD-0037-0024*.)

DOE also published a notice in the **Federal Register** announcing the availability of the Framework document, as well as a public meeting to discuss the document. The notice also solicited comment on the matters raised in the document. 75 FR 70852 (Nov. 19, 2010). The Framework document described the procedural and analytical approaches that DOE anticipated using to evaluate amended standards for automatic commercial ice makers, and identified various issues to be resolved in the rulemaking.

DOE held the Framework public meeting on December 16, 2010, at which it: (1) Presented the contents of the Framework document; (2) described the analyses it planned to conduct during the rulemaking; (3) sought comments from interested parties on these subjects; and (4) in general, sought to inform interested parties about, and facilitate their involvement in, the rulemaking. Major issues discussed at the public meeting included: (1) The scope of coverage for the rulemaking; (2) equipment classes; (3) analytical approaches and methods used in the rulemaking; (4) impacts of standards and burden on manufacturers; (5) technology options; (6) distribution channels, shipments, and end users; (7) impacts of outside regulations; and (8) environmental issues. At the meeting and during the comment period on the Framework document, DOE received many comments that helped it identify and resolve issues pertaining to automatic commercial ice makers relevant to this rulemaking. These comments are discussed in subsequent sections of this notice.

DOE then gathered additional information and performed preliminary analyses to help review standards for this equipment. This process culminated in DOE publishing a notice of another public meeting (the January 2012 notice) to discuss and receive comments regarding the tools and methods DOE used in performing its preliminary analysis, as well as the analyses results. 77 FR 3404 (Jan. 24, 2012). DOE also invited written comments on these subjects and announced the availability on its Web site of a preliminary analysis technical support document (preliminary analysis TSD). *Id.* (The preliminary analysis TSD is available at: *www.regulations.gov/#!documentDetail;D=EERE-2010-BT-STD-0037-0026*.) Finally, DOE sought comments concerning other relevant issues that could affect amended standards for automatic commercial ice makers, or that DOE should address in this NOPR. *Id.*

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

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

manufacturers of amended efficiency standards.

The public meeting announced in the January 2012 notice took place on February 16, 2012 (February 2012 preliminary analysis public meeting). At the February 2012 preliminary analysis public meeting, DOE presented the methodologies and results of the analyses set forth in the preliminary analysis TSD. Interested parties provided comments on the following issues: (1) Equipment classes; (2) technology options; (3) energy modeling and validation of engineering models; (4) cost modeling; (5) market information, including distribution channels and distribution markups; (6) efficiency levels; (7) life-cycle costs to customers, including installation, repair and maintenance costs, and water and wastewater prices; and (8) historical shipments. The comments received since publication of the January 2012 notice, including those received at the February 2012 preliminary analysis public meeting, have contributed to DOE's proposed resolution of the issues in this rulemaking as they pertain to automatic commercial ice makers. This NOPR responds to the issues raised by the comments. (A parenthetical reference at the end of a quotation or paraphrase provides the location of the item in the public record.)

III. General Discussion

A. List of Equipment Class Abbreviations

In this notice, equipment class names are frequently abbreviated. The abbreviations are shown on Table III.1.

TABLE III.1—LIST OF EQUIPMENT CLASS ABBREVIATIONS

Abbreviation	Equipment type	Condenser type	Rated harvest rate *lb ice/24 hours*	Ice type
IMH–W–Small–B	Ice-Making Head	Water	<500	Batch.
IMH–W–Med–B	Ice-Making Head	Water	≥500 and <1,436	Batch.
IMH–W–Large–B *	Ice-Making Head	Water	≥1,436 and <4,000	Batch.
IMH–A–Small–B	Ice-Making Head	Air	<450	Batch.
IMH–A–Large–B* ** (also IMH–A–Large–B–1).	Ice-Making Head	Air	≥450 and <875	Batch.
IMH–A–Extended–B* ** (also IMH–A–Large–B–2).	Ice-Making Head	Air	≥875 and <4,000	Batch.
RCU–NRC–Small–B	Remote Condensing, not Remote Compressor.	Air	<1,000	Batch.
RCU–NRC–Large–B*	Remote Condensing, not Remote Compressor.	Air	≥1,000 and <4,000	Batch.
RCU–RC–Small–B	Remote Condensing, and Remote Compressor.	Air	<934	Batch.
RCU–RC–Large–B	Remote Condensing, and Remote Compressor.	Air	≥934 and <4,000	Batch.
SCU–W–Small–B	Self-Contained Unit	Water	<200	Batch.
SCU–W–Large–B	Self-Contained Unit	Water	≥200 and <4,000	Batch.
SCU–A–Small–B	Self-Contained Unit	Air	<175	Batch.
SCU–A–Large–B	Self-Contained Unit	Air	≥175 and <4,000	Batch.
IMH–W–Small–C	Ice-Making Head	Water	<900	Continuous.
IMH–W–Large–C	Ice-Making Head	Water	≥900 and <4,000	Continuous.
IMH–A–Small–C	Ice-Making Head	Air	<700	Continuous.
IMH–A–Large–C	Ice-Making Head	Air	≥700 and <4,000	Continuous.
RCU–NRC–Small–C	Remote Condensing, not Remote Compressor.	Air	<850	Continuous.
RCU–NRC–Large–C	Remote Condensing, not Remote Compressor.	Air	≥850 and <4,000	Continuous.
RCU–RC–Small–C	Remote Condensing, and Remote Compressor.	Air	<850	Continuous.
RCU–RC–Large–C	Remote Condensing, and Remote Compressor.	Air	≥850 and <4,000	Continuous.
SCU–W–Small–C	Self-Contained Unit	Water	<900	Continuous.
SCU–W–Large–C	Self-Contained Unit	Water	≥900 and <4,000	Continuous.
SCU–A-Small-C	Self-Contained Unit	Air	<700	Continuous.
SCU–A–Large–C	Self-Contained Unit	Air	≥700 and <4,000	Continuous.

* IMH–W–Large–B, IMH–A–Large–B, and RCU–NRC–Large–B were modeled in some NOPR analyses as two different units, one at the lower end of the rated harvest range and one near the high end of the rated harvest range in which a significant number of units are available. In the LCC and NIA models, the low and high harvest rate models were denoted simply as B–1 and B–2. Where appropriate, the analyses add or perform weighted averages of the two typical sizes to present class level results.

** IMH–A–Large–B was established by EPACT–2005 as a class between 450 and 2,500 lb ice/24 hours. In this notice, DOE is proposing to divide this into two classes, which could either be considered "Large" and "Very Large" or "Medium" and "Large." In the LCC and NIA modeling, this was denoted as B–1 and B–2. The rated harvest rate break point shown above is based on TSL 3 results.

B. Test Procedures

On December 8, 2006, DOE published a final rule in which it adopted Air-Conditioning and Refrigeration Institute (ARI) Standard 810–2003, ''Performance Rating of Automatic Commercial Ice Makers,'' with a revised method for calculating energy use, as the DOE test procedure for this equipment. The DOE rule included a clarification to the energy use rate equation to specify that the energy use be calculated using the entire mass of ice produced during the testing period, normalized to 100 lb of ice produced. 71 FR 71340, 71350 (Dec. 8, 2006). ARI Standard 810–2003 requires performance tests to be conducted according to the American National Standards Institute (ANSI)/ American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) Standard 29–1988 (reaffirmed 2005), ''Method of Testing

Automatic Ice Makers.'' The DOE test procedure incorporated by reference the ANSI/ASHRAE Standard 29–1988 (Reaffirmed 2005) as the method of test.

On January 11, 2012, DOE published a test procedure final rule (2012 test procedure final rule) in which it adopted several amendments to the DOE test procedure. This included an amendment to incorporate by reference Air-Conditioning, Heating, and Refrigeration Institute (AHRI) Standard 810–2007, which amends ARI Standard 810–2003 to expand the capacity range of covered equipment, provide definitions and specific test procedures for batch and continuous type ice makers, and provide a definition for ice hardness factor, as the DOE test procedure for this equipment. 77 FR 1591 (Jan. 11, 2012). In March 2011, AHRI published Addendum 1 to Standard 810–2007, which revised the definition of ''potable water use rate'' and added new definitions for ''purge or dump water'' and ''harvest water.'' DOE's 2012 test procedure final rule incorporated this addendum to the AHRI Standard. The 2012 test procedure final rule also included an amendment to incorporate by reference the updated ANSI/ASHRAE Standard 29–2009. *Id.*

In addition, the 2012 test procedure final rule included several amendments designed to address issues that were not accounted for by the previous DOE test procedure. 77 FR at 1593 (Jan. 11, 2012). First, DOE expanded the scope of the test procedure to include equipment with capacities from 50 to 4,000 lb ice/24 hours.[17] DOE also adopted amendments to provide test methods for continuous type ice makers and to standardize the measurement of energy and water use for continuous type ice makers with respect to ice hardness. In the 2012 test procedure final rule, DOE also clarified the test method and reporting requirements for remote condensing automatic commercial ice makers designed for connection to remote compressor racks. Finally, the 2012 test procedure final rule discontinued the use of the clarified energy use rate calculation and instead required energy-use to be calculated per 100 lb of ice as specified in ANSI/ASHRAE Standard 29–2009. The 2012 test procedure final rule became effective on February 10, 2012, and the changes set forth in the final rule became mandatory for equipment testing starting January 7, 2013. 77 FR at 1593 (Jan. 11, 2012).

The test procedure amendments established in the 2012 test procedure final rule are required to be used in conjunction with any new standards promulgated as a result of this standards rulemaking. Use of the amended test procedure to demonstrate compliance with DOE energy conservation standards or for representations with respect to energy consumption of automatic commercial ice makers is required on the compliance date of any energy conservation standards established as part of this rulemaking, and on January 7, 2013 for the energy conservation standards set in the Energy Policy Act of 2005 (EPACT 2005). 77 FR at 1593 (Jan. 11, 2012).

C. Technological Feasibility

1. General

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

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

2. Maximum Technologically Feasible Levels

When DOE proposes to adopt (or not adopt) an amended or new energy conservation standard for a type or class of covered equipment such as automatic commercial ice makers, it determines the maximum improvement in energy efficiency that is technologically feasible for such equipment. (*See* 42 U.S.C. 6295(p)(1) and 6313(d)(4)) Accordingly, in the preliminary analysis, DOE determined the maximum technologically feasible (''max-tech'') improvements in energy efficiency for automatic commercial ice makers in the engineering analysis using the design parameters that passed the screening analysis. See chapter 5 of the NOPR TSD for the results of the analyses, and a list of technologies included in max-tech equipment.

As indicated previously, whether efficiency levels exist or can be achieved in commonly used equipment is not relevant to whether they are max-tech levels. DOE considers technologies to be technologically feasible if they are incorporated in any currently available equipment or working prototypes. Hence, a max-tech level results from the combination of design options predicted to result in the highest efficiency level possible for an equipment class, with such design options consisting of technologies already incorporated in commercial equipment or working prototypes. DOE notes that it reevaluated the efficiency levels, including the max-tech levels, when it updated its results for this NOPR. Table III.2 and Table III.3 show the max-tech levels determined in the engineering analysis for batch and continuous type automatic commercial ice makers, respectively.

[17] EPCA defines *automatic commercial ice maker* in 42 U.S.C. 6311(19) as ''a factory-made assembly (not necessarily shipped in 1 package) that—(1) Consists of a condensing unit and ice-making section operating as an integrated unit, with means for making and harvesting ice; and (2) May include means for storing ice, dispensing ice, or storing and dispensing ice.'' This definition includes commercial ice-making equipment up to 4,000 lb ice/24 hours, though DOE had not previously established test procedures and standards for units with the capacity between 2,500 and 4,000 lb ice/24 hours. While 42 U.S.C. 6313(d)(1) explicitly sets standards for cube type ice makers up to 2,500 lb ice/24 hours, 6313(d)(2) provides authority to set standards for other equipment types—all of which are covered by the EPCA definition of an automatic commercial ice maker.

TABLE III.2—MAX-TECH LEVELS FOR BATCH AUTOMATIC COMMERCIAL ICE MAKERS

Equipment type *	Energy use lower than baseline
IMH–W–Small–B	30%.
IMH–W–Med–B	22%.
IMH–W–Large–B	17% (at 1,500 lb ice/24 hours) 16% (at 2,600 lb ice/24 hours).
IMH–A–Small–B	33%.
IMH–A–Large–B	33% (at 800 lb ice/24 hours) 21% (at 1,500 lb ice/24 hours).
RCU–Small–B	Not analyzed—similar to IMH–A.–Large–B (1500).
RCU–Large–B	21% (at 1,500 lb ice/24 hours) 21% (at 2,400 lb ice/24 hours).
SCU–W–Small–B	Not analyzed—similar to SCU–A–Large–B.
SCU–W–Large–B	35%.
SCU–A–Small–B	41%.
SCU–A–Large–B	36%.

* IMH is ice-making head; RCU is remote condensing unit; SCU is self-contained unit; W is water-cooled; A is air-cooled; Small refers to the lowest harvest category; Med refers to the Medium category (water-cooled IMH only); Large refers to the large size category; RCU units were modeled as one with line losses used to distinguish standards.

** For equipment classes that were not analyzed, DOE did not develop specific cost-efficiency curves but attributed the curve (and maximum technology point) from one of the analyzed equipment classes.

TABLE III.3—MAX-TECH LEVELS FOR CONTINUOUS AUTOMATIC COMMERCIAL ICE MAKERS

Equipment type	Energy use lower than baseline
IMH–W–Small–C	Not analyzed—similar to IMH–A–Large–C (820).
IMH–W–Large–C	Not analyzed at 1,000 lb/day—similar to IMH–A–Large–C (820) Not analyzed at 1,800 lb/day—similar to IMH–A–Large–C (820).
IMH–A–Small–C	25.3%.
IMH–A–Large–C	17% (at 820 lb ice/24 hours) Not analyzed at 1,800 lb/day—similar to IMH–A–Large–C (820).
RCU–Small–C	Not analyzed—similar to IMH–A–Large–C (820).
RCU–Large–C	Not analyzed—similar to IMH–A–Large–C (820).
SCU–W–Small–C	Not analyzed—similar to SCU–A–Small–C.
SCU–W–Large–C *	No units available.
SCU–A–Small–C	24%.
SCU–A–Large–C *	No units available.

* DOE's investigation of equipment on the market revealed that there are no existing products in either of these two equipment classes (as defined in this NOPR).

** For equipment classes that were not analyzed, DOE did not develop specific cost-efficiency curves but attributed the curve (and maximum technology point) from one of the analyzed equipment classes.

D. Energy and Water Savings

1. Determination of Savings

For each TSL, DOE projected energy savings from automatic commercial ice makers purchased in the 30-year period that begins in the year of compliance with amended and new standards (2018–2047). The savings are measured over the entire lifetime of equipment purchased in the 30-year period. DOE quantified the energy savings attributable to each TSL as the difference in energy consumption between each standards case and the base case. The base case represents a projection of energy consumption in the absence of amended mandatory efficiency standards, and considers market forces and policies that affect demand for more-efficient equipment.

DOE used its NIA spreadsheet model to estimate energy savings from amended standards for the equipment that are the subject of this rulemaking. The NIA spreadsheet model (described in section IV.H of this notice) calculates energy savings in site energy, which is the energy directly consumed by equipment at the locations where they are used.

Because automatic commercial ice makers use water, water savings were quantified in the same way as energy savings.

For electricity, DOE reports national energy savings in terms of the savings in energy that is used to generate and transmit the site electricity. To convert this quantity, DOE derives annual conversion factors from the model used to prepare the Energy Information Administration's (EIA's) *Annual Energy Outlook.*

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

2. Significance of Savings

As noted above, 42 U.S.C. 6295(o)(3)(B) prevents DOE from adopting a standard for a covered product unless such standard would result in ''significant'' energy savings. Although the term ''significant'' is not defined in the Act, the U.S. Court of Appeals, in *Natural Resources Defense Council* v. *Herrington,* 768 F.2d 1355, 1373 (D.C. Cir. 1985), indicated that Congress intended ''significant'' energy savings in this context to be savings that were not ''genuinely trivial.'' The estimated energy savings in the 30-year analysis period for the TSLs (presented in section V.A) are nontrivial, and, therefore, DOE considers them ''significant'' within the meaning of section 325 of EPCA.

E. Economic Justification

1. Specific Criteria

EPCA provides seven factors to be evaluated in determining whether a potential energy conservation standard is economically justified. (42 U.S.C. 6295(o)(2)(B)(i) and 6313(d)(4)) The following sections generally discuss how DOE is addressing each of those seven factors in this rulemaking. For further details and the results of DOE's analyses pertaining to economic justification, see sections IV and V of today's rulemaking.

a. Economic Impact on Manufacturers and Commercial Customers

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

For a detailed description of the methodology used to assess the economic impact on manufacturers, see section IV.J of this rulemaking. For results, see section V.B.2 of this rulemaking. Additionally, chapter 12 of the NOPR TSD contains a detailed description of the methodology and discussion of the results.

For individual customers,[18] measures of economic impact include the changes in LCC and the PBP associated with new or amended standards. The LCC, which is specified separately in EPCA as one of the seven factors to be considered in determining the economic justification for a new or amended standard, 42 U.S.C. 6295(o)(2)(B)(i)(II), is discussed in the following section. For customers in the aggregate, DOE also calculates the national net present value of the economic impacts applicable to a particular rulemaking. For a description of the methodology used for assessing the economic impact on customers, see sections IV.G and IV.H; for results, see sections V.B.1 and V.B.2 of this rulemaking. Additionally, chapters 8 and 10 and the associated appendices of the NOPR TSD contain a detailed description of the methodology and discussion of the results. For a description of the methodology used to assess the economic impact on manufacturers, see section IV.J; for results, see section V.B.2 of this rulemaking. Additionally, chapter 12 of the NOPR TSD contains a detailed description of the methodology and discussion of the results.

[18] Customers, or consumers, in the case of commercial and industrial equipment, are considered to be the businesses that purchase or lease the equipment or may be responsible for the cost of operating the equipment.

b. Life-Cycle Costs

The LCC is the sum of the purchase price of equipment (including its installation) and the operating costs (including energy, water, maintenance, and repair expenditures) discounted over the lifetime of the equipment. The LCC savings for the considered efficiency levels are calculated relative to a base case that reflects projected market trends in the absence of new or amended standards. The LCC analysis requires a variety of inputs, such as product prices, product energy and water consumption, energy and water prices, maintenance and repair costs, product lifetime, and consumer discount rates. For its analysis, DOE assumes that consumers will purchase the considered equipment in the first year of compliance with amended standards.

To account for uncertainty and variability in specific inputs, such as equipment lifetime and discount rate, DOE uses a distribution of values, with probabilities attached to each value. DOE identifies the percentage of customers estimated to receive LCC savings, or experience an LCC increase, in addition to the average LCC savings associated with a particular standard level. DOE also evaluates the LCC impacts of potential standards on identifiable subgroups of customers that may be affected disproportionately by a national standard. For the results of DOE's analyses related to the LCC, see section V.B.1 of this rulemaking and chapter 8 of the NOPR TSD; for LCC impacts on identifiable subgroups, see section V.B.1 of this notice and chapter 11 of the NOPR TSD.

c. Energy Savings

Although significant conservation of energy is a separate statutory requirement for imposing an energy conservation standard, EPCA requires DOE, in determining the economic justification of a standard, to consider the total projected energy savings that are expected to result directly from the standard. (42 U.S.C. 6295(o)(2)(B)(i)(III) and 6313(d)(4)) As discussed in section VI.B.3, DOE uses the NIA spreadsheet to project energy savings.

d. Lessening of Utility or Performance of Equipment

In establishing classes of equipment, and in evaluating design options and the impact of potential standard levels, DOE evaluates standards that would not lessen the utility or performance of the equipment under consideration. (42 U.S.C. 6295(o)(2)(B)(i)(IV) and 6313(d)(4)) The standards proposed in today's rulemaking will not reduce the utility or performance of the equipment considered in the rulemaking. For DOE's analyses related to the potential impact of amended standards on equipment utility and performance, see section V.B.4 of this rulemaking and chapter 4 of the NOPR TSD.

e. Impact of Any Lessening of Competition

EPCA directs DOE to consider the impact of any lessening of competition, as determined in writing by the Attorney General, that is likely to result from the imposition of a standard. (42 U.S.C. 6295(o)(2)(B)(i)(V)) It directs the Attorney General to make such determination, if any, of any lessening of competition likely to result from a proposed standard, and to transmit such determination to the Secretary, within 60 days of the publication of a proposed rule, together with an analysis of the nature and extent of the impact. (42 U.S.C. 6295(o)(2)(B)(ii)) DOE will transmit a copy of today's proposed rule to the Attorney General with a request that the Department of Justice (DOJ) provide its determination on this issue. DOE will address the Attorney General's determination in the final rule.

f. Need of the Nation To Conserve Energy

The energy savings from the proposed standards are likely to provide improvements to the security and reliability of the nation's energy system. Reductions in the demand for electricity also may result in reduced costs for maintaining the reliability of the nation's electricity system. DOE conducts a utility impact analysis to estimate how standards may affect the nation's needed power generation capacity. (42 U.S.C. 6295(o)(2)(B)(i)(VI) and 6316(e)(1))

The proposed standards also are likely to result in environmental benefits in the form of reduced emissions of air pollutants and greenhouse gases (GHGs) associated with energy production. DOE reports the emissions impacts from today's standards, and from each TSL it considered, in sections IV.K, IV.L and V.B.6 of this rulemaking. DOE also reports estimates of the economic value of emissions reductions resulting from the considered TSLs.

g. Other Factors

EPCA allows the Secretary of Energy, in determining whether a new or amended standard is economically justified, to consider any other factors that the Secretary deems to be relevant. (42 U.S.C. 6295(o)(2)(B)(i)(VII) and 6316(e)(1)) In developing this proposed rule, DOE has also considered the comments submitted by interested parties. For the results of DOE's analyses related to other factors, see section V.B.7 of this rulemaking.

2. Rebuttable Presumption

As set forth in 42 U.S.C. 6295(o)(2)(B)(iii) and 6313(d)(4), EPCA provides for a rebuttable presumption that an energy conservation standard is economically justified if the additional cost to the customer of equipment that meets the new or amended standard level is less than three times the value of the first year's energy savings resulting from the standard, as calculated under the applicable DOE test procedure. DOE's LCC and PBP analysis generates values used to calculate the effects that proposed energy conservation standards would have on the PBP for customers. These analyses include, but are not limited to, the 3-year PBP contemplated under the rebuttable presumption test. In addition, DOE routinely conducts an economic analysis that considers the full range of impacts to the customer, manufacturer, the Nation, and environment, as required under 42 U.S.C. 6295(o)(2)(B)(i) and 6313(d)(4). The results of these analyses serve as the basis for DOE's evaluation of the economic justification for a potential standard level (thereby supporting or rebutting the results of any preliminary determination of economic justification). The rebuttable presumption payback calculation is discussed in section IV.G.12 of this rulemaking and chapter 8 of the NOPR TSD.

IV. Methodology and Discussion of Comments

A. General Rulemaking Issues

During the February 2012 preliminary analysis public meeting and in subsequent written comments, stakeholders provided input regarding general issues pertinent to the rulemaking, such as issues of scope of coverage and DOE's authority in setting standards. These issues are discussed in this section.

1. Statutory Authority

In the preliminary analysis, DOE stated its position that EPCA prevents the setting of both energy performance standards and prescriptive design requirements (see chapter 2 of the preliminary analysis TSD). DOE also stated its intent to amend the energy performance standards for automatic commercial ice makers, and not to set prescriptive design requirements at this time (see chapter 2 of the preliminary analysis TSD).

2. Test Procedures

As discussed in section III.A, DOE published a test procedure final rule in January 2012 (2012 test procedure final rule). 77 FR 1591 (Jan. 11, 2012). All automatic commercial ice makers covered by DOE energy conservation standards promulgated as a result of this energy conservation standards rulemaking will be required to use the 2012 test procedures to demonstrate compliance beginning on the compliance date set at the conclusion of this rulemaking. 77 FR at 1593 (Jan. 11, 2012). The standards can be found at title 10 CFR part 431, subpart H (or, alternatively, 10 CFR 431.134).

Since the publication of the 2012 test procedure final rule, DOE has received several inquiries from interested parties regarding proper conduct of the DOE test procedure. Specifically, interested parties inquired regarding the appropriate use of baffles and automatic purge water controls during the DOE test procedure. On January 28, 2013, DOE published draft guidance documents to address the issues regarding baffles [19] and automatic purge water controls [20] and provided an opportunity for interested parties to comment on those interpretations of the DOE test procedure for automatic commercial ice makers. The comment period for those guidance documents extended until February 28, 2013. DOE will publish a final guidance document and responses to all comments received on the DOE Appliance and Commercial Equipment Standards Web site (*www1.eere.energy.gov/guidance/default.aspx?pid=2&spid=1*). However, DOE notes that these guidance documents serve only to clarify existing test procedure requirements, as established in the 2012 test procedure final rule, and do not alter the DOE test procedure.

DOE's test procedures are set in separate rulemaking processes. However, as part of the automatic commercial ice maker energy conservation standards rulemaking, DOE did receive two comments related to the test procedures. Howe noted that measuring potable water use is important because de-scaling is crucial for maintaining the efficiency and utility of automatic commercial ice makers. Howe also recommended that DOE obtain information from additional manufacturers on the relationship between potable water use and automatic commercial ice maker performance. (Howe, No. 51 at p. 2) [21]

The People's Republic of China (China) noted that there are differences among test processes for refrigeration products issued by different bodies in the U.S. China stated that different test procedures may lead to different results for one product, and it will affect the judgment of compliance. Therefore, China suggested that the U.S. government unify the test procedure. (China, No. 55 at p. 3)

As noted earlier, the 2012 test procedure final rule was published on January 11, 2012, and the energy conservation standards will be based on this test procedure. 77 FR at 1593. With regard to Howe's comment, in the final rule, DOE elected to not require measurement of potable water. Since DOE is not setting potable water limits for automatic commercial ice makers, requiring manufacturers to measure potable water use would be an unnecessary expense. With regard to China's comment, DOE has no authority regarding adjustment of the test procedures of other organizations. Also, if there is any uncertainty regarding how to conduct the test, manufacturers and others may request clarification from DOE. By updating the test procedure to reflect current AHRI and ANSI/ASHRAE standards, DOE expects any differences of the type noted by China will be minimized.

3. Need for and Scope of Rulemaking

At the February 2012 preliminary analysis public meeting and in written

[19] *http://www1.eere.energy.gov/buildings/appliance_standards/pdfs/acim_baffles_faq_2013-9-24final.pdf.*

[20] *http://www1.eere.energy.gov/buildings/appliance_standards/pdfs/acim_purge_faq_2013-9-25final.pdf.*

[21] A notation in this form provides a reference for information that is in the docket of DOE's ''Energy Conservation Program for Certain Commercial and Industrial Equipment: Energy Conservation Standards for Automatic Commercial Ice Makers'' (Docket No. EERE–2010–BT–STD–0037), which is maintained at *www.regulations.gov.* This notation indicates that the statement preceding the reference is document number 51 in the docket for the automatic commercial ice makers energy conservation standards rulemaking, and appears at page 2 of that document.

comments, DOE received comments about the need for the rulemaking. Hoshizaki suggested DOE not adjust the energy standards for automatic commercial ice makers regulated under EPACT 2005, arguing that tightening the regulations that were just released 2 years ago would negatively impact both manufacturers and end users. (Hoshizaki, No. 53 at p. 3) AHRI opined that, because the full effects of the EPACT 2005 standards will not be known until at least 2013, DOE should only consider the previously uncovered continuous and high-capacity batch type ice makers in this rulemaking. (AHRI, No. 49 at p. 3)

Scotsman asked whether the upcoming rulemaking would cover products that both make and dispense ice. (Scotsman, Public Meeting Transcript, No. 42 at p. 26) [22]

In response to the comments about the need for starting this rulemaking, DOE notes that under EPACT 2005, DOE must review the existing standards and, if justified, develop amended standards by January 1, 2015. Thus, DOE commenced the rulemaking to ensure compliance with the statutory deadline. During the rulemaking, DOE considered alternatives to this rulemaking in the regulatory impact analysis; this analysis is described in Section IV.O of today's NOPR. As for covering products that make and dispense ice, the scope of the rulemaking is ice-making products. While the 42 U.S.C. 6311(19) definition of automatic commercial ice maker stated an ice maker may or may not include a means for dispensing or storing ice, not all ice makers do include such ancillary equipment. As discussed in the preliminary analysis TSD, section 2.2.4.2, DOE determined that promulgating standards to regulate the energy usage of dispensers and storage bins may have an unintended impact on customer choices when choosing between models that include or do not include such ancillary equipment. By regulating energy usage of ancillary equipment, DOE could disincentivize the manufacturing of such equipment. If, and to the extent that, ice dispensing equipment use electricity, such electricity usage is not covered by this rulemaking.

B. Market and Technology Assessment

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

1. Equipment Classes

In evaluating and establishing energy conservation standards, DOE generally divides covered equipment into classes by the type of energy used, or by capacity or another performance-related feature that justifies a different standard for equipment having such a feature. (42 U.S.C. 6295(q) and 6313(d)(4)) In deciding whether a feature justifies a different standard, DOE must consider factors such as the utility of the feature to users. *Id.* DOE normally establishes different energy conservation standards for different equipment classes based on these criteria.

Automatic commercial ice makers are divided into equipment classes based on physical characteristics that affect commercial application, equipment utility, and equipment efficiency. These equipment classes are based on the following criteria:

- Ice-making process
  - ''Batch'' icemakers that operate on a cyclical basis, alternating between periods of ice production and ice harvesting
  - ''Continuous'' icemakers that can produce and harvest ice simultaneously
- Equipment configuration
  - Ice-making head (a single-package ice-making assembly that does not include an ice storage bin)
  - Remote condensing
    - With remote compressor (compressor packaged with the condenser)
    - Without remote compressor (compressor packaged with the evaporator)
  - Self-contained (with storage bin included)
- Condenser cooling
  - Air-cooled
  - Water-cooled
- Capacity range

Table IV.1 shows the 25 automatic commercial ice maker equipment classes that DOE is including in the scope of this rulemaking. The capacity ranges for the continuous units have changed from the preliminary analysis.

TABLE IV.1—AUTOMATIC COMMERCIAL ICE MAKER EQUIPMENT CLASSES

Type of ice maker	Equipment type	Type of condenser cooling	Rated harvest rate *lb ice/24 hours*
Batch	Ice-Making Head	Water	≥50 and <500
			≥500 and <1,436
			≥1,436 and <4,000
		Air	≥50 and <450
			≥450 and <4,000
	Remote Condensing (but not remote compressor)	Air	≥50 and <1,000
			≥1,000 and <4,000
	Remote Condensing and Remote Compressor	Air	≥50 and <934
			≥934 and <4,000

[22] A notation in the form ''Scotsman, Public Meeting Transcript, No. 42 at p. 26'' identifies a comment that DOE has received during a public meeting and has included in the docket of this rulemaking at *www.regulations.gov.* This particular notation refers to a comment: (1) Submitted by Scotsman; (2) transcribed from the public meeting in document number 42 of the docket, and (3) appearing on page 26 of that document.

TABLE IV.1—AUTOMATIC COMMERCIAL ICE MAKER EQUIPMENT CLASSES—Continued

Type of ice maker	Equipment type	Type of condenser cooling	Rated harvest rate lb ice/24 hours
	Self-Contained Unit	Water	≥50 and <200
			≥200 and <4,000
		Air	≥50 and <175
			≥175 and <4,000
Continuous	Ice-Making Head	Water	≥50 and <900
			≥900 and <4,000
		Air	≥50 and <700
			≥700 and <4,000
	Remote Condensing (but not remote compressor)	Air	≥50 and <850
			≥850 and <4,000
	Remote Condensing and Remote Compressor	Air	≥50 and <850
			≥850 and <4,000
	Self-Contained Unit	Water	≥50 and <900
			≥900 and <4,000
		Air	≥50 and <700
			≥700 and <4,000

Batch type and continuous type ice makers are distinguished by the mechanics of their respective ice-making processes. Continuous type ice makers are so named because they simultaneously produce and harvest ice in one continuous, steady-state process. The ice produced in continuous processes is called ''flake'' or ''nugget'' ice, which is often a ''soft'' ice with high liquid water content, in the range from 10 to 35 percent, but can also be subcooled, *i.e.,* be entirely frozen and at temperature lower than 32 °F. Continuous type ice makers were not included in the EPACT 2005 standards and are therefore not currently regulated by DOE energy conservation standards.

Current energy conservation standards cover batch type ice makers that produce ''cube'' ice, which is defined as ice that is fairly uniform, hard, solid, usually clear, and generally weighs less than two ounces (60 grams) per piece, as distinguished from flake, crushed, or fragmented ice. 10 CFR 431.132 Batch ice makers alternate between freezing and harvesting periods and therefore produce ice in discrete batches rather than in a continuous process. After the freeze period, hot gas is typically redirected from the compressor discharge to the evaporator, melting the surface of the ice cubes that is in contact with the evaporator surface, enabling them to be removed from the evaporator. The evaporator is then purged with potable water, which removes impurities that would decrease ice clarity. Consequently, batch type ice makers typically have higher potable water usage than continuous type ice makers.

After the publication of the Framework document, several parties commented that machines producing ''tube'' ice, which is created in a batch process identical to that which produces cube ice, should also be regulated. DOE notes that tube ice machines of the covered capacity range that produce ice fitting the definition for cube type ice are covered by the current standards, whether or not they are referred to as cube type ice makers within the industry. Nonetheless, DOE has addressed the commenters' suggestions by emphasizing that all batch type ice machines are within the scope of this rulemaking, as long as they fall within the covered capacity range of 50 to 4,000 lb ice/24 hours. This includes tube ice makers and other batch type ice machines (if any) that produce ice that does not fit the definition of cube type ice. To help clarify this issue, DOE now refers to all batch automatic commercial ice makers as ''batch type ice makers,'' regardless of the shape of the ice pieces that they produce. 77 FR 1591 (Jan. 11, 2012).

During the February 2012 preliminary analysis public meeting and in subsequent written comments, a number of stakeholders addressed issues related to proposed equipment classes and the inclusion of certain types of equipment in the analysis. These topics are discussed in this section.

a. Cabinet Size

Currently, DOE does not consider physical size as a criterion for setting equipment classes.

Several stakeholders commented on the size standardization of ice makers. Scotsman commented that most ice makers are built in standard widths of 22, 30, and 48 inches and standard depths between 24 and 28 inches, although heights may vary slightly depending on the machine. (Scotsman, Public Meeting Transcript, No. 42 at p. 61) Manitowoc noted that the reason for this standardization is that most ice storage bins have standard sizes based on ice-making capacity, and the footprint of the ice maker on top needs to be the same as the footprint of the storage bin in order for them to fit together. Hence, according to Manitowoc, the industry has developed common sizes that have facilitated ice maker installations and replacements. (Manitowoc, Public Meeting Transcript, No. 42 at pp. 91–92) Howe countered that, contrary to the assertions of other stakeholders, there are no ''standard'' ice maker dimensions. (Howe, No. 51 at pp. 1–2)

Earthjustice commented that it may be helpful to use cabinet size as an additional criterion for defining equipment classes because the existing standard sizes of ice makers affect their efficiency and their utility to the consumer, both of which are factors that DOE typically considers in identifying equipment classes. (Earthjustice, Public Meeting Transcript, No. 42 at pp. 90–91)

However, Manitowoc commented that it manufactures ice makers in different cabinet sizes that deliver the same ice-making capacity, explaining that this facilitates flexible installation decisions but could complicate efforts to define equipment classes by cabinet size. (Manitowoc, Public Meeting Transcript, No. 42 at p. 91)

The Appliance Standards Awareness Project (ASAP) commented that it would be helpful to see a size analysis that would elucidate the effects of size on utility to the customer and potential energy savings. (ASAP, Public Meeting Transcript, No. 42 at pp. 73–74)

As noted by Manitowoc and Scotsman, there are standard sizes for ice makers. DOE's review of product literature supports these claims, in contrast to Howe's assertion that there are no standard sizes. However, not all customers face size constraints.

DOE notes that a reason to consider separate equipment classes based on physical dimensions is to address differences in energy efficiency. An important size-related factor that can affect the efficiency of an ice maker is the size of its heat exchangers (*i.e.,* the evaporator and condenser).[23] A larger evaporator can make more ice per freeze cycle. Hence, for a given harvest capacity rate, the cycle can be allowed to take longer, thus reducing the required heat transfer rate per evaporator surface. The reduced heat transfer rate can be provided by a lower temperature differential between the ice and the refrigerant. Likewise, as the surface area of a condenser increases, the temperature differential between the refrigerant and the cooling medium (either air or water) decreases. These design changes can lead to higher evaporating temperature and lower condensing temperature, which both reduce the pressure differential between the compressor suction and discharge ports, which reduces the amount of electrical power necessary to compress the vapor, thus reducing energy consumption of the ice maker.

To address size limitations and to save energy, DOE could consider Earthjustice's recommendation to use size as a criterion in setting equipment classes. To do so, DOE could establish parallel sets of equipment classes—size-constrained classes (in which physical size would be limited to a prescribed maximum) and non-size-constrained classes (for which there would be no size restrictions). In the size-constrained classes, DOE's ability to set stricter energy usage limits would be limited by the constraint that the physical size of the unit cannot be increased. In the non-size-constrained classes, additional energy savings could be achieved by setting standards that increase the physical size of the unit as well as making the units more efficient. Accounting for size constraints is important in the automatic commercial ice maker industry because replacement sales comprise a majority of sales and equipment must be able to fit into the same space as the unit it replaces, and fit on existing ice storage bins, as described above. For opportunities in which physical size is not critical, non-size-constrained equipment classes could save energy relative to the size-constrained units. If DOE decided not to establish separate equipment classes for space-constrained equipment, it may not be reasonable for DOE to consider design options that significantly increase physical size of the equipment, which would limit potential efficiency gains and/or make them more costly, thus likely resulting in less stringent standards for size-limited equipment classes.

Previous DOE rulemakings provide ample precedent for creating space-constrained equipment classes. For instance, DOE developed space-constrained equipment classes for packaged terminal air conditioners and through-the-wall air conditioners, both of which represent industries in which replacement comprises a majority of sales. 10 CFR 430.32

To determine whether space constraint is an issue (*i.e.,* whether efficiency and physical size are direct functions of one another), DOE followed ASAP's suggestion and prepared an analysis of the size and efficiency of automatic commercial ice makers. Using publicly available manufacturer information, DOE collected size[24] data for approximately 600 ice makers and mapped it to efficiency information listed in the AHRI database. After plotting and analyzing this data, DOE determined that, although there is a correlation between size and efficiency in automatic commercial ice makers, this correlation is not conclusive.

Table IV.2 displays sample results of this size analysis, presenting information for two different large, air-cooled IMH batch type ice makers at each of several selected harvest capacities. In many cases, the larger equipment is more efficient. For example, among the ice makers that can produce 1,500 lb ice/24 hours, the 28 ft^3 products have total energy consumption values that are lower than the current energy consumption standard by greater than >20 percent, while the 19 ft^3 products have total energy consumption values that are only 6 percent below the standard. In other cases, the data do not support this trend. For example, among the 800 lb ice/24 hour ice makers, the 17 ft^3 products are less efficient than the 11 ft^3 products. Finally, in cases such as the 1,430 lb ice/24 hour machines, there are also products with the same harvest capacity and volume that nonetheless have different efficiencies. Therefore, it is difficult to draw a decisive conclusion from this data.

TABLE IV.2—RELATIONSHIP BETWEEN VOLUME AND EFFICIENCY FOR LARGE IMH AIR-COOLED BATCH ICE MAKERS

Rated harvest rate *lb ice/24 hours*	Volume *ft^3*	% Below baseline energy use (percent)
500	9.1	3.2
	12.4	2.2
800	10.8	13.5
	16.8	3.5
1,150	18.0	13.5
	20.8	18.1
1,430	20.1	3.0
	20.1	4.6
1,530	19.3	6.0
	27.7	21.3

Manitowoc noted during the February 2012 preliminary analysis public meeting that it produces units with the same harvest rate in different size chassis sizes, and that these units have very similar features. (Manitowoc, Public Meeting Transcript, No. 42 at p. 91) DOE, in its analysis, has noted that some manufacturers have achieved higher efficiencies for ice makers in smaller sizes (at constant harvest rates). Based on this information, DOE believes that size does affect efficiency levels (as it allows for large heat exchangers), but it is not the definitive factor in determining efficiency for ice makers.

Therefore, DOE has determined that separate equipment classes for size-constrained units are not warranted. DOE notes that there is not a strong correlation between product size and product efficiency that supports separate equipment classes. Furthermore, DOE believes that adding additional classes for size-constrained units complicates the equipment class structure and analysis but does not improve the rulemaking or standards.

b. Large-Capacity Batch Ice Makers

In the November 2010 Framework document for this rulemaking, DOE requested comments on whether coverage should be expanded from the current covered capacity range of 50 to 2,500 lb ice/24 hours to include ice makers producing up to 10,000 lb ice/24 hours. All commenters agreed with expanding the harvest capacity coverage, and all but one of the commenters supported or accepted an upper harvest capacity cap of 4,000 lb ice/24 hours, which would be consistent with the current test procedure, AHRI Standard 810–2007. Most commenters categorized ice makers with harvest

[23] Other examples are use of some higher-efficiency compressors, which can be physically larger, and packaging of drain water heat exchangers within the equipment package.

[24] Size is expressed in terms of volume, calculated by multiplying unit width by unit depth and by unit height (width × depth × height).

capacities above 4,000 lb ice/24 hours as industrial rather than commercial. To be consistent with the majority of these comments, DOE proposed during the preliminary analysis to set the upper harvest capacity limit to 4,000 lb ice/24 hours, even though there are few ice makers currently produced with capacities ranging from 2,500 to 4,000 lb ice/24 hours. 77 FR 3405 (Jan. 24, 2012) Since the publication of the preliminary analysis, DOE revised the test procedure, with the final rule published in January 2012, to include all batch and continuous type ice makers with capacities between 50 and 4,000 lb ice/24 hours. 77 FR 1591, 1613–14 (Jan. 11, 2012). In the 2012 test procedure final rule, DOE noted that 4,000 lb ice/24 hours represented a reasonable limit for commercial ice makers, as larger-sized ice makers were generally used for industrial applications and testing machines up to 4,000 lb was consistent with AHRI 810–2007. 77 FR 1591 (Jan. 11, 2012). Therefore, because DOE now has a procedure for testing ice makers with capacities up to 4,000 lb ice/24 hours, DOE proposes in this NOPR to set efficiency standards that include all ice makers in this extended capacity range.

In written comments after the publication of the preliminary analysis, AHRI and Manitowoc both recommended that DOE refrain from regulating products with capacities above 2,500 lb ice/24 hours if there are not enough high-capacity batch machines available for DOE to analyze. (AHRI, No. 49 at pp. 3–4; Manitowoc, No. 54 at p. 3)

DOE acknowledges that there are currently few automatic commercial ice makers with harvest capacities above 2,500 lb ice/24 hours. However, DOE already has a precedent of setting standards for harvest capacity ranges in which there are no products available. There are currently no IMH air-cooled ice makers on the market with harvest capacities above 1,650 lb ice/24 hours, yet EPACT 2005 amended EPCA to set standards for this equipment class of ice makers with harvest capacities up to 2,500 lb ice/24 hours. Because it is possible that batch-type ice makers with harvest capacities from 2,500 to 4,000 lb ice/24 hours will be manufactured in the future, DOE does not find it unreasonable to set standards in this rulemaking for batch type ice makers with harvest capacities in the range up to 4,000 lb ice/24 hours. Therefore, DOE maintains its position to include large-capacity batch type ice makers in the scope of this rulemaking. However, DOE requests comment and data on the viability of the proposed standard levels selected for batch-type ice makers with harvest capacities from 2,500 to 4,000 lb ice/24 hours. The proposed standard levels are discussed in Section V.A.2 of today's NOPR.

c. Efficiency/Harvest Capacity Relationship

In the current energy conservation standards, DOE uses discrete harvest capacity breakpoints to differentiate cube machine classes, and DOE proposes to do the same with new classes for continuous machines.

In reviewing industry literature, DOE found that compressor efficiency increases over a range of harvest rate capacities and then tends to flatten out at the higher capacities. This trend is illustrated in Table IV.3, which displays the capacities and energy efficiency ratios (EERs) of one family of reciprocating compressors. As shown in this table, the EERs of compressors in this family level off to between 6.5 and 7.2 British thermal units per watt-hour (Btu/Wh) at capacities beyond 14,300 Btu per hour.

TABLE IV.3—RELATIONSHIP OF COMPRESSOR CAPACITY TO EER

Capacity *Btu/hr*	EER *Btu/Wh*
7,970	5.8
8,440	5.1
8,840	6.0
9,870	6.2
10,200	5.5
10,900	6.3
11,300	5.5
12,400	7.0
12,900	6.0
14,100	5.9
14,300	6.5
14,900	6.6
18,100	7.0
18,300	6.5
18,600	6.6
19,600	5.6
22,200	6.5
22,500	7.2
24,300	7.1
24,600	6.6
26,000	6.5
29,300	6.7
29,600	6.6
30,500	6.7
31,300	6.9
34,400	6.7
36,700	6.7
42,200	6.8

Due primarily to the compressor trends discussed above, ice maker energy usage also varies as products increase in cooling capacity. Ice maker energy use (in kilowatt-hours per 100 lb of ice) decreases as the harvest rate increases in all products, but because the compressor trends do not continue indefinitely, the ice maker energy usage becomes constant at larger harvest rates. The point at which usage becomes constant for ice makers varies by equipment type.

DOE has traditionally used a piecewise linear approach [25] to depict the standard levels, with the breakpoints defining the harvest capacity rate limits of different equipment classes. Thus, for the current energy conservation standards for batch type equipment, the maximum allowable energy use declines as harvest capacity increases for the smallest harvest capacity rate equipment classes. In contrast, for most of the larger harvest capacity rate equipment classes, the maximum allowable energy use is a constant. The one exception is the large IMH air-cooled equipment class, where the maximum allowable energy use continues to decrease as harvest capacity rate increases. DOE believes that its piecewise energy consumption limits facilitate the simple calculation of energy standards while accurately depicting the complex relationship between capacity and efficiency.

Several stakeholders commented on DOE's decision to set piecewise efficiency levels according to harvest capacity. At the February 2012 preliminary analysis public meeting, the Northwest Power and Conservation Council (NPCC) questioned whether setting standards by capacity range would create discontinuous breakpoints in efficiency requirements that would drive manufacturers to seek one level of capacity over another to take advantage of a more favorable standard. (NPCC, Public Meeting Transcript, No. 42 at p. 22) In written comments, the Northwest Energy Efficiency Alliance (NEEA), NPCC, and the California Investor-Owned Utilities (CA IOUs) recommended that DOE imitate ENERGY STAR® and use a single equation for each equipment class to define energy consumption standards as a function of harvest rate, rather than having multiple efficiency standards for different harvest capacity bins. (NEEA/NPCC, No. 50 at p. 2; CA IOUs, No. 56 at p. 2) CA IOUs added that, if DOE elects to continue distinguishing equipment classes based on harvest capacity breakpoints, it should explain

[25] A piecewise function is a mathematical relationship where the relationship between the independent variable and dependent variable varies over the inspected range. Different functions are used to describe this relationship for each discrete interval where this relationship is defined. The piecewise function is a way of expressing the full relationship (*http://mathworld.wolfram.com/PiecewiseFunction.html*).

its reasoning for doing so. (CA IOUs, No. 56 at p. 3)

The newly finalized ENERGY STAR specification eliminates discontinuities by using one equation for IMH and self-contained cube equipment as well as all three continuous equipment types, while achieving something similar to the asymptotic relationship mentioned by Manitowoc. The ENERGY STAR specification accomplishes this with equations that are more complex than those currently embodied in DOE's cube ice machine standards, which have simple ''intercept and slope'' or ''fixed and variable'' components. For example, DOE's current energy consumption limit for small IMH air-cooled equipment is as follows:

Maximum Energy Usage (kWh) $\leq 10.26 - 0.0086H$

(Where H = harvest rate capacity, up to 449 lb ice/24 hours)

The April 30, 2012 ENERGY STAR specification for the same equipment is:

Maximum Energy Usage (kWh) $\leq 37.72H^{-0.298}$

By means of a more complicated formula, the ENERGY STAR specification creates a continuous curve while still respecting the asymptotic relationship between efficiency and harvest capacity.

Manitowoc commented that it was not particularly important where the DOE places capacity breakpoints for different equipment classes as long as the breakpoints respect the asymptotic relationships between size and efficiency. Manitowoc also asked that there not be any real discontinuities at these breakpoints or discrepancies from the industry mean efficiency/capacity relationships. (Manitowoc, Public Meeting Transcript, No. 42 at pp. 25–26) CA IOUs similarly requested that DOE base its harvest capacity breakpoints on an investigation of the market, rather than automatically using pre-existing breakpoints, and added that any new equipment classes generated by resetting these breakpoints must not allow backsliding. (CA IOUs, No. 56 at p. 3)

The issue raised by NPCC and echoed by Manitowoc is that the equations used in the standards can cause points of discontinuity where rating equipment at slightly different capacity levels provides a benefit to the manufacturer in terms of allowable energy usage. In the current standards for IMH water-cooled units, one discontinuity exists at 500 lb ice/24 hours, the breakpoint between the small and medium harvest capacity rate equipment classes, where there is a 0.1 kWh/100 lb energy use gap, representing 2.0 percent of the 5.04 kWh/100 lb maximum allowable energy use at this harvest capacity rate. However, eliminating this type of gap in the energy conservation standards would not require departure from a piecewise linear representation of maximum allowable energy use.

Fitting a curve as was done to create the ENERGY STAR limits would be more complicated than creating a new standard that mirrors the existing usage limit structure. It would also be more difficult for customers, such as restaurant owners, who buy ice makers and need to make sense of the standards because the ENERGY STAR equation requires a calculator or a spreadsheet, and, DOE believes, leads to more questions and complexity.

The single equation approach also runs somewhat contrary to the comments received from manufacturers. With the single equation provided by ENERGY STAR, energy usage limits for large machines continue to decline to zero (albeit at diminishing rates). The manufacturer comments cited in the discussion of large machines above provided several reasons that, at very high capacities, design constraints cause these products to have constant energy usage across different harvest capacities. This means that, at a certain point, efficiency tends to become more constant as harvest capacity changes, as is embodied in the current standards. The single equation approach would make it more difficult for the DOE standards to reflect this trend in the market.

DOE has decided to continue structuring the equipment classes by utilizing multiple harvest rate sizes rather than moving to a single equation approach. By continuing to use multiple size classes, DOE will have greater flexibility to adequately address the efficiencies of large equipment classes. The risk of exploiting the system at size class break points can be mitigated by carefully developing standards. Moreover, DOE proposes amending the baseline energy standards to eliminate existing discontinuities at harvest capacity breakpoints. Note that under the DOE test procedure and specifically the updated ANSI/ASHRAE Standard 29–2009 that was incorporated by reference in that rule, harvest rates are to be determined at the time of test, and are not based on manufacturer specifications. (10 CFR 431.134) Furthermore, in EPACT 2005, Congress directed DOE to monitor whether manufacturers reduce harvest rates below tested values for the purpose of bringing non-complying equipment into compliance. (42 U.S.C. 6316(f)(4)(A)) DOE therefore intends to carefully assess whether such manipulation occurs as a result of any final rule using distinct break points.

AHRI Standard 810–2007, as referenced by the DOE test procedure, states that the energy consumption rate of ice makers should be rounded to the nearest 0.1 kWh. By considering the standard levels using this rounding convention, the only existing discontinuity in DOE's standards for batch type ice makers occurs at the breakpoint of 500 lb/24 hr between the IMH–W–Small–B and IMH–W–Medium–B equipment classes. In its analysis, DOE adjusted the baseline energy level for the IMH–W–Small–B equipment class to 7.79–0.0055H from 7.80–0.0055H. This 0.01 change eliminates the discontinuity at this breakpoint, as seen in Table IV.4. In setting up TSLs, DOE sought to ensure that no discontinuities existed between equipment classes.

TABLE IV.4—CURRENT STANDARD AND DOE ENGINEERING BASELINE FOR IMH–W–SMALL–B EQUIPMENT TYPE

Equipment type	Current baseline (7.80–0.0055H)	New baseline (7.79–0.0055H)
IMH–W–Small–B	5.1 (rounded from 5.050)	5.0 (rounded from 5.040).
IMH–W–Medium–B	5.0 (rounded from 5.030)	5.0 (rounded from 5.030).

d. Continuous Ice Maker Equipment Classes

The EPACT 2005 amendments to EPCA did not set standards for continuous type ice makers. At the February 2012 preliminary analysis public meeting, DOE presented NES results (see section IV.H.3 of this notice) that indicated the continuous equipment type accounted for approximately 0.03 quads of savings potential over the 30-year analysis period. The savings levels are low primarily because continuous type ice-making machines represent only 16 percent of automatic commercial ice maker shipments, of which only two equipment classes (IMH air-cooled small and self-contained air-cooled small equipment) represent three-quarters of shipments.

At the February 2012 preliminary analysis public meeting and in written comments, AHRI and Scotsman both questioned the need to regulate continuous type ice makers, noting that the preliminary results of DOE's national impact analysis show negligible NES (rounding to 0.000 quads) for most continuous type equipment classes. (AHRI, No. 49 at pp. 1–2; Scotsman, No. 46 at p. 5; Scotsman, Public Meeting Transcript, No. 42 at p. 105)

AHRI and Scotsman questioned the need to include continuous remote condensing units (RCUs) with remote compressors as equipment classes, noting that these are niche products that represent a very small portion of the overall market. AHRI added that their minimal projected energy savings and low shipment volume would not justify the cost of testing and certifying these products to DOE. (AHRI, No. 49 at p. 3; Scotsman, No. 46 at p. 2)

Pursuant to EPCA, DOE is required to set new or amended energy conservation standards for automatic commercial ice makers to: (1) Achieve the maximum improvement in energy efficiency that is technologically feasible and economically justified; and (2) result in significant conservation of energy. (42 U.S.C. 6295(o)(2)(A) and (o)(3)(B); 6313(d)(4)) The EPCA language does not require DOE to determine the significance of savings at the individual equipment class level in order to justify setting standards for all equipment classes of an equipment type

DOE has decided to regulate all automatic commercial ice maker equipment classes. This will bring two important automatic commercial ice maker classes (self-contained, air-cooled small continuous and IMH air-cooled small continuous) under regulation. Regulating all equipment classes will create a consistent approach for regulating continuous type equipment as was done for batch type equipment.

e. Remote Condensing Unit Classes for Equipment With and Without Remote Compressors

The current standard levels differentiate between remote condensers with compressors in the condenser cabinet and remote condensers without remote compressors. DOE requested comment on whether to retain these equipment classes as separate groups. (DOE, Public Meeting Presentation, No. 7 at p. 30)

Numerous stakeholders expressed their support for DOE's differentiation of RCUs into two separate classes based on the location of their compressors. Manitowoc raised the issue at the public meeting, noting that locating the compressor remotely has a measurable impact on the overall efficiency of an ice maker. (Manitowoc, Public Meeting Transcript, No. 42 at pp. 24–25) Scotsman added that these two classes of RCUs perform at different efficiencies in the field and provide different utility to the customer, thus justifying their separation into separate equipment classes. (Scotsman, Public Meeting Transcript, No. 42 at p. 45 and No. 46 at p. 2) NPCC expressed agreement with Scotsman's comment on the issue. (NPCC, Public Meeting Transcript, No. 42 at p. 45)

Based on DOE's review of these comments and data arising from the analyses, DOE believes the location of the compressor provides different customer utility, and that each equipment class experiences different energy usage trends due to suction line losses. DOE did not receive any information indicating that these equipment classes should not be kept separate. Therefore, DOE will continue to categorize RCUs with and without remote compressors into separate equipment classes.

f. Remote to Rack Equipment

In the preliminary analysis, DOE found that some high-capacity RCU–RC–Large–C ice makers are solely designed to be used with compressor racks and the racks' associated condensers. A compressor rack is typically used with supermarket refrigeration equipment and consists of several compressors joined in a parallel arrangement to service several refrigeration products at once. One related issue is that the manufacturers of these automatic commercial ice makers do not provide for sale a condensing unit that could be paired with them as an alternative option. DOE noted that these units do not meet the statutory definition of ice makers, which states that an ice maker ''consists of a condensing unit and ice-making section operating as an integrated unit, with means for making and harvesting ice.'' (42 U.S.C. 6311(19)(A)) Hence, DOE determined during the preliminary analysis that rack-only RCUs are not defined as ice makers under the statute and thus should not be included in this rulemaking.

Howe recommended that DOE include remote to rack ice makers in the rulemaking because such units already represent a significant fraction of annual ice maker shipments and will become even more significant once the covered capacity range expands to 4,000 lb ice/24 hours. (Howe, No. 51 at p. 4) Conversely, Scotsman commented that continuous RCUs with remote compressors comprise a very tiny piece of the overall automatic commercial ice maker market and thus questioned the need to establish equipment classes for these products. Scotsman added that these RCUs are difficult to test [26] because they are designed to be connected to supermarket rack systems. (Scotsman, No. 46 at p. 2)

Earthjustice observed that DOE has not explained why it believes that ice makers designed for use with remote condenser rack systems do not consist of ''a condensing unit and ice-making section operating as an integrated unit, with means for making and harvesting ice,'' as automatic commercial ice makers are defined. Earthjustice argued that such ice makers use the same basic components, including both a condensing unit and an ice-making section. Moreover, Earthjustice continued, the two components are directly connected, and their integration is not nullified by the fact that other equipment may also be connected to the supermarket rack. Earthjustice added that DOE has long regulated split system residential and commercial air conditioners despite the fact that the outdoor and indoor components are frequently made by different firms. (Earthjustice, No. 47 at p. 5)

Given the small market share of large continuous RCU remote compressor equipment (0.35 percent), DOE finds that Scotsman's claim is credible in that continuous, rack-only equipment comprises only a fraction of the 0.35 percent, and thus a tiny piece of the overall market.

[26] The current and recently completed DOE test procedures do not provide test procedures for this type of equipment.

The Earthjustice comment drawing a parallel to split system residential air conditioners overlooks key distinctions. Residential equipment may pair components from different manufacturers, but only one manufacturer is responsible for the certification.[27] Supermarket racks simultaneously serve multiple units of equipment (including commercial refrigerators and freezers, walk-in coolers and freezers, ice makers, air conditioners, and heat pumps), so there is no way to hold one manufacturer responsible for certifying its energy consumption. Drawing a parallel between these two circumstances is therefore not reasonable in that respect.

Therefore, DOE decided to maintain its position not to cover rack-only RCU units in this standards rulemaking. DOE does request comment and supporting data on the overall market share of these units and any expected market trends.

g. Ice Makers Covered by the Energy Policy Act of 2005

Of the 25 equipment classes that DOE is considering in this rulemaking, 13 are already covered under energy conservation standards that were set for cube type ice makers as part of EPACT 2005. Current automatic commercial ice maker standards covering cube type ice makers took effect on January 1, 2010. Under the requirements of EPCA, DOE must review and make a determination as to whether amendments to the standards are technologically and economically justified by January 1, 2015. (42 U.S.C. 6313(d)(3)(A))

In written comments, AHRI opined that, because the full effects of the EPACT 2005 ruling will not be known until at least 2013, DOE should only consider the previously uncovered continuous and high-capacity batch type ice makers in this rulemaking. (AHRI, No. 49 at p. 3) Similarly, Hoshizaki asked DOE not to adjust the energy standards for automatic commercial ice makers that are currently covered, arguing that tightening the regulations that were just released two years ago would negatively impact both manufacturers and end users. (Hoshizaki, No. 53 at p. 3)

DOE is required by statute to review the standards and, if amended standards are technologically feasible and economically justified, to issue a rule to amend the standards. (42 U.S.C. 6313(d)(3)(A))

Manufacturers have asserted that the automatic commercial ice maker industry is a small component of the commercial refrigeration industry, and that given their size they have little or no influence with the manufacturers of major components such as compressors. (Manitowoc, Public Meeting Transcript, No. 42 at pp. 14–15) Manufacturers noted that they are generally restricted to design options available to larger customers. (Manitowoc, Public Meeting Transcript, No. 42 at pp. 15)

Consistent with the comments from manufacturers, DOE's engineering analysis included design options that are viable for automatic commercial ice makers. Most of the design options are extensively used in existing products, and a few design options (brushless DC motors) are available but rarely implemented in this equipment. Chapter 5 of the NOPR TSD contains further details of the analysis for each design option used.

DOE has alternatives with respect to the date that new standards would take effect. EPCA requires that the amended standards established in this rulemaking must apply to equipment that is manufactured on or after 3 years after the final rule is published in the **Federal Register** unless DOE determines, by rule, that a 3-year period is inadequate, in which case DOE may extend the compliance date for that standard by an additional 2 years. (42 U.S.C. 6313(d)(3)(C))

For the NOPR analyses, DOE assumed a 3-year period to prepare for compliance. DOE requests comments on whether a January 1, 2018 effective date provides an inadequate period for compliance and what economic impacts would be mitigated by a later effective date.

DOE also requests comment on whether the 3-year period is adequate for manufacturers to obtain more efficient components from suppliers to meet proposed revisions of standards.

h. Regulation of Potable Water Use

Under EPACT 2005, water used for ice—referred to as potable water—was not regulated for automatic commercial ice makers.

The amount of potable water used varies significantly among batch type automatic commercial ice makers (*i.e.,* cube, tube, or cracked ice machines). Continuous type ice makers (*i.e.,* flake and nugget machines) convert essentially all of the potable water to ice, using roughly 12 gallons of water to make 100 lb of ice. Batch type ice makers use an additional 3 to 38 gallons of water in the process of making 100 lb of ice. This additional water is referred to as ''dump or purge water'' and is used to cleanse the evaporator of impurities that could interfere with the ice-making process.

The Alliance for Water Efficiency (Alliance), the Natural Resources Defense Council (NRDC), and CA IOUs proposed that DOE regulate the water use of automatic commercial ice makers. (Alliance, No. 45 at pp. 3–4; NRDC, No. 48 at p. 2; CA IOUs, No. 56 at p. 6) The Alliance noted that the potable water lost from purging represents a waste of the energy required to pump, treat, deliver, and dispose of this water on a national scale. This embedded energy use, the Alliance argued, gives DOE justification to include water efficiency standards along with its energy efficiency standards for automatic commercial ice makers. The Alliance recommended that DOE analyze technical data from real ice makers in order to accurately determine the minimum potable purge water rate required to prevent scaling. The Alliance also observed that the huge variation in potable water use among ice makers of similar capacities suggests that some ice makers may be purging water at excessive rates in order to overcome poor maintenance practices and schedules, which is not a justifiable excuse in the opinion of the Alliance. (Alliance, No. 45 at pp. 3–4) CA IOUs also recommended that DOE consider establishing potable water use limits, especially because the ENERGY STAR program already includes such limits. (CA IOUs, No. 56 at p. 6)

In response to comments from the Alliance, NRDC, and CA IOUs, DOE was not given a specific mandate by Congress to regulate potable water. EPCA, as amended, explicitly gives DOE the authority to regulate water use in showerheads, faucets, water closets, and urinals (42 U.S.C. 6291(6), 6295(j) and (k)), clothes washers (42 U.S.C. 6295(g)(9)(B)), dishwashers (42 U.S.C. 6295(g)(10)(B)), commercial clothes washers (42 U.S.C. 6313(e)), and batch (cube) commercial ice makers. (42 U.S.C. 6313(d)) With respect to batch commercial ice makers (cube type machines), however, Congress explicitly set standards in EPACT 2005 only for condenser water use, which appear at 42 U.S.C. 6313(d)(1), and noted in a footnote to the table that potable water

[27] Under DOE regulations, it is possible for more than one central air conditioner manufacturer to submit certification reports for a given condensing unit. 10 CFR 429.16 requires manufacturers of central air conditioners to certify compliance with the energy conservation standards to DOE. Where a coil manufacturer may offer a coil for sale to be matched with a condensing unit made by another manufacturer (mix-matched combination), the coil manufacturer can make representations for condensing unit coil combination, but, since the condensing unit manufacturer does not offer for sale the mixed-matched combination, only the coil manufacturer offering the combination for sale is responsible for certification of that combination.

use was not included.[28] Congress thereby recognized both types of water, and did not provide direction to DOE with respect to potable water standards. This ambiguity gives the DOE considerable discretion to regulate or not regulate potable water. The U.S. Supreme Court has determined that, when legislative intent is ambiguous, a government agency may use its discretion in interpreting the meaning of a statute, so long as the interpretation is reasonable.[29] In the case of ice makers, EPACT 2005 is ambiguous on the subject of whether DOE must regulate water usage for purposes other than condenser water usage in cube-making machines, so DOE therefore has chosen to use its discretion not to mandate a standard in this case. DOE instead considered potable water use reduction in batch-type ice makers as a design option for reducing energy use. DOE notes that the ENERGY STAR program has implemented potable water consumption requirements.

Hoshizaki commented that potable water use varies from place to place, depending on water quality, and added that the market is already dictated to use less water. (Hoshizaki, Public Meeting Transcript, No. 42 at p. 73) AHRI added that limiting potable water use would decrease ice clarity and increase scaling, which would subsequently increase the overall energy use of the ice maker. Therefore, AHRI and Hoshizaki both recommended against establishing maximum potable water use standards in this rulemaking because of the reduced utility and efficiency that it would cause. (AHRI, No. 49 at pp. 2–3; Hoshizaki, No. 53 at p. 1)

The Hoshizaki and AHRI comments suggest that DOE intends to implement potable water use standards, but this is not the case. Rather, DOE is simply suggesting that reduction of potable water use is a viable technology option that satisfies the screening analysis criteria, as long as reductions are not excessive. This approach does not establish potable water use maximums since manufacturers are not required to use this design option in order to meet efficiency standards. Scotsman noted that the ENERGY STAR program has limited potable water use in ice makers to 25 gallons per 100 lb of ice and that the program is moving toward a new standard of 20 gallons per 100 lb of ice, which it believes to be the minimum levels for avoiding machine performance issues. Scotsman recommended that DOE refer to these ENERGY STAR standards in determining new potable water use limits. (Scotsman, Public Meeting Transcript, No. 42 at pp. 64–65 and No. 46 at p. 5) Manitowoc agreed with Scotsman and added that the new 20 gallons per 100 lb metric was developed with the aid of manufacturers and that further reducing potable water use could impact the long-term reliability of its machines. Therefore, Manitowoc stated that 20 gallons per 100 lb is the lowest water use limit with which it would be comfortable. (Manitowoc, Public Meeting Transcript, No. 42 at pp. 65–66)

However, Manitowoc also commented that potable water use is a variable in the design process that manufacturers have already optimized to satisfy a number of competing factors. Manitowoc argued that, although reducing potable water use would improve machine efficiency up to a point, it would also decrease reliability and increase the required frequency for cleaning due to scaling. Manitowoc stated that the design limits for potable water use often depend on proprietary design elements; therefore, it would be difficult to set reasonable potable water use standards that were fair to all companies, in Manitowoc's opinion. (Manitowoc, No. 54 at p. 3)

Howe noted that measuring potable water use is important because de-scaling is crucial for maintaining the efficiency and utility of automatic commercial ice makers. Howe also recommended that DOE obtain information from additional manufacturers on the relationship between potable water use and ice maker performance. (Howe, No. 51 at p. 2)

DOE has implemented in the analysis the recommendations of several stakeholders that 20 gallons per 100 lb of ice is a reasonable lower limit on potable water use for batch type ice makers, especially considering that there are numerous batch type ice machines that have potable water use at this level or lower. For example, in implementing batch water control as a design option, DOE is limiting the reduction in potable water use to 20 gallons per 100 lb. This should not be confused with the establishment of a standard—this limit affects the extent to which a specific design option saves energy by placing a floor under the potable water usage. Though NRDC claims that reducing potable water use beyond this level would be feasible and beneficial, it has not identified specific designs with significantly less potable water use, nor has it provided data to show that long-term field use of such equipment is viable. Chapter 5 of the NOPR TSD contains more information about this analysis.

2. Technology Assessment

As part of the market and technology assessment, DOE developed a comprehensive list of technologies to improve the energy efficiency of automatic commercial ice makers, shown in Table IV.5. Chapter 3 of the NOPR TSD contains a detailed description of each technology that DOE identified. DOE only considered in its analysis technologies that would impact the efficiency rating of equipment as tested under the DOE test procedure. The technologies identified by DOE were carried through to the screening analysis and are discussed in section IV.C.

[28] Footnote to table at 42 U.S.C. 6313(d)(1).

[29] *Nat'l Cable & Telecomms. Ass'n* v. *Brand X Internet Servs.,* 545 U.S. 967, 986 (2005) (quoting *Chevron U.S.A. Inc.* v. *Natural Res. Def. Council, Inc.,* 467 U.S. 837, 845 (1984)).

TABLE IV.5—TECHNOLOGY OPTIONS FOR AUTOMATIC COMMERCIAL ICE MAKERS

Technology options		Batch ice makers	Continuous ice makers	Notes
Compressor	Improved compressor efficiency	√	√	
	Part load operation	√	√	
Condenser	Increased surface area	√	√	
	Enhanced fin surfaces	√	√	Air-cooled only.
	Increased air flow	√	√	Air-cooled only.
	Increased water flow	√	√	Water-cooled only.
	Brazed plate condenser	√	√	Water-cooled only.
	Microchannel condenser	√	√	
Fans and Fan Motors	Higher efficiency condenser fans and fan motors.	√	√	Air-cooled only.
Other Motors	Improved auger motor efficiency	....	√	
	Improved pump motor efficiency	√		
Controls	Smart Technologies	√	√	
Evaporator	Design options which reduce energy loss due to evaporator thermal cycling.	√		
	Design options which reduce harvest meltage or reduce harvest time.	√		
	Larger evaporator surface area	√	√	
	Tube evaporator configuration	√		
Insulation	Improved insulating material and/or thicker insulation around the evaporator compartment.	√	√	
Refrigeration Line	Larger diameter suction line	√	√	RCUs with remote compressor.
Potable Water	Reduced potable water flow	√		
	Drain water thermal exchange	√		

a. Reduced Potable Water Flow for Continuous Type Ice Makers

Howe questioned why the list of design options for continuous type ice makers did not include reduced potable water flow, considering that such machines can have clean or flush cycles. (Howe, Public Meeting Transcript, No. 42 at pp. 30–31)

DOE notes that some continuous machines may include controls or design options that may reduce potable water flow. Therefore, DOE has included reduced potable water flow for continuous machines as one of its design options.

DOE also notes that the test procedure for continuous type ice makers calls for three 14.4-minute long measurements of ice-making production and energy use. The flushing cycles in continuous type ice makers typically do not occur within these measurement periods and the water used for flushing is not captured in the energy use metric; hence, because the engineering analysis cannot evaluate an improvement that occurs outside of the test procedure, this aspect of equipment operation was screened out in the screening analysis.

b. Alternative Refrigerants

Scotsman asked whether hydrocarbon refrigerants were considered as a design option. (Scotsman, Public Meeting Transcript, No. 42 at p. 32) Manitowoc responded that hydrocarbon refrigerants should not be considered in the analysis because they have not been approved for use by the U.S. Environmental Protection Agency's (EPA's) Significant New Alternatives Policy (SNAP). (Manitowoc, Public Meeting Transcript, No. 42 at p. 32) AHRI added that refrigerants that are used as alternatives to chlorofluorocarbons (CFCs) and hydrochlorofluorocarbons (HCFCs) must be approved by both the EPA and the SNAP program. AHRI noted that, although some hydrocarbon refrigerants were approved for use in residential refrigerators and some commercial refrigerated display cases, they have not been approved for ice makers. (AHRI, Public Meeting Transcript, No. 42 at pp. 32–33)

Manitowoc observed that future legislation may require the use of refrigerants that, based on their current status, have the potential to decrease the energy efficiency of ice makers. (Manitowoc, Public Meeting Transcript, No. 42 at p. 33)

As indicated by AHRI, hydrocarbon refrigerants have not yet been approved by the EPA SNAP program and hence cannot be considered as a technology option in DOE's analysis. DOE also notes that, while it is possible that hydrofluorocarbon (HFC) refrigerants currently used in automatic commercial ice makers may be restricted by future legislation, DOE cannot speculate on such future laws and can only consider in its rulemakings laws that have been enacted. This is consistent with past DOE rulings, such as in the 2011 direct final rule for room air conditioners. 76 FR 22454 (April 21, 2011). To the extent that there has been experience within the industry, domestically or internationally, with the use of alternative low-GWP refrigerants, DOE requests any available information, specifically cost and efficiency information relating to use of alternative refrigerants. DOE acknowledges that there are government-wide efforts to reduce emissions of HFCs, and such actions are being pursued both through international diplomacy as well as domestic actions. DOE, in concert with other relevant agencies, will continue to work with industry and other stakeholders to identify safer and more sustainable alternatives to HFCs while evaluating energy efficiency standards for this equipment.

C. Screening Analysis

In the technology assessment section of this NOPR, DOE presents an initial list of technologies that can improve the energy efficiency of automatic commercial ice makers. The purpose of the screening analysis is to evaluate the technologies that improve equipment efficiency to determine which of these technologies is suitable for further consideration in its analyses. To do this, DOE uses four screening criteria—design options will be removed from consideration if they are not technologically feasible; are not practicable to manufacture, install, or service; have adverse impacts on product utility or product availability; or have adverse impacts on health or safety. 10 CFR part 430, subpart C, appendix A, sections (4)(a)(4) and (5)(b) See chapter 4 of the NOPR TSD for further discussion of the screening analysis. Additional screening criteria include whether a design option is expected to save energy or whether savings can be measured (using the prescribed test procedure), and whether an option is a proprietary technology or whether it is widely available to all manufacturers. Table IV.6 shows the EPCA criteria and additional criteria used in this screening analysis, and the design options evaluated using the screening criteria.

In the NOPR phase, DOE made several changes to the treatment of design options from the preliminary analysis approach. These changes included:

- Adding a design option to allow for growth of the unit to increase the size of the condenser and/or evaporator;
- Adjusting assumptions regarding maximum compressor EER levels based on additional research and confidential input from manufacturers;
- Adjusting potable water consumption rates for batch type ice makers subject to a floor that represents the lowest potable water consumption rate that would be expected to flush out dissolved solid reliably;
- Adding a design option to allow condenser growth in water-cooled condensers; and
- Adding a drain water heat exchanger design option.

Table IV.6 Screening Justification

Design Option	EPCA Criteria for Screening				Not Considered in the Analysis for Other Reasons		
	Technological Feasibility	Practicability to Manufacture, Install, and Service	Adverse Impacts on Product Utility	Adverse Impacts on Health and Safety	No Energy Savings or Savings not Measurable	Test Procedure Efficiency Metric Does Not Capture Savings	Proprietary Technology
Compressor Part Load Operation	√					√	
Enhanced Fin Surfaces					√		
Brazed Plate Condenser					√		
Microchannel Condenser					√		
Technology Options to Reduce Evaporator Thermal Cycling			√				√
Technology Options Which Reduce Harvest Meltage or Reduce Harvest Time					√		
Tube Evaporator Configuration			√				
Improved or Thicker Insulation					√		
Larger Diameter Suction Line			√				
Smart Technologies					√		

Table IV.7 contains the list of technologies that remained after the screening analysis.

TABLE IV.7—TECHNOLOGY OPTIONS FOR AUTOMATIC COMMERCIAL ICE MAKERS THAT WERE SCREENED IN

Technology options		Batch ice makers	Continuous ice makers	Notes
Compressor	Improved compressor efficiency	√	√	
Condenser	Increased surface area	√	√	
	Increased air flow	√	√	Air-cooled only.
	Increased water flow	√	√	Water-cooled only.
Fans and Fan Motors	Higher efficiency condenser fans and fan motors.	√	√	Air-cooled only.
Other Motors	Improved auger motor efficiency	....	√	
	Improved pump motor efficiency	√		
Evaporator	Larger evaporator surface area	√	√	
Potable Water	Reduced potable water flow	√		
	Drain water thermal exchange	√		

a. Tube Evaporator Design

Among the technologies that DOE considered were tube evaporators that use a vertical shell and tube configuration in which refrigerant evaporates on the outer surfaces of the tubes inside the shell, and the freezing water flows vertically inside the tubes to create long ice tubes that are cut into smaller pieces during the harvest process. Some of the largest automatic commercial ice makers in the RCU–NRC–Large–B and the IMH–W–Large–B equipment classes use this technology. However, DOE concluded that implementation of this technology for smaller capacity ice makers would significantly impact equipment utility, due to the greater weight and size of these designs, and to the altered ice shape. DOE noted that available tube icemakers (for capacities around 1,500 lb ice/24 hours and 2,200 lb ice/24 hours) were 150 to 200 percent heavier than comparable cube ice makers. Based on the impacts to utility of this technology, DOE screened out tube evaporators from consideration in this analysis.

b. Low Thermal Mass Evaporator Design

DOE's preliminary analysis did not consider low thermal mass evaporator designs. Reducing evaporator thermal mass of batch type ice makers reduces the heat that must be removed from the evaporator after the harvest cycle, and thus decreases refrigeration system energy use. DOE indicated during the preliminary analysis that it was concerned about the potential proprietary status of such evaporator designs, since DOE is aware of only one manufacturer that produces equipment with such evaporators. DOE requested comment on the proprietary status of low-thermal-mass evaporator designs in general, and the design used by the cited manufacturer (Hoshizaki) in particular.

Scotsman commented that Hoshizaki has recently patented or attempted to patent modifications to improve evaporator efficiency and noted that using such evaporator designs would be difficult for other manufacturers because it would require an expensive and risky redesign of entire product lines. (Scotsman, Public Meeting Transcript, No. 42 at pp. 35–36; Scotsman, No. 46 at pp. 2–3) However, Manitowoc observed that, although intellectual property is certainly a concern, there may be ways to implement this low thermal mass evaporator technology without exactly duplicating Hoshizaki's designs. (Manitowoc, Public Meeting Transcript, No. 42 at p. 36)

Hoshizaki commented that its batch type evaporators do indeed contain intellectual property in past and future designs, adding that the tooling costs for manufacturing these evaporators would be too expensive for competing manufacturers to replicate. (Hoshizaki, No. 53 at p. 2)

AHRI recommended that DOE eliminate proprietary designs from consideration and limit its analysis to technologies that are available to all manufacturers in the ice maker industry. (AHRI, No. 49 at p. 4)

Manitowoc commented that, in addition to the obvious legal issues associated with favoring a proprietary design held by a single manufacturer, DOE's analysis tools are also incapable of predicting the potential benefit of low thermal mass evaporators, which are difficult to model accurately. (Manitowoc, Public Meeting Transcript, No. 42 at pp. 36–37 and No. 54 at p. 3) Manitowoc also warned that the impact of this technology on one ice maker should not simply be extrapolated to other machines and that oversimplification of this analysis would affect the predicted efficiency benefits of each technology level. (Manitowoc, Public Meeting Transcript, No. 42 at pp. 36–37) Manitowoc added that customers are very loyal to the style of ice that they get from its machines and that all manufacturers keep customer loyalty in mind when designing their evaporators. Consequently, Manitowoc expressed concern that a new evaporator design could force manufacturers to change the style of their ice, which could drive down sales and result in a low overall payback despite the improved energy performance, and therefore Manitowoc concluded that DOE should not establish higher efficiency levels based on this design option. (Manitowoc, Public Meeting Transcript, No. 42 at pp. 36–37 and No. 54 at p. 3)

On the basis of its proprietary status, DOE concludes that its initial decision to screen out low-thermal-mass evaporator technology was appropriate. Thus, DOE has screened out this technology in its NOPR analysis.

c. Drain Water Heat Exchanger

Batch ice makers can benefit from drain water thermal exchange that cools the potable water supply entering the sump, thereby reducing the energy required to cool down and freeze the water. Technological feasibility is demonstrated by one commercially available drain water thermal heat exchanger that is currently sold only for aftermarket installation. This product is designed to be installed externally to the ice maker, and both drain water and supply water are piped through the device.[30]

In the preliminary analysis, DOE considered whether such a component could be considered to be part of an ice maker as defined in EPCA. The EPCA definition for automatic commercial ice makers states that the ice maker consists of a condensing unit and ice-making section operating as an integral unit, with means for making and harvesting ice. (42 U.S.C. 6311(19)) The definition allows that the ice maker may include means for storing ice, dispensing ice, or storing and dispensing ice. None of the subcomponents of the ice maker listed in the definition could be interpreted as referring to heat exchangers for drain water thermal exchange. DOE notes that an ice maker can still make ice without a drain water heat exchanger; hence, the drain water heat exchanger cannot be considered an integral part of the equipment. For these reasons, DOE concluded during the preliminary analysis that external drain water heat exchangers, the only configuration of this technology for which technological feasibility is demonstrated, should be screened out, and requested comments on this approach.

NPCC asserted that DOE should consider drain water thermal exchange as a technology option. NPCC proposed that reducing the inlet water temperature could enable an ice maker to maintain the same capacity without increasing the overall size of the unit. Although NPCC does not manufacture ice makers, it acknowledged having seen this technology implemented in other applications, such as water heating, without reducing capacity or increasing overall size. (NPCC, Public Meeting Transcript, No. 42 at pp. 37–38)

Earthjustice commented that DOE's rationale for screening out drain water thermal heat exchangers was defective on both legal and factual grounds. In the preliminary analysis TSD, DOE suggested that externally mounted drain water heat exchangers would fall outside EPCA's definition of automatic commercial ice makers, and that DOE therefore had no authority to consider them in this rulemaking. Earthjustice argued that this reading twists the statutory definition's role in identifying which products constitute the ''automatic commercial ice makers'' subject to efficiency standards into a ''Dos and Don'ts'' list from Congress as to which elements of ice makers DOE may examine when amending the standards that Congress enacted. Congress adopted standards that apply to the ice maker as a whole, and Earthjustice asserted that there is therefore no basis to conclude that EPCA intended to prohibit DOE from looking holistically at this equipment when amending the statutory standards. Earthjustice added that, if every technological innovation that improved the efficiency of a covered product needed to be specifically mentioned in the statute's definition of the product, there would be no need for a screening analysis. Earthjustice also noted that, in previous rulemakings, DOE consistently recognized that components that improve the efficiency of covered products merit consideration in the DOE's analyses, notwithstanding that they may be unnecessary to the basic function performed by the product, not referred to in the statutory definition applicable to the product, or external to the case or envelope of the device. Finally, Earthjustice commented that DOE's assertion that internally mounted drain heat exchangers would necessarily increase cabinet size is not true for all ice maker models. Moreover, Earthjustice stated, DOE has not considered options such as microchannel heat exchangers, which would increase both machine efficiency as well as available cabinet space within the ice maker. (Earthjustice, No. 47 at pp. 1–4)

DOE has reconsidered its preliminary suggestion that external drain water heat exchangers cannot be considered part of an ice maker simply because they are not specifically mentioned in the EPCA definition, now concluding that they can be considered as a design option and to be part of a basic model ice maker, assuming that the drain water heat exchanger is sold and shipped with the unit and that the installation and operating instructions clearly reinforce this inclusion by detailing the installation requirements for the heat exchanger.

Thus, DOE is including this technology as a design option. As NPCC noted, externally mounted drain water heat exchangers would provide energy savings by using ''waste'' water to cool the incoming potable water supply, thus reducing the amount of energy necessary to freeze the water into ice. Whereas internal heat exchangers may require increased cabinet size to fit within the ice maker, allowing external heat exchangers as a design option would prevent size increase.

DOE has concluded that drain water heat exchangers, both internally mounted and externally mounted, are design options that can increase the energy efficiency of automatic commercial ice makers. The current test procedures would give manufacturers credit for efficiency improvement of drain water heat exchangers, including externally mounted drain water heat exchangers as long as they are provided with the machine and the installation instructions for the machine indicate that the heat exchangers are part of the machine and must be installed as part of the overall installation.

d. Design Options That Necessitate Increased Cabinet Size

Some of the design options considered by DOE in its technology assessment could require an increased cabinet size. Examples of such design options include increasing the surface area of the evaporator or condenser, or both. Larger heat exchangers would enable the refrigerant circuit to operate with an increased evaporating temperature and a decreased condensing temperature, thus reducing the temperature lift imposed on the refrigeration system and hence the compressor power input. In some cases the added refrigerant charge associated with increasing heat exchanger size could also necessitate the installation of a refrigerant receiver to ensure proper refrigerant charge management in all operating conditions for which the unit is designed, thus increasing the need for larger cabinet size.

In the preliminary analysis, DOE did not consider design options that increase cabinet size, and it requested comment on this approach. (DOE, Public Meeting Presentation, No. 29 at p. 35)

Earthjustice observed that this issue, in which certain design options necessitate larger products and therefore larger installation costs, is common in rulemakings. Despite the potential difficulties that increased size could pose for ice maker manufacturers and customers, Earthjustice commented that the preliminary analysis is not necessarily the stage of the rulemaking in which such design options should be ruled out. (Earthjustice, Public Meeting Transcript, No. 42 at pp. 46–47)

At the February 2012 preliminary analysis public meeting, Manitowoc pointed out that the size of ice makers is severely limited in certain applications, which would make it difficult for manufacturers to implement design changes that reduce energy but require an increase in size. Manitowoc warned that DOE should not assume that all ice maker manufacturers can increase the sizes of their ice machines to meet standards. In many cases,

[30] A.J. Antunes and Co. *Vizion Product Catalog.* (Last accessed May 18, 2013.) *<www.ajantunes.com/VIZION/VIZIONProductCatalog/tabid/229/ProdID/481/CatID/280/language/en-US/Default.aspx>*

according to Manitowoc, increasing the size may result in higher installation costs, which are not considered in DOE's analysis. Manitowoc and AHRI both noted that a high percentage of the ice machine business involves replacing old units and that the size of new ice makers is therefore dictated by the size of the products being replaced. (Manitowoc, Public Meeting Transcript, No. 42 at pp. 57–59 and No. 54 at p. 2; AHRI, No. 49 at p. 2) AHRI also commented that customers continue to demand smaller ice machines as the space used to house them competes against more ''usable'' spaces, such as hotel rooms. Hoshizaki agreed that the industry was moving toward smaller ice makers and also recommended that DOE limit cabinet size. Consequently, Manitowoc, AHRI, and Hoshizaki all commented that DOE should not consider design options that increase cabinet size in its analysis. (Manitowoc, No. 54 at p. 2; AHRI, No. 49 at p. 2; Hoshizaki, No. 53 at p. 1)

Scotsman commented that, for products at the top of the capacity range within a given standard cabinet size, manufacturers cannot increase the size of internal components such as air-cooled condensers without increasing the machines' cabinet size. This would make the machines less competitive because they would no longer physically fit in certain applications, according to Scotsman. (Scotsman, Public Meeting Transcript, No. 42 at pp. 87–88) Moreover, Scotsman noted that assessing the impact of a technology on one type of machine and applying it to other types can be difficult and inaccurate. For example, while increasing condenser area could be simple for a 300-lb machine, it may require retooling several parts, in addition to increasing cabinet size and thus also increasing overall costs, to make the same condenser growth fit in a 600-lb machine. (Scotsman, No. 46 at p. 2) Finally, Scotsman stated that increasing the size of ice makers will cause cabinet costs to increase. (Scotsman, Public Meeting Transcript, No. 42 at p. 64) Therefore, Scotsman agreed with its fellow manufacturers that DOE should avoid design options requiring cabinet size increases. (Scotsman, No. 46 at p. 4)

Manitowoc commented that it is rare for manufacturers to have data regarding available space, ventilation, or other variables regarding the final installation of their products. Moreover, Manitowoc added that forcing an ice maker with larger cabinet size into an existing space that is too small for it would exacerbate condenser air recirculation, which decreases its efficiency and reliability. (Manitowoc, Public Meeting Transcript, No. 42 at pp. 62–63)

However, Scotsman also commented that an ice maker's energy use typically decreases as its size increases, meaning that it may be more efficient to use an oversized machine than one that has been downsized. (Scotsman, Public Meeting Transcript, No. 42 at pp. 61–62)

Howe commented that the physical size of an automatic commercial ice maker has no effect on its efficiency or its run time. According to Howe, the run time of ice makers is a function of their productive capacity as well as the size of their ice storage bins, because ice production automatically ceases when the bin is full. Howe added that regulating the physical size of ice makers may limit the use of new, more efficient technologies in the future. Therefore, Howe urged DOE not to consider limiting the physical size of ice makers. (Howe, No. 51 at pp. 1–2)

NEEA/NPCC also urged DOE not to consider limiting ice maker cabinet size in the rulemaking. NEEA/NPCC pointed out that, although improving the efficiency of an ice maker may require increasing the size of its components, many ice makers have sufficient room in their cabinets to accommodate such size increases. According to NEEA/NPCC, advanced evaporator designs could be used to meet efficiency and capacity requirements for ice makers whose evaporators already require the full cabinet size. (NEEA/NPCC, No. 50 at p. 2)

CA IOUs agreed that DOE should not screen out design options that would require an increase in cabinet size. CA IOUs referred to a limited field study whose results indicated to CA IOUs that larger ice-making equipment may be accommodated in most situations. CA IOUs added that there is no evidence as to whether there may be another space in installation locations that could accommodate a larger ice maker. Therefore, CA IOUs asserted that, in the absence of a survey or field study that shows size constraints to be an issue, DOE should not use size to screen out design options. (CA IOUs, No. 56 at p. 3)

Based on these comments from stakeholders, DOE understands that automatic commercial ice makers are often used in applications where space is very limited. DOE has not received any data supporting or refuting the characterization that installation locations may be able to accommodate larger icemakers.

Although CA IOUs cited a study indicating that installation locations may be able to accommodate larger ice makers,[31] the sample size of this study is extremely small and is not necessarily representative of the entire automatic commercial ice maker market. The study does not present any findings on the size constraints and allowances seen in the inspected products, and the pictures themselves are inconclusive. DOE believes it would be difficult to support any size-based conclusions using this study.

Particularly because replacements comprise such a large portion of the ice maker industry, ice makers affected by the proposed standard must maintain traditional standard widths and depths. Allowing design options that necessitate physical size increases may push certain capacity units beyond their current standard dimensions and would thus force the use of lower-capacity machines in replacement applications, which would significantly reduce equipment utility.

On the other hand, screening out size-increasing design options would eliminate from consideration technologies that could significantly reduce the energy consumption of automatic commercial ice makers.

Consideration of design options that increase the size of ice makers is strongly related to consideration of size-constrained design options. DOE notes that, while stakeholders have pointed out that many automatic ice maker applications are space-constrained, as described in section IV.B.1.a, DOE does not have access to sufficiently-detailed data that would either indicate what percentage of applications could not allow size increase, or be the basis to set size limits for space-constrained classes. Thus, DOE has also decided not to create size-constrained equipment classes.

DOE also notes that there are a wide range of product sizes within most equipment classes, and that DOE must seek out the most-efficient configurations. DOE noted that the equipment it purchased for reverse engineering inspections reflected a general trend that more-efficient units were often larger, had larger condensers, and in some cases had larger evaporators. Based on DOE's market study and equipment inspections, larger chassis sizes appeared often to be a means of achieving higher efficiencies.

Thus, DOE is including this package-size-increasing technologies as design options in the NOPR analysis. DOE only

[31] Karas, A. *A Field Study to Characterize Water And Energy Use of Commercial Ice-Cube Machines and Quantify Savings Potential.* December 2007. Fisher-Nickel, Inc., San Ramon, CA. <*www.fishnick.com/publications/fieldstudies/Ice_Machine_Field_Study.pdf*>

applied these design options for those equipment classes where the representative baseline unit had space to grow relative to the largest units on the market. The equipment growth allowed for larger heat exchangers to increase equipment efficiency.

For equipment classes with remote condensers, DOE only applied this design option to the condenser package, and not to the ice-making head that is placed indoors. In general, DOE only considered increasing the size of the evaporator whenever the product inspections (see section IV.D.4.e) indicated that it was needed to increase efficiency.

In addition, DOE recognizes that space constraints are more critical for SCU units; hence, DOE did not consider package size growth for SCU equipment classes.

Table IV.8 indicates for which analyzed equipment classes DOE considered chassis growing design options.

TABLE IV.8—ANALYZED EQUIPMENT CLASSES WHERE DOE ANALYZED SIZE-INCREASING DESIGN OPTIONS

Unit	Rated harvest rate *lb ice/24 hours*	Used design options that increased size?
IMH–A–Small–B	300	Yes.
IMH–A–Large–B (med)	800	Yes.
IMH–A–Large–B (large)	1,500	No.
IMH–W–Small–B	300	Yes.
IMH–W–Med–B	850	No.
IMH–W–Large–B	2,600	No.
RCU–XXX–Large–B (med)	1,500	For the remote condenser, but not for the ice-making head.
RCU–XXX–Large–B (large)	2,400	For the remote condenser, but not for the ice-making head.
SCU–A–Small–B	110	No.
SCU–A–Large–B	200	No.
SCU–W–Large–B	300	No.
IMH–A–Small–C	310	No.
IMH–A–Large–C (med)	820	No.
SCU–A–Small–C	110	No.

Table IV.9 shows the size increases that DOE considered in the analysis. DOE only considered these size increases when a unit existed on the market that was larger than the baseline unit. DOE based the new chassis sizes on the sizes of current units on the market.

TABLE IV.9—DESCRIPTION OF SIZE INCREASE DESIGN OPTIONS IN THE ENGINEERING ANALYSIS

Equipment class	Equipment type	Size descriptor	Height *inches*	Width *inches*	Depth *inches*	Volume *cubic feet*
IMH–A–Small–B	IMH	Baseline	16.5	30	24.5	7.02
		Growth	21.5	30	24.5	9.14
IMH–A–Large–B (Med).	IMH	Baseline	26	30	24	10.83
		Growth	29	30	24	12.08
IMH–W–Small–B	IMH	Baseline	20	30	24	8.33
		Growth	23.5	30	23.5	9.59

Further information on this analysis is available in chapter 5 of the NOPR TSD.

e. Microchannel Heat Exchangers

NEEA/NPCC, ASAP, and Earthjustice all recommended that DOE include microchannel heat exchanger technology in its examination of design options for improving condenser and evaporator efficiency. NEEA/NPCC noted that this technology has been used in heat exchangers for air handling equipment for years and it would allow for increased efficiency or greater ice production capacity. (NEEA/NPCC, No. 50 at p. 2) ASAP commented that, although it is not aware of ice makers on the market that incorporate microchannel heat exchangers, ice maker manufacturers who have tested prototype units that implement this technology have noticed significant efficiency improvements. (ASAP, No. 52 at p. 1) Finally, Earthjustice noted that microchannel heat exchanger technology would increase both machine efficiency and available cabinet space within the ice maker. (Earthjustice, No. 47 at pp. 1–4)

DOE has not found evidence that this technology is cost-effective. Moreover, through discussions with manufacturers, DOE has learned of no instances of energy savings associated with the use of microchannel heat exchangers in ice makers. Manufacturers also noted that the reduced refrigerant charge associated with microchannel heat exchangers can be detrimental to the harvest performance of batch type ice makers, as there is not enough charge to transfer heat to the evaporator from the condenser.

DOE contacted microchannel manufacturers to determine whether there were savings associated with use of microchannel heat exchangers in automatic commercial ice makers. These microchannel manufacturers noted that investigation of microchannel was driven by space constraints rather than efficiency.

Because the potential for energy savings is inconclusive, based on DOE analysis as well as feedback from manufacturers and heat exchanger suppliers, and based on the potential utility considerations associated with compromised harvest performance in batch type ice makers associated with this heat exchanger technology's reduced refrigerant charge, DOE screened out microchannel heat exchangers as a design option in this rulemaking.

f. Smart Technologies

CA IOUs recommended that DOE also consider including ''smart'' technologies as design options that will go beyond simple energy savings by capturing demand reductions as well. To support this proposition, CA IOUs referenced a study showing that, for automatic commercial ice-making equipment, there are 450 megawatts of demand reduction potential in California alone, indicating a significant nationwide possibility for reducing the energy demand associated with ice makers. If DOE does not include ''smart'' technologies as design options, CA IOUs instead asked that DOE comment on whether states will be allowed to implement such design option requirements for ice-making equipment. (CA IOUs, No. 56 at pp. 5–6)

While there may be energy demand benefits associated with use of ''smart technologies'' in ice makers in that they reduce energy demand (*e.g.,* shift the refrigeration system operation to a time of utility lower demand), DOE is not aware of any commercialized products or prototypes that also demonstrate improved energy efficiency in automatic commercial ice makers. Demand savings alone do not impact energy efficiency, and DOE cannot consider technologies that do not offer energy savings as measured by the test procedure. Since the scope of this rulemaking is to consider energy conservation standards that increase the energy efficiency of automatic commercial ice makers, not how they operate, for example, in relation to utility demand, this technology option has been screened out because it does not save energy as measured by the test procedure.

g. Screening Analysis: General Comments

Howe suggested that DOE gather information on a wider variety of design types of both batch and continuous type ice makers before completing its analyses, noting that DOE may have prematurely screened out design options simply because they had adverse effects on the ice makers within the small range of design parameters for which DOE collected data. (Howe, No. 51 at p. 4)

Howe has not provided specific examples of technologies that it has claimed that DOE prematurely screened out, so DOE is not in a position to respond. During the NOPR analysis, DOE analyzed additional units and accounted for this additional data in its engineering analysis. DOE considered a wide range of design types for ice makers, and screened out technologies as described in section IV.D.

D. Engineering Analysis

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

As discussed in the Framework document and preliminary analysis, DOE conducted the engineering analyses for this rulemaking using a combined efficiency level/design option/reverse engineering approach to developing cost-efficiency curves for automatic commercial ice makers. DOE established efficiency levels defined as percent energy use lower than that of baseline efficiency products. DOE's analysis is based on the efficiency improvements associated with groups of design options. Also, DOE developed manufacturing cost models based on reverse engineering of products to develop a baseline manufacturer production cost (MPC) and to support calculation of the incremental costs associated with improvement of efficiency.

DOE selected a set of 25 equipment classes to analyze directly in the engineering analysis. To develop the analytically derived cost-efficiency curves, DOE collected information from various sources on the manufacturing cost and energy use reduction characteristics of each of the design options. DOE reviewed product literature, tested and conducted reverse engineering of 39 ice makers, and interviewed component vendors of compressors and fan motors. DOE also conducted interviews with manufacturers during the preliminary analysis. Additional details of the engineering analysis are available in chapter 5 of the NOPR TSD and a copy of the engineering questionnaire is reproduced in appendix 12A of the NOPR TSD.

Cost information from the vendor interviews and discussions with manufacturers provided input to the manufacturing cost model. DOE determined incremental costs associated with specific design options from both vendor information and the cost model. DOE modeled energy use reduction using the FREEZE program, which was developed in the 1990s and upgraded as part of the preliminary analysis. The reverse engineering, vendor interviews, and manufacturer interviews provided input for the energy analysis. The final incremental cost estimates and the energy modeling results together constitute the energy efficiency curves presented in the NOPR TSD chapter 5.

DOE also considered conducting the engineering analysis using an efficiency level approach based on rated and/or measured energy use and manufacturing cost estimates based on reverse engineering data. DOE completed efficiency level analyses for several equipment classes but concluded that this approach was not viable, because the analysis suggested that cost would be reduced for higher efficiency designs for several of the equipment classes. This analysis is discussed in section IV.D.4.e and in chapter 5 of the NOPR TSD.

1. Representative Equipment for Analysis

In performing its engineering analysis, DOE selected representative units for 12 equipment class to serve as analysis points in the development of cost-efficiency curves. In selecting these units, DOE selected models that were generally representative of the typical offerings produced within the given equipment class. DOE sought to select models having features and technologies typically found in the minimum efficiency equipment currently available on the market, but selected some models having features and technologies typically found in the highest efficiency equipment currently available on the market.

2. Efficiency Levels

a. Baseline Efficiency Levels

EPCA, as amended by the EPACT 2005, prescribed the following standards for batch type ice makers, shown in Table IV.10, effective January 1, 2010. (42 U.S.C. 6313(d)(1)) For the engineering analysis, DOE used the existing batch type equipment standards as the baseline efficiency level for the equipment types under consideration in this rulemaking. Also, DOE applied the standards for equipment with harvest capacities up to 2,500 lb ice/24 hours as baseline efficiency levels for the larger batch type equipment with harvest capacities between 2,500 and 4,000 lb ice/24 hours, which are currently not regulated. DOE applied two exceptions to this approach, as discussed below.

For the IMH–W–Small–B equipment class, DOE slightly adjusted the baseline energy use level to close a gap between the IMH–W–Small–B and the IMH–W–Medium–B equipment classes. For equipment in the IMH–A–Large–B equipment class with harvest capacity above 2,500 lb ice per 24 hours, DOE chose a baseline efficiency level equal to the current standard level at the 2,500 lb ice per 24 hours capacity. In its analysis, DOE is treating the constant portion of the IMH–A–Large–B equipment class as a separate equipment class, IMH–A–Extended–B. Section IV.C contains more details of these adjustments.

DOE is not proposing adjustment of maximum condenser water use standards for batch type ice makers. First, DOE's authority does not extend to regulation of water use, except as explicitly provided by EPCA. Second, DOE determined that increasing condenser water use standards to allow for more water flow in order to reduce energy use is not cost-effective. The details of this analysis are available in chapter 5 of the NOPR TSD.

For water-cooled batch equipment with harvest capacity less than 2,500 lb ice per 24 hours, the baseline condenser water use is equal to the current condenser water use standards for this equipment.

For water-cooled equipment with harvest capacity greater than 2,500 lb ice per 24 hours, DOE proposes to set maximum condenser water standards equal to the current standard level for the same type of equipment with a harvest capacity of 2,500 lb ice per 24 hours—the proposed standard level would not continue to drop as harvest capacity increases, as it does for equipment with harvest capacity less than 2,500 lb ice per 24 hours.

TABLE IV.10—BASELINE EFFICIENCY LEVELS FOR BATCH ICE MAKERS

Equipment type	Type of cooling	Rated harvest rate *lb ice/24 hours*	Maximum energy use *kWh/100 lb ice*	Maximum condenser water use * *gal/100 lb ice*
Ice-Making Head	Water	<500	7.79–0.0055H ** †	200–0.022H.
		≥500 and <1,436	5.58–0.0011H	200–0.022H.
		≥1,436	4.0	145.
	Air	<450	10.26–0.0086H	Not Applicable.
		≥450 and <2,500	6.89–0.0011H	Not Applicable.
		≥2,500	4.1	Not Applicable.
Remote Condensing (but not remote compressor).	Air	<1,000	8.85–0.0038H	Not Applicable.
		≥1,000	5.10	Not Applicable.
Remote Condensing and Remote Compressor.	Air	<934	8.85–0.0038H	Not Applicable.
		≥934	5.30	Not Applicable.
Self-Contained	Water	<200	11.4–0.019H	191–0.0.
		≥200	7.60	For <2,500: 191–0.0315H For ≥2,500: 112.
	Air	<175	18.0–0.0469H	Not Applicable.
		≥175	9.80	Not Applicable.

* Water use is for the condenser only and does not include potable water used to make ice.
** H = rated harvest rate in pounds per 24 hours, indicating the water or energy use for a given rated harvest rate. Source: 42 U.S.C. 6313(d).
† There is a gap between the existing IMH–W–Small–B standard and the IMH–W–Medium–B standard. The baseline equation for the IMH–W–Small–B equipment class was adjusted from 7.8—0.0055*H to 7.79—0.0055*H to close this gap.

Currently there are no DOE energy standards for continuous type ice makers. During the preliminary analysis, DOE developed baseline efficiency levels using energy use data available from several sources, as discussed in chapter 3 of the preliminary TSD. DOE chose baseline efficiency levels that would be met by nearly all ice makers represented in the databases. Also, because energy use reported at the time DOE was preparing the preliminary analysis did not include the hardness adjustment prescribed by the new test procedure,[32] DOE made these adjustments to the data. At that time, hardness data was also not generally available for ice makers; therefore, DOE used assumptions of 0.7 ice hardness for flake ice makers and 0.85 for nugget ice makers to make the hardness adjustments, thus estimating energy use as it would be measured by the new test procedure. 77 FR 3404 (Jan. 24, 2012). DOE selected harvest capacity break points (harvest capacities at which the slopes of the trial baseline efficiency levels change) for all but the self-contained equipment classes consistent with those selected by the Consortium for Energy Efficiency (CEE) for their new Tier 2 efficiency level for flake ice makers. Note that DOE did not also adopt the CEE energy use levels for any of its incremental efficiency levels because the CEE energy use levels do not incorporate adjustment of the measured energy use based on ice hardness.

For the NOPR analysis, DOE used newly available information published in the AHRI Directory of Certified Product Performance, the California Energy Commission, the ENERGY STAR program, and vendor Web sites, to update its icemaker ratings database (''DOE icemaker ratings database''). In 2012, AHRI published equipment ratings for many continuous type ice makers, including ice hardness factors calculated as prescribed by ASHRAE 29–2009, which is incorporated by reference in the new DOE test procedure. DOE recreated its database for continuous type ice makers based on the available AHRI data, considering only the ice makers for which AHRI ratings for ice hardness were available. DOE also adjusted the harvest capacity break points for the continuous equipment classes based on the new data.

The baseline efficiency levels for continuous type ice makers are presented in Table IV.11. They are

[32] Ice hardness is a term used for ice produced by continuous type ice makers, describing what percentage of the output is hard ice (as compared to water).

compared with the ice maker energy use data in chapter 3 of the NOPR TSD. For the remote condensing equipment, the large-capacity remote compressor and large-capacity non-remote compressor classes have been separated and are different by 0.2 kWh/100 lb, identical to the batch equipment differential. This differential is also discussed briefly in section IV.B.1.e. DOE requests comments on the development of efficiency levels for continuous type ice makers and whether the selected levels appropriately represent baseline equipment.

TABLE IV.11—BASELINE EFFICIENCY LEVELS FOR CONTINUOUS ICE MAKER EQUIPMENT CLASSES

Equipment type	Type of cooling	Rated harvest rate *lb ice/24 hours*	Maximum energy use *kWh/100 lb ice**	Maximum condenser water use* *gal/100 lb ice*
Ice-Making Head	Water	Small (<900)	8.1–0.00333H	160–0.0176H.
		Large (≥900)	5.1	≤2,500: 160–0.0176H; >2,500: 116.
	Air	Small (<700)	11.0–0.00629H	Not Applicable.
		Large (≥700)	6.6	Not Applicable.
Remote Condensing (Remote Compressor).	Air	Small (<850)	10.2–0.00459H	Not Applicable.
		Large (≥850)	6.3	Not Applicable.
Remote Condensing (Non-remote Compressor).	Air	Small (<850)	10.0–0.00459H	Not Applicable.
		Large (≥850)	6.1	Not Applicable.
Self-Contained	Water	Small (<900)	9.1–0.00333H	153–0.0252H.
		Large (≥900)	6.1	≤2,500: 153–0.0252H; >2,500: 90.
	Air	Small (<700)	11.5–0.00629H	Not Applicable.
		Large (≥700)	7.1	Not Applicable.

* H = rated harvest rate in lb ice/24 hours.

b. Incremental Efficiency Levels

For each of the nine analyzed batch type ice-making equipment classes, DOE established a series of incremental efficiency levels for which it has developed incremental cost data and quantified the cost-efficiency relationship. DOE chose a set of analyzed equipment classes that would be representative of all batch type ice-making equipment classes, and grouped non-analyzed equipment classes with analyzed equipment classes accordingly in the downstream analysis. Table IV.12 shows the selected incremental efficiency levels.

For the IMH–A–Large–B equipment class, DOE is adopting its suggested approach from the preliminary analysis meeting. (DOE, Preliminary Analysis Public Meeting Presentation, No. 42 at p. 29) As part of this approach, DOE is treating the largest units as an extended equipment class (IMH–A–Extended–B), basing the analysis for this equipment class on the analysis for a 1,500 lb ice/24 hour IMH–A–Large–B unit. When setting TSLs, DOE is considering the 800 lb ice/24 hour IMH–A–Large–B analysis separately from the 1,500 lb ice/24 hour analysis.

TABLE IV.12—INCREMENTAL EFFICIENCY LEVELS FOR BATCH ICE MAKER EQUIPMENT CLASSES

Equipment type*	Rated harvest rate *lb ice/24 hours*	EL 2**	EL 3 *(%)*	EL 4 *(%)*	EL 5 *(%)*	EL 6 *(%)*
IMH–W–Small–B	<500	10%	15	20	25	
IMH–W–Med–B	≥500 and <1,436	10%	15	20		
IMH–W–Large–B	≥1,436	10%	15	20		
IMH–A–Small–B	<450	10% (E–STAR†)	15	20	25	30
IMH–A–Large–B‡	≥450	10% (E–STAR†)	15	20	25	
RCU–NRC–Small–B***	<1,000	9% (E–STAR†)	15	20		
RCU–NRC–Large–B	≥1,000	9% (E–STAR†)	15	20		
RCU–RC–B	<934	9% (E–STAR†)	15	20		
	≥934	9% (E–STAR†)	15	20		
SCU–W–Small–B***	<200	7%	15	20	25	30
SCU–W–Large–B	≥200	7%	15	20	25	30
SCU–A–Small–B	<175	7% (E–STAR†)	15	20	25	30
SCU–A–Large–B	≥175	7% (E–STAR†)	15	20	25	30

* See Table III.1 for a description of these abbreviations.
** EL = efficiency level; EL 1 is the baseline efficiency level, while EL 2 through EL 6 represent increased efficiency levels.
*** These equipment classes were not directly analyzed.
† New ENERGY STAR levels became effective on February 1, 2013. These levels represent the ENERGY STAR levels prior to February 1, 2013.
‡ The IMH–A–Large–B levels were analyzed at the 800 lb ice/24 hour size and the 1,500 lb ice/24 hour size, and the 1,500 lb ice/24 hour size were used to set standards for the new IMH–A–Extended–B class.

For each of the three analyzed continuous type ice maker equipment classes, DOE established a series of incremental efficiency levels, for which it has developed incremental cost data and quantified the cost-efficiency relationship. DOE chose a set of analyzed equipment classes that would be representative of all continuous type ice-making equipment classes, and grouped non-analyzed equipment classes with analyzed equipment classes accordingly in the downstream analysis, as discussed in section V.A.1. Table IV.13 shows the selected incremental efficiency levels. The efficiency levels are defined by the percent energy use less than the baseline energy use.

TABLE IV.13—SELECTED INCREMENTAL EFFICIENCY LEVELS FOR CONTINUOUS TYPE ICE MAKER EQUIPMENT CLASSES

Equipment type *	Rated harvest rate *lb ice/24 hours*	EL 2 ** *(%)*	EL 3 *(%)*	EL 4 *(%)*	EL 5 *(%)*	EL 6 *(%)*
IMH–W–Small–C	<900					
IMH–W–Large–C	≥900					
IMH–A–Small–C	<700	10	15	20	25	30
IMH–A–Large–C	≥700	10	15	20	25	30
RCU–Small–C	<850	Not Analyzed.				
RCU–Large–C	≥850	Not Analyzed.				
SCU–W–Small–C	<900	Not Analyzed.				
SCU–W–Large–C	≥900	No existing products on the market.				
SCU–A–Small–C	<700	7	15	20	25	
SCU–A–Large–C	≥700	No existing products on the market.				

* See Table III.1 for a description of these abbreviations.
** EL 1 is the baseline efficiency level, while EL 2 through EL 6 represent increased efficiency levels.

DOE selected the efficiency levels for the continuous type ice makers based on the levels proposed in the preliminary analysis.

c. IMH–A–Large–B Treatment

The current DOE energy conservation standard for large air-cooled IMH cube type ice makers is represented by an equation for which maximum allowable energy usage decreases linearly as harvest rate increases from 450 to 2,500 lb ice/24 hours. Extending the current IMH–A–Large–B equation to the 4,000 lb ice/24 hours range would result in efficiency levels in the newly covered range (between 2,500 lb/day and 4,000 lb/day) that may not be technically feasible. For example, at 4,000 lb ice/24 hours, the specified baseline energy use would be 2.49 kWh/100 lb, a value far below the energy consumption of existing IMH–A–Large–B ice makers (*e.g.,* it is 39 percent lower than the lowest rating for IMH–A–Large–B equipment of which DOE is aware, 4.1 kWh/100 lb). In the preliminary analysis, DOE proposed establishing baseline and incremental efficiency levels for this equipment class that maintain a constant level of energy use at higher harvest capacities, with exceptions in certain harvest capacity ranges to avoid backsliding. For example, for efficiency level 2, DOE proposed that (a) between 1,600 and 2,080 lb ice/24 hours, the maximum energy use would be independent of harvest capacity, as is the case for all other high-harvest-capacity equipment classes, (b) between 2,080 lb ice/24 hours, the maximum energy usage would be calculated according to the current standard to avoid EPCA anti-backsliding provisions, and (c) between 2,500 and 4,000 lb ice/24 hours, the maximum energy use would remain constant. DOE presented this approach in the preliminary analysis and requested comment on it; DOE did not receive any comments on this approach.

Hence, DOE is proposing to use the approach it outlined in the preliminary analysis meeting for the IMH–A–Large–B equipment class (DOE, Preliminary Analysis Public Meeting Presentation, No. at p. 29). Further, DOE proposes to separate capacity ranges of this class into ranges designated IMH–A–B and IMH–A–Extended–B, the first for equipment with harvest capacity less than 1,500 lb ice/24 hours and the second with greater harvest capacity. The proposed IMH–A–B efficiency levels would be constant between 800 and 1,500 lb ice/24 hours. Each proposed IMH–A–Extended–B efficiency level would start at an energy use that is equal to that of one of IMH–A–B efficiency levels. Its energy use would remain constant at this level within its lower range of harvest capacity rates, but would follow the current DOE standard between the harvest capacity for which the constant level equals the current DOE standard and 2,500 lb ice/24 hours. Beyond 2,500 lb ice/24 hours, it would remain constant from 2,500 to 4,000 lb ice/24 hours.

d. Maximum Available Efficiency Equipment

For the NOPR analysis, DOE considered the most-efficient equipment available on the market, known as maximum available equipment. In some cases, the maximum available equipment uses technology options that DOE chose to screen out for its analysis. Hence, DOE also identified maximum available equipment without screened technologies (see the discussion of the engineering analysis in section IV.D.2.f). The technologies that are used in some maximum available equipment that were screened out include low thermal-mass evaporators and tube evaporators for batch type ice makers.

Efficiency levels for maximum available equipment in the batch type ice-making equipment classes are tabulated in Table V.16. This information is based on DOE's icemaker ratings database (also see data in chapter 3 of the NOPR TSD). The efficiency levels are represented as an energy use percentage reduction compared to the energy use of baseline-efficiency equipment, the selection of which is discussed in section IV.D.2.a.

TABLE IV.14—EFFICIENCY LEVELS FOR MAXIMUM AVAILABLE EQUIPMENT IN BATCH ICE MAKER EQUIPMENT CLASSES

Equipment class	Energy use lower than baseline
IMH–W–Small–B	24.5%.
IMH–W–Med–B	22.4%.
IMH–W–Large–B	7.5% (at 1,500 lb ice/24 hours).
	8.3% (at 2,600 lb ice/24 hours).
IMH–A–Small–B	23.6%.
IMH–A–Large–B	20.7% (at 800 lb ice/24 hours).
	21.3% (at 1,500 lb ice/24 hours).
RCU–Small–B	24.6%.
RCU–Large–B	40.2% (at 1,500 lb ice/24 hours).
	26.7% (at 2,400 lb ice/24 hours).
SCU–W–Small–B	22.5%.
SCU–W–Large–B	27.6%.
SCU–A–Small–B	35.8%.
SCU–A–Large–B	29.6%.*

* This is the second highest rated product; the highest rated product is also a dispenser unit.

Efficiency levels for maximum available equipment in the continuous type ice-making equipment classes are tabulated in Table IV.15. This information is based on a survey of product databases and manufacturer Web sites (also see data in chapter 3 of the TSD). The efficiency levels are represented as an energy use percentage reduction compared to the energy use of baseline-efficiency equipment, the selection for which is discussed in section IV.D.2.a. DOE used the maximum available efficiency levels to calibrate its engineering analysis against current equipment.

TABLE IV.15—EFFICIENCY LEVELS FOR MAXIMUM AVAILABLE EQUIPMENT FOR CONTINUOUS TYPE ICE MAKER EQUIPMENT CLASSES

Equipment class	Energy use lower than baseline
IMH–W–Small–C	16.5%.
IMH–W–Large–C	12.2% (at 1,000 lb ice/24 hours).
	8.6% (at 1,800 lb ice/24 hours).
IMH–A–Small–C ..	25.3%.
IMH–A–Large–C	8.1% (at 820 lb ice/24 hours).
	17.0% (at 1,500 lb ice/24 hours).
RCU–Small–C	18.4%.
RCU–Large–C	18.5%.
SCU–W–Small–C	18.7%.*
SCU–W–Large–C	No equipment on the market.*
SCU–A–Small–C	24.4%.
SCU–A–Large–C	No equipment on the market.*

* DOE's inspection of currently available equipment revealed that there are no available products in the defined SCU–W–Large–C and SCU–A–Large–C equipment classes at this time.

e. Maximum Technologically Feasible Efficiency Levels

When DOE proposes to adopt (or not adopt) an amended or new energy conservation standard for a type or class of covered equipment such as automatic commercial ice makers, it determines the maximum improvement in energy efficiency that is technologically feasible for such equipment. (*See* 42 U.S.C. 6295(p)(1) and 6313(d)(4)) Accordingly, in the preliminary analysis, DOE determined the maximum technologically feasible (''max-tech'') improvements in energy efficiency for automatic commercial ice makers in the engineering analysis using energy modeling and the design options that passed the screening analysis. As part of the NOPR analysis, DOE modified its energy use analysis. In addition, DOE considered a different range of design options. Evaluation of maximum technological feasibility was again based on energy modeling, but DOE compared energy modeling results with maximum available without screened technologies to ensure consistency of results with actual designs at that level. See chapter 5 of the NOPR TSD for the results of the analyses, and a list of technologies included in max-tech equipment.

The max-tech efficiency levels represent equipment combining all of the design options. However, they are not generally attained by existing equipment—this is largely due to the consideration of design options seldom used in commercially available equipment because they are not considered to be cost-effective by manufacturers, such as brushless DC motors and drain water heat exchangers. DOE does not screen out design options based on cost-effectiveness.

Table III.2 and Table III.3 show the max-tech levels determined in the engineering analysis for batch and continuous type automatic commercial ice makers, respectively.

TABLE IV.16—MAX-TECH LEVELS FOR BATCH AUTOMATIC COMMERCIAL ICE MAKERS

Equipment type *	Energy use lower than baseline
IMH–W–Small–B	30%.
IMH–W–Med–B ...	22%.
IMH–W–Large–B	17% (at 1,500 lb ice/24 hours).
	16% (at 2,600 lb ice/24 hours).
IMH–A–Small–B ..	33%.
IMH–A–Large–B ..	33% (at 800 lb ice/24 hours).
	21% (at 1,500 lb ice/24 hours).
RCU–Small–B	Not analyzed.
RCU–Large–B	21% (at 1,500 lb ice/24 hours).
	21% (at 2,400 lb ice/24 hours).
SCU–W–Small–B	Not analyzed.
SCU–W–Large–B	35%.
SCU–A–Small–B	41%.
SCU–A–Large–B	36%.

* IMH is ice-making head; RCU is remote condensing unit; SCU is self-contained unit; W is water-cooled; A is air-cooled; Small refers to the lowest harvest category; Med refers to the Medium category (water-cooled IMH only); Large refers to the large size category; RCU units were modeled as one with line losses used to distinguish standards.

TABLE IV.17—MAX-TECH LEVELS FOR CONTINUOUS AUTOMATIC COMMERCIAL ICE MAKERS

Equipment type	Energy use lower than baseline
IMH–W–Small–C	Not analyzed.
IMH–W–Large–C	Not analyzed.
IMH–A–Small–C ..	25.3%.
IMH–A–Large–C	17% (at 820 lb ice/24 hours).
RCU–Small–C	Not analyzed.
RCU–Large–C	Not analyzed.
SCU–W–Small–C	Not analyzed.
SCU–W–Large–C.*	No units available.
SCU–A–Small–C	24%.
SCU–A–Large–C.*	No units available.

* DOE's investigation of equipment on the market revealed that there are no existing products in either of these two equipment classes (as defined in this NOPR).

f. Comment Discussion

Impact of the Variability of Ice Hardness Measurements on Efficiency Levels for Continuous Type Ice Maker Equipment

Manitowoc noted that there are no industry standards for the calorimetric values of different types of ice and cautioned that DOE's assumptions for these calorimetric values may invalidate its analysis of manufacturer-supplied data. (Manitowoc, Public Meeting Transcript, No. 42 at pp. 51–52) Hoshizaki recommended that ice hardness have one standard that incorporates all continuous type ice maker data and added that DOE should readdress the baseline for continuous type ice-making equipment after taking AHRI's 2012 ice hardness verification testing into account. (Hoshizaki, No. 53 at p. 1)

Howe recommended that DOE supplement its data on continuous type ice makers by including results from tests using the current test procedure, adding that information on continuous type ice makers has changed drastically as of late. (Howe, No. 51 at p. 2)

DOE notes that some of these comments were made before AHRI had completed verification testing work that is mentioned by Hoshizaki. DOE updated its database over the course of 2012, as many of the continuous type ice maker data in AHRI's database were updated, and hardness data was provided. DOE has primarily used this data, supplemented by DOE test data (including hardness test data) to evaluate the energy consumption characteristics of continuous type ice-making equipment and to set efficiency levels.

DOE notes that, consistent with Hoshizaki's suggestion, the proposed standards for continuous type ice makers use one metric that combines ice quality and energy usage. In addition, DOE has not proposed use of the Canadian efficiency levels for continuous type ice makers. The proposed efficiency levels for continuous type ice makers are discussed in sections IV.D.2.a and IV.D.2.b.

Correlation of Efficiency Levels With Design Options

Manitowoc expressed confusion over the relationship between the efficiency levels and the technology options that go into those efficiency levels. Therefore, Manitowoc requested that DOE provide additional information to explain which technology options were associated with each efficiency level. (Manitowoc, Public Meeting Transcript, No. 42 at p. 51)

Manitowoc pointed out that one of the SCU-air-cooled models used for the max-available efficiency level is actually a combined ice machine and hotel dispenser, and as such is not a representative example of the SCU category, which generally consists of undercounter designs. Manitowoc further stated that its larger size would allow the model to achieve higher efficiencies than would normally be possible for the majority of SCU air-cooled models. Therefore, Manitowoc commented, this model should not be used to justify the max-available efficiency attainable for this category of ice makers. (Manitowoc, No. 54 at pp. 2–3)

In response to Manitowoc's comment regarding the relationship of design options and efficiency levels, DOE provided additional information in the automatic commercial ice maker docket, as a supporting and related material document [33] (DOE, Preliminary Analysis Presentation Supplementary Engineering Data, No. 43). The data in this document reflects the preliminary engineering analysis. For the NOPR analysis, the relationship between design options and efficiency levels has changed due to changes made to the design options considered, assumptions, and analysis approach. The new information is detailed in sections IV.D.4.a (cost model adjustments) and IV.D.4.f (energy model adjustments) and in the NOPR TSD chapter 5.

DOE notes that Manitowoc is correct in its observation that one of the max-available SCU models from the preliminary analysis is not representative of the undercounter units that make up the majority of the SCU category. DOE had intended to avoid inclusion of oversize SCU models that are not suitable for undercounter design in its establishment of maximum technology for SCU equipment classes. DOE has reviewed the maximum technology designations and has removed all ice maker-dispenser combinations from consideration in its analysis.

RCU Class Efficiency Level Differential

In its preliminary engineering analysis, DOE concluded that the 0.2 kWh per 100 lb ice differential in maximum allowable energy use for large-sized batch RCU ice makers with remote compressors as compared with those with compressors in the ice-making heads is appropriate, both for batch and continuous type ice makers. (DOE, Preliminary Analysis Public Meeting Presentation, No. 29 at p. 30) DOE requested comment on this conclusion.

Manitowoc confirmed that the 0.2 kWh per 100 lb of ice difference in energy use between these two classes of RCUs seemed valid and that it was reasonable to continue using this value while developing the new standards. (Manitowoc, Public Meeting Transcript, No. 42 at p. 44 and No. 54 at p. 3) CA IOUs stated that its analysis of product data indicates that RCUs with and without dedicated remote compressors do not consume significantly different levels of energy. CA IOUs thus suggested that DOE continue to look at product performance data and customer utility in order to determine whether separate equipment classes and efficiency levels are necessary for these two types of RCU units. (CA IOUs, No. 56 at p. 2)

Consistent with the comment from Manitowoc, DOE plans to continue using this differential of 0.2 kWh per 100 lb of ice to differentiate between RCUs with and without remote compressors.

Batch Efficiency Levels for High-Capacity Ice Maker

DOE has established baseline and incremental efficiency levels for large-capacity ice makers in the newly extended capacity between 2,500 and 4,000 lb ice/24 hours.

AHRI noted that the current efficiency standard for high-capacity batch machines was established based on the performance of ice makers available in the marketplace and that extending this efficiency level to ice makers with capacities exceeding 2,500 lb ice/24 hours may not be appropriate. AHRI recommended that DOE either select and analyze products in this capacity range or refrain from regulating these products if there are not actually enough high-capacity batch machines available for DOE to analyze. (AHRI, No. 49 at pp. 3–4)

Manitowoc stated that efficiency curves are typically flat for icemakers with capacities above 2,000 to 2,500 lb ice/24 hours and noted that this phenomenon is driven mainly by trends in compressor efficiencies, which have decreasing efficiency gains above a certain size. Additionally, Manitowoc commented that it tends to use multiple evaporators for large-capacity machines, rather than making new evaporators for every size, so its overall evaporator performance also does not improve significantly over a certain size. (Manitowoc, Public Meeting Transcript, No. 42 at pp. 48–49)

However, Manitowoc also commented that DOE did not adequately analyze the efficiency of ice machines in the 2,000 to 4,000 lb ice/24 hour capacity range. Manitowoc suggested that it is likely that, above a certain capacity, DOE will find that the relative benefit of some design options to be lower due to the relatively higher efficiency of the baseline components already in use. (Manitowoc, No. 54 at p. 3)

Howe commented that most high-capacity ice makers are inherently more efficient than their lower-capacity counterparts and thus cannot be expected to achieve the same incremental efficiency gains. Howe added that, if incremental efficiency gains do indeed vary significantly by harvest capacity, equipment class definitions may need to change. (Howe, No. 51 at pp. 2–3)

Hoshizaki recommended that DOE make equipment plots for high-capacity batch models in order to compare existing models against the proposed efficiency levels. (Hoshizaki, No. 53 at p. 2)

Hoshizaki commented that DOE needs to analyze the available data for all eligible RCU models rather than just relying on software assumptions to inform its analysis. Hoshizaki added that there is not enough data available for DOE to adequately assess high-capacity (>2,500 lb ice/24 hours) RCU energy use and recommended that manufacturers provide input to DOE regarding these high-capacity units. (Hoshizaki, No. 53 at p. 1)

In response to AHRI, DOE reiterates that there is precedence for setting standards for capacity ranges for which equipment is not being sold, including

[33] See *www.regulations.gov/#!documentDetail;D=EERE-2010-BT-STD-0037-0043*. After the February 2012 preliminary analysis public meeting, DOE published cost-efficiency curves showing the relationship of efficiency levels to design options for each directly analyzed equipment class.

when DOE adopted standards for air-cooled IMH cube type ice makers up to 2,500 lb ice/24 hours, even though no such equipment is manufactured with capacities above 1,650 lb ice/24 hours. DOE simply is extending the capacity range of the standard for consistency with the applicability of the test procedure. DOE notes that it has proposed efficiency levels for the larger ice makers that, to the extent possible, do not change as a function of harvest capacity. Manitowoc's comments suggest that larger-capacity ice machines would have comparable efficiency level as compared with lower-capacity machines, and Howe's comments suggest that larger-capacity ice machines are inherently more efficient. Hence, the constant energy use efficiency level would be appropriate. The commenters did not highlight any other specific factors that would suggest that the constant energy use approach is inappropriate. Examination of the limited available data showing rated energy use as a function of harvest capacity certainly supports the approach, even though there is much less data to consider that at the lower capacity levels.

In response to Manitowoc's comment regarding analysis of batch type ice makers in the 2,000 to 4,000 lb ice/24 hours harvest capacity range, DOE notes that it has conducted analysis for three of these products—given the limited number of such products available, this likely represents a greater percentage of the available products than DOE evaluated at lower-harvest-capacity rates. Because, as mentioned by Manitowoc, efficiency characteristics of the components of ice makers such as compressors and evaporators no longer improve as capacity increases, it is reasonable to expect that ice maker efficiency will also remain constant at high-harvest-capacity rates. For this reason, it is appropriate to represent performance of the full harvest capacity range with the available ice makers of the highest harvest capacities, as DOE has done.

In response to Howe's comment, DOE has not considered reductions in efficiency at constant kilowatt-hours per 100 lb ice levels across the harvest capacity range. Instead, DOE has considered reductions in energy use in terms of percentages of baseline energy use. Hence, the energy use reductions associated with the incremental efficiency levels would be significantly less for a large-harvest-capacity ice maker with an already inherently low energy use than it would for a lower-harvest-capacity ice maker. Further, if the larger-capacity ice makers are inherently more efficient, as Howe contends, DOE's approach using efficiency levels that do not vary with capacity should not be overly aggressive, *i.e.* setting efficiency levels too stringently.

With respect to Hoshizaki's recommendation regarding examination of efficiency plots, DOE has reviewed energy use data for all products for which such data is available. The maximum efficiency levels considered in the analysis are not generally attained by existing equipment—this is largely due to the consideration of design options often considered not to be cost-effective by manufacturers, such as brushless DC motors and drain water heat exchangers. However, DOE's analysis results compared well to the maximum available without screened technologies efficiency level.

In response to the second comment from Hoshizaki, DOE notes that the analysis for high-capacity units considered several pieces of information, including available performance rating data of the AHRI database and confidential interviews with manufacturers. A significant amount of the information obtained from manufacturers in confidential interviews was obtained during the NOPR phase, in part in response to preliminary analysis phase comments, such as the Hoshizaki comment, recommending some information exchange. In addition, DOE purchased and conducted reverse engineering on the largest-capacity batch and continuous type ice makers made by the manufacturers that comprise 90 percent or greater share of the ice maker market. DOE also conducted energy testing on a few of these ice makers. DOE believes that its analysis of RCU equipment is representative of the large-capacity equipment classes. Additional information on the teardown analysis is available in chapter 5 of the NOPR TSD.

Discrepancies Between Maximum Technology Levels and Most-Efficient Equipment Available in the Marketplace

NPCC, ASAP, and NEEA/NPCC commented on the max-tech efficiency levels (*i.e.,* least energy consumptive level) and that, in some cases, max-tech levels were less efficient than the most-efficient level on the marketplace (*i.e.,* ''max-available'' energy level). NPCC further commented that DOE should indicate whether this discrepancy is due to technologies that were screened out. NEEA/NPCC pointed to products in a Natural Resources Canada (NRCan) database that surpassed DOE's max-tech levels. (NPCC, Public Meeting Transcript, No. 42 at pp. 45–46; ASAP, Public Meeting Transcript, No. 42 at p. 50; NEEA/NPCC, No. 50 at pp. 2–4) NPCC also recommended that DOE investigate whether there are superior technologies on the market that were not being analyzed simply because of the way max-tech is defined. NPCC added that the process by which design options are screened out should be very deliberate. (NPCC, Public Meeting Transcript, No. 42 at pp. 53–54)

Scotsman noted that, even within a single equipment class, maximum technology levels will differ among models. For example, although DOE is considering compressor upgrade as a design option, many ice maker units are already using the most-efficient compressor suitable to their respective applications. Scotsman added that the analytical model used to calculate energy use for max-tech levels had not been validated and was thus unreliable. (Scotsman, No. 46 at p. 4)

DOE acknowledges that there are units on the market that surpass the max-tech levels it proposed for the preliminary analysis. In some cases maximum available efficiency units include technologies that DOE had decided not to consider. For example, some max-tech units utilize proprietary technologies that are not available to the majority of manufacturers and were screened out in the screening analysis. Due to these differences, DOE's max-tech efficiency levels did not always exceed the max-available levels found on the market. Because they are representative of the whole market, DOE's max-tech levels must take into account issues with proprietary technologies as well as utility issues stemming from certain technologies (such as chassis size increases or ice cube shapes).

In the NOPR phase, DOE made several changes to the preliminary analysis. These changes included:

• Adding a design option to allow for growth of the unit to increase the size of the condenser and/or evaporator;

• adjusting assumptions regarding maximum compressor EER levels based on additional research and confidential input from manufacturers;

• adjusting potable water consumption rates for batch type ice makers subject to a floor that represents the lowest potable water consumption rate that would be expected to flush out dissolved solid reliably;

• adding a design option to allow condenser growth in water-cooled condensers; and

• adding a drain water heat exchanger design option.

These changes have led to new max-tech levels. These levels are compared to the most-efficient levels available on the market in Table IV.18. The levels are also compared with the most-efficient levels available that do not use technologies that DOE screened out in the screening analysis (called ''max available without screened technologies''). Specifically, for batch type ice makers, the differences between these two max available market levels are that the max using analyzed technologies levels do not consider (a) low-thermal-mass evaporators, and (b) tube ice evaporators. The new max-tech levels all exceed the ''max available without screened technologies'' efficiency levels. DOE also notes that this discrepancy only existed for batch units, as DOE did not screen out any continuous unit technologies in its engineering analysis.

DOE considered max-tech and max-available levels as part of its analysis. The max-tech levels for batch and continuous type ice makers are discussed in section IV.D.2.e. In addition to comparing the max-tech, ''most efficient on market'', and the ''max available without screened technologies'' efficiency levels for batch type ice makers. Table IV.18 provides brief explanations for the differences between max-available and max-tech levels. More details regarding the design options that correlate with the different efficiency levels are provided in the NOPR TSD. DOE requests comments on the max-tech levels identified in today's NOPR, the max available and max available without screened technologies levels, and the reasons cited for the max tech/max available differences.

TABLE IV.18—COMPARISON OF LEVELS FOR BATCH AUTOMATIC COMMERCIAL ICE MAKERS

Equipment class	Max-tech level	Max-available without screened technologies (%)	Max-available (%)	Reason for gap between max-available and max available without screened technologies
IMH–W–Small–B	30%	22.0	24.5	Proprietary technology.
IMH–W–Med–B	22%	15.7	22.4	Proprietary technology.
IMH–W–Large–B	16% (at 2,600 lb ice/24 hours)	8.3	22.5	Proprietary technology and utility issues.
IMH–A–Small–B	33%	23.6	23.6	No gap.
IMH–A–Large–B	33% (at 800 lb ice/24 hours) 21% (at 1,500 lb ice/24 hours)	20.7	21.3	proprietary technology.
RCU–NRC–Small–B	Not analyzed	24.6	24.6	No gap.
RCU–NRC–Large–B	21% (at 1,500 lb ice/24 hours) 21% (at 2,400 lb ice/24 hours)	15.7	40.2	Proprietary technology and utility issues.
RCU–RC–Small–B	Not directly analyzed	19.0	19.0	No gap.
RCU–RC–Large–B	Not directly analyzed	15.1	15.1	No gap.
SCU–W–Small–B	Not directly analyzed	22.2	22.5	Proprietary technology.
SCU–W–Large–B	35%	27.6	32.9	Proprietary technology.
SCU–A–Small–B	41%	27.4	35.8	Proprietary technology.
SCU–A–Large–B	36%	29.6	33.4	Proprietary technology.

Baseline Efficiency Levels for Currently Unregulated Ice Makers

For continuous and high-capacity batch type ice makers, AHRI recommended that DOE derive its baseline efficiency levels from machines that are currently on the market, for which AHRI's new directory of certified products could be a useful information source. AHRI cautioned, however, that its certification program was new and that it expected the data to change after completion of its 2012 test program. (AHRI, No. 49 at p. 3)

Manitowoc asserted that, while EPACT 2005 is the correct baseline efficiency level for batch equipment, continuous type ice machines do not have sufficient history under any alternative certification programs and therefore require careful review and analysis by DOE prior to setting efficiency levels. (Manitowoc, No. 54 at p. 3)

Hoshizaki asserted that DOE should not use Canadian levels for continuous type ice makers and instead suggested that DOE use efficiency levels developed for machines that are currently on the market. (Hoshizaki, No. 53 at p. 1)

In the preliminary analysis, DOE proposed a set of equations to represent baseline efficiency levels for the 12 continuous equipment classes. 77 FR 3404 (Jan. 24, 2012). The equations were developed based on publicly available information of continuous type ice maker energy use for products on the market. As there was no source of ice quality data for most of these products to allow calculation of the energy use consistent with the new test procedure, which calls for adjustment of the rating to account for ice hardness, DOE made these adjustments using ice hardness equal to 0.85 for nugget ice makers and 0.8 for flake ice makers. Further details of this analysis are available in the preliminary analysis TSD.

DOE revised its development of continuous type ice maker efficiency levels for the NOPR, based on data for continuous type ice machines that was available on the AHRI database Web site as of October 11, 2012. The database now contains ratings for ice quality, which DOE incorporated into its analysis. DOE's analyses consider higher max tech levels than the max available levels, as represented by the AHRI data, because the analysis considers use of design options, such as higher efficiency permanent magnet motors, which are not used in the majority of existing ice makers. DOE's continuous baseline levels for the NOPR analysis are presented in Table IV.11.

DOE has taken advantage of the new information for continuous type ice makers that has become available on the AHRI Web site to support its selection of efficiency levels for these equipment classes.

General Methodology

Howe asked that DOE further clarify the methodology it used to establish efficiency and technology levels, especially for equipment classes in which there are few models available. Howe also asked whether DOE considered the refrigerating conditions used to produce ice or the typical efficiency levels associated with the refrigeration system. (Howe, No. 51 at p. 3)

DOE does not have sufficient resources to thoroughly analyze all equipment classes. Hence, the analyses for some classes are used to represent other classes. The analysis prioritized those classes for which shipments and the number of models available are high. The energy model used to support the analysis, which is described in the NOPR TSD, considers the refrigerating conditions used to produce ice and the capacity and power input of the equipment's refrigerant compressors when operating at these conditions.

3. Design Options

After conducting the screening analysis and removing from consideration the technologies described above, DOE included the remaining technologies as design options in the NOPR engineering analysis. These technologies are listed in Table IV.19, with indication of the equipment classes to which they apply.

Table IV.19 Design Options by Equipment Class

Ice Maker Type	Equipment Class	Compressor Upgrade	Condenser Fan Motors	Pump Motors	Auger Motors	Larger Air-Cooled Condensers	Larger Water-Cooled Condensers	Batch Fill	Larger Evaporators	Drainwater Heat Exchanger
Batch	IMH-W-B	√		√			√	√	√	√
	IMH-A-B	√	√	√		√		√	√	√
	RCU-B	√	√	√		√		√	√	√
	SCU-W-B	√		√			√	√	√	√
	SCU-A-B	√	√	√		√		√	√	√
Continuous	IMH-W-C	Not Analyzed								
	IMH-A-C	√	√		√	√			√	
	RCU-C	Not Analyzed								
	SCU-W-C	Not Analyzed								
	SCU-A-C	√	√		√	√			√	

a. Improved Condenser Performance in Batch Equipment

During the preliminary analysis, DOE considered size increase for the condenser to reduce condensing temperature and compressor power input. DOE requested comment on use of this design option and on the difficulty of implementing it in ice makers with size constraints.

AHRI commented that most condensers are already optimized and occasionally oversized; therefore, further increasing condenser area would not have any efficiency benefits and could instead necessitate increased cabinet size. (AHRI, No. 49 at p. 2)

Manitowoc commented that the outdoor condensers of RCUs can more easily accommodate size increases than the condensers incorporated into IMH equipment. However, Manitowoc also noted that increasing the size of the condenser coil in order to improve efficiency would necessitate an increased level of refrigerant. Manitowoc stated that this could require the installation of a larger receiver in the ice-making head, which may be difficult due to size constraints. (Manitowoc, Public Meeting Transcript, No. 42 at p. 59)

Manitowoc added that increasing the size of the condenser while maintaining a constant evaporator size can also interfere with the ability of the ice machine to properly make ice over the full range of ambient conditions. Manitowoc stated that DOE's analysis is only concerned with performance at 90 °F air/70 °F water testing conditions, but that real ice makers have to work in air temperatures ranging from 50 to 110 °F and water temperatures from 40 to 90 °F. As air temperature drops, Manitowoc stated, unless special refrigerant management devices are employed, a larger condenser will be forced to store more refrigerant at a lower temperature. This will prevent batch type ice machines from being able to harvest ice at low ambient temperatures, according to Manitowoc. (Manitowoc, No. 54 at p. 2) Similarly, Scotsman commented that increasing the efficiency of the freeze cycle will lengthen the harvest process and minimize overall energy savings. (Scotsman, Public Meeting Transcript, No. 42 at pp. 59–60) Scotsman asserted that DOE's analysis of condenser surface area must include this impact on the batch harvest cycle. (Scotsman, No. 46 at p. 3)

Hoshizaki commented that manufacturers would need more time to evaluate the implications of using larger water-cooled condensers on a closed-loop system. Although larger condensers would increase the efficiency of heat transfer, Hoshizaki opined that this benefit must be compared with the increased final cost to the consumer as well as the potential need to increase cabinet size. (Hoshizaki, No. 53 at p. 2)

In response to Manitowoc's written comments, DOE has considered data obtained through testing of water-cooled units, as well as data provided by manufacturers on expected efficiency increases versus condenser growths.

DOE notes that the key concerns expressed in Hoshizaki's comment relate to the potential need to increase cabinet size and the concern about whether the larger condenser (and perhaps cabinet) is cost-justified. As discussed in section IV.C.d, DOE has considered a modest size increase for the ice-making head for some ice maker equipment classes. Answering the question of whether condenser size increase within these modest allowances for cabinet size increase is cost-effective is a key goal of the DOE analyses—the potential that the approach is not cost-effective is not a relevant argument for screening out this technology.

In response to Scotsman and Manitowoc's written comments, DOE conducted testing to assess the correlation of batch type ice maker efficiency level with condensing temperature and has used this information, which accounts for the increase in harvest energy use associated with lower condensing temperature, to adjust its analyses. DOE tested a water-cooled batch unit using different water-flow settings; the results are shown in Table IV.20. DOE notes that these test results indicate that there are energy benefits from increasing condenser area, even though harvest cycle energy use increases. The results show that the increase in harvest cycle energy use represents a loss of 15 percent of the gain that would have been achieved if harvest energy use had not increased. DOE used these test results to adjust the modeled harvest energy when condenser improvement such as size increase was applied as a design option. These analyses are described in chapter 5 of the NOPR TSD.

TABLE IV.20—CONDENSER WATER TEST RESULTS

Test attribute	Test setting 1 (factory-setting)	Test setting 2	Test setting 3
Condensing Temperature °F	97	107	111
Ice Harvest Rate lb ice/24 hours	375	361	355
Energy Consumption kWh/100 lb ice	4.67	5.13	5.28
Average Harvest Time (s)	104	81	73
Average Harvest Energy Wh	21.2	17.9	17.0
Average Harvest Energy per Ice kWh/100 lb	0.53	0.44	0.42
Percent of Savings Lost due to Harvest Energy Increase	15%	12%	N/A

DOE inspected baseline and high-efficiency units, including condenser sizes typical of each. For equipment classes for which DOE inspected high-efficiency units, DOE considered maximum condenser sizes consistent with the inspected units. For equipment classes where DOE did not have such information, DOE considered maximum condenser sizes consistent with the range of chassis sizes of commercially available equipment of the given class and harvest capacity. DOE notes that none of the evaluated IMH or SCU equipment has receivers, thus indicating that they would not be needed for the range of condenser sizes DOE considered in its analysis for these equipment classes. DOE also considered whether a larger remote condenser would require installation of a larger receiver, and talked with receiver manufacturers about receiver sizing. DOE did not seek to increase receiver sizes for any of the models analyzed.

In response to comments by AHRI and Manitowoc, DOE studied the condensing temperatures of tested units to set limits for available efficiency improvement. DOE in its analyses considered only condenser changes that resulted in condensing temperatures within the range of those observed in the tested ice makers for comparable equipment classes (for instance DOE used different minimum condensing temperatures for air-cooled and water-cooled equipment). These analyses are described in chapter 5 of the NOPR TSD.

b. Harvest Capacity Oversizing

NPCC noted that many ice makers may be oversized for their particular applications, suggesting that there would be little compromise of customer utility if the capacity available for a given ice maker chassis size decreased as a result of design changes that increased their efficiency. (NPCC, Public Meeting Transcript, No. 42 at pp. 60–61)

Manitowoc countered that its customers are very aware of how much ice they need and that they consequently size machines for peak demand days, rather than average use. Manitowoc added that it is very important that customers not shut down on days with high demand, such as the 4th of July. (Manitowoc, Public Meeting Transcript, No. 42 at p. 63)

DOE did not investigate potential down-sizing of equipment, instead relying on information regarding commercially available units as the basis for consideration of what sizes are acceptable for given capacity levels.

c. Open-Loop Condensing Water Designs

Open-loop cooling systems use condenser cooling water only once before disposing of it, whereas closed-loop (single-pass) systems repeatedly recirculate cooling water. In closed loops, the water is cooled in a cooling tower and recirculated to accept heat from the automatic commercial ice maker condenser again. Alternatively, the water passes through another heat exchanger where the heat is removed and used in another piece of equipment, such as a space or water heater, before cycling back to the ice maker condenser. Although some condenser water may still be lost to evaporation in cooling towers, closed-loop systems still have negligible condenser water disposal or consumption compared to open-loop systems.

The Alliance expressed strong opposition to open-loop condenser water cooling for automatic commercial ice makers, arguing that such technology is obsolete and excessively wastes water and energy. The Alliance noted that more energy-efficient technologies such as air cooling, remote condensing, and closed-loop water-cooling systems have made single-pass water cooling unnecessary. Therefore, the Alliance urged DOE to disallow all ice makers that can be installed and operated with a single-pass cooling system. (Alliance, No. 45 at pp. 3–4)

DOE recognizes that open-loop water-cooling systems use significantly more water than other condenser cooling technologies. However, DOE determined after the Framework public meeting that its rulemaking authority extends only to the manufacturing of equipment and not to the installation or usage of equipment. Thus, DOE has no authority to mandate that dual-use water-cooled machines (those that can be used in either closed-loop or open-loop configurations) be used with closed-loop systems. Furthermore, DOE is not aware of any potential design requirements it could impose that would effectively prohibit open-loop cooling systems for water-cooled ice makers. Even if a design requirement could be effective in this regard, DOE can only adopt either a prescriptive design requirement or a performance standard for commercial equipment. (42 U.S.C. 6311(18)) The focus of this rulemaking is an equipment performance standard. Due to the nature of this rulemaking, DOE is not considering any prescriptive design requirements, and open-loop cooling systems therefore remain a viable option for manufacturers of water-cooled ice makers who want to reduce their water consumption.

d. Condenser Water Flow

EPACT 2005 prescribes maximum condenser water use levels for water-cooled cube type automatic commercial ice makers. (42 U.S.C. 6313(d)) [34] For units not currently covered by the standard (continuous machines of all harvest rates and batch machines with harvest rates exceeding 2,500 lb ice/24 hours), there currently are no limits on condenser water use.

In this rulemaking, DOE considered using higher condenser water flow rates as a design option for water-cooled ice makers.

In chapter 2 of the preliminary TSD, DOE indicated that the ice maker standards primarily focus on energy use, and that DOE is not bound by EPCA to comprehensively evaluate and propose reductions in the maximum condenser water consumption levels, and likewise has the option to allow increases in condenser water use, if this is a cost-effective way to improve energy efficiency.

DOE did not analyze potential changes in condenser water use standards during the preliminary analysis. However, it did propose an approach for balancing energy use and condenser water use in the engineering analysis in a way that maintains the rulemaking's focus on energy use reduction while appropriately considering the cost implications of changing condenser water use. DOE proposed using appropriate representative values for water and energy costs, product lifetime, and discount rates to calculate a representative LCC for baseline and modified design configurations as part of the engineering analysis. In this way, the engineering analysis would develop a relationship between energy efficiency and manufacturing cost as is customary in engineering analyses (*i.e.,* the cost-efficiency curves), but the ordering of different design configurations in this curve would be based on minimizing the representative LCC calculated for the candidate design configurations at each successive efficiency level. Using this proposed analytical approach, an energy-saving increase in condenser water use would be expected to be cost-effective when the remaining design options, which do not change water use, have greater LCC increases than the option of increasing condenser water use. This approach would avoid the complexity of developing several cost curves representing multiple condenser water use levels and determining in the downstream analyses the efficiency levels at which increasing condenser water use would be appropriate. During the preliminary analysis, DOE requested comment on this approach for addressing condenser water use.

AHRI commented that water-cooled ice makers are already efficient products and that reducing condenser water consumption could significantly increase their energy use. AHRI and Scotsman both cautioned that DOE must consider the impact that lower condensing temperatures could have on the harvest rate of batch type ice makers and ensure that product utility is not diminished by implementing new condenser water use standards. (AHRI, No. 49 at p. 4; Scotsman, Public Meeting Transcript, No. 42 at p. 70)

In the public meeting discussions, Manitowoc suggested that DOE consider decreasing the allowable condenser water use, which could be a more economical approach if water costs increase. (Manitowoc, Public Meeting Transcript, No. 42 at pp. 70–72) However, Manitowoc also noted in its written comments that condenser water use is carefully managed to ensure that ice makers can harvest ice under worst-case conditions and maintain water velocities within specified limits in order to avoid erosion. Manitowoc expressed doubt about the ability of DOE's energy model to accurately predict the effects of these variables, and for this reason, Manitowoc strongly discouraged introducing condenser water use standards. (Manitowoc, No. 54 at pp. 3–4)

DOE stated that EPCA's anti-backsliding provision in section 325(o)(1), which lists specific products for which DOE is forbidden from prescribing amended standards that increase the maximum allowable water use, does not include ice makers. However, Earthjustice asserted that DOE lacks the authority to relax condenser water limits for water-cooled ice makers. Earthjustice argued that the failure of section 325(o)(1) to specifically call out ice maker condenser water use as a metric that is subject to the statute's prohibition against the relaxation of a standard is not determinative. On the contrary, Earthjustice maintained that the plain language of EPCA shows that Congress intended to apply the anti-backsliding provision to ice makers. Earthjustice commented that section 342(d)(4) requires DOE to adopt standards for ice-makers ''at the maximum level that is technically feasible and economically justified, as provided in [section 325(o) and (p)].'' (42 U.S.C. 6313(d)(4)) Earthjustice stated that, by referencing all of section 325(o), the statute pulls in each of the distinct provisions of that subsection, including, among other things, the anti-backsliding provision, the statutory factors governing economic justification, and the prohibition on adopting a standard that eliminates certain performance characteristics. By applying all of section 325(o) to ice-makers, section 342(d)(4) had already made the anti-backsliding provision applicable to condenser water use, according to Earthjustice. Finally, Earthjustice stated that even if DOE concludes that the plain language of EPCA is not clear on this point, the only reasonable interpretation is that Congress did not intend to grant DOE the authority to relax the condenser water use standards for ice makers. Earthjustice added that the anti-backsliding provision is one of EPCA's most powerful tools to improve the energy and water efficiency of appliances and commercial equipment, and Congress would presumably speak clearly if it intended to withhold its application to a specific product. (Earthjustice, No. 47 at pp. 4–5)

Scotsman commented that balancing condenser water use with energy use was a reasonable analytical approach. (Scotsman, No. 46 at p. 3) Scotsman added that including condenser water usage in the overall energy use of a machine would also impact continuous type ice machines by affecting ice hardness. (Scotsman, Public Meeting Transcript, No. 42 at p. 70)

The Alliance argued that water use and energy use cannot be compared on a simple price basis because of key differences between the two resources. While energy comes from multiple sources and is a commodity whose prices fluctuate based on supply and demand, fresh water is in limited supply, the Alliance stated. Hence, water prices are heavily regulated and based on the cost of treatment and delivery, which is less directly affected by supply and demand, according to the Alliance. Therefore, the Alliance recommended that DOE consider the marginal costs of alternative water sources, such as desalination, in its analyses to properly account for all

[34] The table in 42 U.S.C. 6313(d)(1) states maximum energy and condenser water usage limits for cube-type ice machines producing between 50 and 2,500 lb of ice per 24 hour period (lb ice/24 hours). A footnote to the table states explicitly the water limits are for water used in the condenser and not potable water used to make ice.

water costs as applied to water-cooled condensers. (Alliance, No. 45 at p. 4)

In response to Earthjustice's comment, DOE maintains its position from the preliminary analysis that the anti-backsliding provision of EPCA (42 U.S.C. 6313(d)(4)) does not apply to condenser water use in batch-type automatic commercial ice makers. While EPCA's anti-backsliding provision (42 U.S.C. 6295(o)) applies to consumer products, 42 U.S.C. 6313(d)(4) makes the backsliding provision applicable to automatic commercial ice makers. However, 42 U.S.C. Sec. 6295(o)(1) anti-backsliding provisions apply to water in only a limited set of residential appliances and fixtures. Under 42 U.S.C. Sec. 6295(o)(1), ''the Secretary may not prescribe any amended standard which increases the maximum allowable energy use, or, in the case of showerheads, faucets, water closets, or urinals, water use, or decreases the minimum required energy efficiency, of a covered product.'' This provision links automatic commercial ice makers to the energy efficiency anti-backsliding provision as a covered product, and does not include automatic commercial ice makers among the products covered by the water efficiency anti-backsliding provision. Thus, this section of EPCA prohibits DOE from amending any standard in such a way as to decrease minimum energy efficiency for any covered automatic commercial ice maker equipment class. It does not, however, prohibit an increase in water use in any products other than those enumerated in the statute, and nothing in 6313(d)(4) expands the specific list of equipment or appliances to which the water anti-backsliding applies. Therefore, an increase in condenser water use would not be considered backsliding under the statute. Nevertheless, the proposals do not include increases in condenser water use.

Noting that condenser water standards are already in place for batch type ice makers, DOE has decided to consider an increase in condenser water use as a design option to improve energy efficiency for all water-cooled ice makers. Acknowledging the concerns of stakeholders such as AHRI, Manitowoc, and Scotsman, DOE recognizes that such an approach must consider the cost-effectiveness of this design option based on the end-user's water cost. DOE does not believe that the contemplated changes would diminish product utility, because an increase in the maximum allowed condenser water use would increase the flexibility of manufacturers to meet the condenser water use standard. Manufacturers would obviously not be required to increase condenser water use, especially if such a design decision would negatively impact the energy use or harvest rate of their ice makers.

In response to Manitowoc's observation that water velocities must be maintained within specified limits in order to avoid erosion, DOE conducted an analysis to determine whether current levels of water use in water-cooled condensers are close to exceeding these limits. DOE has learned from manufacturers of water-cooled condensers that water flow rates generally should not exceed 3.5 gallons per minute per nominal ton of condenser cooling capacity (gpm per ton).[35] DOE's analysis of test data for batch machines shows that the maximum condenser water flow rate occurs shortly after harvest, and that there is some room for increase of condenser water flow rate with the 3.5 gpm per ton limit. DOE considered some increase of condenser water flow for batch type units that did not already operate at this limit at the start of the freeze cycle. Unlike batch type ice makers, whose condenser loads spike shortly after the harvest cycle, continuous type ice makers typically operate in steady-state. DOE's testing shows that flow rates in continuous type ice makers are therefore far from the maximum levels recommended to prevent erosion. However, DOE notes that it did not perform direct analysis on any water-cooled continuous equipment classes.

As the manufacturers and AHRI point out, DOE must be careful in the analysis of condenser water to ensure that the complex relationship between condenser water and machine energy usage are modeled correctly. However, balancing energy use and condenser water use following the approach outlined above greatly simplifies an otherwise highly complex, three-dimensional analysis of design options, condenser water use levels, and efficiency. This analysis approach helped DOE determine whether increasing condenser water limits could cost-effectively save electricity.

DOE tested three water-cooled ice makers with varying condensing water flow to evaluate the potential for energy savings and the cost-effectiveness of using this approach. The results of this evaluation for a batch type ice maker are shown in Table IV.21. The analysis assumed that in the field half of the ice makers would be used in open systems and half in closed-loop systems, which significantly reduce water flow, as documented in chapter 5 of the NOPR TSD.

TABLE IV.21—TEST DATA FOR A WATER-COOLED BATCH UNIT

Condensing Temperature, *°F*	97	107	111
Harvest Capacity, *lb/24 hr*	375	361	355
Energy Consumption, *kWh/100 lb*	4.67	5.13	5.28
LCC Operating Cost, *$/100 lb*	$1.75	$1.38	$1.32
Condenser Water Use, *gal/100 lb*	165.4	106.5	94.1

The analysis shows that increasing condenser water flow is not a cost-effective way to reduce energy use. This was demonstrated also for the two continuous type ice makers that were tested. As a result, DOE did not comprehensively evaluate this approach for all water-cooled equipment classes in its engineering analysis. Additional details are available in chapter 5 of the NOPR TSD.

e. Compressors

Scotsman commented that the high-EER compressors in DOE's analysis may not be feasible for ice makers, particularly batch type ice makers, in which liquid refrigerant can often enter the compressor during the harvest process. Scotsman noted that the design changes used by compressor manufacturers to improve EER can reduce reliability, for instance placing the compressor suction line closer to the suction intake within the shell, which can cause liquid refrigerant to impinge on the suction valve during harvest and rapidly lead to compressor failure.

[35] Personal communication with Piyush Desai at Packless Industries on May 16, 2012.

(Scotsman, No. 46 at p. 5) Manitowoc echoed Scotsman's second point, indicating that a direct suction compressor would allow liquid to enter the compressor cylinder and damage the valve system. (Manitowoc, No. 54 at p. 2)

In response to these comments, DOE consulted with manufacturers regarding which compressors are appropriate for ice makers. DOE removed from its analysis those compressors that manufacturers have indicated are unsuitable for use in ice makers. As part of the NOPR analyses, DOE also considered additional compressors of compressor lines that manufacturers indicated are acceptable. The impact of these changes in the analysis on the predicted potential efficiency improvement associated with use of higher efficiency compressors varied by equipment class. Additional details are available in chapter 5 of the NOPR TSD.

f. Limitations on Available Design Options

Manitowoc commented that the small size of the ice maker industry makes it difficult for ice maker manufacturers to implement new technologies or influence the component (*e.g.,* compressor or motor) suppliers that they depend on for efficiency gains. Manitowoc noted that, compared to other appliance industries, ice maker sales volumes do not drive component suppliers to make design changes, so ice maker manufacturers are limited to those changes that suppliers will implement for larger customers. Furthermore, Manitowoc noted that, rather than being independent appliances, ice makers are typically part of a larger equipment chain for delivering food service products, which places them under physical constraints and causes their technology changes to have broader impacts on the entire food delivery industry. (Manitowoc, Public Meeting Transcript, No. 42 at pp. 14–15)

For the NOPR analyses, DOE has used design options that are commercially available. Many of these technologies are found in ice makers that were inspected, and a few are available from component manufacturers. DOE has taken care to ensure that those design options identified do apply to these products.

- For example, DOE has removed from its analysis any compressors that may potentially interfere with ice maker operation (based on their design).
- DOE has also included an option to increase chassis sizes (in order to grow internal components such as heat exchangers), but limited chassis growth design options to only cover the modest levels suggested by the available equipment offerings

Further information on DOE's analyses is contained in sections IV.D.4.e and IV.D.4.f.

4. Development of the Cost-Efficiency Relationship

In this rulemaking, DOE has adopted a combined efficiency level/design option/reverse engineering approach to developing cost-efficiency curves. To support this effort, DOE developed manufacturing cost models based heavily on reverse engineering of products to develop a baseline MPC. DOE estimated the energy use of different design configurations using an energy model whose input data was based on reverse engineering, automatic commercial ice maker performance ratings, and test data. DOE combined the manufacturing cost and energy modeling to develop cost-efficiency curves for automatic commercial ice maker equipment based on baseline-efficiency equipment selected to represent their equipment classes. Next, DOE derived manufacturer markups using publicly available automatic commercial ice maker industry financial data, in conjunction with manufacturer feedback. The markups were used to convert the MPC-based cost-efficiency curves into MSP-based curves. Details of these analyses developed for the preliminary analysis were presented in the preliminary analysis TSD and in a supplementary data publication posted on the rulemaking Web site.

Stakeholder comments regarding DOE's preliminary engineering analyses addressed the following broad areas:

1. Estimated costs in many cases were lower than manufacturers' actual costs.
2. Estimated efficiency benefits of many modeled design options were greater than the actual benefits, according to manufacturers' experience with equipment development.
3. DOE should validate its energy use model based on comparison with actual equipment test data.
4. DOE should validate its cost-efficiency analysis by investigating the relationship of efficiency with retail prices for ice makers.
5. The incremental costs in the engineering analysis should take into consideration the design, development, and testing costs associated with new designs.

These topics are addressed in greater detail in the sections below.

a. Manufacturing Cost

Manitowoc requested that DOE provide more information on the inputs and methodology behind calculating the MPCs for each efficiency level. (Manitowoc, Public Meeting Transcript, No. 42 at pp. 76–77) Manitowoc, Scotsman, and AHRI all asserted that it is important for DOE to accurately assess the potential incremental costs associated with each efficiency level, since they will drive the decisions in this rulemaking. (Manitowoc, Public Meeting Transcript, No. 42 at pp. 170–171 and No. 54 at p. 1; Scotsman, Public Meeting Transcript, No. 42 at p. 173; AHRI, No. 49 at p. 6)

Regarding the accuracy of DOE's cost model, Manitowoc commented that some of the incremental costs between efficiency levels were incorrect. Manitowoc added that, while it could not provide its bill of materials, it would be willing to give DOE guidance regarding the actual costs of implementing technology design changes at realistic volumes. (Manitowoc, Public Meeting Transcript, No. 42 at pp. 80–81) Scotsman agreed with Manitowoc that the table of incremental costs was optimistic at best and added that changing one component in an ice maker will often require also changing other components, further affecting incremental costs. (Scotsman, Public Meeting Transcript, No. 42 at p. 85)

Specifically, Manitowoc, Scotsman, and AHRI each stated the belief that DOE has underestimated the incremental costs of its proposed design options. (Manitowoc, No. 54 at p. 1; Scotsman, No. 46 at p. 5; AHRI, No. 49 at p. 6) For example, DOE estimated that the incremental cost of using an electronically commutated motor (ECM) in place of a shaded pole motor would be $13, whereas Scotsman's supplier quoted an incremental cost of $35 for this same design option. Scotsman added that, because the ice maker industry is relatively low-volume, ice maker manufacturers face large cost premiums for component technologies. (Scotsman, No. 46 at p. 5) AHRI noted that DOE assumed that an 8 percent increase in compressor efficiency would cost only $9. However, AHRI asserted that most compressors currently used in ice makers are already mechanically optimized and could therefore achieve greater efficiency only by switching to permanent magnet motors, which would cost seven times more than DOE's incremental cost estimate. AHRI cautioned that DOE should not assume that information it derived for other rulemakings is automatically applicable to ice makers. AHRI also opined that DOE drastically underestimated the cost of increasing condenser surface area. (AHRI, No. 49 at p. 2) Finally, Manitowoc commented that DOE's cost estimates for ECM versions of the fan motors and pumps were unrealistically low. (Manitowoc, No. 54 at p. 2)

In response to Manitowoc's first comment, DOE has provided additional information correlating efficiency levels and design options in this NOPR and its accompanying TSD. The TSD details the design option changes and associated costs, calculated for each efficiency level for the equipment analyzed.

In response to the comments by Manitowoc, Scotsman, and AHRI, DOE had received very limited feedback from manufacturers regarding cost estimates to support its preliminary engineering analysis. During the NOPR phase of this rulemaking, DOE emphasized the need to obtain relevant information from stakeholders by extending the comment period by 40 days and welcoming comment on specific details presented in the TSD regarding technology options and costs. Moreover, DOE's contractor again worked directly with manufacturers under non-disclosure agreements in order to obtain additional cost information.

DOE has significantly revised its component cost estimates for the engineering analysis for the NOPR phase based on the additional information obtained, both in discussions with manufacturers and in stakeholder comments. DOE used the detailed feedback that it solicited from manufacturers to update its cost estimates for all ice maker components, significantly increasing its estimates of nearly all of these costs. Additional details on the adjusted component costs are available in chapter 5 of the NOPR TSD.

b. Energy Consumption Model

The energy consumption model calculates the energy consumption of automatic commercial ice makers in kilowatt-hours per 100 lb of ice based on detailed description of equipment design. The DOE analysis for a given equipment class and capacity applied the model for a variety of design configurations representing different performance levels. The analysis starts with a baseline design, subsequently assessing the differing energy consumption for incrementally more-efficient equipment designs that utilize increasing numbers of design options. The results of the energy consumption model are paired with the cost model results to produce the points on the cost-efficiency curves, which correspond to specific equipment configurations. After the publication of the preliminary analysis, DOE received numerous stakeholder comments regarding the methodology and results of the energy consumption model.

Manitowoc and Howe both commented that DOE's models significantly overstated the efficiency gains associated with many of the design options. (Howe, No. 51 at p. 3; Manitowoc, No. 54 at p. 2) As an example, Howe pointed out that using a more efficient fan may not have a significant impact on the overall efficiency of the ice maker, since the fan represents a small fraction of its overall energy use. (Howe, No. 51 at p. 3) Manitowoc added that its own tests on actual ice machines under controlled conditions resulted in lower performance gains than those predicted by the DOE models. (Manitowoc, No. 54 at p. 2)

Manitowoc commented that it would like to have more information on the models used in DOE's engineering analysis. In particular, Manitowoc stated that it would like to learn more about the FREEZE model, since it is difficult to model the process of freezing water into ice and even more difficult to model ice harvesting. Manitowoc noted that this model will drive DOE's estimation of energy efficiency and that it is important for manufacturers to understand the impacts of the model before new standards take effect, especially if new efficiency levels take manufacturers to technology levels far beyond their level of experience. (Manitowoc, Public Meeting Transcript, No. 42 at pp. 171–173)

Manitowoc also commented that the FREEZE model is limited by its inability to model the harvest portion of the batch cycle. Manitowoc stated that, although the harvest portion is shorter in duration than the freeze portion, it represents a significant fraction of energy consumption due to the higher energy input to the compressor and the additional energy required to cool the evaporator after each harvest. Manitowoc added that many changes that improve the freeze operation efficiency, such as increasing condenser area, also reduce harvest operation efficiency. Manitowoc expounded on this example by noting that the increased condenser surface area reduces the design temperature of the refrigerant, which results in lower energy available during the harvest cycle, which in turn results in slower harvest times and an overall increase in energy during the harvest cycle. Manitowoc commented that DOE's FREEZE model is unable to account for such behavior. (Manitowoc, No. 54 at pp. 1–2)

Scotsman and Hoshizaki both commented that the energy model will be incomplete until it has been validated with real test results of different technology design options. (Scotsman, Public Meeting Transcript, No. 42 at pp. 173–174) Hoshizaki asserted that DOE should not use the FREEZE model in the analyses until it has been validated. (Hoshizaki, No. 53 at p. 1)

Scotsman inquired whether DOE intends to validate its cost-efficiency model by implementing these design changes on actual machines and evaluating their subsequent energy performance. (Scotsman, Public Meeting Transcript, No. 42 at pp. 85–86)

In response to comments by Manitowoc, Howe, and Scotsman, DOE has made changes to the energy modeling based on feedback received from the manufacturers under non-disclosure agreements. To address concerns by Manitowoc that the FREEZE model did not adequately model the effects of increased condenser size on the harvesting energy, DOE also performed testing of a water-cooled condenser batch unit, and used the test data to develop a relationship between condensing temperatures and harvest energy. DOE did note that lower condensing temperatures did result in lower overall energy consumption, but higher harvest energy consumption.

TABLE IV.22—TEST DATA FOR A WATER-COOLED BATCH UNIT

Test level	Units	1	2	3
Condenser Temperature	°F	97.36	107.47	111.36
Ice Harvest	lb/24 hr	375	361	355
Overall Energy Consumption	kWh/100 lb	4.67	5.13	5.28
Average Harvest Energy Consumption	Wh	21.21	17.86	17.03
LCC Operating Cost	$/100 lb	$1.75	$1.38	$1.32
Condenser Water Use	gal/100 lb	165.4	106.5	94.1

Further information on DOE's engineering analysis and energy model adjustments is contained in sections IV.D.4.e and IV.D.4.f.

c. Retail Cost Review

AHRI and Hoshizaki both questioned the accuracy of DOE's incremental cost-efficiency analysis. AHRI and Hoshizaki recommended that DOE validate it by comparing its results with actual retail prices. (AHRI, Public Meeting Transcript, No. 42 at pp. 78–80, 82–83, 174–175, and No. 49 at p. 6; Hoshizaki, Public Meeting Transcript, No. 42 at p. 84 and No. 53 at p. 1).

In response to AHRI's and Hoshizaki's request for cost validation, DOE prepared a price analysis for automatic commercial ice makers to evaluate the correlation of price with higher ice maker efficiency. DOE collected list price information from publicly available automatic commercial ice maker manufacturer price sheets for 470 ice makers. DOE collected other information relevant to the analysis appropriate sources, including equipment dimensions, harvest capacity, ENERGY STAR qualification, and energy use. For equipment classes for which there were data available for more than 20 ice makers, price and ice harvest rate were shown to have a strong linear correlation, with R-squared values ranging from 0.63 to 0.84. This result indicates that customers pay more for higher-capacity ice makers.

While an initial evaluation of price trends with efficiency suggested that prices are higher for higher efficiency ice makers, subsequent analysis suggests that this trend can be attributed to the trend for reduction in energy use for higher harvest capacity and the aforementioned relationship between price and harvest capacity. For the equipment classes for which there were sufficient ice makers to analyze, DOE determined the best-fit linear relationship predicting price as a function of ice harvest rate. DOE then evaluated the relationship between each ice maker's price differential (*i.e.,* the difference between its price and the best-fit linear function), expressed as a percentage of the predicted price, with the ice maker's energy consumption rate (in kWh/100 lb ice), developing best-fit linear relationships for these trends. DOE noted that the linear relationships showed either no growth or very small growth in price as energy consumption increased. These results indicate that there is no correlation between higher efficiency and higher retail prices for ice machines. However, DOE did not conclude, based on this analysis, that there would be no costs associated with improving equipment efficiency—rather, it concluded that retail prices are not a reliable indicator of these costs. Additional information on this analysis can be found in chapter 3 of the NOPR TSD.

d. Design, Development, and Testing Costs

Hoshizaki commented that DOE's incremental cost-efficiency analysis must include all aspects of design changes, including the additional design time, testing, and increased labor, when calculating incremental costs. Hoshizaki added that manufacturers could help DOE by reviewing the actual costs associated with redesigning their machines to meet the 2010 DOE energy standards as well as ENERGY STAR standards. Hoshizaki expressed its willingness to collaborate with DOE and AHRI. (Hoshizaki, No. 53 at p. 3)

DOE incorporates the cost of additional design time, testing, labor, and tooling into its manufacturer impacts analysis, as described in section IV.J. During the NOPR analyses, DOE and its contractors contacted manufacturers and obtained related costs under non-disclosure agreements. More information on these analyses is available in section IV.J.

e. Empirical-Based Analysis

In response to comments from Scotsman and Hoshizaki about the validity of the energy model, DOE investigated using an empirical efficiency level approach for the engineering analysis rather than the approach combining energy modeling and manufacturing cost modeling that was used in the preliminary analysis. DOE performed this analysis for eight batch equipment classes and three continuous equipment classes. The alternative approach was to develop the cost-efficiency curves based on rated or tested automatic commercial ice makers energy use levels and costs estimated using the manufacturing cost model with updates from manufacturer discussions, as described in section IV.D.4.a. To support the empirical analysis, DOE purchased and tested 20 additional ice makers, giving DOE a total of 39 ice makers for evaluation.

Table IV.23 shows the resulting costs for equipment classes that were analyzed using the empirical approach and the energy modeling approach. The incremental cost of reaching a 15 percent below baseline efficiency level is listed below. In 7 out of 9 equipment classes, the energy modeling approach result was far more conservative (*i.e.,* resulted in higher incremental cost estimates) than the empirical approach result; DOE estimated a negative cost-efficiency relationship in five of these cases for the empirical approach.

TABLE IV.23—COMPARISON OF NOPR AND EMPIRICAL ANALYSIS APPROACHES AT THE 15% EFFICIENCY LEVEL

	15% EL Incremental cost from empirical approach	15% E ncremental cost from NOPR (energy modeling)
IMH–A–Small–B	$4.88	$45.00
IMH–A–Large–B	(32.32)	39.00
IMH–W–Small–B	(102.62)	37.00
IMH–W–Medium–B	(543.66)	53.00
RCU–NRC–Small–B	4.70	* NA
RCU–NRC–Large–B	166.03	198.00
SCU–A–Large–B	(106.45)	40.00
SCU–A–Small–B	47.41	32.00
IMH–A–C	74.60	46.00
RCU–NRC–C	(354.91)	* NA
SCU–A–C	(244.80)	28.00

* The NOPR analysis did not directly analyze this equipment class.

DOE compared the results of the empirical analysis and the results of the energy modeling, and concluded that the energy modeling results provided a better and more consistent forecast in the ability of manufacturers to reach certain efficiency levels. While the analyses rigorously account for the cost differences in key components that affect energy use, the costs to achieve higher efficiency levels range from higher than the NOPR estimates to very low to negative. DOE is concerned that, while the calculated cost differences may accurately reflect actual cost differences between the chosen pairs of models, the results may be very dependent on the details associated with the specific model selections, and may vary depending on the units that are selected. DOE's empirical analysis does indicate that the energy modeling approach does not underestimate the cost-efficiency steps required to reach higher efficiencies. DOE believes that careful calibration of the energy model combined with reassessment of the cost model can result in accurate cost-efficiency curves.

Thus, DOE decided to proceed with the energy modeling approach as the main basis for the engineering analysis. DOE has addressed many of the stakeholder comments as it updated the energy modeling analysis. The details of the energy modeling approach are described in the next section, section IV.D.4.f.

Additional details and results of the empirical analysis are available in chapter 5 of the NOPR TSD. DOE believes that the results of the empirical analyses support the results of DOE's design option analysis.

f. Revision of Preliminary Engineering Analysis

After investigation of and rejection of an empirical efficiency level analysis approach, DOE instead developed the NOPR engineering analysis by updating the preliminary engineering analysis. This included making adjustments to the manufacturing cost model as described in section IV.D.4.a. It also included adjustments to energy modeling.

The design options considered in the analysis changed, as the discussion of the updated screening analysis details in section IV.C.

DOE also made several changes to the FREEZE energy model used to estimate energy use of different ice maker design configurations. To address the concerns raised by Manitowoc and Howe, DOE adjusted its energy models based on input received in manufacturers' public and confidential comments and discussions DOE's contractor conducted under non-disclosure agreements. These changes included:

- Adjustment of the compressor coefficients for batch type ice makers;
- using data from tests of ice makers to model the increase of harvest energy as condensing temperature decreases for batch type ice makers;
- developing an approach based on test data to determine the condensing temperature reductions associated with use of larger water-cooled condensers;
- limiting adjustments to the potable water use of batch products to a minimum of 20 gallons per 100 lb (or the starting potable water use level, if lower)
- incorporating energy use reduction for drain water heat exchangers used in batch equipment.

Finally, for the max-tech design options that extended beyond what was typically found in commercially available products (such as permanent magnet motors and drain water heat exchangers) that could not be calibrated against existing units, DOE relied on testing and literature to properly account for the energy savings of these units.

For drain water heat exchangers, DOE performed testing of a batch type ice maker with a commercially available drain water heat exchanger, and used the test results to calibrate the energy savings obtained from this technology for each equipment class where it was applied.

DOE used motor efficiency ratings discussed in the preliminary analysis and verified with stakeholders to scale the motor use of each component using permanent magnet motors. During the NOPR analyses, DOE's energy model was calibrated to properly account for the energy consumption of each component, and for energy reductions resulting in jumps to PSC technologies. Increases in the efficiency of the motor components can then be expressed as reductions in the energy consumption of these components.

DOE calibrated the efficiency gains calculated by the energy model against the design options and test results gathered during the empirical analysis investigation. DOE used this comparison to determine the suite of design options that should be found at the appropriate high-efficiency level, and calibrated the results of the energy against the inspected results.

For example, DOE inspected a pair of IMH–A–Small–B automatic commercial ice makers with measured efficiency levels of 2.2 percent below baseline and 17.5 percent below baseline, and noted the following changes between units:

- Increases in both the evaporator face area and condenser volume, and an increase in the chassis size to accommodate these growths,
- an increase in condenser fan size and a change from an SPM motor to a PSC motor, and
- an increase in compressor EER.

In the energy model, DOE separated out each of the different design options and considered separately, ordering them in order of cost-efficiency. For this equipment class, DOE had the following design options to increase efficiency from baseline to 23.5 percent below baseline, as shown in Table IV.24.

TABLE IV.24—IMH–A–SMALL–B DESIGN OPTIONS

% Below baseline	Design option
0.00	Baseline.
6.22	Increase compressor EER from 4.86 EER to 5.25 EER.
7.71	Increase condenser width (no chassis size increase).
20.52	Increase Evaporator Area (with chassis size increase).
23.51	Switch to PSC Condenser Fan Motor.

In some instances, DOE considered slightly different design options, especially when DOE's analysis found that more efficient compressor options were available. For example, the maximum compressor EER used in the energy modeling analysis was more efficient than the inspected unit compressor EER. This is the reason this suite of design options reaches higher efficiencies. DOE did not consider chassis sizes larger than those available on the market.

DOE believes that these changes help ensure that the energy model results accurately reflect technology behavior in the market. Further details on the analyses are available in chapter 5 of the NOPR TSD.

E. Markups Analysis

DOE applies multipliers called ''markups'' to the MSP to calculate the customer purchase price of the analyzed equipment. These markups are in addition to the manufacturer markup (discussed in section IV.D.4) and are intended to reflect the cost and profit margins associated with the distribution and sales of the equipment between the manufacturer and customer. DOE identified three major distribution channels for automatic commercial ice makers, and markup values were calculated for each distribution channel based on industry financial data. Table IV.25 shows the three distribution channels and the percentage of the shipments each is assumed to reflect. The overall markup values were then calculated by weighted-averaging the individual markups with market share values of the distribution channels. See chapter 6 of the NOPR TSD for more details on DOE's methodology for markups analysis.

TABLE IV.25—DISTRIBUTION CHANNEL MARKET SHARES

Analysis phase	National account channel: Manufacturer direct to customer (1-party) (%)	Wholesaler channel: Manufacturer to distributor to customer (2-party) (%)	Contractor channel: Contractor purchase from distributor for installation (3-party) (%)
Preliminary Analysis	6	32	62
NOPR	0	38	62

In general, DOE has found that markup values vary over a wide range based on general economic outlook, manufacturer brand value, inventory levels, manufacturer rebates to distributors based on sales volume, newer versions of the same equipment model introduced into the market by the manufacturers, and availability of cheaper or more technologically advanced alternatives. Based on market data, DOE divided distributor costs into (1) direct cost of equipment sales; (2) labor expenses; (3) occupancy expenses; (4) other operating expenses (such as depreciation, advertising, and insurance); and (5) profit. DOE assumed that, for higher efficiency equipment only, the ''other operating costs'' and ''profit'' scale with MSP, while the remaining costs stay constant irrespective of equipment efficiency level. Thus, DOE applied a baseline markup through which all estimated distribution costs are collected as part of the total baseline equipment cost, and the baseline markups were applied as multipliers only to the baseline MSP. Incremental markups were applied as multipliers only to the MSP increments (of higher efficiency equipment compared to baseline) and not to the entire MSP. Taken together the two markups are consistent with economic behavior in a competitive market—the participants are only able to recover costs and a reasonable profit level.

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

AHRI stated that equipment markups often result in retail prices that are lower than what is observed in the market place, and stated that DOE should supplement its analysis with a survey or retail sale prices. (AHRI, No. 49 at pp. 4–5) Scotsman suggested reviewing equipment pricing on the internet because many ice makers are available online. (Scotsman, No. 46 at p. 5)

Scotsman stated that the national account chain is not accurate. Scotsman commented that the national account distribution chain resembles the wholesaler distribution chain, because an equipment supplier is part of the process. The supplier may contract directly with the customer but equipment still goes through another party, according to Scotsman. (Scotsman, No. 42 at p. 97) Manitowoc agreed with Scotsman that the national accounts chain is misrepresented, and actually includes a third party to do installation, repair, and maintenance. (Manitowoc, No. 42 at pp. 99–100)

Manitowoc stated that mechanical contractors are typically not part of the distribution chain. Manitowoc indicated dealers may in fact provide those services, but the model is a little different from the model presented. (Manitowoc, No. 42 at p. 102–3)

Hoshizaki agreed with the analysis of distribution channels. (Hoshizaki, No. 53 at p. 2) Manitowoc suggested another distribution channel exists: rather than a sale to an end-user, the dealer leases it to the customer. (Manitowoc, No. 42 at p. 98) Manitowoc was of the opinion that whether the equipment was sold or leased to the customer, the end result would be that the ultimate equipment price would not be affected. (Manitowoc, No. 42 at p. 99)

Manitowoc questioned the basic methodology of using a base and incremental markup. Manitowoc stated that if it changed a product, it would expect the same gross margin on the incremental cost as on the base. (Manitowoc, No. 42 at p. 104) Manitowoc stated that entities in the distribution chain take the manufacturer's list price and add a markup. Manitowoc stated that by using the incremental markup, DOE is understating the impact in the market place of adding additional costs to raise the efficiency level, and that is not what happens in the market, according to Manitowoc. (Manitowoc, No. 42 at p. 105) Manitowoc stated that the incremental markup should be the same as the baseline markup and that it would be unreasonable to expect that vendors would earn a lower margin on additional costs associated with complying by the increased minimum efficiency regulations. (Manitowoc, No. 54 at p. 3)

With regard to the AHRI, Scotsman, and Manitowoc comments related to retail prices surveys or studies to determine if DOE was underestimating prices, DOE performed a market price survey, reported earlier in the engineering section IV.D.4.c. Previously DOE has not performed retail price surveys, believing that scatter in the data—particularly when internet and non-internet prices are co-mingled—would cause surveys to provide data of poor value or usefulness. The results of the retail price survey performed for the engineering analysis supports this belief.

With regard to the comment that mechanical contractors are typically not part of the distribution chain, DOE is using mechanical contractor cost information to model a three-party distribution channel. Available Census Bureau data as well as comments received at the Framework public meeting indicates that a three-party distribution channel is common. At present the mechanical contractor cost data is the best information available for quantifying the local contractor portion of the three-party channel, and DOE used this data for developing costs contained in this notice. DOE requests specific data or data sources to better categorize the third party costs attributable to local dealers or contractors.

The Scotsman and Manitowoc comments about the national account chain being misrepresented indicate that the national account channel is basically the same as the wholesaler channel. Thus, the 6 percent of shipments initially assigned to the national account channel will be combined with the wholesaler channel shipments and assessed the wholesaler channel markup. With regard to adding another channel for leased equipment, since Manitowoc suggested the pricing of equipment in such a hypothetical channel would not differ from other equipment, DOE elects to not add an additional channel.

With respect to the comments questioning the use of an incremental markup, DOE believes that there is likely an inaccurate comparison taking place. In competitive markets, such as the automatic commercial ice maker market, the participants are expected to be able to recover costs and a reasonable profit, which is what the markups designed and used by participants would be expected to do. In the DOE analysis, the baseline markup has been calculated to recover all currently existing overhead expenses with baseline equipment costs. DOE's analysis focuses on changes. Profit margin and other costs that change as MSP changes were assigned to incremental markups. Most overhead costs were allocated to the base markup because DOE does not expect these costs to change because of MSP changes brought on by efficiency standards. DOE developed the baseline and incremental markup methodology to ensure all overhead costs are fully collected and a reasonable profit margin is received and to identify costs that change, and apply such to the incremental MSP in the form of incremental markups.

F. Energy Use Analysis

For the preliminary analysis and for the NOPR, DOE estimated energy usage for use in the LCC and NIA models based on the kWh/100 lb ice and gal/100 lb ice values developed in the engineering analysis in combination with other assumptions. In the preliminary analysis, DOE assumed that ice makers on average are used to produce one-half of the ice the machines could produce (*i.e.,* a 50 percent capacity factor). DOE also assumed that when not making ice, on average ice makers would draw 5 watts of power. DOE modeled condenser water usage as ''open-loop'' installations, or installations where water is used in the condenser one time (single pass) and released into the wastewater system.

Several stakeholders agreed with the 50 percent capacity factor being reasonable. Scotsman stated that the 50 percent utilization factor is relatively close, given the wide spectrum that exists based on seasonality and installation location. (Scotsman, Public Meeting Transcript, No. 42 at p. 108) AHRI stated that on average, across all applications and seasons, the 50 percent utilization factor assumed by DOE is appropriate. (AHRI, No. 49 at p. 5) Manitowoc agreed that 50 percent utilization is a good number to use. (Manitowoc, Public Meeting Transcript, No. 42 at p. 110) Hoshizaki, on the other hand, thought 50 percent was on the low side for the industry, and some business types, like 24-hour restaurants, might have much higher usage factors. (Hoshizaki, Public Meeting Transcript, No. 42 at p. 111) NPCC expressed a desire to have information made available to determine if there is an equipment class relationship between the duty cycles and the business type, and whether duty cycle is related to the equipment class and/or the product capacity. NPCC believed that this may determine whether one is more cost-effective to pursue than another. (NPCC, Public Meeting Transcript, No. 42 at p. 111)

For the NOPR, DOE has continued to utilize a 50 percent capacity factor, as most commenters believed it to be a reasonable number and DOE did not receive utilization data in the comments that would lead it to consider alternative capacity factors in the analysis. In response to the Hoshizaki comment and in agreement with the NPCC comment, DOE requests additional information about reasonable values that could be used to vary the assumption by business type.

Several stakeholders commented on the assumption of an open-loop installation for water-cooled condensers. Scotsman commented that the majority of ice makers are installed in open-loop configurations. Scotsman stated that in some business types like hotels or casinos, there will typically be cooling towers and recirculation systems that the ice maker can tap into. In smaller locations without that type of a resource, it would typically be open loop, according to Scotsman. (Scotsman, Public Meeting Transcript, No. 42 at pp. 108–109) Scotsman added that single-pass configuration provides a worst-case energy use, and is appropriate for this analysis. (Scotsman, No. 46 at p. 3) Manitowoc stated that it only knows of installations in casinos or other large projects where ice makers are installed on closed loops, and suspects that most historical installations are open loop. (Manitowoc, No. 42 at p. 110)

NEEA recommended that DOE investigate the market share of automatic commercial ice makers with single-pass condensers, because they use substantially more water than those with other condenser configurations. (NEEA, Public Meeting Transcript, No, 42 at pp. 165–166) NPCC stated that some jurisdictions do not permit open-loop installations because of water usage. (NPCC, Public Meeting Transcript, No. 42 at pp. 109–110)

Hoshizaki suggested placing water-cooled units in closed-loop systems. (Hoshizaki, No. 42 at p. 110) Hoshizaki stated that, in certain areas, water-cooled condensers could be the most effective form of condensing. (Hoshizaki, No. 53 at p. 2)

DOE agrees with Hoshizaki's comment that water-cooled condensers can be a cost-effective form of condensing. DOE does not envision promulgating any rule that would eliminate water-cooled condensers. Since DOE's regulatory authority relates to the efficiency of equipment manufactured or sold in the U.S. but not to how equipment is installed or used, DOE does not plan to promulgate rules mandating use of closed loops. DOE is not proposing to perform the research suggested by NEEA into the prevalence of open- versus closed-loop installations. It is always DOE's objective to model energy usage as accurately as possible, so DOE requests stakeholder assistance in quantifying the impact of local regulations such as any local regulation potentially forbidding an open-loop installation. Scotsman and Manitowoc stated that, historically, most installations were likely open-loop, but the regulations discussed by NPCC would argue that in the future such is less likely to be true. DOE's analyses to date have not included design options that would change condenser water usage, a fact that means the question of modeling condenser water in the LCC models condenser water usage as open- or closed-loop impacts the absolute value of life-cycle costs and total national costs of ownership and operation, but not LCC savings or increases/decreases in NPV. Given that Scotsman and Manitowoc believe that historically most installations have likely been open loop, DOE chose to continue to model water usage as an open-loop (or single-pass) system.

G. Life-Cycle Cost and Payback Period Analysis

In response to the requirements of EPCA in (42 U.S.C. 6295(o)(2)(B)(i) and 6313(d)(4)), DOE conducts LCC and PBP analysis to evaluate the economic impacts of potential amended energy conservation standards on individual commercial customers—that is, buyers of the equipment. This section describes the analyses and the spreadsheet model DOE used. NOPR TSD chapter 8 details the model and all the inputs to the LCC and PBP analyses.

LCC is defined as the total customer cost over the lifetime of the equipment, and consists of installed cost (purchase and installation costs) and operating costs (maintenance, repair, water,[36] and energy costs). DOE discounts future operating costs to the time of purchase and sums them over the expected lifetime of the unit of equipment. PBP is defined as the estimated amount of time it takes customers to recover the higher installed costs of more-efficient equipment through savings in operating costs. DOE calculates the PBP by dividing the increase in installed costs by the savings in annual operating costs. DOE measures the changes in LCC and in PBP associated with a given energy and water use standard level relative to a base-case forecast of equipment energy and water use (or the ''baseline energy and water use''). The base-case forecast reflects the market in the absence of new or amended energy conservation standards.

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

Operating costs for automatic commercial ice makers are the sum of maintenance costs, repair costs, water, and energy costs. These costs are incurred over the life of the equipment and therefore are discounted to the base year (2018, which is the proposed effective date of the amended standards that will be established as part of this rulemaking). The sum of the installed cost and the operating cost, discounted to reflect the present value, is termed the life-cycle cost or LCC.

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

The PBP of higher efficiency equipment is obtained by dividing the increase in the installed cost by the decrease in annual operating cost. For this calculation, DOE uses the first-year operating cost decreases as the estimate of the decrease in operating cost, noting that some of the repair and maintenance costs used in the analysis are annualized estimates of costs. DOE calculates a PBP for each efficiency level of each equipment class. In addition to the energy costs (calculated using the electricity price forecast for the first year), the first-year operating costs also include annualized maintenance and repair costs.

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

As part of the engineering analysis, design option levels were ordered based on increasing efficiency (decreased energy and water consumption) and increasing MSP values. DOE developed four to seven energy use levels for each equipment class, henceforth referred to as ''efficiency levels,'' through the analysis of engineering design options. For all equipment classes, efficiency levels were set at specific intervals—*e.g.,* 10 percent improvement over base energy usage, 15 percent improvement, 20 percent improvement. The max-tech efficiency level is the only exception. At the max-tech level, the efficiency improvement matched the specific levels identified in the engineering analysis.

The base efficiency level (level 1) in each equipment class is the least efficient and the least expensive equipment in that class. The higher efficiency levels (level 2 and higher) exhibit progressive increases in efficiency and cost with the highest efficiency level corresponding to the max-tech level. LCC savings and PBP are calculated for each selected efficiency level of each equipment class.

Many inputs for the LCC analysis are estimated from the best available data in the market, and in some cases the inputs are generally accepted values within the industry. In general, each input value has a range of values associated with it. While single representative values for each input may yield an output that is the most probable value for that output, such an analysis does not give the general range of values that can be attributed to a particular output value. Therefore, DOE carried out the LCC analysis in the form of Monte Carlo simulations [37] in which certain inputs were expressed as a range of values and probability distributions that account for the ranges of values that may be typically associated with the respective input values. The results or outputs of the LCC analysis are presented in the form of mean LCC savings, percentages of customers experiencing net savings, net cost and no impact in LCC, and median PBP. For each equipment class, 10,000 Monte Carlo simulations were carried out. The simulations were conducted using Microsoft Excel and Crystal Ball, a commercially available Excel add-in used to carry out Monte Carlo simulations.

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

[36] Water costs are the total of water and wastewater costs. Wastewater utilities tend to not meter customer wastewater flows, and base billings on water commodity billings. For this reason, water usage is used as the basis for both water and wastewater costs, and the two are aggregated in the LCC and PBP analysis.

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

Recognizing that different types of businesses and industries that use automatic commercial ice makers face different energy prices, and apply different discount rates to purchase decisions, DOE analyzed variability and uncertainty in the LCC and PBP results by performing the LCC and PBP calculations for seven types of businesses: (1) Health care; (2) lodging; (3) foodservice; (4) retail; (5) education; (6) food sales; and (7) offices. Different types of businesses face different energy prices and also exhibit differing discount rates that they apply to purchase decisions.

Expected equipment lifetime is another input for which it is inappropriate to use a single value for each equipment class. Therefore, DOE assumed a distribution of equipment lifetimes that are defined by Weibull survival functions.[38]

Equipment lifetime is a key input for the LCC and PBP analysis. For automatic commercial ice maker equipment, there is a general consensus among industry stakeholders that the typical equipment lifetime is approximately 7 to 10 years with an average of 8.5 years. There was no data or comment to suggest that lifetimes are unique to each equipment class. Therefore, DOE assumed a distribution of equipment lifetimes that is defined by Weibull[39] survival functions, with an average value of 8.5 years.

Another factor influencing the LCC analysis is the State in which the automatic commercial ice maker is installed. Inputs that vary based on this factor include installation costs, water and energy prices, and sales tax (plus the associated distribution chain markups). At the national level, the spreadsheets explicitly modeled variability in the model inputs for water price, electricity price, and markups using probability distributions based on the relative populations in all States.

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

1. Equipment Cost

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

In the preliminary analysis, DOE developed a projection of price trends for automatic commercial ice maker equipment, indicating that based on historical price trends the MSP would be projected to decline by 0.4 percent from the 2012 estimation of MSP values through the 2018 assumed start date of new or amended standards. The preliminary analysis also indicated an approximately 1.6 percent decline from the MSP values estimated in 2012 to the end of the 30-year NIA analysis period used in the preliminary analysis. Price trends generated considerable discussion during the LCC presentation at the February 2012 preliminary analysis public meeting (and nearly all comments specific to the NIA were concerning price trends).

Scotsman stated that it typically sees some increase in costs and that it tries to recapture at least some of the increased cost in the form of price increases and usually cannot recover all of it. Scotsman stated that it does not expect to see prices going down over the years and does not think it makes a lot of sense. Scotsman added that for household refrigerators and other industries, much of the price decrease that has been seen over the years is offshored manufacturing. The automatic commercial ice maker manufacturers do not have the scale to consider doing that, according to Scotsman. (Scotsman, Public Meeting Transcript, No. 42 at pp. 127–128) Scotsman analyzed the historical shipments data and provided graphs showing how different the forecast would be if a different time period was selected. Scotsman suggested that a long-term growth trend of 1.5 percent is most realistic. (Scotsman, No. 46 at pp. 6–7)

NRDC stated that price learning is theoretically expected and empirically demonstrated, and that it supported DOE's incorporation of price learning in the rulemaking. (NRDC, No. 48 at p. 2)

AHRI urged DOE to assume that price learning is zero, or in other words, to hold MSP constant. AHRI stated that it had performed an analysis of the data used by DOE and that it believed that the data did not support an assumption of price learning greater than zero. (AHRI, No. 49 at p. 5 and exhibit A)

Manitowoc stated that there is no real basis to expect that the manufacturing costs of ice machines will decrease in the future due to efficiency gains in production because the ice machine designs are mature and the manufacturing processes are stable. Manitowoc added that the increase in costs associated with design options is only due to higher cost components or higher cost material employed and that the annual production volumes do not allow for further investment in automation of the manufacturing processes beyond what is already in place. (Manitowoc, No. 54 at p. 4)

As is customary between the preliminary analysis and the NOPR phases of a rulemaking, DOE re-examined the data available and updated the analyses, in this specific instance, the price trend analysis. At a high level, DOE agrees with the NRDC comment that evidence indicates price learning is theoretically expected. In response to the AHRI, Manitowoc, and Scotsman comments that the data do not support the price trends, DOE re-examined the data used in the analysis, and re-analyzed price trends with updated data. In the preliminary analysis, DOE used a Producer Price Index (PPI) that included air-conditioning, refrigeration, and forced air heating equipment. For the NOPR, DOE was able to identify a PPI that was a subset of the PPI used for the preliminary analysis. The subset includes only commercial refrigeration and related equipment, and excludes unrelated equipment. Using this PPI for the automatic commercial ice maker price trends analysis yields a price decline of roughly 1.6 percent over the period of 2012 (the year for which MSP was estimated) through 2047.

2. Installation, Maintenance, and Repair Costs

a. Installation Costs

Installation cost includes labor, overhead, and any miscellaneous materials and parts needed to install the equipment. The installation costs may vary from one equipment class to another, but they typically do not vary among efficiency levels within an equipment class. Most automatic commercial ice makers are installed in fairly standard configurations. For its preliminary analysis, DOE tentatively concluded that the engineering design options do not impact the installation cost within an equipment class. DOE therefore assumed that the installation cost for automatic commercial ice makers does not vary among efficiency levels within an equipment class. Costs that do not vary with efficiency levels do not impact the LCC, PBP, or NIA results. In the preliminary analysis, DOE estimated the installation cost as a fixed percentage of the total MSP for the baseline efficiency level for a given equipment class, set at 10 percent.

[39] Weibull survival function is a continuous probability distribution function that is commonly used to approximate the distribution of equipment lifetimes.

Manitowoc agreed with DOE's assumption that installation costs generally would be unaffected by moving to the higher efficiency level. However, Manitowoc pointed out that some efficiency differences may cause variation in installation costs. Manitowoc further explained that many remote condensers require a crane for installation; therefore, bigger condensers of automatic commercial ice maker equipment with higher efficiency levels might result in higher rental and labor costs associated with the installation. (Manitowoc, Public Meeting Transcript, No. 42 at p. 136) In its written comments to DOE, Manitowoc further clarified that higher efficiency equipment would not incur additional installation costs unless the size of the equipment increases in such a way as to exceed the industry norms. (Manitowoc, No. 54 at p. 4) However, Hoshizaki indicated installation costs will increase with higher levels of energy efficiency due to special installation requirements for the new machine and possible changes to the structure that might be required. Furthermore, AHRI commented that it is incorrect for DOE to assume that changes in installation will be negligible for more-efficient equipment. (AHRI, No. 49 at p. 5)

Scotsman pointed out that if the technology were assumed to involve a drain water heat exchange, the installation costs would increase. (Scotsman, No. 46 at p. 3)

In responses to the comments above, DOE further evaluated the costs associated with installation and revised the installation cost estimation methods. For the NOPR, DOE estimated material and labor cost to install equipment based on RS Means cost estimation data [40] and on telephone conservations with contractors. Estimated installation costs vary by equipment class and by State. DOE decided to continue to assume installation cost will be constant for all efficiency levels within an equipment class.

In response to Manitowoc's comment that greater equipment size might result in higher rental and labor costs, DOE notes that while the initial decision to avoid equipment size increases in the engineering analysis was eliminated, DOE attempted to minimize equipment size increases. Thus, proposed standard levels should not add significantly to labor and crane rental costs. Nor does DOE believe the size increases would require structural changes as hypothesized by Hoshizaki. In response to the Manitowoc and Scotsman comments about drain water heat exchanger installation costs, DOE notes the promotional material of drain water heat exchanger manufacturers indicate the units can be installed with four additional water attachments, a level of effort that would likely not add to the cost of installations. Finally, in response to Hoshizaki's general statement that higher efficiency levels will impose specialized installation requirements, a review of the design options included in the DOE engineering analysis did not reveal any options likely to impose specific cost increases. To better respond to the Hoshizaki comment, DOE requests specificity—which design options will impose increases in installation costs and what would the magnitude of such cost increases be?

b. Repair and Maintenance Costs

The repair cost is the average annual cost to the customer for replacing or repairing components in the automatic commercial ice maker that have failed. In the preliminary analysis, DOE approximated the repair cost as a 3-percent fixed percentage of the total baseline MSP for each equipment class and assumed that repair costs were constant within an equipment class for all efficiency levels.

Maintenance costs are associated with maintaining the proper operation of the equipment. The maintenance cost does not include the costs associated with the replacement or repair of components that have failed, which are included as repair costs. In the preliminary analysis, DOE applied a 3-percent preventative maintenance cost that remains constant across all equipment efficiency levels because data were not available to indicate how maintenance costs vary with equipment levels.

Scotsman stated that, in general, whenever new technology is introduced, failure rates increase. Scotsman stated that when the failures occur during the warranty period, the cost falls on manufacturers. Ice makers stress components in ways that they are not stressed in steady-state machines, according to Scotsman, so even with well-known technologies it is not known how their failure rates will fare in ice makers. In addition, Scotsman commented that if the technology was assumed to involve a drain water heat exchanger, the maintenance cost would increase. (Scotsman, No. 46 at pp. 3–4) Likewise, Hoshizaki stated that repair costs are relative to each machine and that it is difficult to compute a standard average. Manufacturers are still working to analyze the effects of the 2010 standards on repair costs, according to Hoshizaki. (Hoshizaki, No. 46 at pp. 3–4)

Manitowoc commented that the repair costs will be affected by the efficiency levels. Manitowoc stated that is has specific concerns about some components such as motors. Manitowoc pointed out that ECM motors might enhance the energy efficiencies, but these motors are probably less reliable than standard permanent split capacitor motors because ECM motors have more parts. Manitowoc further stated that, in general, more parts increase the chances that a component will fail, which in turn potentially increases the repair costs. (Manitowoc, Public Meeting Transcript, No. 42 at p. 136) In addition, Scotsman stated that modeling repair cost as a percentage of baseline costs would understate repair cost. Also using the example of an ECM fan motor, Scotsman explained that ECM motor has an incremental cost of $35 to install; however, when it needs to be replaced, it is considerably more costly than the replacement of the motors that are currently used on the market. Additionally, Scotsman also noted the ECM fan motor has more parts than the current motors that are commonly applied in the market, making it likely to fail more often. Therefore, according to Scotsman, ECM fan motors might require higher average annual repair costs than current motors used in the baseline units. (Scotsman, No. 46 at pp. 3–4) Hoshizaki pointed out higher water and energy efficiency level may increase maintenance costs. Hoshizaki elaborated that equipment with lower water usage and improved electrical efficiencies might need more frequent maintenance such as cleaning. (Hoshizaki, No. 53 at p. 2)

In addition, Howe commented on the impact of new standards on repairing and maintenance costs. Howe stated that the modification of new ice makers will cause increased repair and maintenance costs due to the need to educate service personnel. The percentage of the baseline costs will increase, according to Howe. (Howe, No. 51 at p. 4)

In response to these comments, DOE evaluated how repair and maintenance costs were estimated and revised the methodology. For repair costs, DOE examined the major components of ice makers and identified expected failure rates for each component. For those components for which available information indicates a failure might occur within the expected 8.5-year equipment life, DOE estimated repair or replacement costs. Under this methodology, repair and replacement costs are based on the original

[40] RS Means Company, Inc. *2013 RS Means Electrical Cost Data.* 2013. Kingston, MA.

equipment costs, so the more expensive the components are, the greater the expected repair or replacement cost. For design options modeled in the engineering analysis, DOE estimated repair costs and if they were different than the baseline cost, the repair costs were either increased or decreased accordingly. (Although theoretically possible, in the case of the ice maker analysis, repair costs did not decrease with efficiency levels for any equipment class.) Thus, consistent with Hoshizaki's comment about the difficulty of estimating one standard average, DOE now estimates different repair and replacement costs for all equipment classes.

DOE's revision to the repair cost methodology is consistent with the Manitowoc, Hoshizaki, Scotsman, and Howe comments that repair costs should increase with efficiency level. Consistent with the Manitowoc and Scotsman comments, DOE assumed that ECM fan motors would increase repair costs relative to the baseline. In response to Scotsman's comments about drain water heat exchangers, DOE notes that manufacturer literature indicates an expected useful life greater than 8.5 years, so no replacement was assumed for this component.

In the NOPR analyses, DOE estimated material and labor costs for preventative maintenance based on RS Means cost estimation data and on telephone conservations with contractors. DOE assumed maintenance cost would remain constant for all efficiency levels within an equipment class. In response to Hoshizaki's comment about the impact of reduced water usage on maintenance, the DOE analyses for 7 of 12 primary equipment classes did not involve changes to water usage. In the remaining 5 (batch) equipment classes, DOE's analysis did not assume potable water usage would be reduced below 20 gallons per 100 lb ice—a level manufacturers indicated was a point below which maintenance costs would increase. (Scotsman, Public Meeting Transcript, No. 42 at p. 64; Manitowoc, Public Meeting Transcript, No. 42 at p. 65) Thus, for the NOPR, DOE assumes that maintenance costs will not vary by efficiency level.

3. Annual Energy and Water Consumption

Chapter 7 of the NOPR TSD details DOE's analysis of annual energy and water usage at various efficiency levels of automatic commercial ice makers. Annual energy and water consumption inputs by automatic commercial ice maker equipment class are based on the engineering analysis estimates of kilowatt-hours of electricity per 100 lb ice and gallons of water per 100 lb ice, translated to annual kilowatt-hours and gallons in the energy and water use analysis (chapter 7 of the NOPR TSD). The development of energy and water usage inputs is discussed in section IV.G.6 along with public input and DOE's response to the public input.

4. Energy Prices

DOE calculated average commercial electricity prices using the EIA Form EIA–826 data obtained online from the ''Database: Sales (consumption), revenue, prices & customers'' Web page.[41] The EIA data reports average commercial sector retail prices calculated as total revenues from commercial sales divided by total commercial energy sales in kilowatt-hours, by State and for the nation. DOE received no recommendations or suggestions regarding this set of assumptions at the February 2012 preliminary analysis public meeting or in written comments.

5. Energy Price Projections

To estimate energy prices in future years for the preliminary analysis TSD, DOE multiplied the average regional energy prices described above by the forecast of annual average commercial energy price indices developed in the Reference Case from *AEO2013*.[42] *AEO2013* forecasted prices through 2040. To estimate the price trends after 2040, DOE assumed the same average annual rate of change in prices as exhibited by the forecast over the 2031 to 2040 period. DOE received no recommendations or suggestions regarding this set of assumptions at the February 2012 preliminary analysis public meeting or in written comments.

6. Water Prices

To estimate water prices in future years for the preliminary analysis TSD, DOE used price data from the 2008,[43] 2010,[44] and 2012 American Water Works Water (AWWA) and Wastewater Surveys.[45] The AWWA 2012 survey was the primary data set. No data exists to disaggregate water prices for individual business types, so DOE varied prices by state only and not by business type within a state. For each state, DOE combined all individual utility observations within the state to develop one value for each state for water and wastewater service. Since water and wastewater billings are frequently tied to the same metered commodity values, DOE combined the prices for water and wastewater into one total dollars per 1,000 gallons figure. DOE used the Consumer Price Index (CPI) data for water-related consumption (1973–2012) [46] in developing a real growth rate for water and wastewater price forecasts.

During the public meeting and in written comments, stakeholders commented on the water prices DOE used in its LCC analysis. NPCC stated that water and wastewater price escalation has been systematically higher than the CPI. Further, NPCC pointed out that EPA's water-related regulations governed by the Clean Water Act might level out the escalation rates once the regulations' requirements were satisfied, even though NPCC does not anticipate the escalation rates will diminish much. Given the impact of EPA's latest water-related regulations was not completed, NPCC then raised the question whether DOE should use both a higher escalation rate and CPI in its analysis. NPCC then suggested using a higher escalated rate in the analysis for a short-run period until the effective date of EPA's latest water-related regulations and move to the CPI for the longer term analysis starting with the effective date of EPA's relevant regulations. (NPCC, Public Meeting Transcript, No, 42 at pp. 132–134) In addition, the Alliance argued that water use and energy use cannot be compared on a simple price basis because of key differences between the two resources. The Alliance stated that, first, energy comes from multiple sources and is a commodity whose prices fluctuate based on supply and demand. Freshwater, on the other hand, is in limited supply and water prices are heavily regulated based on the cost of treatment and delivery, which is less directly affected by supply and demand, according to the Alliance. The Alliance

[41] U.S. Energy Information Administration. *Sales and revenue data by state, monthly back to 1990 (Form EIA–826).* (Last accessed June 26, 2013). *www.eia.gov/electricity/data.cfm#sales*

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

[43] American Water Works Association. *2008 Water and Wastewater Rate Survey.* 2009. Denver, CO. Report No. 54004.

[44] American Water Works Association. *2010 Water and Wastewater Rate Survey.* 2011. Denver, CO. Report No. 54006.

[45] American Water Works Association. *2012 Water and Wastewater Rate Survey.* 2013. Denver, CO. Report No. 54008.

[46] The Bureau of Labor Statistics defines CPI as a measure of the average change over time in the prices paid by urban consumers for a market basket of consumer goods and services. For more information see *www.bls.gov/cpi/home.htm.*

further stated that when water demand overcomes the readily available fresh water resources in the U.S., the alternative water sources will likely require more costly infrastructure and operational changes such as desalination to fulfill the demand for fresh water, which is also a very energy intensive process. Therefore, the Alliance recommended that DOE consider the marginal costs of alternative water sources, such as desalination, in its analyses to properly account for all water costs as applied to water-cooled condensers. (Alliance, No. 45 at p. 4)

DOE appreciates the comments that EPA water regulations under the Clean Water Act may impact the escalation rate of water price used in DOE's analysis and the observation about desalination plants being the next source of water available in many localities. With respect to the Clean Water Act comment, DOE notes that the Clean Water Act has been in existence since 1972. Thus, the water price trends should include the impacts of historical costs attributable to the Clean Water Act. Throughout that entire period, the CPI for water utility costs grew at an average rate of 1.6 percent faster than the total CPI, perhaps validating the NPCC point. As for capturing the effects of unknown future EPA regulations, DOE considers this a speculative effort, and DOE has long adhered to a guiding principle that the analyses avoid speculating in this fashion. With respect to the comment about desalination and the accompanying suggestion that DOE should use marginal water prices, DOE has developed water prices using recent water price data, which would include resource costs that underlie the provision of water. Looking forward, DOE acknowledges that new water resources brought online in future years may differ from those of the past, but DOE has not identified a source that carefully and systematically forecasts the impact of future developments of this nature, as the AEO2013 does in the case of electricity. Thus, to attempt to project growth rates for 50 states to capture these resource changes would be speculative. Rather than speculate, DOE has updated the calculation of State-level water prices with the inclusion of the 2012 AWWA survey [47] and additional consumer price index values.

[47] American Water Works Association. *2012 Water and Wastewater Rate Survey*. 2013. Denver, CO. Report No. 54008.

7. Discount Rates

The discount rate is the rate at which future expenditures are discounted to establish their present value. DOE determined the discount rate by estimating the cost of capital for purchasers of automatic commercial ice makers. Most purchasers use both debt and equity capital to fund investments. Therefore, for most purchasers, the discount rate is the weighted average cost of debt and equity financing, or the weighted average cost of capital (WACC), less the expected inflation.

To estimate the WACC of automatic commercial ice maker purchasers, DOE used a sample of nearly 1,200 companies grouped to be representative of operators of each of the commercial business types (health care, lodging, foodservice, retail, education, food sales, and offices) drawn from a database of 6,177 U.S. companies presented on the Damodaran Online Web site.[48] This database includes most of the publicly-traded companies in the United States. The WACC approach for determining discount rates accounts for the current tax status of individual firms on an overall corporate basis. DOE did not evaluate the marginal effects of increased costs, and, thus, depreciation due to more expensive equipment, on the overall tax status.

DOE used the final sample of companies to represent purchasers of automatic commercial ice makers. For each company in the sample, DOE combined company-specific information from the Damodaran Online Web site, long-term returns on the Standard & Poor's 500 stock market index from the Damodaran Online Web site, nominal long-term Federal government bond rates, and long-term inflation to estimate a WACC for each firm in the sample.

For most educational buildings and a portion of the office buildings and cafeterias occupied and/or operated by public schools, universities, and State and local government agencies, DOE estimated the cost of capital based on a 40-year geometric mean of an index of long-term tax-exempt municipal bonds (≤20 years).[49] [50] Federal office space was assumed to use the Federal bond rate, derived as the 40-year geometric average of long-term (≤10 years) U.S. government securities.[51]

DOE recognizes that within the business types purchasing automatic commercial ice makers there will be small businesses with limited access to capital markets. Such businesses tend to be viewed as higher risk by lenders and face higher capital costs as a result. To account for this, DOE included an additional risk premium for small businesses. The premium, 1.9 percent, was developed from information found on the Small Business Administration Web site.[52]

Chapter 8 of the TSD provides more information on the derivation of discount rates. The average discount rate by business type is shown on Table IV.26.

TABLE IV.26—AVERAGE DISCOUNT RATE BY BUSINESS TYPE

Business type	Average discount rate (real) *(%)*
Health Care	2.7
Lodging	6.8
Foodservice	5.8
Retail	4.6
Education	3.0
Food Sales	5.1
Office	4.6

8. Lifetime

DOE defines lifetime as the age at which typical automatic commercial ice maker equipment is retired from service. DOE estimated equipment lifetime based on its discussion with industry experts, and concluded a typical lifetime of 8.5 years. AHRI agreed with DOE's proposed average equipment lifetime of 8.5 years. (Alliance, No. 49 at p. 5) Hoshizaki agreed that 8.5 years is a fair assumption for commercial cube type ice makers. However, Hoshizaki stated that continuous type ice makers might have a shorter life. (Hoshizaki, No. 53 at p. 2)

For the NOPR analyses, DOE elected to use an 8.5-year average life for all equipment classes. With regard to the Hoshizaki statement that continuous type ice makers might have shorter life spans, DOE requests specific information to assist in determining whether continuous and batch type equipment should be analyzed using differing assumptions for equipment

[48] Damodaran financial data is available at: *http://pages.stern.nyu.edu/~adamodar/* (Last accessed January 31, 2013).

[49] Federal Reserve Bank of St. Louis, *State and Local Bonds—Bond Buyer Go 20-Bond Municipal Bond Index*. (Last accessed April 6, 2012). Annual data for 1973–2011 was available at: *http://research.stlouisfed.org/fred2/series/MSLB20/downloaddata?cid=32995*).

[50] Rate for 2012 calculated from monthly data. Data source: U.S. Federal Reserve (Last accessed February 20, 2013) (Available at: *www.federalreserve.gov/releases/h15/data.htm*).

[51] Rate calculated with 1973–2012 data. Data source: U.S. Federal Reserve (Last accessed February 20, 2013) (Available at: *www.federalreserve.gov/releases/h15/data.htm*).

[52] Small Business Administration data on loans between $10,000 and $99,000 compared to AAA Corporate Rates. <*http://www.sba.gov/advocacy/7540/6282*> Data last accessed on June 10, 2013.

life. All literature on the subject of ice maker lifetimes reviewed by DOE, including comments received during the Framework phase of this rulemaking, indicates a 7 to 10 year life, with 8.5 years being a reasonable average. DOE therefore is proposing in this NOPR to use 8.5 years as automatic commercial ice maker lifetime for DOE's LCC analysis for covered automatic commercial ice maker equipment, but would welcome additional data concerning specific differences between equipment classes.

9. Compliance Date of Standards

EPCA prescribes that DOE must review and determine whether to amend performance-based standards for cube type automatic commercial ice makers by January 1, 2015. (42 U.S.C. 6313(d)(3)(A)) In addition, EPCA requires that the amended standards established in this rulemaking must apply to equipment that is manufactured on or after 3 years after the final rule is published in the **Federal Register** unless DOE determines, by rule, that a 3-year period is inadequate, in which case DOE may extend the compliance date for that standard by an additional 2 years. (42 U.S.C. 6313(d)(3)(C)) DOE began this rulemaking with the expectation of completing it prior to the January 1, 2015 required date, and, therefore, assumed during the preliminary analysis that new and amended standards would take effect in 2016. However, for the NOPR analyses, based on the January 1, 2015 statutory deadline and giving manufacturers 3 years to meet the new and amended standards, DOE assumes that the most likely compliance date for the standards set by this rulemaking would be January 1, 2018. Therefore, DOE calculated the LCC and PBP for automatic commercial ice makers under the assumption that compliant equipment would be purchased in 2018, the year when compliance with the amended standard is required. DOE requests comments on the January 1, 2018 effective date.

10. Base-Case and Standards-Case Efficiency Distributions

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

DOE's methodology to estimate market shares of each efficiency level within each equipment class is based on an analysis of the automatic commercial ice makers currently available for purchase by customers. DOE analyzed all available models, calculated the percentage difference between the baseline energy usage embodied in the ice maker rulemaking analyses, and organized the available units by the efficiency levels. DOE then calculated the percentage of available models falling within each efficiency level bin. This efficiency distribution was used in the LCC and other downstream analyses as the baseline efficiency distribution.

11. Inputs to Payback Period Analysis

Payback period is the amount of time it takes the customer to recover the higher purchase cost of more energy-efficient equipment as a result of lower operating costs. Numerically, the PBP is the ratio of the increase in purchase cost to the decrease in annual operating expenditures. This type of calculation is known as a ''simple'' PBP because it does not take into account changes in operating cost over time (*i.e.,* as a result of changing cost of electricity) or the time value of money; that is, the calculation is done at an effective discount rate of zero percent. PBPs are expressed in years. PBPs greater than the life of the equipment mean that the increased total installed cost of the more-efficient equipment is not recovered in reduced operating costs over the life of the equipment, given the conditions specified within the analysis such as electricity prices.

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

12. Rebuttable Presumption Payback Period

EPCA (42 U.S.C. 6295(o)(2)(B)(iii) and 6313(d)(4)) established a rebuttable presumption that a new or amended standards are economically justified if the Secretary finds that the additional cost to the consumer of purchasing a product complying with an energy conservation standard level will be less than three times the value of the energy savings during the first year that the consumer will receive as a result of the standard, as calculated under the applicable test procedure.

While DOE examined the rebuttable presumption criterion, it considered whether the standard levels considered are economically justified through a more detailed analysis of the economic impacts of these levels pursuant to 42 U.S.C. 6295(o)(2)(B)(iii) 6313(d)(4). The results of this analysis served as the basis for DOE to evaluate the economic justification for a potential standard level definitively (thereby supporting or rebutting the results of any preliminary determination of economic justification).

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

The NIA assesses the NES and the NPV of total customer costs and savings that would be expected as a result of the amended energy conservation standards. The NES and NPV are analyzed at specific efficiency levels (*i.e.,* TSL) for each equipment class of automatic commercial ice makers. DOE calculates the NES and NPV based on projections of annual equipment shipments, along with the annual energy consumption and total installed cost data from the LCC analysis. For the NOPR analysis, DOE forecasted the energy savings, operating cost savings, equipment costs, and NPV of customer benefits for equipment sold from 2018 through 2047—the year in which the last standards-compliant equipment is shipped during the 30-year analysis.

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

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

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

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

1. Shipments

DOE obtained data from AHRI and U.S. Census Bureau's Current Industrial Reports (CIR) to estimate historical shipments for automatic commercial ice makers. AHRI provided DOE with automatic commercial ice maker shipment data for 2010 describing the distribution of shipments by equipment class and by harvest capacity. AHRI's data to DOE also included a 11-year history of total shipments from 2000 to 2010. Additionally, DOE collected total automatic commercial ice maker shipment data for the period of 1973 to 2009 from the CIR. DOE reviewed the total shipments in the AHRI and CIR data, and noted that the CIR-reported shipments were consistently higher than the AHRI-reported shipments. DOE considered the possibility that these discrepancies were associated with net exports. However, the CIR data presented exports as a percentage of total production at a high level of industry aggregation, thus making it impossible to identify ice maker exports as a percentage of ice maker production. DOE requested input to aid in understanding the differences between the AHRI and CIR shipments data. DOE identified one source with identifiable export information, the North American Association of Food Equipment Manufacturers (NAFEM). NAFEM data for two recent calendar years (2007 and 2008) showed approximately 20 percent of total ice maker shipments associated with food service equipment as exports. Applying a 20 percent export factor to the CIR shipments data brought the CIR data into approximate agreement with the AHRI data.

For the preliminary analysis, DOE relied on the CIR shipment values, reduced 20 percent for exports. Using adjusted CIR data, DOE created a rolling estimate of total existing stock by aggregating historical shipments across 8.5-year historical periods. DOE used the CIR data to estimate a time series of shipments and total stock for 1994 to 2006—at the time of the analysis, the last year of data available without significant gaps in the data due to disclosure limitations. For each year, using shipments, stock, and the estimated 8.5-year life of the equipment, DOE estimated that, on average, 14 percent of shipments were for new installations and the remainder for replacement of existing stock.

DOE then combined the historical shipments, disaggregated between shipments for new installations and those for replacement of existing stock, and the historical stock values with projections of new construction activity from *AEO2011* to generate a forecast of shipments. Stock and shipments were first disaggregated to individual business types based on data developed for DOE on commercial ice maker stocks.[53] The business types and share of stock represented by each type are shown in Table IV.27. Using a Weibull distribution assuming equipment has an average life of 8.5 years and lasts from 5 to 11 years, DOE developed a 30-year series of replacement ice maker shipments. Using the base shipments to new equipment, and year-to-year changes in new commercial sector floor space additions from *AEO2011,* DOE estimated shipments for new construction. (For the NOPR, DOE is using *AEO2013* projections of floor space additions. The *AEO2013* floor space additions by building type are shown in Table IV.28.) The combination of the replacement and new construction shipments yields total shipments. The final step was to distribute total sales to equipment classes by multiplying the total shipments by percentage shares by class. Table IV.29 shows the percentages represented by all equipment classes, both the primary classes modeled explicitly in all NOPR analyses as well as the secondary classes.

TABLE IV.27—BUSINESS TYPES INCLUDED IN SHIPMENTS ANALYSIS

Building type	Building type as percent of stock *(%)*
Health Care	9
Lodging	33
Foodservice	22
Retail	8
Education	7
Food Sales	16
Office	4
Total	100

TABLE IV.28—*AEO2013* FORECAST OF NEW BUILDING SQUARE FOOTAGE

Year	New construction *million ft²*						
	Health care	Lodging	Foodservice	Retail	Education	Food sales	Office
2013	66	147	30	276	247	21	173
2018	67	164	50	424	208	35	409
2020	65	178	48	407	197	33	452
2025	63	181	48	442	169	33	392
2030	71	150	54	508	191	38	273
2035	73	207	56	522	228	39	412
2040	76	190	56	562	252	39	405
Annual Growth Factor, 2031–2040	2.4%	2.5%	2.4%	2.5%	1.7%	2.3%	2.1%

[53] Navigant Consulting, Inc. *Energy Savings Potential and R&D Opportunities for Commercial Refrigeration.* Final Report, submitted to the U.S. Department of Energy. September 23, 2009. Page 41.

TABLE IV.29—PERCENT OF SHIPPED UNITS OF AUTOMATIC COMMERCIAL ICE MAKERS

Equipment class	Percentage of shipments
IMH–W–Small–B	4.54
IMH–W–Med–B	2.90
IMH–W–Large–B	0.48
IMH–A–Small–B	27.08
IMH–A–Large–B	16.14
RCU–Small–B	5.43
RCU–RC/NC–Large–B	6.08
SCU–W–Small–B	0.68
SCU–W–Large–B	0.22
SCU–A–Small–B	13.85
SCU–A–Large–B	6.56
IMH–W–Small–C	0.68
IMH–W–Large–C	0.17
IMH–A–Small–C	3.53
IMH–A–Large–C	1.07
RCU–Small–C	0.83
RCU–Large–C	0.87
SCU–W–Small–C	0.15
SCU–W–Large–C	0.00
SCU–A–Small–C	8.75
SCU–A–Large–C	0.00
Total	100.00

Source: AHRI, 2010 Shipments data submitted to DOE as part of this rulemaking.

Comments related to shipment analysis received during the February 2012 preliminary analysis public meeting are listed below along with DOE's responses to the comments.

AHRI, in response to DOE's question about inconsistencies between AHRI and CIR data, indicated it has found discrepancies and that these discrepancies relate to the way manufacturers report to the Census Bureau. AHRI stated that some residential ice makers may be lumped into the Census Bureau data. AHRI stated that it is confident in its data and would trust it as compared to the Census Bureau data. (AHRI, Public Meeting Transcript, No. 42 at p. 155) AHRI commented that it believes the historical shipments numbers it provided to DOE are more consistent in terms of product definitions and other factors than the Census Bureau shipments. (AHRI, No. 49 at p. 6) In response to a question by NPCC, Manitowoc indicated that while the automatic commercial ice makers market was still a little below historical levels, it was recovered from 2009. Manitowoc stated the product mix calculated by DOE is a ''pretty good'' snapshot, but there are shifts over time between batch and continuous types. (Manitowoc, Public Meeting Transcript, No. 42 at p. 147) Howe recommended using the Census Bureau shipments data because it is more encompassing. (Howe, No. 51 at p. 4) Hoshizaki stated AHRI shipment data could be skewed by models not sold in AHRI model class or manufacturers that do not participate with AHRI, but more information is needed to evaluate this issue. (Hoshizaki, No. 53 at p. 2)

In response to AHRI's comments about the known consistency of the AHRI data versus the less-well-known consistency of the Census Bureau data, DOE elected to use the AHRI historical data for the DOE Reference Case projections. As noted by Howe and Hoshizaki, the Census Bureau data could reflect broader coverage of all manufacturers. Thus, DOE configured the NIA model such that consistent scenarios can be modeled with either AHRI or Census Bureau data. With respect to the Manitowoc comments, DOE appreciates that the product mix represents a good snapshot. With respect to changing the mix, DOE requests additional data concerning trends, in the absence of which, DOE will by necessity hold the product mix static in the forecast.

2. Forecasted Efficiency in the Base Case and Standards Cases

The method for estimating the market share distribution of efficiency levels is presented in section IV.G.10, and a detailed description can be found in chapter 10 of the NOPR TSD. To estimate efficiency trends in the standards cases, DOE uses a ''roll-up'' scenario in its standards rulemakings. Under the roll-up scenario, DOE assumes that equipment efficiencies in the base case that do not meet the standard level under consideration would ''roll up'' to the efficiency level that just meets the proposed standard level and equipment already being purchased at efficiencies at or above the standard level under consideration would be unaffected. Table IV.30 shows the shipment-weighted market shares by efficiency level in the base-case scenario.

TABLE IV.30—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	39.1	26.1	23.9	10.9	0.0	0.0	
IMH–W–Med–B	69.0	16.7	11.9	0.0	2.4		
IMH–W–Large–B							
IMH–W–Large–B–1	71.4	0.0	4.8	23.8			
IMH–W–Large–B–2	33.3	50.0	0.0	16.7			
IMH–A–Small–B	37.0	31.5	25.9	5.6	0.0	0.0	0.0
IMH–A–Large–B							
IMH–A–Large–B–1	41.5	43.9	7.3	7.3	0.0	0.0	
IMH–A–Large–B–2	33.3	26.7	26.7	13.3			
RCU–Large–B							
RCU–Large–B–1	42.9	39.3	8.9	0.0	8.9		
RCU–Large–B–2	27.3	45.5	9.1	0.0	18.2		
SCU–W–Large–B	28.6	0.0	14.3	0.0	42.9	0.0	14.3
SCU–A–Small–B	17.1	40.0	5.7	11.4	14.3	11.4	0.0
SCU–A–Large–B	28.6	35.7	0.0	7.1	21.4	7.1	0.0
IMH–A–Small–C	22.9	22.9	14.3	8.6	17.1	2.9	11.4
IMH–A–Large–C	35.0	20.0	15.0	15.0	0.0	5.0	10.0
SCU–A–Small–C	26.7	20.0	16.7	13.3	3.3	20.0	

3. National Energy Savings

For each year in the forecast period, DOE calculates the NES for each TSL by multiplying the stock of equipment affected by the energy conservation standards by the estimated per-unit annual energy savings. DOE typically considers the impact of a rebound effect, introduced in the energy use analysis, in its calculation of NES for a given product. A rebound effect occurs when users operate higher efficiency equipment more frequently and/or for longer durations, thus offsetting estimated energy savings. When a rebound effect occurs, it is generally because the users of the equipment perceive it as less costly to use the equipment and elect to use it more intensively. In the case of automatic commercial ice makers, users of the equipment include restaurant wait staff, hotel guests, cafeteria patrons, or hospital staff using ice in the treatment of patients. Users of automatic commercial ice makers tend to have no perception of the cost of the ice, and rather are using the ice to serve a specific need. Given this, DOE believes there is no potential for a rebound effect. For the preliminary analysis, DOE used a rebound factor of 1, or no effect, for automatic commercial ice makers.

Inputs to the calculation of NES are annual unit energy consumption, shipments, equipment stock, and a site-to-source conversion factor.

The annual unit energy consumption is the site energy consumed by an automatic commercial ice maker unit in a given year. Using the efficiency of units at each efficiency level and the baseline efficiency distribution, DOE determined annual forecasted shipment-weighted average equipment efficiencies that, in turn, enabled determination of shipment-weighted annual energy consumption values.

The automatic commercial ice makers stock in a given year is the total number of automatic commercial ice makers shipped from earlier years (up to 12 years earlier) that remain in use in that year. The NES spreadsheet model keeps track of the total units shipped each year. For purposes of the NES and NPV analyses in the NOPR analysis, DOE assumed that, based on an 8.5-year average equipment lifetimes, approximately 12 percent of the existing automatic commercial ice makers are retired and replaced in each year. DOE assumes that, for units shipped in 2047, any units still remaining at the end of 2055 will be replaced.

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

In the preliminary analysis, DOE used annual site-to-source conversion factors based on the version of the National Energy Modeling System (NEMS) that corresponds to *AEO2008*.[54] For today's NOPR, DOE updated its conversion factors based on the U.S. energy sector modeling using the NEMS Building Technologies (NEMS–BT) version that corresponds to *AEO2013* and which provides national energy forecasts through 2040. Within the results of NEMS–BT model runs performed by DOE, a site-to-source ratio for commercial refrigeration was developed. The site-to-source ratio was extended beyond 2040 by using growth rates calculated at 5-year intervals to extrapolate the trend to 2045, after which it was held constant through the end of the analysis period (30-years plus the life of equipment).

DOE has historically presented NES in terms of primary energy savings. In response to the recommendations of a committee on ''Point-of-Use and Full-Fuel-Cycle Measurement Approaches to Energy Efficiency Standards'' appointed by the National Academy of Science, DOE announced its intention to use full-fuel-cycle (FFC) measures of energy use and greenhouse gas and other emissions in the national impact analyses and emissions analyses included in future energy conservation standards rulemakings. 76 FR 51281 (August 18, 2011) While DOE stated in that notice that it intended to use the Greenhouse Gases, Regulated Emissions, and Energy Use in Transportation (GREET) model to conduct the analysis, it also said it would review alternative methods, including the use of NEMS. After evaluating both models and the approaches discussed in the August 18, 2011 notice, DOE published a statement of amended policy in the **Federal Register** in which DOE explained its determination that NEMS is a more appropriate tool for its FFC analysis and its intention to use NEMS for that purpose. 77 FR 49701 (August 17, 2012). DOE received one comment, which was supportive of the use of NEMS for DOE's FFC analysis.[55]

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

4. Net Present Value of Customer Benefit

The inputs for determining the NPV of the total costs and benefits experienced by customers of the automatic commercial ice makers are: (1) total annual installed cost; (2) total annual savings in operating costs; and (3) a discount factor. DOE calculated net national savings for each year as the difference in installation and operating costs between the base-case scenario and standards-case scenarios. DOE calculated operating cost savings over the life of each piece of equipment shipped in the forecast period.

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

As discussed in IV.G.1, DOE included a projection of price trends in the

[54] In the past for preliminary analysis estimates, DOE typically did not perform analyses using NEMS. Rather, DOE relied on existing estimates considered appropriate for the analysis. The site-to-source values DOE considered most appropriate were those used in the prior 2009 commercial refrigeration equipment rulemaking final rule.

[55] Docket ID: EERE–2010–BT–NOA0028, comment by Kirk Lundblade.

preliminary analysis NIA. For the NOPR, DOE reviewed and updated the analysis with the result that the projected reference case downward trend in prices is quite modest. For the NOPR, DOE also developed high and low case price trend projections, as discussed in a NOPR TSD appendix to chapter 10.

I. Customer Subgroup Analysis

In analyzing the potential impact of new or amended standards on commercial customers, DOE evaluates the impact on identifiable groups (*i.e.,* subgroups) of customers, such as different types of businesses that may be disproportionately affected. Based on the data available to DOE, automatic commercial ice maker ownership in three building types represent over 70 percent of the market: food sales, foodservice, and hotels. Based on data from the 2007 U.S. Economic Census and size standards set by the U.S. Small Business Administration (SBA), DOE determined that a majority of food sales, foodservice and lodging firms fall under the definition of small businesses. Small businesses typically face a higher cost of capital. In general, the lower the cost of electricity and higher the cost of capital, the more likely it is that an entity would be disadvantaged by the requirement to purchase higher efficiency equipment. Chapter 8 of the NOPR TSD presents the electricity price by business type and discount rates by building types, respectively, while chapter 11 discusses these topics as they specifically relate to small businesses.

Comparing the foodservice, food sales, and lodging categories, foodservice faces the highest energy price, with food sales and lodging facing lower and nearly the same energy prices. Lodging faces the highest cost of capital. Foodservice faces a higher cost of capital than food sales. Given the cost of capital disparity, lodging was selected for LCC subgroup analysis. With foodservice facing a higher cost of capital, it was selected for subgroup analysis because the higher cost of capital should lead foodservice customers to value first cost more and future electricity savings less than would be the case for food sales customers.

At the February 2012 preliminary analysis public meeting, DOE asked for input on the LCC subgroup analysis, and in particular, about appropriate groups for analysis. Manitowoc recommended that DOE look at small businesses, such as franchise operations and independent proprietor-run establishments. Manitowoc added that while there are institutional sectors with longer windows, there are others—''mom and pops''—that represent a large part of the market and which may be unfairly impacted by new standards because of their short payback windows and cash constraints. Manitowoc also indicated it is not just restaurants, it is hotels operated by franchisees and in some cases even hotel chains. (Manitowoc, Public Meeting Transcript, No. 42 at p. 169)

DOE estimated the impact on the identified customer subgroups using the LCC spreadsheet model. The standard LCC and PBP analyses (described in section IV.G) include various types of businesses that use automatic commercial ice makers. For the LCC subgroup analysis, it was assumed that the subgroups analyzed do not have access to national purchasing accounts or two major capital markets thereby making the discount rates higher for these subgroups. Details of the data used for LCC subgroup analysis and results are presented in chapter 11 of the NOPR TSD.

J. Manufacturer Impact Analysis

1. Overview

DOE performed an MIA to estimate the impacts of amended energy conservation standards on manufacturers of automatic commercial ice makers. The MIA has both quantitative and qualitative aspects and includes analyses of forecasted industry cash flows, the INPV, investments in research and development (R&D) and manufacturing capital, and domestic manufacturing employment. Additionally, the MIA seeks to determine how amended energy conservation standards might affect manufacturing employment, capacity, and competition, as well as how standards contribute to overall regulatory burden. Finally, the MIA serves to identify any disproportionate impacts on manufacturer subgroups, in particular, small businesses.

The quantitative part of the MIA primarily relies on the Government Regulatory Impact Model (GRIM), an industry cash flow model with inputs specific to this rulemaking. The key GRIM inputs include data on the industry cost structure, unit production costs, product shipments, manufacturer markups, and investments in R&D and manufacturing capital required to produce compliant products. The key GRIM outputs are the INPV, which is the sum of industry annual cash flows over the analysis period, discounted using the industry weighted average cost of capital, and the impact to domestic manufacturing employment. The model estimates the impacts of more-stringent energy conservation standards on a given industry by comparing changes in INPV and domestic manufacturing employment between a base case and the various TSLs in the standards case. To capture the uncertainty relating to manufacturer pricing strategy following amended standards, the GRIM estimates a range of possible impacts under different markup scenarios.

The qualitative part of the MIA addresses manufacturer characteristics and market trends. Specifically, the MIA considers such factors as manufacturing capacity, competition within the industry, the cumulative impact of other DOE and non-DOE regulations, and impacts on small business manufacturers. The complete MIA is outlined in chapter 12 of the NOPR TSD.

DOE conducted the MIA for this rulemaking in three phases. In Phase 1 of the MIA, DOE prepared a profile of the automatic commercial ice maker industry. This included a top-down cost analysis of automatic commercial ice maker manufacturers that DOE used to derive preliminary financial inputs for the GRIM (*e.g.,* revenues; materials, labor, overhead, and depreciation expenses; selling, general, and administrative expenses (SG&A); and R&D expenses). DOE also used public sources of information to further calibrate its initial characterization of the automatic commercial ice maker industry, including company Securities and Exchange Commission (SEC) 10–K filings, corporate annual reports, the U.S. Census Bureau's Economic Census, and reports from Dunn & Bradstreet.

In Phase 2 of the MIA, DOE prepared a framework industry cash flow analysis to quantify the impacts of new and amended energy conservation standards. The GRIM uses several factors to determine a series of annual cash flows starting with the announcement of the standard and extending over a 30-year period following the effective date of the standard. These factors include annual expected revenues, costs of sales, SG&A and R&D expenses, taxes, and capital expenditures. In general, energy conservation standards can affect manufacturer cash flow in three distinct ways: (1) create a need for increased investment; (2) raise production costs per unit; and (3) alter revenue due to higher per-unit prices and changes in sales volumes.

In addition, during Phase 2, DOE developed interview guides to distribute to manufacturers of automatic commercial ice makers in order to develop other key GRIM inputs, including product and capital conversion costs, and to gather additional information on the anticipated effects of energy conservation standards on revenues, direct employment, capital assets, industry competitiveness, and subgroup impacts.

In Phase 3 of the MIA, DOE conducted structured, detailed interviews with a representative cross-section of manufacturers. During these interviews, DOE discussed engineering, manufacturing, procurement, and financial topics to validate assumptions used in the GRIM and to identify key issues or concerns. See section IV.J.4 for a description of the key issues raised by manufacturers during the interviews. As part of Phase 3, DOE also evaluated subgroups of manufacturers that may be disproportionately impacted by amended standards or that may not be accurately represented by the average cost assumptions used to develop the industry cash flow analysis. Such manufacturer subgroups may include small manufacturers, low volume manufacturers, niche players, and/or manufacturers exhibiting a cost structure that largely differs from the industry average.

DOE identified one subgroup, small manufacturers, for which average cost assumptions may not hold. DOE applied the small business size standards published by the SBA to determine whether a company is considered a small business. 65 FR 30840, May 15, 2000, as amended at 67 FR 52602, Aug. 13, 2002; 74 FR 46313, Sept. 9, 2009. To be categorized as a small business under North American Industry Classification System (NAICS) 333415, ''Air-Conditioning and Warm Air Heating Equipment and Commercial and Industrial Refrigeration Equipment Manufacturing,'' which includes commercial ice maker manufacturing, a manufacturer and its affiliates may employ a maximum of 750 employees. The 750-employee threshold includes all employees in a business's parent company and any other subsidiaries. Based on this classification, DOE identified seven manufacturers of automatic commercial ice makers that qualify as small businesses. The automatic commercial ice maker small manufacturer subgroup is discussed in chapter 12 of the NOPR TSD and in section VI.B.1 of this rulemaking.

2. Government Regulatory Impact Model

DOE uses the GRIM to quantify the changes in industry cash flows resulting from new or amended energy conservation standards. The GRIM uses manufacturer costs, markups, shipments, and industry financial information to arrive at a series of base-case annual cash flows absent new or amended standards, beginning with the present year, 2013, and continuing through 2047. The GRIM then models changes in costs, investments, shipments, and manufacturer margins that may result from new or amended energy conservation standards and compares these results against those in the base-case forecast of annual cash flows. The primary quantitative output of the GRIM is the INPV, which DOE calculates by summing the stream of annual discounted cash flows over the full analysis period. For manufacturers of automatic commercial ice makers, DOE used a real discount rate of 9.2 percent, the weighted average cost of capital as derived from industry financials. DOE then modified this figure based on feedback received during confidential interviews with manufacturers.

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

a. Government Regulatory Impact Model Key Inputs

Manufacturer Production Costs

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

For each efficiency level of each equipment class that was directly analyzed, DOE used the MPCs developed in the engineering analysis, as described in section IV.A.2 and further detailed in chapter 5 of the NOPR TSD. For equipment classes that were indirectly analyzed, DOE used a composite of MPCs from similar equipment classes, substitute component costs, and design options to develop an MPC for each efficiency level. For equipment classes that had multiple units analyzed, DOE used a weighted average MPC based on the relative shipments of products at each efficiency level as the input for the GRIM. Additionally, DOE used information from its teardown analysis, described in section IV.D, to disaggregate the MPCs into material and labor costs. These cost breakdowns and equipment markups were validated with manufacturers during manufacturer interviews.

Base-Case Shipments Forecast

The GRIM estimates manufacturer revenues based on total unit shipment forecasts and the distribution of shipments by efficiency level. Changes in sales volumes and efficiency mix over time can significantly affect manufacturer finances. For this analysis, the GRIM uses the NIA's annual shipment forecasts derived from the shipments analysis from 2013, the base year, to 2047, the end of the analysis period. See chapter 9 of the NOPR TSD for additional details.

Product and Capital Conversion Costs

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

Stranded Assets

If new or amended energy conservation standards require investment in new manufacturing capital, there also exists the possibility that they will render existing manufacturing capital obsolete. In the case that this obsolete manufacturing capital is not fully depreciated at the time new or amended standards go into effect, this would result in the stranding of these assets, and would necessitate the write-down of their residual un-depreciated value.

DOE used multiple sources of data to evaluate the level of product and capital conversion costs and stranded assets manufacturers would likely face to comply with new or amended energy conservation standards. DOE used manufacturer interviews to gather data on the level of investment anticipated at each proposed efficiency level and validated these assumptions using estimates of capital requirements derived from the product teardown analysis and engineering model described in section IV.D. These estimates were then aggregated and scaled using information gained from industry product databases to derive total industry estimates of product and capital conversion costs and to protect confidential information.

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

b. Government Regulatory Impact Model Scenarios

Markup Scenarios

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

Under the preservation of gross margin percentage scenario, DOE applied a single, uniform ''gross margin percentage'' markup across all efficiency levels. As production costs increase with efficiency, this scenario implies that the absolute dollar markup will increase as well. Based on publicly available financial information for manufacturers of automatic commercial ice makers and comments from manufacturer interviews, DOE assumed the industry average markup on production costs to be 1.25. Because this markup scenario assumes that manufacturers would be able to maintain their gross margin percentage as production costs increase in response to an amended energy conservation standard, it represents a lower bound of industry impacts (higher industry profitability) under an amended energy conservation standard.

In the preservation of EBIT markup scenario, manufacturer markups are calibrated so that EBIT in the year after the compliance date of the amended energy conservation standard is the same as in the base case. Under this scenario, as the cost of production goes up, manufacturers are generally required to reduce the markups on their minimally compliant products to maintain a cost competitive offering. The implicit assumption behind this scenario is that the industry can only maintain EBIT in absolute dollars after compliance with the amended standard is required. Therefore, operating margin (as a percentage) shrinks in the standards cases. This markup scenario represents an upper bound of industry impacts (lower profitability) under an amended energy conservation standard.

3. Discussion of Comments

In response to the February 2012 preliminary analysis public meeting, interested parties commented on the assumptions and results of the preliminary analysis TSD. Oral and written comments addressed several topics, including the impact to suppliers and the distribution channel, the importance of the ENERGYSTAR program, cumulative regulatory burden, and the impact to small manufacturers.

a. Impact to Suppliers, Distributors, Dealers, and Contractors

AHRI commented that DOE must perform analyses to assess the impact of the rule on component suppliers, distributors, dealers, and contractors. Where the MIA serves to assess the impact of amended energy conservation standards on manufacturers of automatic commercial ice makers; any impact on distributors, dealers, and contractors falls outside the scope of this analysis.

Impacts on component suppliers might arise if manufacturers switched to more-efficient components, or if there was a substantial reduction of orders following new or amended standards. In public comments, manufacturers expressed that given their low production volumes, the automatic commercial ice maker manufacturing industry has little influence over component suppliers relative to other commercial refrigeration equipment industries. It follows that energy conservation standards for automatic commercial ice makers would have little impact on component suppliers given their marginal contribution to overall commercial refrigeration component demand.

b. ENERGY STAR

Manitowoc commented that it is a very strong supporter of ENERGY STAR and that certification is very important to its customers because of the potential for utility rebates, Leadership in Energy and Environmental Design (LEED) certification, and other reasons. Manitowoc expressed concern that, if efficiency standards were raised to the max-tech level, there would be no more room for an ENERGY STAR category, which would be disruptive to the industry.

DOE acknowledges the importance of the ENERGY STAR program and of understanding its interaction with energy efficiency standards. However, EPCA requires DOE to establish energy conservation standards at the maximum level that is technically feasible and economically justified. DOE has found, over time, with other products, as the standard level is increased, manufacturers' research results in energy efficiency improvements that are regarded by the ENERGY STAR program. As such, any standard level below the max-tech level continues to leave room for ENERGY STAR rebate programs.

c. Cumulative Regulatory Burden

AHRI commented on the cumulative regulatory burden associated with DOE efficiency standards. AHRI indicated that several legislative and regulatory activities should be considered, including legislation intended to reduce lead in drinking water and climate change bills that may be considered by Congress. (AHRI, No. 49 at p. 4)

DOE takes into account the cumulative cost of multiple Federal regulations on manufacturers in the cumulative regulatory burden section of its analysis, which can be found in section V.B.2.e of this notice. DOE does not analyze the quantitative impacts of standards that have not yet been finalized. Similarly, DOE does not analyze the impacts of potential climate change bills because any impacts would be speculative in the absence of final legislation.

AHRI noted that California has regulations to limit GHGs and the measures established by the California Air Resources Board (CARB) to reduce global warming will reduce the use of refrigerants such as HFCs. CARB is currently limiting the in-State use of refrigerants considered to have high global warming potential (GWP) in non-residential refrigeration systems through its Refrigerant Management Program that became effective on January 1, 2011.[56] According to this new regulation, facilities with refrigeration systems that have a refrigerant capacity exceeding 50 lb must repair leaks within 14 days of detection, maintain on-site records of all leak repairs, and keep receipts of all refrigerant purchases. The regulation applies to any person or company that installs, services, or disposes of appliances with high-GWP refrigerants. Refrigeration systems with a refrigerant capacity exceeding 50 lb typically belong to food retail operations with remote condensing racks that store refrigerant serving multiple commercial refrigeration and ice-making units within a business. However, automatic commercial ice makers in food retail establishments are usually installed and serviced by refrigeration contractors, not manufacturers. As a result, although these CARB regulations apply to refrigeration technicians and owners of facilities with refrigeration systems, they are unlikely to represent a regulatory burden for manufacturers of automatic commercial ice makers.

The discussion of cumulative regulatory burden on manufacturers of automatic commercial ice makers is detailed further in chapter 12 of the NOPR TSD.

d. Small Manufacturers

Howe observed that most high-capacity ice makers are made by small manufacturers, and consequently, setting higher efficiency standards for high-capacity equipment may be discriminatory against small manufacturers. (Howe, No. 51 at p. 2)

DOE agrees that amended standards may have disproportionate impacts on smaller manufacturers. To make this determination, the DOE conducts an analysis of impacts on certain manufacturer subgroups including small businesses to assess if any impacts prove to be disproportionate. The results of this analysis are described further in section VI.B of this notice and detailed in chapter 12 of the NOPR TSD.

4. Manufacturer Interviews

To inform the MIA, DOE interviewed manufacturers with an estimated combined market share of 95 percent. The information gathered during these interviews enabled DOE to tailor the GRIM to reflect the unique financial characteristics of the automatic commercial ice maker industry. These confidential interviews provided information that DOE used to evaluate the impacts of amended energy conservation standards on manufacturer cash flows, manufacturing capacities, and employment levels.

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

a. Price Sensitivity

All manufacturers interviewed characterized the market for automatic commercial ice makers as extremely price sensitive. They hold the position that new and amended standards will result in decreased profit margins as they will be unable to pass through costs relating to standards compliance. They noted that this will be particularly troublesome for lower capacity equipment classes (Small SCU and Small IMH), which are sold primarily to smaller restaurants and food service establishments with limited access to capital. Additionally, they noted that distributors tend to be individual proprietors or small franchises with limited opportunities to extend financing to their customers. Manufacturers went on to report that while energy efficiency is important, it is not a feature for which customers would pay a premium.

One manufacturer also noted that replacement parts represented 70 percent of sales, and while sales of parts had increased since 2009, unit sales had decreased, indicating that customers were holding onto units longer. The ability to extend the life of a unit through repairs and refurbishment presents a further economic challenge to manufacturers facing energy efficiency standards.

b. Enforcement

Manufacturers characterized the automatic commercial ice maker market as a niche market with a high degree of competition. The recent entrance of foreign manufacturers has led to a further tightening of price competition due to the lower labor costs of these foreign manufacturers. Several domestic manufacturers expressed concern about the enforcement of an amended energy efficiency standard for automatic commercial ice makers produced overseas. Manufacturers believe that insufficient enforcement will lead to market distortions, as companies that make the necessary investments to meet amended standards would be at a distinct pricing disadvantage to unscrupulous competitors, often times foreign manufacturers, that do not fully comply. The manufacturers requested that DOE take the enforcement action necessary to maintain a level playing field and to eliminate non-compliant products from the market.

c. Reliability Impacts

Some manufacturers expressed concerns that future energy conservation standards would have an adverse impact on the reliability of their products. One manufacturer stated that any time new components or designs are introduced, that there is an increase in service calls and the mean time between failures drops as they work out the issues. This manufacturer went on to emphasize that reliability is the most important feature of their products.

d. Impact on Innovation

Several manufacturers expressed concerns over the imbalance of internal engineering resources brought about by the regular revision and introduction of energy conservation standards. As energy use has become increasingly regulated, manufacturers have had to shift engineering and support resources away from other initiatives, adversely affecting product innovation outside of energy efficiency. One manufacturer reported that a previous round of standards required nearly all of the company's engineering resources for between 1 and 2 years. Where the R&D effort required for compliance is intermittent, innovation is impacted without adding to overall employment. DOE requests additional comment on the intermittency of R&D efforts directed at compliance with energy conservation standards and its impact on other research and development resources.

K. Emissions Analysis

In the emissions analysis, DOE estimates the reduction in power sector emissions of CO_2, NO_X, SO_2, and Hg from potential energy conservation standards for automatic commercial ice makers. In addition, DOE estimates emissions impacts in production activities (extracting, processing, and transporting fuels) that provide the energy inputs to power plants. These are

[56] See *www.arb.ca.gov/cc/reftrack/reftrackrule.html*.

referred to as ''upstream'' emissions. Together, these emissions account for the full-fuel-cycle (FFC). In accordance with DOE's FFC Statement of Policy (76 FR 51282 (Aug. 18, 2011)), as amended at 77 FR 49701 (Aug. 17, 2012), the FFC analysis includes impacts on emissions of methane (CH_4) and nitrous oxide (N_2O), both of which are recognized as GHGs.

DOE conducted the emissions analysis using emissions factors that were derived from data in *AEO2013,* supplemented by data from other sources. DOE developed separate emissions factors for power sector emissions and upstream emissions. The method that DOE used to derive emissions factors is described in chapter 13 of the NOPR TSD.

The emissions intensity factors are expressed in terms of physical units per MWh or MMBtu of site energy savings. For CH_4 and N_2O, DOE also presents results in terms of units of carbon dioxide equivalent (CO_2eq). Gases are converted to CO_2eq by multiplying the physical units by the gas' global warming potential (GWP) over a 100 year time horizon. Based on the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, DOE used GWP values of 25 for CH_4 and 298 for N_2O.

EIA prepares the *AEO* using NEMS. Each annual version of NEMS incorporates the projected impacts of existing air quality regulations on emissions. *AEO2013* generally represents current legislation and environmental regulations, including recent government actions, for which implementing regulations were available as of December 31, 2012.

SO_2 emissions from affected electric generating units (EGUs) are subject to nationwide and regional emissions cap-and-trade programs. Title IV of the Clean Air Act sets an annual emissions cap on SO_2 for affected EGUs in the 48 contiguous States and the District of Columbia (DC). SO_2 emissions from 28 eastern States and DC were also limited under the Clean Air Interstate Rule (CAIR; 70 FR 25162 (May 12, 2005)), which created an allowance-based trading program that operates along with the Title IV program. CAIR was remanded to U.S. Environmental Protection Agency (EPA) by the U.S. Court of Appeals for the District of Columbia Circuit but it remained in effect. See *North Carolina* v. *EPA,* 550 F.3d 1176 (D.C. Cir. 2008); *North Carolina* v. *EPA,* 531 F.3d 896 (D.C. Cir. 2008). On July 6, 2011 EPA issued a replacement for CAIR, the Cross-State Air Pollution Rule (CSAPR). 76 FR 48208 (August 8, 2011). On August 21, 2012, the DC Circuit issued a decision to vacate CSAPR. See *EME Homer City Generation, LP* v. *EPA,* 696 F.3d 7, 38 (D.C. Cir. 2012). The court ordered EPA to continue administering CAIR. The *AEO2013* emissions factors used for today's NOPR assume that CAIR remains a binding regulation through 2040.

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

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

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

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

L. Monetizing Carbon Dioxide and Other Emissions Impacts

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

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

1. Social Cost of Carbon

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

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

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

a. Monetizing Carbon Dioxide Emissions

When attempting to assess the incremental economic impacts of carbon dioxide (CO_2) emissions, the analyst faces a number of serious challenges. A report from the National Research Council [57] points out that any assessment will suffer from uncertainty, speculation, and lack of information about (1) future emissions of greenhouse gases, (2) the effects of past and future emissions on the climate system, (3) the impact of changes in climate on the physical and biological environment, and (4) the translation of these environmental impacts into economic damages. As a result, any effort to quantify and monetize the harms associated with climate change will raise serious questions of science, economics, and ethics and should be viewed as provisional.

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

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

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

Economic analyses for Federal regulations have used a wide range of values to estimate the benefits associated with reducing carbon dioxide emissions. The model year 2011 Corporate Average Fuel Economy final rule, the U.S. Department of Transportation (DOT) used both a ''domestic'' SCC value of $2 per metric ton of CO_2 and a ''global'' SCC value of $33 per metric ton of CO_2 for 2007 emission reductions (in 2007$), increasing both values at 2.4 percent per year. DOT also included a sensitivity analysis at $80 per metric ton of CO_2.[58] A 2008 regulation proposed by DOT assumed a domestic SCC value of $7 per metric ton of CO_2 (in 2006$) for 2011 emission reductions (with a range of $0–$14 for sensitivity analysis), also increasing at 2.4 percent per year.[59] A regulation for packaged terminal air conditioners and packaged terminal heat pumps finalized by DOE in 2008 used a domestic SCC range of $0 to $20 per metric ton CO_2 for 2007 emission reductions (in 2007$). 73 FR 58772, 58814 (Oct. 7, 2008) In addition, EPA's 2008 Advance Notice of Proposed Rulemaking on Regulating Greenhouse Gas Emissions Under the Clean Air Act identified what it described as ''very preliminary'' SCC estimates subject to revision. 73 FR 44354 (July 30, 2008). EPA's global mean values were $68 and $40 per metric ton CO_2 for discount rates of approximately 2 percent and 3 percent, respectively (in 2006$ for 2007 emissions).

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

c. Current Approach and Key Assumptions

Since the release of the interim values, the interagency group reconvened on a regular basis to generate improved SCC estimates. Specifically, the group considered public comments and further explored

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

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

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

the technical literature in relevant fields. The interagency group relied on three integrated assessment models commonly used to estimate the SCC: the FUND, DICE, and PAGE models. These models are frequently cited in the peer-reviewed literature, and were used in the last assessment of the Intergovernmental Panel on Climate Change. Each model was given equal weight in the SCC values that were developed.

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

The interagency group selected four sets of SCC values for use in regulatory analyses. Three sets of values are based on the average SCC from the three integrated assessment models, at discount rates of 2.5, 3, and 5 percent. The fourth set, which represents the 95th percentile SCC estimate across all three models at a 3-percent discount rate, is included to represent higher-than-expected impacts from temperature change further out in the tails of the SCC distribution. The values grow in real terms over time. Additionally, the interagency group determined that a range of values from 7 percent to 23 percent should be used to adjust the global SCC to calculate domestic effects, although preference is given to consideration of the global benefits of reducing CO_2 emissions. Table IV.31 presents the values in the 2010 interagency group report,[60] which is reproduced in appendix 14–A of the NOPR TSD.

TABLE IV.31—ANNUAL SCC VALUES FROM 2010 INTERAGENCY REPORT, 2010–2050

[2007 dollars per metric ton]

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

The SCC values used for today's notice were generated using the most recent versions of the three integrated assessment models that have been published in the peer-reviewed literature.[61] Table IV.32 shows the updated sets of SCC estimates in five year increments from 2010 to 2050. The full set of annual SCC estimates between 2010 and 2050 is reported in appendix 14–B of the NOPR TSD. The central value that emerges is the average SCC across models at the 3-percent discount rate. However, for purposes of capturing the uncertainties involved in regulatory impact analysis, the interagency group emphasizes the importance of including all four sets of SCC values.

TABLE IV.32—ANNUAL SCC VALUES FROM 2013 INTERAGENCY UPDATE, 2010–2050

[2007 dollars per metric ton CO_2]

Year	Discount rate (%)			
	5	3	2.5	3
	Average	Average	Average	95th percentile
2010	11	32	51	89
2015	11	37	57	109
2020	12	43	64	128
2025	14	47	69	143
2030	16	52	75	159
2035	19	56	80	175
2040	21	61	86	191

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

[61] *Technical Update of the Social Cost of Carbon for Regulatory Impact Analysis Under Executive Order 12866.* Interagency Working Group on Social Cost of Carbon, United States Government. May 2013; revised November 2013. <*http://www.whitehouse.gov/sites/default/files/omb/assets/inforeg/technical-update-social-cost-of-carbon-for-regulator-impact-analysis.pdf*>

TABLE IV.32—ANNUAL SCC VALUES FROM 2013 INTERAGENCY UPDATE, 2010–2050—Continued
[2007 dollars per metric ton CO_2]

Year	Discount rate (%)			
	5	3	2.5	3
	Average	Average	Average	95th percentile
2045	24	66	92	206
2050	26	71	97	220

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

In summary, in considering the potential global benefits resulting from reduced CO_2 emissions, DOE used the values from the 2013 interagency report adjusted to 2012$ using the Gross Domestic Product (GDP) price deflator. For each of the four case of SCC values, the values for emissions in 2015 were $11.8, $39.7, $61.2, and $117.0 per metric ton avoided (values expressed in 2012$). DOE derived values after 2050 using the relevant growth rates for the 2040–2050 period in the interagency update.

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

2. Valuation of Other Emissions Reductions

As noted above, DOE has taken into account how new or amended energy conservation standards would reduce NO_X emissions in those 22 States not affected by emission caps. DOE estimated the monetized value of NO_X emissions reductions resulting from each of the TSLs considered for today's NOPR based on estimates found in the relevant scientific literature. Estimates of monetary value for reducing NO_X from stationary sources range from $468 to $4,809 per ton (2012$).[62] DOE calculated monetary benefits using a medium value for NO_X emissions of $2,639 per short ton (in 2012$), and real discount rates of 3 percent and 7 percent.

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

M. Utility Impact Analysis

In the utility impact analysis, DOE analyzes the changes in electric installed capacity and generation that result for each TSL. The utility impact analysis uses a variant of NEMS,[63] which is a public domain, multi-sectored, partial equilibrium model of the U.S. energy sector. DOE uses a variant of this model, referred to as NEMS–BT,[64] to account for selected utility impacts of new or amended energy conservation standards. DOE's analysis consists of a comparison between model results for the most recent *AEO* Reference Case and for cases in which energy use is decremented to reflect the impact of potential standards. The energy savings inputs associated with each TSL come from the NIA. Chapter 15 of the NOPR TSD describes the utility impact analysis.

N. Employment Impact Analysis

Employment impacts include direct and indirect impacts. Direct employment impacts are any changes in the number of employees of manufacturers of the products subject to standards; the MIA addresses those impacts. Indirect employment impacts are changes in national employment that occur due to the shift in expenditures and capital investment caused by the purchase and operation of more-efficient appliances. Indirect employment impacts from standards consist of the jobs created or eliminated in the national economy due to: (1) reduced spending by end users on energy; (2) reduced spending on new energy supply by the utility industry; (3) increased customer spending on the purchase of new products; and (4) the effects of those three factors throughout the economy.

One method for assessing the possible effects on the demand for labor of such shifts in economic activity is to compare sector employment statistics developed by the Labor Department's Bureau of Labor Statistics (BLS). BLS regularly publishes its estimates of the number of jobs per million dollars of economic activity in different sectors of the economy, as well as the jobs created elsewhere in the economy by this same economic activity. Data from BLS indicate that expenditures in the utility sector generally create fewer jobs (both directly and indirectly) than expenditures in other sectors of the economy.[65] There are many reasons for these differences, including wage differences and the fact that the utility sector is more capital-intensive and less

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

[63] For more information on NEMS, refer to the U.S. Department of Energy, Energy Information Administration documentation. A useful summary is *National Energy Modeling System: An Overview 2003,* DOE/EIA–0581 (2003), March, 2003.

[64] DOE/EIA approves use of the name ''NEMS'' to describe only an official version of the model without any modification to code or data. Because this analysis entails some minor code modifications and the model is run under various policy scenarios that are variations on DOE/EIA assumptions, DOE refers to it by the name ''NEMS–BT'' (''BT'' is DOE's Building Technologies Program, under whose aegis this work has been performed).

[65] *See* Bureau of Economic Analysis, ''Regional Multipliers: A User Handbook for the Regional Input-Output Modeling System (RIMS II),'' U.S. Department of Commerce (1992).

labor-intensive than other sectors. Energy conservation standards have the effect of reducing customer utility bills. Because reduced customer expenditures for energy likely lead to increased expenditures in other sectors of the economy, the general effect of efficiency standards is to shift economic activity from a less labor-intensive sector (*i.e.,* the utility sector) to more labor-intensive sectors (*e.g.,* the retail and service sectors). Thus, based on the BLS data alone, DOE believes net national employment may increase because of shifts in economic activity resulting from amended energy conservation standards for automatic commercial ice makers.

For the amended standard levels considered in today's NOPR, DOE estimated indirect national employment impacts using an input/output model of the U.S. economy called Impact of Sector Energy Technologies version 3.1.1 (ImSET).[66] ImSET is a special-purpose version of the ''U.S. Benchmark National Input-Output'' (I–O) model, which was designed to estimate the national employment and income effects of energy-saving technologies. The ImSET software includes a computer-based I–O model having structural coefficients that characterize economic flows among the 187 sectors. ImSET's national economic I–O structure is based on a 2002 U.S. benchmark table, specially aggregated to the 187 sectors most relevant to industrial, commercial, and residential building energy use. DOE notes that ImSET is not a general equilibrium forecasting model, and understands the uncertainties involved in projecting employment impacts, especially changes in the later years of the analysis. Because ImSET does not incorporate price changes, the employment effects predicted by ImSET may over-estimate actual job impacts over the long run. For the NOPR, DOE used ImSET only to estimate short-term (through 2022) employment impacts.

For more details on the employment impact analysis, see chapter 16 of the NOPR TSD.

At the February 2012 preliminary analysis public meeting, NPCC inquired whether the money saved from low water consumption will be moved into the employment impact analysis along with the money saved from lower energy consumption. (NPCC, No. 42 at pp. 164 and 165) In response, DOE notes that all changes in operations and maintenance costs, including water costs, are captured in the employment analysis.

For more details on the employment impact analysis and its results, see chapter 16 of the NOPR TSD and section V.B.3.d of this notice.

O. Regulatory Impact Analysis

DOE prepared a regulatory impact analysis (RIA) for this rulemaking, which is described in chapter 17 of the NOPR TSD. The RIA is subject to review by OIRA in the OMB. The RIA consists of (1) a statement of the problem addressed by this regulation and the mandate for Government action; (2) a description and analysis of policy alternatives to this regulation; (3) a qualitative review of the potential impacts of the alternatives; and (4) the national economic impacts of the proposed standard.

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

DOE identified the following major policy alternatives for achieving increased automatic commercial ice makers efficiency:

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

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

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

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

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

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

Bulk government purchases and early replacement incentive programs: DOE also considered, but did not analyze, the potential of bulk government purchases

[66] Scott, M.J., O.V. Livingston, P.J. Balducci, J.M. Roop, and R.W. Schultz. *ImSET 3.1: Impact of Sector Energy Technologies.* 2009. Pacific Northwest National Laboratory, Richland, WA. Report No. PNNL–18412. <*www.pnl.gov/main/publications/external/technical_reports/PNNL-18412.pdf*>

and early replacement incentive programs as alternatives to the proposed standards. Bulk government purchases would have a very limited impact on improving the overall market efficiency of automatic commercial ice makers because they would be a small part of the total equipment sold in the market. In the case of replacement incentives, several policy options exist to promote early replacement, including a direct national program of customer incentives, incentives paid to utilities to promote an early replacement program, market promotions through equipment manufacturers, and replacement of government-owned equipment. In considering early replacements, DOE estimates that the energy savings realized through a one-time early replacement of existing stock equipment does not result in energy savings commensurate to the cost to administer the program. Consequently, DOE did not analyze this option in detail.

V. Analytical Results

A. Trial Standard Levels

1. Trial Standard Level Formulation Process and Criteria

DOE selected between four and seven efficiency levels for all equipment classes for analysis. For all equipment classes, the first efficiency level is the baseline efficiency level. Based on the results of the LCC analysis and NIA, DOE selected five TSLs above the baseline level for each equipment class for the NOPR stage of this rulemaking. Table V.1 shows the mapping between TSLs and efficiency levels.

TSL 5 was selected at the max-tech level for all equipment classes.

TSL 4 was chosen as an intermediate level between the max-tech level and the maximum customer NPV level, subject to the requirement that the TSL 4 NPV must be positive. ''Customer NPV'' is the NPV of future savings obtained from the NIA. It provides a measure of the benefits only to the customers of the automatic commercial ice makers, and does not account for the net benefits to the Nation. The net benefits to the Nation also include monetized values of emissions reductions in addition to the customer NPV. Where a sufficient number of efficiency levels allow it, TSL 4 is set at least one level below max-tech and one level above the efficiency level with the highest NPV. In one case, the TSL 4 efficiency level is the maximum NPV level because the next higher level had a negative NPV. In cases where the maximum NPV efficiency level is the penultimate efficiency level and the max-tech level showed a positive NPV the TSL 4 efficiency level is also the max-tech level.

TSL 3 was chosen to represent the group of efficiency levels with the highest customer NPV at a 7-percent discount rate.

TSL 2 was selected to provide intermediate efficiency levels that fill the gap between the TSLs 1 and 3. Note that with the number of efficiency levels available for each equipment class, there is often overlap between TSL levels. Thus, TSL 2 includes levels that overlap with both TSLs 1 and 3. The intent of TSL 2 is to provide an intermediate level to preclude big jumps in efficiency between TSLs 1 and 3.

TSL 1 was set equal to efficiency level 2. In the analysis, efficiency level 2 was set equivalent to ENERGY STAR for products rated by ENERGY STAR, and an equivalent efficiency improvement for other equipment classes.

TABLE V.1—MAPPING BETWEEN TSLS AND EFFICIENCY LEVELS *

Equipment class	TSL 1	TSL 2	TSL 3	TSL 4	TSL 5
IMH–W–Small–B	Level 2	Level 3	Level 5	Level 5	Level 6
IMH–W–Med–B	Level 2	Level 2	Level 3	Level 4	Level 5
IMH–W–Large–B †					
IMH–W–Large–B1	Level 2	Level 2	Level 2	Level 3	Level 4
IMH–W–Large–B2	Level 2	Level 2	Level 2	Level 3	Level 4
IMH–A–Small–B	Level 2	Level 3	Level 5	Level 6	Level 7
IMH–A–Large–B †					
IMH–A–Large–B1	Level 2	Level 3	Level 5	Level 6	Level 6
IMH–A–Large–B2	Level 2	Level 2	Level 3	Level 4	Level 4
RCU–Large–B †					
RCU–Large–B1	Level 2	Level 2	Level 3	Level 4	Level 5
RCU–Large–B2	Level 2	Level 2	Level 3	Level 4	Level 5
SCU–W–Large–B	Level 2	Level 3	Level 5	Level 6	Level 7
SCU–A–Small–B	Level 2	Level 4	Level 6	Level 7	Level 7
SCU–A–Large–B	Level 2	Level 4	Level 6	Level 7	Level 7
IMH–A–Small–C	Level 2	Level 3	Level 4	Level 5	Level 7
IMH–A–Large–C	Level 2	Level 3	Level 5	Level 6	Level 7
SCU–A–Small–C	Level 2	Level 3	Level 4	Level 4	Level 6

* For three large equipment classes—IMH–W–Large–B, IMH–A–Large–B and RCU–Large–B—because the harvest capacity range is so wide DOE analyzed two typical models to ensure models at the low and the higher portions of the applicable range were accurately modeled. The smaller of the two is noted as B1 and the larger as B2.

† DOE analyzed impacts for the B1 and B2 typical units and aggregated impacts to the equipment class level.

Table V.2 illustrates the efficiency improvements incorporated in all efficiency levels.

TABLE V.2—PERCENTAGE EFFICIENCY IMPROVEMENT FROM BASELINE BY TSL *

Equipment class	TSL 1 (%)	TSL 2 (%)	TSL 3 (%)	TSL 4 (%)	TSL 5 (%)
IMH–W–Small–B	10.0	15.0	25.0	25.0	29.4

TABLE V.2—PERCENTAGE EFFICIENCY IMPROVEMENT FROM BASELINE BY TSL *—Continued

Equipment class	TSL 1 (%)	TSL 2 (%)	TSL 3 (%)	TSL 4 (%)	TSL 5 (%)
IMH–W–Med–B	10.0	10.0	15.0	20.0	21.3
IMH–W–Large–B	10.0	10.0	10.0	15.0	16.4
IMH–W–Large–B1	10.0	10.0	10.0	15.0	16.7
IMH–W–Large–B2	10.0	10.0	10.0	15.0	15.5
IMH–A–Small–B	10.0	15.0	25.0	30.0	31.3
IMH–A–Large–B	10.0	14.2	23.4	28.0	28.0
IMH–A–Large–B1	10.0	15.0	25.0	29.4	29.4
IMH–A–Large–B2	10.0	10.0	15.0	20.0	20.0
RCU–Large–B	9.0	9.0	15.0	20.0	20.6
RCU–Large–B1	9.0	9.0	15.0	20.0	20.6
RCU–Large–B2	9.0	9.0	15.0	20.0	20.5
SCU–W–Large–B	7.0	15.0	25.0	30.0	30.2
SCU–A–Small–B	7.0	20.0	30.0	39.3	39.3
SCU–A–Large–B	7.0	20.0	30.0	34.9	34.9
IMH–A–Small–C	10.0	15.0	20.0	25.0	31.0
IMH–A–Large–C	10.0	15.0	25.0	30.0	30.2
SCU–A–Small–C	7.0	15.0	20.0	20.0	28.2

* Percentage improvements for IMH–W–Large–B, IMH–A–Large–B and RCU–Large–B are a weighted average of the B1 and B2 units, using weights provided in TSD chapter 7.

Table V.3 illustrates the design options associated with each TSL level, for each analyzed product class. The design options are discussed in Section IV.D.3 of today's NOPR, and in Chapter 5 of the NOPR TSD.

TABLE V.3—DESIGN OPTIONS FOR ANALYZED PRODUCTS CLASSES AT EACH TSL

Equipment class	Baseline	TSL 1	TSL 2	TSL 3	TSL 4	TSL 5
Design Options for Each TSL (options are cumulative—TSL5 includes all preceding options)						
IMH–W–Small–B	No BW Fill, PSC PM.	Increase Comp EER, Increase Cond.	Same as previous.	Increase Cond, BW Fill.	BW Fill, Increase Evap, ECM PM.	ECM PM, DWHX.
IMH–W–Med–B	BW Fill, PSC PM.	Increase Comp EER.	Same as previous.	Increase Comp EER, Increase Cond.	Increase Comp EER, ECM PM, DWHX.	DWHX.
IMH–W–Large–B1	BW Fill, PSC PM.	Increase Comp EER, Increase Cond.	Same as previous.	Same as previous.	Increase Cond, ECM PM, DWHX.	DWHX.
IMH–W–Large–B2	BW Fill, PSC PM.	Increase Comp EER, Increase Cond.	Same as previous.	Same as previous.	ECM PM, DWHX.	DWHX.
IMH–A–Small–B	BW Fill, PSC PM, SPM FM.	Increase Comp EER, Increase Cond, Increase Evap.	Increase Evap ...	Increase Evap, PSC FM, ECM FM, Increase Cond.	Increase Cond, ECM PM, DWHX.	DWHX.
IMH–A–Large–B1	BW Fill, PSC PM, SPM FM.	PSC FM, Comp EER.	Increase Comp EER.	Increase Comp EER, BW Fill, ECM PM, ECM FM, Increase Cond.	Increase Cond, DWHX.	DWHX.
IMH–A–Large–B2	BW Fill, PSC PM, SPM FM.	Increase Comp EER, PSC FM.	Same as previous.	PSC FM, Increase Cond.	ECM FM, ECM PM, DWHX.	ECM FM, ECM PM, DWHX.
RCU–Large–B1	BW Fill, PSC PM, PSC FM.	Increase Comp EER.	Same as previous.	Increase Comp EER, Increase Cond, ECM FM.	ECM FM, Increase Cond, ECM PM, DWHX.	DWHX.
RCU–Large–B2	BW Fill, PSC PM, PSC FM.	Increase Comp EER, Increase Cond.	Same as previous.	ECM PM Increase Cond.	Increase Cond, ECM FM, DWHX.	DWHX.
SCU–W–Large–B	No BW Fill, PSC PM.	BW Fill ...	BW Fill, Increase Comp EER, Increase Cond.	Increase Cond, ECM PM.	ECM PM, DWHX.	DWHX.
SCU–A–Small–B	No BW Fill, PSC PM, SPM FM.	PSC FM, Increase Cond.	Increase Cond, Increase Comp EER.	Increase Comp EER, BW Fill.	BW Fill, ECM PM, ECM FM, DWHX.	Same as previous.
SCU–A–Large–B	No BW Fill, PSC PM, SPM FM.	Increase Comp EER.	Increase Comp EER, Increase Cond, BW Fill.	BW Fill, PSC FM, ECM FM, ECM PM.	ECM PM, DWHX.	Same as previous.

TABLE V.3—DESIGN OPTIONS FOR ANALYZED PRODUCTS CLASSES AT EACH TSL—Continued

Equipment class	Baseline	TSL 1	TSL 2	TSL 3	TSL 4	TSL 5
IMH–A–Small–C	PSC AM, SPM FM.	PSC FM, Increase Comp EER.	PSC FM, Increase Comp EER.	Increase Comp EER, Increase Cond, ECM FM.	ECM FM, ECM AM.	ECM AM.
IMH–A–Large–C	PSC AM, SPM FM.	Increase Cond, Increase Comp EER.	Increase Comp EER.	Increase Comp EER, PSC FM, ECM FM.	ECM FM, ECM AM.	ECM AM.
SCU–A–Small–C	PSC AM, SPM FM.	Increase Cond	Increase Cond, Increase Comp EER.	Increase Comp EER, PSC FM.	Same as previous.	ECM FM, ECM AM.

SPM = Shaded Pole Motor
PSC = Permanent Split Capacitor Motor
ECM = Electronically Commutated Motor
FM = Fan Motor (Air-Cooled Units)
PM = Pump Motor (Batch Units)
AM = Auger Motor (Continuous Units)
BW Fill = Batch Water Fill Option Included
Increase Cond = Increase in Condenser Size
Increase Evap = Increase in Evaporator Size
Increase Comp EER = Increase in Compressor EER
DWHX = Addition of Drainwater Heat Exchanger

DOE requests comment and data related to the required equipment size increases associated with the design options at each TSL levels. Chapter 5 of the NOPR TSD contains full descriptions of the design options and DOE's analyses for the equipment size increase associated with the design options selected. DOE also requests comments and data on the efficiency gains associated with each set of design options. Chapter 5 of the NOPR TSD contains DOE's analyses of the efficiency gains for each design option considered. Finally, DOE requests comment and data on any utility impacts associated with each set of design options, such as potential ice-style changes.

2. Trial Standard Level Equations

Table V.4 and Table V.5 translate the TSLs into potential standards. In Table V.4, the TSLs are translated into energy consumption standards for the directly analyzed (primary) equipment classes. Table V.5. provides the equipment class mapping showing which of the directly analyzed standards' results were used to extend standards to secondary classes. Table V.6 extends the standards to the remaining (secondary) equipment classes that have not been analyzed directly.

TABLE V.4—POTENTIAL ENERGY CONSUMPTION STANDARDS FOR DIRECTLY ANALYZED CLASSES

Equipment class	TSL 1	TSL 2	TSL 3	TSL 4	TSL 5
IMH–W–Small–B	7.01–0.0050H	6.62–0.0047H	5.84–0.0041H	5.84–0.0041H	5.49–0.0039H.
IMH–W–Med–B	5.04–0.0010H	4.65–0.0007H	3.88–0.0002H	3.98–0.0004H	3.63–0.0002H.
IMH–W–Large–B	3.6	3.6	3.6	3.4	3.3.
IMH–A–Small–B	9.23–0.0077H	8.74–0.0073H	7.70–0.0065H	7.18–0.0060H	7.05–0.0059H.
IMH–A–Large–B	6.20–0.0010H	5.86–0.0009H	5.17–0.0008H	4.82–0.0008H	4.74–0.0008H.
IMH–A–Extended–B	(>= 2,500 and <4,000) 3.7;	(>=1,240 and <1,975) 4.7; (>=1,975 and <2,500) 6.89–0.0011H; (>= 2,500) 4.1.	(>=875 and <2,210) 4.5; (>=2,210 and <2,500) 6.89–0.0011H; (>= 2,500) 4.1.	(>=815 and <2,455) 4.2; (>=2,455 and <2,500) 6.89–0.0011H; (>= 2,500) 4.1.	(>=710 and <2,455) 4.2; (>=2,455 and <2,500) 6.89–0.0011H; (>= 2,500) 4.1.
RCU–NRC–Large–B	4.6	4.6	4.3	4.1	4.1.
SCU–W–Large–B	7.1	6.5	5.7	5.3	5.3.
SCU–A–Small–B	16.74–0.0436H	14.40–0.0375H	12.6–0.0328H	10.34–0.0227H	10.34–0.0227H.
SCU–A–Large–B	9.1	7.8	6.9	6.4	6.4.
IMH–A–Small–C	9.90–0.0057H	9.35–0.0053H	9.24–0.0061H	8.69–0.0058H	7.55–0.0042H.
IMH–A–Large–C	5.9	5.6	5.0	4.6	4.6.
SCU–A–Small–C	10.70–0.0058H	9.75–0.0053H	9.20–0.0050H	9.20–0.0050H	8.26–0.0045H.

TABLE V.5—DIRECTLY ANALYZED EQUIPMENT CLASSES USED TO DEVELOP STANDARDS FOR SECONDARY CLASSES

Secondary equipment class	Directly analyzed product class associated with efficiency level for secondary product class
RCU–NRC–Small–B.	RCU–NRC–Large–B.
RCU–RC–Small–B	RCU–NRC–Large–B.
RCU–RC–Large–B	RCU–NRC–Large–B.
SCU–W–Small–B	SCU–W–Large–B.
IMH–W–Small–C	IMH–A–Large–C.
IMH–W–Large–C	IMH–A–Large–C.
RCU–NRC–Small–C.	IMH–A–Large–C.
RCU–NRC–Large–C.	IMH–A–Large–C.
RCU–RC–Small–C	IMH–A–Large–C.
RCU–RC–Large–C	IMH–A–Large–C.
SCU–W–Small–C	SCU–A–Small–C.
SCU–W–Large–C	SCU–A–Small–C.
SCU–A–Large–C	SCU–A–Small–C.

TABLE V.6—POTENTIAL ENERGY CONSUMPTION STANDARDS FOR SECONDARY CLASSES

Equipment class	TSL 1	TSL 2	TSL 3	TSL 4	TSL 5
RCU–NRC–Small–B	8.04–0.0034H	8.04–0.0034H	7.52–0.0032H	7.08–0.0030H	7.05–0.0030H.
RCU–RC–Small–B	8.02–0.0034H	8.02–0.0034H	7.52–0.0032H	7.08–0.0030H	7.06–0.0030H.
RCU–RC–Large–B	4.8	4.8	4.5	4.3	4.3.
SCU–W–Small–B	10.60–0.0177H	9.69–0.0162H	8.55–0.0143H	7.98–0.0133H	7.96–0.0133H.
IMH–W–Small–C	7.29–0.0030H	6.86–0.0028H	6.08–0.0025H	5.67–0.0023H	5.65–0.0023H.
IMH–W–Large–C	4.6	4.3	3.8	3.6	3.6.
RCU–NRC–Small–C	9.00–0.0041H	8.50–0.0039H	7.5–0.0034H	7.00–0.0032H	6.98–0.0032H.
RCU–NRC–Large–C	5.5	5.2	4.6	4.3	4.3.
RCU–RC–Small–C	9.18–0.0041H	8.67–0.0039H	7.65–0.0034H	7.14–0.0031H	7.12–0.0031H.
RCU–RC–Large–C	5.7	5.4	4.8	4.5	4.5.
SCU–W–Small–C	8.46–0.0031H	7.74–0.0028H	7.28–0.0027H	7.28–0.0027H	6.53–0.0024H.
SCU–W–Large–C	5.7	5.2	4.9	4.9	4.4.
SCU–A–Large–C	6.6	6.0	5.7	5.7	5.1.

In developing TSLs, DOE analyzed each equipment class separately, and attributed a percentage reduction with each portion of the standard curve (small/medium/large). To ensure that the standard curve remained connected (no gaps at the breakpoints), DOE developed a method for expressing the consumption standards that relied on pivoting the low-capacity equipment classes about a representative point. DOE was able to use the same methodology for most equipment classes, with exceptions for IMH–W–B, IMH–A–B, and RCU–RC equipment classes.

In drawing a relationship between the harvest capacity (lb ice/24 hours) and the maximum allowed energy usage (kilowatt-hours per 100 lb of ice), DOE first took the large-capacity equipment class (which is set at a constant value for all equipment types except IMH–A) and applied the allocated percentage reduction (percentage reduction associated with the TSL for that equipment class). For example, for IMH–W–Large–B, the baseline level is set at 4.0. If the TSL allocated a 10-percent reduction for IMH–W–Large–B, then the next level was set at 4.0 × (1–10 percent) = 3.6 kWh/100 lb of ice.

Then, for the small equipment classes, DOE applied the allocated percentage reduction at a designated median capacity in that harvest rate range. The medium capacity was selected based on shipment levels, and where the median fell within the shipments data. For example, if the median capacity for the small equipment class was at 300 lb ice/24 hours, DOE would calculate the baseline energy usage and then apply the allocated percentage reduction to obtain a point at 300 lb ice/24 hours. DOE would then draw a line between the start of the large equipment class and this median capacity point to obtain the equation for the small equipment class, ensuring that there were no gaps between small and large-capacity.

For the IMH–W–B equipment classes, this equipment type has small, medium, and large equipment classes. In this case, for the small equipment class, DOE applied the allocated percentage reduction to the whole equation. So if the percentage reduction was 10 percent, the new equation for the small equipment class would be (1–10 percent) × (7.80 − 0.0055H) = 7.02 − 0.00495H. DOE would then draw a line between the end of the small equipment class and the start of the large equipment class, to obtain the equation for the medium equipment class.

For the IMH–A–B equipment classes, DOE sought to obtain a constant efficiency level for the largest equipment classes. This calculation is discussed in section IV.B.1.b.

For the RCU–RC–B and RCU–RC–C equipment classes, DOE simply took the standard levels calculated for the large RCU–NRC–B and RCU–NRC–C equipment classes, respectively, and subtracted the 0.2 kWh/100 lb of ice differential discussed in section IV.B.1.e, to arrive at the standard levels. For the small RCU classes, the remote compressor standards were developed such that no gap exists at the harvest rate breakpoints.

Using the typical unit size for directly analyzed equipment classes, the potential standards shown on Table V.4, DOE estimates energy usage for equipment within each class to be as shown on Table V.7.

TABLE V.7—ENERGY CONSUMPTION BY TSL FOR THE REPRESENTATIVE AUTOMATIC COMMERCIAL ICE MAKER UNITS

Equipment class	Representative harvest rate *lb ice/24 hours*	Energy consumption of the representative automatic commercial ice maker unit *kWh/100 lb*				
		TSL 1	TSL 2	TSL 3	TSL 4	TSL 5
IMH–W–Small–B	300	5.5	5.2	4.6	4.6	4.3
IMH–W–Med–B	850	4.2	4.0	3.7	3.6	3.5
IMH–W–Large–B–1	1500	3.6	3.6	3.6	3.4	3.3
IMH–W–Large–B–2	2600	3.6	3.6	3.6	3.4	3.3
IMH–A–Small–B	300	6.9	6.5	5.8	5.4	5.3
IMH–A–Large–B–1	800	5.4	5.1	4.5	4.2	4.1
IMH–A–Large–B–2	1500	3.7	4.7	4.5	4.2	4.2
RCU–Large–B–1	1500	4.6	4.6	4.3	4.1	4.1
RCU–Large–B–2	2400	4.6	4.6	4.3	4.1	4.1
SCU–W–Large–B	300	7.1	6.5	5.7	5.3	5.3
SCU–A–Small–B	110	11.9	10.3	9.0	7.8	7.8
SCU–A–Large–B	200	9.1	7.8	6.9	6.4	6.4
IMH–A–Small–C	310	8.1	7.7	7.3	6.9	6.2
IMH–A–Large–C	820	5.9	5.6	5.0	4.6	4.6
SCU–A–Small–C	110	10.1	9.2	8.7	8.7	7.8

B. Economic Justification and Energy Savings

1. Economic Impacts on Commercial Customers

a. Life-Cycle Cost and Payback Period

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

Table V.8 through Table V.25 show the results of the LCC analysis for each equipment class. Each table presents the results of the LCC analysis, including mean LCC, mean LCC savings, median PBP, and distribution of customer impacts in the form of percentages of customers who experience net cost, no impact, or net benefit.

Only two equipment classes have negative LCC savings values at TSL 5: SCU–A–Small–C and IMH–A–Small–C. Negative average LCC savings imply that, on average, customers experience an increase in LCC of the equipment as a consequence of buying equipment associated with that particular TSL. In many cases, the TSL 5 level is not negative, but the LCC savings are sharply lower than the TSL 3 levels. For IMH–W–Small–B, SCU–W–Large–B, and SCU–A–Small–B, the TSL 5 LCC savings are less than one-third the TSL 3 savings. In other cases, such as IMH–W–Large–B2, IMH–A–Small–B, SCU–A–Large–B, and IMH–A–Large–C, the TSL 5 LCC savings are roughly one-half of the TSL 3 LCC savings or less. All of these results indicate the cost increments associated with the max-tech design option are high, and the increase in LCC (and corresponding decrease in LCC savings) indicates that this design option may result in negative customer impacts. TSL 5 is associated with the max-tech level for all the equipment classes. Drain water heat exchanger technology is the design option associated with the max-tech efficiency levels for batch equipment classes. For continuous equipment classes, the max-tech design options are auger motors using permanent magnets.

The mean LCC savings associated with TSL 4 are all positive values for all equipment classes. The mean LCC savings at all lower TSL levels are also positive. The trend is generally an increase in LCC savings for TSL 1 through 3, with LCC savings either remaining constant or declining at TSL 4. In three cases, the highest LCC savings are at TSL 2: IMH–A–Large–B2, RCU–Large–B2, and SCU–A–Large–B. The drop-off in LCC savings at TSL 4 is generally associated with the relatively large cost for the max-tech design options, the savings for which frequently span the last two efficiency levels.

As described in section IV.H.2, DOE used a ''roll-up'' scenario in this rulemaking. Under the roll-up scenario, DOE assumes that the market shares of the efficiency levels (in the base case) that do not meet the standard level under consideration would be ''rolled up'' into (meaning ''added to'') the market share of the efficiency level at the standard level under consideration, and the market shares of efficiency levels that are above the standard level under consideration would remain unaffected. Customers, in the base-case scenario, who buy the equipment at or above the TSL under consideration, would be unaffected if the amended standard were to be set at that TSL. Customers, in the base-case scenario, who buy equipment below the TSL under consideration would be affected if the amended standard were to be set at that TSL. Among these affected customers, some may benefit from lower LCC of the equipment and some may incur net cost due to higher LCC, depending on the inputs to LCC analysis such as electricity prices, discount rates, installation costs, and markups. DOE's results indicate that, with one exception, customers either benefit or are unaffected by setting standards at TSLs 1, 2, or 3, and at TSL 4 in the case of SCU–A–Small–C. Customers either benefit or are unaffected at all 5 TSLs in the case of IMH–W–Large–B1. In the case of IMH–W–Small–B, 3 percent of customers are projected to experience a net cost at TSL 3. A large percentage of customers in batch equipment classes are unaffected by a standard set at TSL 1 given the equivalence to ENERGY STAR and the prevalence of ENERGY STAR qualifying equipment in those classes. At the other end of the range, in almost all cases, a portion of the market would experience net costs starting with TSL 4, although generally the portion experiencing a net cost is fairly low. At TSL 5, the range is wide, with all customers either unaffected or with a net benefit for the IMH–W–Large–B1 typical unit at one extreme and 100 percent of customers with either a net cost or unaffected for SCU–A–Small–C. In the cases of nine of the 18 equipment classes and/or typical unit sizes modeled (12 classes plus 3 pairs of typical units for large, batch type equipment classes), 20 percent or more of customers would experience a net cost at TSL 5. In the other nine cases, the percent of customers experiencing a net cost at TSL 5 ranges from 0 to 16 percent, with the remaining customers either unaffected or experiencing a net benefit.

The median PBP values for TSLs 1 through 3 are all less than 2 years, except for IMH–W–Small–B where the TSL 3 PBP is 2.3 years. The median PBP values for TSL 4 range from 1.9 years to 4.8 years.

PBP values for TSL 5 range from 2.2 years to over 19 years. SCU–A–Small–C exhibits the longest PBP for TSL 5 at 19.1 years. IMH–A–Small–C has a PBP of nearly 7 years, while IMH–W–Small–B has a PBP over 5 years. IMH–A–Small–B and SCU–A–Small–B both PBPs at or above 4 years for TSL 5.

TABLE V.8—SUMMARY LCC AND PBP RESULTS FOR IMH–W–SMALL–B EQUIPMENT CLASS

TSL	Energy usage *kWh/yr*	Life-cycle cost, all customers *2012$*			Life-cycle cost savings				Payback period, median *years*
		Installed cost	Discounted operating cost	LCC	Affected customers' average savings *2012$*	% of customers that experience			
						Net cost %	No impact %	Net benefit %	
1	3,052	2,425	10,862	13,286	199	0	61	39	1.1
2	2,884	2,451	10,740	13,191	215	0	35	65	1.3
3	2,547	2,614	10,369	12,982	328	3	0	97	2.3
4	2,547	2,614	10,369	12,982	328	3	0	97	2.3
5	2,400	2,999	10,262	13,261	49	45	0	55	5.4

TABLE V.9—SUMMARY LCC AND PBP RESULTS FOR IMH–W–MED–B EQUIPMENT CLASS

TSL	Energy usage *kWh/yr*	Life-cycle cost, all customers *2012$*			Life-cycle cost savings				Payback period, median *years*
		Installed cost	Discounted operating cost	LCC	Affected customers' average savings *2012$*	% of customers that experience			
						Net cost %	No impact %	Net benefit %	
1	6,507	4,241	24,859	29,100	464	0	31	69	0.6
2	6,507	4,241	24,859	29,100	464	0	31	69	0.6
3	6,147	4,286	24,601	28,887	587	0	14	86	0.9
4	5,786	4,656	24,341	28,997	405	15	2	83	3.3
5	5,691	4,671	24,272	28,943	460	11	2	87	3.2

TABLE V.10—SUMMARY LCC AND PBP RESULTS FOR IMH–W–LARGE–B EQUIPMENT CLASS

TSL	Energy usage *kWh/yr*	Life-cycle cost, all customers *2012$*			Life-cycle cost savings				Payback period, median *years*
		Installed cost	Discounted operating cost	LCC	Affected customers' average savings *2012$*	% of customers that experience			
						Net cost %	No impact %	Net benefit %	
1	11,585	6,243	49,854	56,097	833	0	38	62	0.7
2	11,585	6,243	49,854	56,097	833	0	38	62	0.7
3	11,585	6,243	49,854	56,097	833	0	38	62	0.7
4	10,943	6,813	49,390	56,202	550	8	26	66	3.6
5	10,783	6,868	49,274	56,142	582	7	22	71	3.6

TABLE V.11—SUMMARY LCC AND PBP RESULTS FOR IMH–W–LARGE–B1 EQUIPMENT CLASS

TSL	Energy usage *kWh/yr*	Life-cycle cost, all customers *2012$*			Life-cycle cost savings				Payback period, median *years*
		Installed cost	Discounted operating cost	LCC	Affected customers' average savings *2012$*	% of customers that experience			
						Net cost %	No impact %	Net benefit %	
1	9,877	5,132	42,919	48,051	701	0	29	71	0.7
2	9,877	5,132	42,919	48,051	701	0	29	71	0.7
3	9,877	5,132	42,919	48,051	701	0	29	71	0.7
4	9,329	5,646	42,523	48,170	583	0	29	71	3.7
5	9,147	5,717	42,392	48,109	607	0	24	76	3.8

TABLE V.12—SUMMARY LCC AND PBP RESULTS FOR IMH–W–LARGE–B2 EQUIPMENT CLASS

TSL	Energy usage *kWh/yr*	Life-cycle cost, all customers *2012$*			Life-cycle cost savings				Payback period, median *years*
		Installed cost	Discounted operating cost	LCC	Affected customers' average savings *2012$*	% of customers that experience			
						Net cost *%*	No impact *%*	Net benefit *%*	
1	17,104	9,833	72,254	82,087	1,260	0	67	33	0.6
2	17,104	9,833	72,254	82,087	1,260	0	67	33	0.6
3	17,104	9,833	72,254	82,087	1,260	0	67	33	0.6
4	16,155	10,581	71,569	82,150	442	35	17	48	3.1
5	16,067	10,587	71,506	82,093	500	29	17	54	3.0

TABLE V.13—SUMMARY LCC AND PBP RESULTS FOR IMH–A–SMALL–B EQUIPMENT CLASS

TSL	Energy usage kWh/yr	Life-cycle cost, all customers 2012$			Life-cycle cost savings				Payback period, median *years*
		Installed cost	Discounted operating cost	LCC	Affected customers' average savings 2012$	% of customers that experience			
						Net cost %	No impact %	Net benefit %	
1	3,806	2,475	9,046	11,521	254	0	63	37	1.1
2	3,596	2,506	8,894	11,400	259	0	32	68	1.2
3	3,176	2,574	8,601	11,174	396	0	0	100	1.4
4	2,965	2,951	8,449	11,400	170	27	0	73	4.3
5	2,909	2,964	8,408	11,372	198	22	0	78	4.2

TABLE V.14—SUMMARY LCC AND PBP RESULTS FOR IMH–A–LARGE–B EQUIPMENT CLASS

TSL	Energy usage kWh/yr	Life-cycle cost, all customers 2012$			Life-cycle cost savings				Payback period, median *years*
		Installed cost	Discounted operating cost	LCC	Affected customers' average savings 2012$	% of customers that experience			
						Net cost %	No impact %	Net benefit %	
1	8,704	4,179	16,075	20,254	648	0	60	40	0.5
2	8,334	4,199	15,813	20,013	633	0	23	77	0.5
3	7,482	4,335	15,017	19,352	1,127	0	6	94	0.8
4	7,041	4,739	14,703	19,442	994	4	2	94	2.2
5	7,041	4,739	14,703	19,442	994	4	2	94	2.2

TABLE V.15—SUMMARY LCC AND PBP RESULTS FOR IMH–A–LARGE–B1 EQUIPMENT CLASS

TSL	Energy usage kWh/yr	Life-cycle cost, all customers 2012$			Life-cycle cost savings				Payback period, median *years*
		Installed cost	Discounted operating cost	LCC	Affected customers' average savings 2012$	% of customers that experience			
						Net cost %	No impact %	Net benefit %	
1	7,919	4,119	15,303	19,421	590	0	59	41	0.5
2	7,480	4,143	14,993	19,135	572	0	15	85	0.5
3	6,603	4,279	14,143	18,421	1,168	0	0	100	0.8
4	6,213	4,663	13,865	18,528	1,062	1	0	99	2.1
5	6,213	4,663	13,865	18,528	1,062	1	0	99	2.1

TABLE V.16—SUMMARY LCC AND PBP RESULTS FOR IMH–A–LARGE–B2 EQUIPMENT CLASS

TSL	Energy usage kWh/yr	Life-cycle cost, all customers 2012$			Life-cycle cost savings				Payback period, median *years*
		Installed cost	Discounted operating cost	LCC	Affected customers' average savings 2012$	% of customers that experience			
						Net cost %	No impact %	Net benefit %	
1	12,932	4,505	20,234	24,739	960	0	67	33	0.4
2	12,932	4,505	20,234	24,739	960	0	67	33	0.4
3	12,215	4,641	19,725	24,366	908	0	40	60	0.9
4	11,498	5,151	19,217	24,368	627	16	13	70	2.6
5	11,498	5,151	19,217	24,368	627	16	13	70	2.6

TABLE V.17—SUMMARY LCC AND PBP RESULTS FOR RCU–LARGE–B EQUIPMENT CLASS

TSL	Energy usage kWh/yr	Life-cycle cost, all customers 2012$			Life-cycle cost savings				Payback period, median *years*
		Installed cost	Discounted operating cost	LCC	Affected customers' average savings 2012$	% of customers that experience			
						Net cost %	No impact %	Net benefit %	
1	13,205	6,321	16,686	23,007	875	0	58	42	0.4
2	13,205	6,321	16,686	23,007	875	0	58	42	0.4
3	12,335	6,406	16,063	22,469	983	0	18	82	0.6
4	11,611	6,934	15,551	22,485	870	6	10	85	2.4
5	11,526	6,968	15,490	22,458	897	5	10	85	2.4

TABLE V.18—SUMMARY LCC AND PBP RESULTS FOR RCU–LARGE–B1 EQUIPMENT CLASS

TSL	Energy usage kWh/yr	Life-cycle cost, all customers 2012$			Life-cycle cost savings				Payback period, median *years*
		Installed cost	Discounted operating cost	LCC	Affected customers' average savings 2012$	% of customers that experience			
						Net cost %	No impact %	Net benefit %	
1	12,727	6,135	16,214	22,349	847	0	57	43	0.4
2	12,727	6,135	16,214	22,349	847	0	57	43	0.4
3	11,889	6,214	15,614	21,828	963	0	18	82	0.6
4	11,191	6,722	15,119	21,840	857	6	9	85	2.4
5	11,108	6,756	15,059	21,815	882	5	9	86	2.4

TABLE V.19—SUMMARY LCC AND PBP RESULTS FOR RCU–LARGE–B2 EQUIPMENT CLASS

TSL	Energy usage kWh/yr	Life-cycle cost, all customers 2012$			Life-cycle cost savings				Payback period, median *years*
		Installed cost	Discounted operating cost	LCC	Affected customers' average savings 2012$	% of customers that experience			
						Net cost %	No impact %	Net benefit %	
1	20,349	9,105	23,743	32,847	1,298	0	73	27	0.8
2	20,349	9,105	23,743	32,847	1,298	0	73	27	0.8
3	19,009	9,283	22,775	32,058	1,277	0	27	73	1.0
4	17,892	10,108	22,017	32,124	1,070	7	18	75	2.7
5	17,779	10,137	21,935	32,072	1,123	6	18	76	2.7

TABLE V.20—SUMMARY LCC AND PBP RESULTS FOR SCU–W–LARGE–B EQUIPMENT CLASS

TSL	Energy usage kWh/yr	Life-cycle cost, all customers 2012$			Life-cycle cost savings				Payback period, median *years*
		Installed cost	Discounted operating cost	LCC	Affected customers' average savings 2012$	% of customers that experience			
						Net cost %	No impact %	Net benefit %	
1	3,892	3,501	12,082	15,583	483	0	71	29	0.7
2	3,559	3,530	11,849	15,379	687	0	71	29	0.8
3	3,143	3,596	11,548	15,144	694	0	57	43	1.0
4	2,935	3,950	11,398	15,348	143	49	14	36	3.0
5	2,925	3,951	11,391	15,342	149	49	14	37	3.0

TABLE V.21—SUMMARY LCC AND PBP RESULTS FOR SCU–A–SMALL–B EQUIPMENT CLASS

TSL	Energy usage kWh/yr	Life-cycle cost, all customers 2012$			Life-cycle cost savings				Payback period, median *years*
		Installed cost	Discounted operating cost	LCC	Affected customers' average savings 2012$	% of customers that experience			
						Net cost %	No impact %	Net benefit %	
1	2,419	2,772	7,548	10,321	103	0	83	17	1.4
2	2,084	2,821	7,320	10,141	198	0	37	63	1.5
3	1,826	2,896	6,979	9,875	396	0	11	89	1.6
4	1,585	3,306	6,813	10,119	106	32	0	68	4.8
5	1,585	3,306	6,813	10,119	106	32	0	68	4.8

TABLE V.22—SUMMARY LCC AND PBP RESULTS FOR SCU–A–LARGE–B EQUIPMENT CLASS

TSL	Energy usage kWh/yr	Life-cycle cost, all customers 2012$			Life-cycle cost savings				Payback period, median *years*
		Installed cost	Discounted operating cost	LCC	Affected customers' average savings 2012$	% of customers that experience			
						Net cost %	No impact %	Net benefit %	
1	3,349	3,243	10,645	13,888	140	0	71	29	1.4
2	2,884	3,324	10,105	13,429	522	0	36	64	1.2
3	2,526	3,405	9,857	13,262	502	0	7	93	1.5
4	2,351	3,758	9,731	13,489	240	34	0	66	3.7
5	2,351	3,758	9,731	13,489	240	34	0	66	3.7

TABLE V.23—SUMMARY LCC AND PBP RESULTS FOR IMH–A–SMALL–C EQUIPMENT CLASS

TSL	Energy usage kWh/yr	Life-cycle cost, all customers 2012$			Life-cycle cost savings				Payback period, median *years*
		Installed cost	Discounted operating cost	LCC	Affected customers' average savings 2012$ *	% of customers that experience			
						Net cost %	No impact %	Net benefit %	
1	4,630	6,644	9,390	16,034	315	0	77	23	0.9
2	4,374	6,666	9,212	15,877	314	0	54	46	0.9
3	4,118	6,694	9,031	15,726	391	0	40	60	1.0
4	3,862	6,913	8,848	15,761	307	8	31	61	2.6
5	3,555	7,461	8,789	16,251	(237)	73	11	16	6.8

* Values in parentheses are negative values.

TABLE V.24—SUMMARY LCC AND PBP RESULTS FOR IMH–A–LARGE–C EQUIPMENT CLASS

TSL	Energy usage kWh/yr	Life-cycle cost, all customers 2012$			Life-cycle cost savings				Payback period, median *years*
		Installed cost	Discounted operating cost	LCC	Affected customers' average savings 2012$	% of customers that experience			
						Net cost %	No impact %	Net benefit %	
1	8,911	5,518	15,462	20,980	660	0	65	35	0.5
2	8,417	5,543	15,113	20,656	744	0	45	55	0.5
3	7,430	5,630	14,426	20,055	1,026	0	15	85	0.7
4	6,936	6,288	14,269	20,557	524	21	15	64	3.2
5	6,912	6,289	14,262	20,552	500	21	10	69	3.2

TABLE V.25—SUMMARY LCC AND PBP RESULTS FOR SCU–A–SMALL–C EQUIPMENT CLASS

TSL	Energy usage kWh/yr	Life-cycle cost, all customers 2012$			Life-cycle cost savings				Payback period, median *years*
		Installed cost	Discounted operating cost	LCC	Affected customers' average savings 2012$ *	% of customers that experience			
						Net cost %	No impact %	Net benefit %	
1	2,040	3,603	7,243	10,846	93	0	73	27	1.1
2	1,866	3,632	7,127	10,760	140	0	53	47	1.5
3	1,758	3,659	7,057	10,717	146	0	37	63	1.9
4	1,758	3,659	7,057	10,717	146	0	37	63	1.9
5	1,580	4,196	7,099	11,295	(441)	80	20	0	19.1

* Values in parentheses are negative values.

b. Life-Cycle Cost Subgroup Analysis

As described in section IV.I, DOE estimated the impact of amended energy conservation standards for automatic commercial ice makers, at each TSL, on two customer subgroups—the foodservice sector and the lodging sector. For the automatic commercial ice makers, DOE has not distinguished between subsectors of the foodservice industry. In other words, DOE has been treating it as one sector as opposed to modeling limited or full service restaurants and other types of foodservice firms separately. Foodservice was chosen as one representative subgroup because of the large percentage of the industry represented by family or locally owned restaurants. Likewise, lodging was chosen due to the large percentage of the industry represented by locally owned, or franchisee-owned hotels. DOE carried out two LCC subgroup analyses, one each for restaurants and lodging, by using the LCC spreadsheet described in chapter 8 of the NOPR, but with certain modifications. The input for business type was fixed to the identified subgroup, which ensured that the discount rates and electricity price rates associated with only that subgroup were selected in the Monte Carlo simulations (see chapter 8 of the NOPR TSD). Another major change from the LCC analysis was an added assumption that the subgroups do not have access to national capital markets, which results in higher discount rates for the subgroups. The higher discount rates lead the subgroups valuing more highly upfront equipment purchase costs relative to the future operating cost savings. The LCC subgroup analysis is described in chapter 8 of the NOPR TSD.

Table V.26 presents the comparison of mean LCC savings for the small business subgroup in foodservice sector with the national average values (LCC savings results from chapter 8 of the NOPR TSD). For almost all TSLs in all equipment classes, the LCC savings for the small business subgroup are lower than the national average values. The exception is the TSL 5 result for SCU–A–Small–C. Table V.27 presents the percentage change in LCC savings compared to national average values. DOE modeled all equipment classes in this analysis, although DOE believes it is likely that the very large equipment classes are not commonly used in foodservice establishments. For TSLs 1 through 3, the differences range from −2 percent to −6 percent. For all but three equipment classes in Table V.27, the percentage decrease in LCC savings is less than 10 percent for all TSLs. For SCU–W–Large–B, the TSL 4 and 5 differences were −11 percent. SCU–A–Small–B, the TSL 4 and 5 differences were −17 percent. For IMH–W–Small–B, the TSL 5 difference is −37 percent.

Table V.28 presents the comparison of median PBPs for the small business subgroup in foodservice sector with national median values (median PBPs from chapter 8 of the NOPR TSD). The PBP values are shorter for the small business subgroup in all cases. This arises because the first-year operating cost savings—which are used for payback period—are higher leading to a shorter payback, but given their higher discount rates, these customers value future savings less, leading to lower LCC savings. First-year savings are higher because the foodservice electricity prices are higher than the average of all classes.

Table V.29 presents the comparison of mean LCC savings for the small business subgroup in lodging sector (hotels and casinos) with the national average values (LCC savings results from chapter 8 of the NOPR TSD). Table V.30 presents the percentage change in LCC savings of the lodging sector customer subgroup to national average values. For lodging sector small business, LCC savings are lower across the board. For TSLs 1 through 3, the lodging subgroup LCC savings range from 9 to 13 percent lower. The reason for this is that the energy price for lodging is slightly lower than the average of all commercial business types (97 percent of the average). This combined with a higher discount rate reduces the nominal value of future operating and maintenance benefits as well as the present value of the benefits, thus resulting in lower LCC savings.

Table V.31 presents the comparison of median PBPs for small business subgroup in the lodging sector with national median values (median PBPs from chapter 8 of the NOPR TSD). The PBP values are slightly higher in the lodging small business subgroup in all instances. As noted above, the energy savings would be lower in nominal terms than a national average Thus, the slightly lower median PBP appears to be a result of a narrower electricity saving results distribution that is close to but below the national average.

TABLE V.26—COMPARISON OF MEAN LCC SAVINGS FOR THE FOODSERVICE SECTOR SMALL BUSINESS SUBGROUP WITH THE NATIONAL AVERAGE VALUES

Equipment class	Category	Mean LCC savings *2012$**				
		TSL 1	TSL 2	TSL 3	TSL 4	TSL 5
IMH–W–Small–B	Small Business	195	210	312	312	31
	All Business Types	199	215	328	328	49
IMH–W–Med–B	Small Business	455	455	575	390	443
	All Business Types	464	464	587	405	460
IMH–W–Large–B	Small Business	816	816	816	528	559
	All Business Types	833	833	833	550	582
IMH–W–Large–B1	Small Business	687	687	687	561	585
	All Business Types	701	701	701	583	607
IMH–W–Large–B2	Small Business	1,233	1,233	1,233	419	476
	All Business Types	1,260	1,260	1,260	442	500
IMH–A–Small–B	Small Business	249	253	387	159	185
	All Business Types	254	259	396	170	198
IMH–A–Large–B	Small Business	635	621	1,094	956	956
	All Business Types	648	633	1,127	994	994
IMH–A–Large–B1	Small Business	578	561	1,132	1,021	1,021
	All Business Types	590	572	1,168	1,062	1,062
IMH–A–Large–B2	Small Business	941	941	888	604	604
	All Business Types	960	960	908	627	627
RCU–Large–B	Small Business	858	858	963	843	869
	All Business Types	875	875	983	870	897
RCU–Large–B1	Small Business	830	830	944	831	855
	All Business Types	847	847	963	857	882
RCU–Large–B2	Small Business	1,270	1,270	1,249	1,032	1,084
	All Business Types	1,298	1,298	1,277	1,070	1,123
SCU–W–Large–B	Small Business	455	655	666	126	132
	All Business Types	483	687	694	143	149
SCU–A–Small–B	Small Business	100	194	378	88	88
	All Business Types	103	198	396	106	106
SCU–A–Large–B	Small Business	137	498	483	219	219
	All Business Types	140	522	502	240	240
IMH–A–Small–C	Small Business	308	307	383	296	(238)
	All Business Types	315	314	391	307	(237)
IMH–A–Large–C	Small Business	647	729	1,006	512	489
	All Business Types	660	744	1,026	524	500
SCU–A–Small–C	Small Business	91	137	143	143	(434)

TABLE V.26—COMPARISON OF MEAN LCC SAVINGS FOR THE FOODSERVICE SECTOR SMALL BUSINESS SUBGROUP WITH THE NATIONAL AVERAGE VALUES—Continued

Equipment class	Category	Mean LCC savings 2012$*				
		TSL 1	TSL 2	TSL 3	TSL 4	TSL 5
	All Business Types	93	140	146	146	(441)

* Values in parenthesis are negative numbers.

TABLE V.27—PERCENTAGE CHANGE IN MEAN LCC SAVINGS FOR THE FOODSERVICE SECTOR SMALL BUSINESS SUBGROUP COMPARED TO NATIONAL AVERAGE VALUES *

Equipment class	TSL 1	TSL 2	TSL 3	TSL 4	TSL 5
IMH–W–Small–B	(2%)	(2%)	(5%)	(5%)	(37%)
IMH–W–Med–B	(2%)	(2%)	(2%)	(4%)	(4%)
IMH–W–Large–B	(2%)	(2%)	(2%)	(4%)	(4%)
IMH–W–Large–B1	(2%)	(2%)	(2%)	(4%)	(4%)
IMH–W–Large–B2	(2%)	(2%)	(2%)	(5%)	(5%)
IMH–A–Small–B	(2%)	(2%)	(2%)	(7%)	(6%)
IMH–A–Large–B	(2%)	(2%)	(3%)	(4%)	(4%)
IMH–A–Large–B1	(2%)	(2%)	(3%)	(4%)	(4%)
IMH–A–Large–B2	(2%)	(2%)	(2%)	(4%)	(4%)
RCU–Large–B	(2%)	(2%)	(2%)	(3%)	(3%)
RCU–Large–B1	(2%)	(2%)	(2%)	(3%)	(3%)
RCU–Large–B2	(2%)	(2%)	(2%)	(3%)	(3%)
SCU–W–Large–B	(6%)	(5%)	(4%)	(11%)	(11%)
SCU–A–Small–B	(2%)	(2%)	(5%)	(17%)	(17%)
SCU–A–Large–B	(2%)	(4%)	(4%)	(9%)	(9%)
IMH–A–Small–C	(2%)	(2%)	(2%)	(3%)	0%
IMH–A–Large–C	(2%)	(2%)	(2%)	(2%)	(2%)
SCU–A–Small–C	(2%)	(2%)	(2%)	(2%)	2%

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

TABLE V.28—COMPARISON OF MEDIAN PAYBACK PERIODS FOR THE FOODSERVICE SECTOR SMALL BUSINESS SUBGROUP WITH NATIONAL MEDIAN VALUES

Equipment class	Category	Median payback period years				
		TSL 1	TSL 2	TSL 3	TSL 4	TSL 5
IMH–W–Small–B	Small Business	1.02	1.20	2.16	2.16	5.14
	All Business Types	1.07	1.26	2.27	2.27	5.42
IMH–W–Med–B	Small Business	0.60	0.60	0.81	3.17	3.06
	All Business Types	0.63	0.63	0.85	3.33	3.22
IMH–W–Large–B	Small Business	0.65	0.65	0.65	3.42	3.42
	All Business Types	0.69	0.69	0.69	3.59	3.60
IMH–W–Large–B1	Small Business	0.68	0.68	0.68	3.57	3.59
	All Business Types	0.72	0.72	0.72	3.75	3.77
IMH–W–Large–B2	Small Business	0.55	0.55	0.55	2.95	2.88
	All Business Types	0.58	0.58	0.58	3.10	3.02
IMH–A–Small–B	Small Business	1.02	1.16	1.35	4.11	4.03
	All Business Types	1.07	1.22	1.42	4.32	4.24
IMH–A–Large–B	Small Business	0.44	0.47	0.80	2.06	2.06
	All Business Types	0.46	0.49	0.84	2.16	2.16
IMH–A–Large–B1	Small Business	0.44	0.48	0.78	1.99	1.99
	All Business Types	0.46	0.50	0.82	2.08	2.08
IMH–A–Large–B2	Small Business	0.40	0.40	0.90	2.45	2.45
	All Business Types	0.42	0.42	0.94	2.58	2.58
RCU–Large–B	Small Business	0.39	0.39	0.62	2.27	2.32
	All Business Types	0.41	0.41	0.65	2.39	2.44
RCU–Large–B1	Small Business	0.37	0.37	0.59	2.25	2.31
	All Business Types	0.38	0.38	0.62	2.37	2.42
RCU–Large–B2	Small Business	0.72	0.72	0.96	2.57	2.57
	All Business Types	0.75	0.75	1.00	2.70	2.70
SCU–W–Large–B	Small Business	0.65	0.73	0.96	2.87	2.86
	All Business Types	0.67	0.76	1.00	3.01	3.00
SCU–A–Small–B	Small Business	1.33	1.44	1.48	4.54	4.54
	All Business Types	1.40	1.52	1.56	4.79	4.79
SCU–A–Large–B	Small Business	1.29	1.11	1.42	3.54	3.54

TABLE V.28—COMPARISON OF MEDIAN PAYBACK PERIODS FOR THE FOODSERVICE SECTOR SMALL BUSINESS SUBGROUP WITH NATIONAL MEDIAN VALUES—Continued

Equipment class	Category	Median payback period *years*				
		TSL 1	TSL 2	TSL 3	TSL 4	TSL 5
	All Business Types	1.37	1.17	1.49	3.72	3.72
IMH–A–Small–C	Small Business	0.86	0.86	0.92	2.46	6.38
	All Business Types	0.90	0.90	0.97	2.59	6.83
IMH–A–Large–C	Small Business	0.50	0.50	0.65	3.06	3.05
	All Business Types	0.52	0.53	0.69	3.25	3.24
SCU–A–Small–C	Small Business	1.08	1.45	1.76	1.76	17.09
	All Business Types	1.13	1.53	1.85	1.85	19.12

TABLE V.29—COMPARISON OF LCC SAVINGS FOR THE LODGING SECTOR SMALL BUSINESS SUBGROUP WITH THE NATIONAL AVERAGE VALUES

Equipment class	Category	Mean LCC savings *2012$**				
		TSL 1	TSL 2	TSL 3	TSL 4	TSL 5
IMH–W–Small–B	Small Business	179	192	285	285	(3)
	All Business Types	199	215	328	328	49
IMH–W–Med–B	Small Business	421	421	531	334	382
	All Business Types	464	464	587	405	460
IMH–W–Large–B	Small Business	756	756	756	449	476
	All Business Types	833	833	833	550	582
IMH–W–Large–B1	Small Business	635	635	635	484	503
	All Business Types	701	701	701	583	607
IMH–W–Large–B2	Small Business	1,144	1,144	1,144	338	390
	All Business Types	1,260	1,260	1,260	442	500
IMH–A–Small–B	Small Business	229	232	354	115	139
	All Business Types	254	259	396	170	198
IMH–A–Large–B	Small Business	589	575	1,018	862	862
	All Business Types	648	633	1,127	994	994
IMH–A–Large–B1	Small Business	536	520	1,056	926	926
	All Business Types	590	572	1,168	1,062	1,062
IMH–A–Large–B2	Small Business	873	873	816	521	521
	All Business Types	960	960	908	627	627
RCU–Large–B	Small Business	796	796	890	744	766
	All Business Types	875	875	983	870	897
RCU–Large–B1	Small Business	771	771	873	734	754
	All Business Types	847	847	963	857	882
RCU–Large–B2	Small Business	1,175	1,175	1,149	891	937
	All Business Types	1,298	1,298	1,277	1,070	1,123
SCU–W–Large–B	Small Business	440	624	626	96	102
	All Business Types	483	687	694	143	149
SCU–A–Small–B	Small Business	92	177	353	55	55
	All Business Types	103	198	396	106	106
SCU–A–Large–B	Small Business	126	470	448	179	179
	All Business Types	140	522	502	240	240
IMH–A–Small–C	Small Business	284	283	352	257	(281)
	All Business Types	315	314	391	307	(237)
IMH–A–Large–C	Small Business	600	676	929	412	394
	All Business Types	660	744	1,026	524	500
SCU–A–Small–C	Small Business	84	125	128	128	(452)
	All Business Types	93	140	146	146	(441)

* Values in parentheses are negative numbers.

TABLE V.30—PERCENTAGE CHANGE IN MEAN LCC SAVINGS FOR THE LODGING SECTOR SMALL BUSINESS SUBGROUP COMPARED TO NATIONAL AVERAGE VALUES *

Equipment class	TSL 1	TSL 2	TSL 3	TSL 4	TSL 5
IMH–W–Small–B	(10%)	(10%)	(13%)	(13%)	(107%)
IMH–W–Med–B	(9%)	(9%)	(10%)	(18%)	(17%)
IMH–W–Large–B	(9%)	(9%)	(9%)	(18%)	(18%)
IMH–W–Large–B1	(9%)	(9%)	(9%)	(17%)	(17%)
IMH–W–Large–B2	(9%)	(9%)	(9%)	(24%)	(22%)
IMH–A–Small–B	(10%)	(10%)	(11%)	(32%)	(30%)
IMH–A–Large–B	(9%)	(9%)	(10%)	(13%)	(13%)

TABLE V.30—PERCENTAGE CHANGE IN MEAN LCC SAVINGS FOR THE LODGING SECTOR SMALL BUSINESS SUBGROUP COMPARED TO NATIONAL AVERAGE VALUES *—Continued

Equipment class	TSL 1	TSL 2	TSL 3	TSL 4	TSL 5
IMH–A–Large–B1	(9%)	(9%)	(10%)	(13%)	(13%)
IMH–A–Large–B2	(9%)	(9%)	(10%)	(17%)	(17%)
RCU–Large–B	(9%)	(9%)	(9%)	(15%)	(15%)
RCU–Large–B1	(9%)	(9%)	(9%)	(14%)	(15%)
RCU–Large–B2	(9%)	(9%)	(10%)	(17%)	(16%)
SCU–W–Large–B	(9%)	(9%)	(10%)	(33%)	(32%)
SCU–A–Small–B	(11%)	(11%)	(11%)	(49%)	(49%)
SCU–A–Large–B	(10%)	(10%)	(11%)	(25%)	(25%)
IMH–A–Small–C	(10%)	(10%)	(10%)	(16%)	(18%)
IMH–A–Large–C	(9%)	(9%)	(9%)	(21%)	(21%)
SCU–A–Small–C	(10%)	(11%)	(12%)	(12%)	(2%)

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

TABLE V.31—COMPARISON OF MEDIAN PAYBACK PERIODS FOR THE LODGING SECTOR SMALL BUSINESS SUBGROUP WITH THE NATIONAL MEDIAN VALUES

Equipment class	Category	Median payback period *years*				
		TSL 1	TSL 2	TSL 3	TSL 4	TSL 5
IMH–W–Small–B	Small Business	1.09	1.28	2.27	2.27	5.42
	All Business Types	1.07	1.26	2.27	2.27	5.42
IMH–W–Med–B	Small Business	0.64	0.64	0.86	3.38	3.26
	All Business Types	0.63	0.63	0.85	3.33	3.22
IMH–W–Large–B	Small Business	0.70	0.70	0.70	3.65	3.65
	All Business Types	0.69	0.69	0.69	3.59	3.60
IMH–W–Large–B1	Small Business	0.73	0.73	0.73	3.80	3.83
	All Business Types	0.72	0.72	0.72	3.75	3.77
IMH–W–Large–B2	Small Business	0.58	0.58	0.58	3.14	3.07
	All Business Types	0.58	0.58	0.58	3.10	3.02
IMH–A–Small–B	Small Business	1.08	1.24	1.44	4.39	4.30
	All Business Types	1.07	1.22	1.42	4.32	4.24
IMH–A–Large–B	Small Business	0.46	0.50	0.85	2.19	2.19
	All Business Types	0.46	0.49	0.84	2.16	2.16
IMH–A–Large–B1	Small Business	0.47	0.51	0.83	2.11	2.11
	All Business Types	0.46	0.50	0.82	2.08	2.08
IMH–A–Large–B2	Small Business	0.43	0.43	0.96	2.61	2.61
	All Business Types	0.42	0.42	0.94	2.58	2.58
RCU–Large–B	Small Business	0.41	0.41	0.66	2.42	2.48
	All Business Types	0.41	0.41	0.65	2.39	2.44
RCU–Large–B1	Small Business	0.39	0.39	0.63	2.40	2.46
	All Business Types	0.38	0.38	0.62	2.37	2.42
RCU–Large–B2	Small Business	0.77	0.77	1.02	2.74	2.74
	All Business Types	0.75	0.75	1.00	2.70	2.70
SCU–W–Large–B	Small Business	0.67	0.75	1.01	3.01	3.00
	All Business Types	0.67	0.76	1.00	3.01	3.00
SCU–A–Small–B	Small Business	1.42	1.54	1.56	4.79	4.79
	All Business Types	1.40	1.52	1.56	4.79	4.79
SCU–A–Large–B	Small Business	1.38	1.17	1.49	3.72	3.72
	All Business Types	1.37	1.17	1.49	3.72	3.72
IMH–A–Small–C	Small Business	0.92	0.92	0.99	2.63	6.88
	All Business Types	0.90	0.90	0.97	2.59	6.83
IMH–A–Large–C	Small Business	0.53	0.53	0.70	3.28	3.28
	All Business Types	0.52	0.53	0.69	3.25	3.24
SCU–A–Small–C	Small Business	1.15	1.55	1.88	1.88	19.13
	All Business Types	1.13	1.53	1.85	1.85	19.12

2. Economic Impacts on Manufacturers

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

a. Industry Cash Flow Analysis Results

The following tables depict the financial impacts (represented by changes in INPV) of amended energy conservation standards on manufacturers of automatic commercial ice makers as well as the conversion costs that DOE estimates manufacturers would incur for all equipment classes at each TSL. To evaluate the range of cash flow impacts on the commercial ice maker industry, DOE used two different markup assumptions to model scenarios that correspond to the range of anticipated market responses to new and amended energy conservation standards.

To assess the lower (less severe) end of the range of potential impacts, DOE modeled a preservation of gross margin percentage markup scenario, in which a uniform ''gross margin percentage'' markup is applied across all efficiency levels. In this scenario, DOE assumed that a manufacturer's absolute dollar markup would increase as production costs increase in the amended energy conservation standards case. Manufacturers have indicated that it is optimistic to assume that they would be able to maintain the same gross margin percentage markup as their production costs increase in response to a new or amended energy conservation standard, particularly at higher TSLs.

To assess the higher (more severe) end of the range of potential impacts, DOE modeled the preservation of the EBIT markup scenario, which assumes that manufacturers would not be able to preserve the same overall gross margin, but instead cut their markup for marginally compliant products to maintain a cost competitive product offering and keep the same overall level of EBIT as in the base case. The two tables below show the range of potential INPV impacts for manufacturers of automatic commercial ice makers. The first table reflects the lower bound of impacts (higher profitability) and the second represents the upper bound of impacts (lower profitability).

Each scenario results in a unique set of cash flows and corresponding industry values at each TSL. In the following discussion, the INPV results refer to the sum of discounted cash flows through 2047, the difference in INPV between the base case and each standards case, and the total industry conversion costs required for each standards case.

TABLE V.32—MANUFACTURER IMPACT ANALYSIS FOR AUTOMATIC COMMERCIAL ICE MAKERS—PRESERVATION OF GROSS MARGIN PERCENTAGE MARKUP SCENARIO *

	Units	Base case	Trial standard level				
			1	2	3	4	5
INPV	2012$ Millions	$101.8	$93.4	$89.0	$80.9	$82.2	$81.9
Change in INPV	2012$ Millions		$(8.4)	$(12.8)	$(20.9)	$(19.6)	$(19.9)
	(%)		(8.2)%	(12.6)%	(20.5)%	(19.2)%	(19.5)%
Product Conversion Costs	2012$ Millions		$17.0	$25.4	$38.3	$44.8	$46.9
Capital Conversion Costs	2012$ Millions		$0.4	$1.2	$3.9	$6.4	$7.3
Total Conversion Costs	2012$ Millions		$17.4	$26.6	$42.2	$51.2	$54.2

* Values in parentheses are negative numbers.

TABLE V.33—MANUFACTURER IMPACT ANALYSIS FOR AUTOMATIC COMMERCIAL ICE MAKERS—PRESERVATION OF EBIT MARKUP SCENARIO *

	Units	Base case	Trial standard level				
			1	2	3	4	5
INPV	2012$ Millions	$101.8	$93.1	$88.2	$77.9	$71.3	$69.2
Change in INPV	2012$ Millions		$(8.7)	$(13.6)	$(23.9)	$(30.5)	$(32.6)
	(%)		(8.5)%	(13.4)%	(23.5)%	(30.0)%	(32.0)%
Product Conversion Costs	2012$ Millions		$17.0	$25.4	$38.3	$44.8	$46.9
Capital Conversion Costs	2012$ Millions		$0.4	$1.2	$3.9	$6.4	$7.3
Total Conversion Costs	2012$ Millions		$17.4	$26.6	$42.2	$51.2	$54.2

* Values in parentheses are negative numbers.

Beyond impacts on INPV, DOE includes a comparison of free cash flow between the base case and the standards case at each TSL in the year before amended standards take effect to provide perspective on the short-run cash flow impacts in the discussion of the results below.

At TSL 1, DOE estimates impacts on INPV for manufacturers of automatic commercial ice makers to range from −$8.4 million to −$8.7 million, or a change in INPV of −8.2 percent to −8.5 percent. At this TSL, industry free cash flow is estimated to decrease by approximately 61 percent to $3.3 million, compared to the base-case value of $8.4 million in the year before the compliance date (2017).

DOE estimates that approximately 40 percent of all batch commercial ice makers and 30 percent of all continuous commercial ice makers on the market will require redesign to meet standards at TSL 1. Additionally, for both batch and continuous products, the number of products requiring redesign at this TSL is commensurate with each manufacturer's estimated market share. Twelve manufacturers, including three small businesses, produce equipment that complies with the efficiency levels specified at TSL 1.

At TSL 1, the majority of efficiency gains could be made through swapping purchased components for higher efficiency equivalents. It is expected that very few evaporators and condensers are affected at TSL 1, leading to very low expected industry capital conversion costs totaling only $0.4 million. However, moderate product conversion costs of $17.0 million are expected, as redesigned units will require low levels of engineering design labor, as well as testing for equipment certification.

At TSL 2, DOE estimates impacts on INPV for manufacturers of automatic commercial ice makers to range from −$12.8 million to −$13.6 million, or a change in INPV of −12.6 percent to −13.4 percent. At this TSL, industry free cash flow is estimated to decrease by approximately 97 percent to $0.2 million, compared to the base-case value of $8.4 million in the year before the compliance date (2017).

At TSL 2, total conversion costs increase to $26.6 million, 53 percent higher than those incurred by industry at TSL 1. DOE estimates that approximately 58 percent of all units on the market will require redesign to meet the standards outlined at TSL 2. As with TSL 1, for batch and continuous commercial ice makers, the number of products requiring redesign at this TSL is largely commensurate with each manufacturer's estimated market share. Ten manufacturers, including three small businesses, produce equipment that complies with the efficiency levels specified at TSL 2.

The majority of redesigns still rely on switching to higher efficiency components, but a limited number of units are expected to require more complex system redesigns including the evaporator and condenser. The increased, but moderate, complexity of these redesigns causes product conversion costs to grow at a slightly higher rate than the additional number of units requiring redesign, resulting in industry-wide product conversion costs totaling $25.4 million. Capital conversion costs continue to remain relatively low at $1.2 million, as most design options considered at TSL 2 can be integrated into production without changes to manufacturing capital.

At TSL 3, DOE estimates impacts on INPV for manufacturers of automatic commercial ice makers to range from −$20.9 million to −$23.9 million, or a change in INPV of −20.5 percent to −23.5 percent. At this TSL, industry free cash flow is estimated to decrease by approximately 180 percent to −$6.7 million, compared to the base-case value of $8.4 million in the year before the compliance date (2017).

At TSL 3, total conversion costs grow significantly to $42.2 million, an increase of 59 percent over those incurred by manufacturers at TSL 2. DOE estimates that approximately 88 percent of all batch products and 75 percent of all continuous products on the market will require redesign to meet this TSL. Six of the 12 manufacturers of batch equipment currently produce batch commercial ice makers that comply with the efficiency levels specified at TSL 3. This includes one small business manufacturer. In contrast, all six manufacturers of continuous commercial ice makers identified produce products that comply with the efficiency levels specified at TSL 3.

The majority of redesigns necessary to meet the standards at TSL 3 involve more complex changes to the evaporator and condenser systems. These complex redesigns result in product conversion costs increasing at a rate higher than simply the additional number of units that require redesign. At TSL 3, the resulting industry product conversion costs total $38.3 million. Additionally, capital conversion costs jump significantly to $3.9 million, as evaporator and condenser redesigns spur investments in tooling for both of these components and the surrounding enclosure.

At TSL 4, DOE estimates impacts on INPV for manufacturers of automatic commercial ice makers to range from −$19.6 million to −$30.5 million, or a change in INPV of −19.2 percent to −30.0 percent. At this TSL, industry free cash flow is estimated to decrease by approximately 227 percent to −$10.7 million, compared to the base-case value of $8.4 million in the year before the compliance date (2017).

At TSL 4, total conversion costs grow to $51.2 million. Relative to the change between TSLs 2 and 3, the increases in conversion costs at TSL 4 are smaller as the percentage of batch and continuous units requiring redesign grows to 96 percent and 77 percent, respectively. These fractions are up from 88 percent and 75 percent, respectively, at TSL 3. Only two manufacturers, including one small business manufacturer, currently produce batch commercial ice makers that comply with the efficiency levels specified at TSL 4. In contrast, all six manufacturers of continuous commercial ice makers identified produce products that comply with the efficiency levels specified at TSL 4.

With very few additional units needing redesigns, costs incurred are mainly incremental, and account for the increasing complexity of condenser and evaporator redesigns. Product conversion costs grow to $44.8 million, 17 percent above those at TSL 3. However, the increasing complexity of redesign does incur greater capital conversion costs, which grow to $6.4 million as additional capital investments are required to modify production lines to manufacture these more complex designs.

At TSL 5, DOE estimates impacts on INPV for manufacturers of automatic commercial ice makers to range from −$19.9 million to −$32.6 million, or a change in INPV of −19.5 percent to −32.0 percent. At this TSL, industry free cash flow is estimated to decrease by approximately 243 percent to −$12.0 million, compared to the base-case value of $8.4 million in the year before the compliance date (2017).

As with TSL 4, only two manufacturers, including one small business manufacturer, currently produce batch commercial ice makers that comply with the efficiency levels specified at TSL 5. For manufacturers of continuous commercial ice makers, this number drops from six to four. As compared to the previous increases in required efficiency between TSLs, the changes between TSL 4 and TSL 5 are minimal. As a result, total conversion costs grow only slightly, rising 6 percent to $54.2 million. This consists of $46.9 million in product conversion costs and $7.3 million in capital conversion costs.

b. Impacts on Direct Employment

DOE used the GRIM to estimate the domestic labor expenditures and number of domestic production workers in the base case and at each TSL from 2013 to 2047. DOE used statistical data from the most recent U.S Census Bureau's ''Annual Survey of Manufactures,'' the results of the engineering analysis, and interviews with manufacturers to determine the inputs necessary to calculate industry-wide labor expenditures and domestic employment levels. Labor expenditures for the manufacture of a product are a function of the labor intensity of the product, the sales volume, and an assumption that wages in real terms remain constant.

In the GRIM, DOE used the labor content of each product and the manufacturing production costs from the engineering analysis to estimate the annual labor expenditures in the automatic commercial ice maker industry. DOE used information gained through interviews with manufacturers to estimate the portion of the total labor expenditures that is attributable to domestic labor.

The production worker estimates in this section cover workers only up to the line-supervisor level who are directly involved in fabricating and assembling automatic commercial ice makers within an original equipment manufacturer (OEM) facility. Workers performing services that are closely associated with production operations, such as material handling with a forklift, are also included as production labor.

The employment impacts shown in Table V.34 represent the potential production employment that could result following new and amended energy conservation standards. The upper end of the results in this table estimates the total potential increase in the number of production workers after amended energy conservation standards. To calculate the total potential increase, DOE assumed that manufacturers continue to produce the same scope of covered products in domestic production facilities and domestic production is not shifted to lower-labor-cost countries. Because there is a risk of manufacturers evaluating sourcing decisions in response to amended energy conservation standards, the lower end of the range of employment results in Table V.34 includes the estimated total number of U.S. production workers in the industry who could lose their jobs if all existing production were moved outside of the United States. While the results present a range of employment impacts following the compliance date of amended energy conservation standards, the discussion below also includes a qualitative discussion of the likelihood of negative employment impacts at the various TSLs. Finally, the employment impacts shown are independent of the employment impacts from the broader U.S. economy, which are documented in chapter 13 of the NOPR TSD.

DOE estimates that in the absence of amended energy conservation standards, there would be 268 domestic production workers involved in manufacturing automatic commercial ice makers in 2018. Using 2011 Census Bureau data and interviews with manufacturers, DOE estimates that approximately 84 percent of automatic commercial ice makers sold in the United States are manufactured domestically. Table V.34 shows the range of the impacts of potential amended energy conservation standards on U.S. production workers in the automatic commercial ice maker industry.

TABLE V.34—POTENTIAL CHANGES IN THE TOTAL NUMBER OF DOMESTIC AUTOMATIC COMMERCIAL ICE MAKER PRODUCTION WORKERS IN 2018

	Base case	1	2	3	4	5
Total Number of Domestic Production Workers in 2018 (without changes in production locations)	268	268	268	269	269	269
Potential Changes in Domestic Production Workers in 2018 *	....	0–(268)	0–(268)	1–(268)	1–(268)	1–(268)

* DOE presents a range of potential employment impacts. Values in parentheses are negative numbers.

All examined TSLs show relatively minor impacts on domestic employment levels relative to total industry employment. At all TSLs, most of the design options analyzed by DOE do not greatly alter the labor content of the final product. For example, the use of higher efficiency compressors or fan motors involve one-time changes to the final product, but do not significantly change the number of steps required for the final assembly. One manufacturer suggested that their domestic production employment levels would only change if market demand contracted following higher overall prices. However, more than one manufacturer suggested that where they already have overseas manufacturing capabilities, they would consider moving additional manufacturing to those facilities if they felt the need to offset a significant rise in materials costs. Provided the changes in materials costs do not support the relocation of manufacturing facilities, one would expect only modest changes to domestic manufacturing employment balancing additional requirements for assembly labor with the effects of price elasticity.

c. Impacts on Manufacturing Capacity

According to the majority of automatic commercial ice maker manufacturers interviewed, amended energy conservation standards that require modest changes to product efficiency will not significantly affect manufacturers' production capacities. Any redesign of automatic commercial ice makers would not change the fundamental assembly of the equipment, but manufacturers do anticipate some potential for additional lead time immediately following standards associated with changes in sourcing of higher efficiency components, which may be supply constrained.

One manufacturer cited the possibility of a 3- to 6-month shutdown in the event that amended standards were set high enough to require retooling of their entire product line. Most of the design options being evaluated are already available on the market as product options. Thus, DOE believes that short of widespread retooling, manufacturers would be able to maintain manufacturing capacity levels and continue to meet market demand under amended energy conservation standards.

d. Impacts on Subgroups of Manufacturers

Small business, low volume, and niche equipment manufacturers, and manufacturers exhibiting a cost structure substantially different from the industry average could be affected disproportionately. As discussed in section IV.J, using average cost assumptions to develop an industry cash flow estimate is inadequate to assess differential impacts among manufacturer subgroups.

For automatic commercial ice makers, DOE identified and evaluated the impact of amended energy conservation standards on one subgroup: small manufacturers. The SBA defines a ''small business'' as having 750 employees or less for NAICS 333415, ''Air-Conditioning and Warm Air Heating Equipment and Commercial and Industrial Refrigeration Equipment Manufacturing,'' which includes ice-making machinery manufacturing. Based on this definition, DOE identified seven manufacturers in the automatic commercial ice makers industry that are small businesses.

For a discussion of the impacts on the small manufacturer subgroup, see the regulatory flexibility analysis in section VI.B of this notice and chapter 12 of the NOPR TSD.

e. Cumulative Regulatory Burden

While any one regulation may not impose a significant burden on manufacturers, the combined effects of recent or impending regulations may have serious consequences for some manufacturers, groups of manufacturers, or an entire industry. Assessing the impact of a single regulation may overlook this cumulative regulatory burden. In addition to energy conservation standards, other regulations can significantly affect manufacturers' financial operations. Multiple regulations affecting the same manufacturer can strain profits and lead companies to abandon product lines or markets with lower expected future returns than competing products. For these reasons, DOE conducts an analysis of cumulative regulatory burden as part of its rulemakings pertaining to equipment efficiency.

During previous stages of this rulemaking, DOE identified a number of requirements in addition to amended energy conservation standards for automatic commercial ice makers. The following section briefly addresses comments DOE received with respect to cumulative regulatory burden and summarizes other key related concerns that manufacturers raised during interviews.

Existing Federal Standards for Automatic Commercial Ice Makers

Several manufacturers commented that they had made substantial investments in order to comply with the previous Federal energy conservation standards for batch style automatic commercial ice makers, which took effect in January 2010. While DOE acknowledges the significant investment on the part of industry, because the proposed compliance date for new and amended standards is 2018, there should be no direct overlap of compliance costs from either standard. The residual financial impact of the previous energy conservation standards manifest themselves in the 2018 standards MIA as the prevailing industry conditions absent new or amended energy conservation standards. This serves as the basis for the base-case INPV.

Certification, Compliance, and Enforcement (CC&E) Rule

Multiple manufacturers expressed concerns about the burden CC&E would impose on the automatic commercial ice maker industry. CC&E requires testing and compliance for a wide array of equipment offerings. One manufacturer cited the increase in testing burden associated with the DOE's new definition of ''basic'' model, which has contributed significantly to the number of models considered to be basic. Manufacturers worry that testing each variation would present a significant testing burden, especially for small business manufacturers.

In addition to costs associated with DOE CC&E requirements, manufacturers cited an array of other certifications as being an additional and substantial burden. Such certifications include codes and standards developed by American Society of Mechanical Engineers (ASME), which include standards for compressors, fasteners, flow measurement, nuclear, environmental control, piping, pressure vessels, pumps, storage tanks, and more.[67] Other critical certification programs for manufacturers of automatic commercial ice makers include those of National Sanitation Foundation (NSF), Underwriters Laboratories (UL), NRCan, and CEC. A new energy efficiency standard put forth by the DOE that requires a complete product redesign will necessitate recertification from the above-mentioned programs. Manufacturers are concerned about the cumulative testing burden associated with such re-certifications.

DOE understands that testing and certification requirements may have a significant impact on manufacturers, and the CC&E burden is identified as a key issue in the MIA. DOE also understands that CC&E requirements can be particularly onerous for manufacturers producing low volume or highly customized equipment. Regarding other certification programs, the DOE again acknowledges the potential burden associated with recertification. However, DOE also recognizes that these programs are voluntary.

EPA and ENERGY STAR

Some manufacturers expressed concerns regarding potential conflicts with the ENERGY STAR certification program. Manitowoc publicly commented that certification by the ENERGY STAR program is very important to their customers for a variety of reasons including the potential for utility rebates and LEED certification. Manitowoc went on to say that if DOE's energy efficiency standard level is raised to the max-tech level, there would be no room for the ENERGY STAR classification and that this could be highly disruptive to the industry (Manitowoc, No. 42 at pp. 15–16). Due to the clear market value of the ENERGY STAR program, manufacturers expressed concern about the additional testing burdens associated with having to re-certify products, or alternatively, having to forfeit market share by offering products that are not ENERGY STAR certified.

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

Other Federal Regulations

Manufacturers also expressed concerns regarding the additional burden caused by other Federal regulations, including the upcoming amended energy conservation standards for residential refrigerators and freezers, commercial refrigeration equipment, walk-in coolers and freezers, miscellaneous residential refrigeration products, and cooking products.

DOE recognizes the additional burden faced by manufacturers that produce both automatic commercial ice makers in combination with one or many of the above-mentioned products. Companies that produce a wide range of regulated equipment may be faced with more capital and equipment design development expenditures than competitors with a narrower scope of production. DOE does attempt to quantify the cumulative burden of Federal energy conservation standards on manufacturers in its manufacturer impact analysis (see chapter 12 of TSD). However, DOE cannot consider the quantitative impacts of amended standards that have not yet been finalized, such as those for walk-in coolers and walk-in freezers.

State Regulations

Relating to the CEC codes and standards, one manufacturer noted California's 2020 energy policy goals, including the reduction of greenhouse gas emissions to 1990 levels, as a source of additional burden for automatic commercial ice maker manufacturers. Manufacturers also added that the lead limit guidelines (see, for example, section 4–101.13(C) of the Food Code 2013)[68] put forth by the U.S. Food and Drug Administration (FDA), and adopted as code by all 50 states,[69] carry associated compliance costs. The levels specified by these guidelines have remained unchanged for at least 15 years.

International Regulations

Finally, one manufacturer noted additional burden associated with the European Union (EU) Restriction on Hazardous Substances Directive (RoHS), which restricts the use of six hazardous materials, including lead, mercury, and cadmium, in the manufacture of various types of electronic and electrical equipment.[70]

[67] Information about ASME codes and standards can be obtained at: *www.asme.org/kb/standards/standards*.

[68] *http://www.fda.gov/Food/GuidanceRegulation/RetailFoodProtection/FoodCode/ucm374275.htm*).

[69] *http://www.fda.gov/downloads/Food/GuidanceRegulation/RetailFoodProtection/FederalStateCooperativePrograms/UCM230336.pdf*.

[70] Information on EU RoHS can be found at: *www.bis.gov.uk/nmo/enforcement/rohs-home*.

DOE discusses these and other requirements, and includes the full details of the cumulative regulatory burden analysis, in chapter 12 of the NOPR TSD.

3. National Impact Analysis

a. Amount and Significance of Energy Savings

DOE estimated the NES by calculating the difference in annual energy consumption for the base-case scenario and standards-case scenario at each TSL for each equipment class and summing up the annual energy savings for the automatic commercial ice maker equipment purchased during the 30-year 2018 to 2047 analysis period. Energy impacts include the 30-year period, plus the life of equipment purchased in the last year of the analysis, or roughly 2018 to 2057. The energy consumption calculated in the NIA is full-fuel-cycle (FFC) energy, which quantifies savings beginning at the source of energy production. DOE also reports primary or source energy that takes into account losses in the generation and transmission of electricity. FFC and primary energy are discussed in section IV.H.

Table V.35 presents the source NES for all equipment classes at each TSL and the sum total of NES for each TSL. Table V.36 presents the energy savings at each TSL for each equipment class in the form of percentage of the cumulative energy use of the equipment stock in the base-case scenario.

TABLE V.35—CUMULATIVE NATIONAL ENERGY SAVINGS AT SOURCE FOR EQUIPMENT PURCHASED IN 2018–2047

Equipment class	Standard level *, **				
	TSL 1	TSL 2	TSL 3	TSL 4	TSL 5
IMH–W–Small–B	0.002	0.004	0.010	0.010	0.013
IMH–W–Med–B	0.006	0.006	0.009	0.013	0.014
IMH–W–Large–B ***	0.001	0.001	0.001	0.002	0.003
IMH–W–Large–B1	0.001	0.001	0.001	0.002	0.002
IMH–W–Large–B2	0.000	0.000	0.000	0.001	0.001
IMH–A–Small–B	0.017	0.032	0.076	0.099	0.105
IMH–A–Large–B ***	0.024	0.045	0.095	0.122	0.122
IMH–A–Large–B1	0.020	0.040	0.086	0.107	0.107
IMH–A–Large–B2	0.005	0.005	0.009	0.015	0.015
RCU–Large–B ***	0.013	0.013	0.030	0.046	0.047
RCU–Large–B1	0.012	0.012	0.028	0.043	0.045
RCU–Large–B2	0.001	0.001	0.002	0.003	0.003
SCU–W–Large–B	0.000	0.000	0.000	0.000	0.000
SCU–A–Small–B	0.002	0.013	0.024	0.037	0.037
SCU–A–Large–B	0.002	0.010	0.017	0.022	0.022
IMH–A–Small–C	0.002	0.003	0.005	0.008	0.012
IMH–A–Large–C	0.001	0.003	0.006	0.008	0.008
SCU–A–Small–C	0.001	0.004	0.007	0.007	0.011
Total	0.072	0.134	0.281	0.374	0.395

* A value equal to 0.000 means the NES rounds to less than 0.001 quads.
** Numbers may not add to totals due to rounding.
*** IMH–W–Large–B, IMH–A–Large–B, and RCU–Large–B results are the sum of the results for the 2 typical units denoted by B1 and B2.

TABLE V.36—CUMULATIVE ENERGY SAVINGS BY TSL AS A PERCENTAGE OF CUMULATIVE BASELINE ENERGY USAGE OF AUTOMATIC COMMERCIAL ICE MAKER EQUIPMENT PURCHASED IN 2018–2047

Equipment class	Base case energy usage	TSL savings as percent of baseline usage				
		TSL 1 *(%)*	TSL 2 *(%)*	TSL 3 *(%)*	TSL 4 *(%)*	TSL 5 *(%)*
IMH–W–Small–B	0.062	4	7	16	16	21
IMH–W–Med–B	0.089	6	6	10	15	16
IMH–W–Large–B *	0.026	6	6	6	9	10
IMH–W–Large–B1	0.017	7	7	7	10	11
IMH–W–Large–B2	0.009	3	3	3	7	8
IMH–A–Small–B	0.463	4	7	16	21	23
IMH–A–Large–B *	0.635	4	7	15	19	19
IMH–A–Large–B1	0.490	4	8	17	22	22
IMH–A–Large–B2	0.145	3	3	6	11	11
RCU–Large–B *	0.357	4	4	8	13	13
RCU–Large–B1	0.333	4	4	8	13	13
RCU–Large–B2	0.024	2	2	7	11	11
SCU–W–Large–B	0.003	2	5	9	14	14
SCU–A–Small–B	0.138	1	9	18	27	27
SCU–A–Large–B	0.092	2	10	19	24	24
IMH–A–Small–C	0.068	2	5	8	12	17
IMH–A–Large–C	0.041	4	6	14	19	19
SCU–A–Small–C	0.073	2	6	9	9	16
Total	2.047	4	7	14	18	19

* IMH–W–Large–B, IMH–A–Large–B, and RCU–Large–B results are the sum of the results for the 2 typical units denoted by B1 and B2.

Table V.37 presents energy savings at each TSL for each equipment class with the FFC adjustment. The NES increases from 0.073 quads at TSL 1 to 0.401 quads at TSL 5.

TABLE V.37—CUMULATIVE NATIONAL ENERGY SAVINGS INCLUDING FULL-FUEL-CYCLE FOR EQUIPMENT PURCHASED IN 2018–2047

Equipment class	Standard level ***				
	TSL 1	TSL 2	TSL 3	TSL 4	TS L5
IMH–W–Small–B	0.002	0.004	0.010	0.010	0.013
IMH–W–Med–B	0.006	0.006	0.009	0.014	0.015
IMH–W–Large–B ***	0.001	0.001	0.001	0.002	0.003
IMH–W–Large–B1	0.001	0.001	0.001	0.002	0.002
IMH–W–Large–B2	0.000	0.000	0.000	0.001	0.001
IMH–A–Small–B	0.017	0.033	0.077	0.100	0.107
IMH–A–Large–B ***	0.025	0.045	0.096	0.124	0.124
IMH–A–Large–B1	0.020	0.041	0.087	0.108	0.108
IMH–A–Large–B2	0.005	0.005	0.009	0.016	0.016
RCU–Large–B ***	0.013	0.013	0.030	0.046	0.048
RCU–Large–B1	0.013	0.013	0.029	0.044	0.045
RCU–Large–B2	0.001	0.001	0.002	0.003	0.003
SCU–W–Large–B	0.000	0.000	0.000	0.000	0.000
SCU–A–Small–B	0.002	0.013	0.025	0.038	0.038
SCU–A–Large–B	0.002	0.010	0.018	0.022	0.022
IMH–A–Small–C	0.002	0.003	0.006	0.008	0.012
IMH–A–Large–C	0.001	0.003	0.006	0.008	0.008
SCU–A–Small–C	0.001	0.004	0.007	0.007	0.012
Total	0.073	0.136	0.286	0.380	0.401

* A value equal to 0.000 means the NES rounds to less than 0.001 quads.
** Numbers may not add to totals due to rounding.
*** IMH–W–Large–B, IMH–A–Large–B, and RCU–Large–B results are the sum of the results for the 2 typical units denoted by B1 and B2.

Circular A–4 requires agencies to present analytical results, including separate schedules of the monetized benefits and costs that show the type and timing of benefits and costs. Circular A–4 also directs agencies to consider the variability of key elements underlying the estimates of benefits and costs. For this rulemaking, DOE undertook a sensitivity analysis using 9 rather than 30 years of product shipments. The choice of a 9-year period is a proxy for the timeline in EPCA for the review of certain energy conservation standards and potential revision of and compliance with such revised standards.[71] We would note that the review timeframe established in EPCA generally does not overlap with the product lifetime, product manufacturing cycles or other factors specific to automatic commercial ice makers. Thus, this information is presented for informational purposes only and is not indicative of any change in DOE's analytical methodology. The NES results based on a 9-year analysis period are presented in Table V.38. The impacts are counted over the lifetime of equipment purchased in 2018–2026

TABLE V.38—NATIONAL FULL-FUEL-CYCLE ENERGY SAVINGS FOR 9-YEAR ANALYSIS PERIOD FOR EQUIPMENT PURCHASED IN 2018–2026

Equipment class	Standard level ***				
	TSL 1	TSL 2	TSL 3	TSL 4	TSL 5
IMH–W–Small–B	0.001	0.001	0.003	0.003	0.004
IMH–W–Med–B	0.002	0.002	0.003	0.004	0.004
IMH–W–Large–B ***	0.000	0.000	0.000	0.001	0.001
IMH–W–Large–B1	0.000	0.000	0.000	0.000	0.001
IMH–W–Large–B2	0.000	0.000	0.000	0.000	0.000
IMH–A–Small–B	0.005	0.009	0.021	0.028	0.029
IMH–A–Large–B ***	0.007	0.012	0.026	0.034	0.034
IMH–A–Large–B1	0.005	0.011	0.024	0.030	0.030
IMH–A–Large–B2	0.001	0.001	0.003	0.004	0.004
RCU–Large–B ***	0.004	0.004	0.008	0.013	0.013
RCU–Large–B1	0.003	0.003	0.008	0.012	0.012

[71] For automatic commercial ice makers, DOE is required to review standards at least every five years after the effective date of any amended standards. (42 U.S.C. 6313(d)(3)(B)) If new standards are promulgated, EPCA requires DOE to provide manufacturers a minimum of 3 and a maximum of 5 years to comply with the standards. (42 U.S.C. 6313(d)(3)(C)) In addition, for certain other types of commercial equipment that are not specified in 42 U.S.C. 6311(1)(B)–(G), EPCA requires DOE to review its standards at least once every 6 years (42 U.S.C. 6295(m)(1) and 6316(a)), and either a 3-year or a 5-year period after any new standard is promulgated before compliance is required. (42 U.S.C. 6295(m)(4) and 6316(a)) As a result, DOE's standards for automatic commercial ice makers can be expected to be in effect for 8 to 10 years between compliance dates, and its standards governing certain other commercial equipment, the period is 9 to 11 years. A 9-year analysis was selected as representative of the time between standard revisions.

TABLE V.38—NATIONAL FULL-FUEL-CYCLE ENERGY SAVINGS FOR 9-YEAR ANALYSIS PERIOD FOR EQUIPMENT PURCHASED IN 2018–2026—Continued

Equipment class	Standard level ***				
	TSL 1	TSL 2	TSL 3	TSL 4	TSL 5
RCU–Large–B2	0.000	0.000	0.000	0.001	0.001
SCU–W–Large–B	0.000	0.000	0.000	0.000	0.000
SCU–A–Small–B	0.000	0.004	0.007	0.010	0.010
SCU–A–Large–B	0.001	0.003	0.005	0.006	0.006
IMH–A–Small–C	0.000	0.001	0.002	0.002	0.003
IMH–A–Large–C	0.000	0.001	0.002	0.002	0.002
SCU–A–Small–C	0.000	0.001	0.002	0.002	0.003
Total	0.020	0.037	0.079	0.104	0.110

* A value equal to 0.000 means the NES rounds to less than 0.001 quads.
** Numbers may not add to totals due to rounding.
*** IMH–W–Large–B, IMH–A–Large–B, and RCU–Large–B results are the sum of the results for the 2 typical units denoted by B1 and B2.

b. Net Present Value of Customer Costs and Benefits

DOE estimated the cumulative NPV to the Nation of the total savings for the customers that would result from potential standards at each TSL. In accordance with OMB guidelines on regulatory analysis (OMB Circular A–4, section E, September 17, 2003), DOE calculated NPV using both a 7-percent and a 3-percent real discount rate. The 7-percent rate is an estimate of the average before-tax rate of return on private capital in the U.S. economy, and reflects the returns on real estate and small business capital, including corporate capital. DOE used this discount rate to approximate the opportunity cost of capital in the private sector, because recent OMB analysis has found the average rate of return on capital to be near this rate. In addition, DOE used the 3-percent rate to capture the potential effects of amended standards on private consumption. This rate represents the rate at which society discounts future consumption flows to their present value. It can be approximated by the real rate of return on long-term government debt (*i.e.,* yield on Treasury notes minus annual rate of change in the CPI), which has averaged about 3 percent on a pre-tax basis for the last 30 years.

Table V.39 and Table V.40 show the customer NPV results for each of the TSLs DOE considered for automatic commercial ice makers at both 7-percent and 3-percent discount rates. In each case, the impacts cover the expected lifetime of equipment purchased from 2018–2047. Detailed NPV results are presented in chapter 10 of the NOPR TSD.

The NPV results at a 7-percent discount rate for TSL 5 were negative for three equipment classes and significantly lower than the TSL 3 results for several other classes. This is consistent with the results of LCC analysis results for TSL 5, which showed significant increase in LCC and significantly higher PBPs that were in some cases greater than the average equipment lifetimes. Efficiency levels for TSL 4 were chosen to correspond to the highest efficiency level with a positive NPV for all classes at a 7-percent discount rate. Similarly, the criteria for choice of efficiency levels for TSL 3, TSL 2, and TSL 1 were such that the NPV values for all the equipment classes show positive values. The criterion for TSL 3 was to select efficiency levels with the highest NPV at a 7-percent discount rate. Consequently, the total NPV for automatic commercial ice makers was highest for TSL 3, with a value of $0.791 billion (2012$) at a 7-percent discount rate. TSL 4 showed the second highest total NPV, with a value of $0.484 billion (2012$) at a 7-percent discount rate. TSL 1, TSL 2 and TSL 5 have a total NPV lower than TSL 3 or 4.

TABLE V.39—NET PRESENT VALUE AT A 7-PERCENT DISCOUNT RATE FOR EQUIPMENT PURCHASED IN 2018–2047
[2012$]

Equipment class	Standard level *				
	TSL 1	TSL 2	TSL 3	TSL 4	TSL 5
IMH–W–Small–B	0.006	0.011	0.025	0.025	(0.002)
IMH–W–Med–B	0.016	0.016	0.025	0.017	0.019
IMH–W–Large–B **	0.004	0.004	0.004	0.003	0.003
IMH–W–Large–B1	0.003	0.003	0.003	0.002	0.002
IMH–W–Large–B2	0.001	0.001	0.001	0.001	0.001
IMH–A–Small–B	0.043	0.080	0.177	0.046	0.058
IMH–A–Large–B **	0.070	0.127	0.297	0.256	0.256
IMH–A–Large–B1	0.057	0.113	0.274	0.236	0.236
IMH–A–Large–B2	0.014	0.014	0.023	0.020	0.020
RCU–Large–B **	0.038	0.038	0.082	0.073	0.075
RCU–Large–B1	0.036	0.036	0.078	0.070	0.072
RCU–Large–B2	0.002	0.002	0.004	0.004	0.004
SCU–W–Large–B	0.001	0.001	0.001	0.000	0.000
SCU–A–Small–B	0.004	0.029	0.085	0.012	0.012
SCU–A–Large–B	0.004	0.039	0.052	0.021	0.021
IMH–A–Small–C	0.004	0.009	0.014	0.011	(0.018)
IMH–A–Large–C	0.004	0.007	0.016	0.007	0.007

TABLE V.39—NET PRESENT VALUE AT A 7-PERCENT DISCOUNT RATE FOR EQUIPMENT PURCHASED IN 2018–2047—Continued

[2012$]

Equipment class	Standard level*				
	TSL 1	TSL 2	TSL 3	TSL 4	TSL 5
SCU–A–Small–C	0.004	0.009	0.013	0.013	(0.062)
Total	0.198	0.368	0.791	0.484	0.370

* A value equal to 0.000 means the NPV rounds to less than $0.001 (2012$). Values in parentheses are negative numbers.
** IMH–W–Large–B, IMH–A–Large–B, and RCU–Large–B results are the sum of the results for the 2 typical units denoted by B1 and B2.

TABLE V.40—NET PRESENT VALUE AT A 3-PERCENT DISCOUNT RATE FOR EQUIPMENT PURCHASED IN 2018–2047

[2012$]

Equipment class	Standard level*				
	TSL 1	TSL 2	TSL 3	TSL 4	TSL 5
IMH–W–Small–B	0.013	0.023	0.057	0.057	0.010
IMH–W–Med–B	0.034	0.034	0.054	0.042	0.047
IMH–W–Large–B**	0.009	0.009	0.009	0.007	0.008
IMH–W–Large–B1	0.007	0.007	0.007	0.006	0.006
IMH–W–Large–B2	0.002	0.002	0.002	0.001	0.002
IMH–A–Small–B	0.094	0.176	0.394	0.163	0.190
IMH–A–Large–B**	0.152	0.275	0.653	0.596	0.596
IMH–A–Large–B1	0.123	0.245	0.602	0.546	0.546
IMH–A–Large–B2	0.030	0.030	0.051	0.050	0.050
RCU–Large–B**	0.081	0.081	0.178	0.174	0.179
RCU–Large–B1	0.078	0.078	0.169	0.165	0.170
RCU–Large–B2	0.004	0.004	0.009	0.009	0.009
SCU–W–Large–B	0.001	0.002	0.002	0.001	0.001
SCU–A–Small–B	0.009	0.064	0.190	0.062	0.062
SCU–A–Large–B	0.010	0.086	0.118	0.062	0.062
IMH–A–Small–C	0.009	0.019	0.031	0.027	(0.028)
IMH–A–Large–C	0.009	0.016	0.034	0.018	0.018
SCU–A–Small–C	0.008	0.021	0.030	0.030	(0.114)
Total	0.430	0.806	1.751	1.238	1.032

* A value equal to 0.000 means the NPV rounds to less than $0.001 (2012$). Values in parentheses are negative numbers.
** IMH–W–Large–B, IMH–A–Large–B, and RCU–Large–B results are the sum of the results for the 2 typical units denoted by B1 and B2.

The NPV results based on the aforementioned 9-year analysis period are presented in Table V.41 and Table V.42. The impacts are counted over the lifetime of equipment purchased in 2018–2026. As mentioned previously, this information is presented for informational purposes only and is not indicative of any change in DOE's analytical methodology or decision criteria.

TABLE V.41—NET PRESENT VALUE AT A 7-PERCENT DISCOUNT RATE FOR 9-YEAR ANALYSIS PERIOD FOR EQUIPMENT PURCHASED IN 2018–2026

Equipment class	Standard level*				
	TSL 1	TSL 2	TSL 3	TSL 4	TSL 5
IMH–W–Small–B	0.003	0.005	0.012	0.012	(0.001)
IMH–W–Med–B	0.008	0.008	0.012	0.008	0.009
IMH–W–Large–B	0.002	0.002	0.002	0.001	0.002
IMH–W–Large–B–1	0.002	0.002	0.002	0.001	0.001
IMH–W–Large–B–2	0.000	0.000	0.000	0.000	0.000
IMH–A–Small–B	0.021	0.039	0.086	0.023	0.029
IMH–A–Large–B	0.034	0.062	0.143	0.123	0.123
IMH–A–Large–B–1	0.028	0.055	0.132	0.113	0.113
IMH–A–Large–B–2	0.007	0.007	0.011	0.010	0.010
RCU–Large–B	0.018	0.018	0.040	0.036	0.037
RCU–Large–B–1	0.017	0.017	0.038	0.034	0.035
RCU–Large–B–2	0.001	0.001	0.002	0.002	0.002
SCU–W–Large–B	0.000	0.000	0.001	0.000	0.000
SCU–A–Small–B	0.002	0.014	0.040	0.005	0.005
SCU–A–Large–B	0.002	0.018	0.025	0.010	0.010
IMH–A–Small–C	0.002	0.004	0.007	0.005	(0.009)

TABLE V.41—NET PRESENT VALUE AT A 7-PERCENT DISCOUNT RATE FOR 9-YEAR ANALYSIS PERIOD FOR EQUIPMENT PURCHASED IN 2018–2026—Continued

Equipment class	Standard level *				
	TSL 1	TSL 2	TSL 3	TSL 4	TSL 5
IMH–A–Large–C	0.002	0.004	0.008	0.003	0.003
SCU–A–Small–C	0.002	0.005	0.006	0.006	(0.031)
Total	0.096	0.179	0.381	0.233	0.177

* A value equal to 0.000 means the NPV rounds to less than $0.001 (2012$). Values in parentheses are negative numbers.

TABLE V.42—NET PRESENT VALUE AT A 3-PERCENT DISCOUNT RATE FOR 9-YEAR ANALYSIS PERIOD FOR EQUIPMENT PURCHASED IN 2018–2026

Equipment class	Standard level*				
	TSL 1	TSL 2	TSL 3	TSL 4	TSL 5
IMH–W–Small–B	0.005	0.008	0.020	0.020	0.003
IMH–W–Med–B	0.012	0.012	0.019	0.015	0.017
IMH–W–Large–B	0.003	0.003	0.003	0.003	0.003
IMH–W–Large–B–1	0.002	0.002	0.002	0.002	0.002
IMH–W–Large–B–2	0.001	0.001	0.001	0.001	0.001
IMH–A–Small–B	0.034	0.063	0.141	0.058	0.068
IMH–A–Large–B	0.054	0.098	0.230	0.209	0.209
IMH–A–Large–B–1	0.044	0.088	0.211	0.191	0.191
IMH–A–Large–B–2	0.011	0.011	0.018	0.018	0.018
RCU–Large–B	0.029	0.029	0.064	0.062	0.064
RCU–Large–B–1	0.028	0.028	0.060	0.059	0.061
RCU–Large–B–2	0.001	0.001	0.003	0.003	0.003
SCU–W–Large–B	0.000	0.001	0.001	0.000	0.000
SCU–A–Small–B	0.003	0.023	0.065	0.020	0.020
SCU–A–Large–B	0.003	0.030	0.041	0.021	0.021
IMH–A–Small–C	0.003	0.007	0.011	0.010	(0.010)
IMH–A–Large–C	0.003	0.006	0.012	0.006	0.006
SCU–A–Small–C	0.003	0.007	0.010	0.010	(0.042)
Total	0.153	0.287	0.617	0.434	0.359

*A value equal to 0.000 means the NPV rounds to less than $0.001 (2012$). Values in parentheses are negative numbers.

c. Water Savings

In analyzing energy-saving design options for batch type ice makers, one option had the additional impact of reducing potable water usage for some types of batch type ice makers. The potable water savings are identified on Table V.43.

TABLE V.43—POTABLE WATER SAVINGS

Equipment class	National water savings by standard level*,** *million gallons*				
	TSL 1	TSL 2	TSL 3	TSL 4	TSL 5
IMH–W–Small–B	0	0	3,699	3,699	3,699
IMH–W–Med–B	0	0	0	0	0
IMH–W–Large–B	0	0	0	0	0
IMH–W–Large–B–1	0	0	0	0	0
IMH–W–Large–B–2	0	0	0	0	0
IMH–A–Small–B	0	0	0	0	0
IMH–A–Large–B	0	0	20,753	20,753	20,753
IMH–A–Large–B–1	0	0	20,753	20,753	20,753
IMH–A–Large–B–2	0	0	0	0	0
RCU–063–Large–B	0	0	0	0	0
RCU–064–Large–B–1	0	0	0	0	0
RCU–065–Large–B–2	0	0	0	0	0
SCU–W–Large–B	141	141	141	141	141
SCU–A–Small–B	0	0	14,391	14,391	14,391
SCU–A–Large–B	0	6,424	6,424	6,424	6,424
IMH–A–Small–C	0	0	0	0	0
IMH–A–Large–C	0	0	0	0	0
SCU–A–Small–C	0	0	0	0	0

TABLE V.43—POTABLE WATER SAVINGS—Continued

Equipment class	National water savings by standard level*,** *million gallons*				
	TSL 1	TSL 2	TSL 3	TSL 4	TSL 5
Total	141	6,565	45,407	45,407	45,407

d. Employment Impacts

In addition to the direct impacts on manufacturing employment discussed in section V.B.2, DOE develops general estimates of the indirect employment impacts of proposed standards on the economy. As discussed above, DOE expects amended energy conservation standards for automatic commercial ice makers to reduce energy bills for commercial customers, and the resulting net savings to be redirected to other forms of economic activity. DOE also realizes that these shifts in spending and economic activity by automatic commercial ice maker owners could affect the demand for labor. Thus, indirect employment impacts may result from expenditures shifting between goods (the substitution effect) and changes in income and overall expenditure levels (the income effect) that occur due to the imposition of amended standards. These impacts may affect a variety of businesses not directly involved in the decision to make, operate, or pay the utility bills for automatic commercial ice makers. To estimate these indirect economic effects, DOE used an input/output model of the U.S. economy using U.S. Department of Commerce, Bureau of Economic Analysis (BEA) and BLS data (as described in section IV.N of this notice; see chapter 16 of the NOPR TSD for more details).

In this input/output model, the dollars saved on utility bills from more-efficient automatic commercial ice makers are concentrated in economic sectors that create more jobs than are lost in electric and water utilities sectors when spending is shifted from electricity and/or water to other products and services. Thus, the proposed amended energy conservation standards for automatic commercial ice makers are likely to slightly increase the net demand for labor in the economy. However, the net increase in jobs might be offset by other, unanticipated effects on employment. Neither the BLS data nor the input/output model used by DOE includes the quality of jobs. As shown in Table V.44, DOE estimates that net indirect employment impacts from a proposed automatic commercial ice makers amended standard are small relative to the national economy.

TABLE V.44—NET SHORT-TERM CHANGE IN EMPLOYMENT

Trial standard level	2018	2022
1	19 to 20	100 to 101.
2	36 to 40	192 to 196.
3	75 to 87	431 to 442.
4	44 to 91	506 to 552.
5	34 to 90	518 to 572.

4. Impact on Utility or Performance of Equipment

In performing the engineering analysis, DOE considers design options that would not lessen the utility or performance of the individual classes of equipment. (42 U.S.C. 6295(o)(2)(B)(i)(IV) and 6316(e)(1)) As presented in the screening analysis (chapter 4 of the NOPR TSD), DOE eliminates from consideration any design options that reduce the utility of the equipment. For this notice, DOE proposes that none of the TSLs considered for automatic commercial ice makers reduce the utility or performance of the equipment.

5. Impact of Any Lessening of Competition

EPCA directs DOE to consider any lessening of competition likely to result from amended standards. It directs the Attorney General of the United States (Attorney General) to determine in writing the impact, if any, of any lessening of competition likely to result from a proposed standard. (42 U.S.C. 6295(o)(2)(B)(i)(V) and 6313(d)(4)) To assist the Attorney General in making such a determination, DOE provided the DOJ with copies of this notice and the TSD for review. During MIA interviews, domestic manufacturers indicated that foreign manufacturers have begun to enter the automatic commercial ice maker industry, but not in significant numbers. Manufacturers also stated that consolidation has occurred among automatic commercial ice makers manufacturers in recent years. Interviewed manufacturers believe that these trends may continue in this market even in the absence of amended standards.

DOE does not believe that amended standards would result in domestic firms moving their production facilities outside the United States. The majority of automatic commercial ice makers are manufactured in the United States and, during interviews, manufacturers in general indicated they would modify their existing facilities to comply with amended energy conservation standards.

6. Need of the Nation To Conserve Energy

An improvement in the energy efficiency of the equipment subject to today's NOPR is likely to improve the security of the Nation's energy system by reducing overall demand for energy. Reduced electricity demand may also improve the reliability of the electricity system. As a measure of this reduced demand, chapter 15 in the NOPR TSD presents the estimated reduction in national generating capacity for the TSLs that DOE considered in this rulemaking.

Energy savings from amended standards for automatic commercial ice makers could also produce environmental benefits in the form of reduced emissions of air pollutants and GHGs associated with electricity production. Table V.45 provides DOE's estimate of cumulative CO_2, NO_X, Hg, N_2O, CH_4 and SO_2 emissions reductions projected to result from the TSLs considered in this rule. The table includes both power sector emissions and upstream emissions. The upstream emissions were calculated using the multipliers discussed in section IV.K. DOE reports annual emissions reductions for each TSL in chapter 13 of the NOPR TSD.

TABLE V.45—SUMMARY OF EMISSIONS REDUCTION ESTIMATED FOR AUTOMATIC COMMERCIAL ICE MAKERS TSLS

[Cumulative for equipment purchased in 2018–2047]

	TSL				
	1	2	3	4	5
Power Sector and Site Emissions					
CO_2 (*million metric tons*)	3.50	6.52	13.68	18.19	19.19
NO_X (*thousand tons*)	−0.89	−1.66	−3.49	−4.64	−4.89
Hg (*tons*)	0.01	0.01	0.02	0.03	0.03
N_2O (*thousand tons*)	0.08	0.15	0.31	0.41	0.43
CH_4 (*thousand tons*)	0.47	0.88	1.84	2.45	2.58
SO_2 (*thousand tons*)	5.31	9.89	20.76	27.60	29.12
Upstream Emissions					
CO_2 (*million metric tons*)	0.23	0.42	0.89	1.18	1.24
NO_X (*thousand tons*)	3.11	5.80	12.18	16.19	17.08
Hg (*tons*)	0.000	0.000	0.000	0.001	0.001
N_2O (*thousand tons*)	0.00	0.00	0.01	0.01	0.01
CH_4 (*thousand tons*)	18.89	35.22	73.93	98.30	103.68
SO_2 (*thousand tons*)	0.05	0.09	0.19	0.25	0.27
Total Emissions					
CO_2 (*million metric tons*)	3.72	6.94	14.57	19.37	20.43
NO_X (*thousand tons*)	2.22	4.14	8.69	11.56	12.19
Hg (*tons*)	0.01	0.01	0.02	0.03	0.03
N_2O (*thousand tons*)	0.08	0.15	0.32	0.42	0.45
CH_4 (*thousand tons*)	19.36	36.09	75.77	100.75	106.27
SO_2 (*thousand tons*)	5.35	9.98	20.95	27.86	29.38

As part of the analysis for this NOPR, DOE estimated monetary benefits likely to result from the reduced emissions of CO_2 and NO_X that DOE estimated for each of the TSLs considered. As discussed in section IV.L, DOE used values for the SCC developed by an interagency process. The interagency group selected four sets of SCC values for use in regulatory analyses. Three sets are based on the average SCC from three integrated assessment models, at discount rates of 2.5 percent, 3 percent, and 5 percent. The fourth set, which represents the 95th-percentile SCC estimate across all three models at a 3-percent discount rate, is included to represent higher-than-expected impacts from temperature change further out in the tails of the SCC distribution. The four SCC values for CO_2 emissions reductions in 2015, expressed in 2012$, are $11.8/ton, $39.7/ton, $61.2/ton, and $117.0/ton. These values for later years are higher due to increasing emissions-related costs as the magnitude of projected climate change is expected to increase.

Table V.46 presents the global value of CO_2 emissions reductions at each TSL. DOE calculated domestic values as a range from 7 percent to 23 percent of the global values, and these results are presented in chapter 14 of the NOPR TSD.

TABLE V.46—GLOBAL PRESENT VALUE OF CO_2 EMISSIONS REDUCTION FOR POTENTIAL STANDARDS FOR AUTOMATIC COMMERCIAL ICE MAKERS

TSL	SCC Scenario *			
	5% discount rate, average	3% discount rate, average	2.5% discount rate, average	3% discount rate, 95th percentile
	million 2012$			
Power Sector and Site Emissions				
1	24.6	111.2	176.2	342.8
2	45.9	207.3	328.5	639.0
3	96.3	435.2	689.5	1,341.5
4	128.0	578.6	916.8	1,783.6
5	135.1	610.3	967.0	1,881.4
Upstream Emissions				
1	1.5	7.0	11.2	21.7
2	2.8	13.1	20.8	40.4
3	6.0	27.5	43.7	84.9
4	7.9	36.5	58.1	112.8

TABLE V.46—GLOBAL PRESENT VALUE OF CO_2 EMISSIONS REDUCTION FOR POTENTIAL STANDARDS FOR AUTOMATIC COMMERCIAL ICE MAKERS—Continued

TSL	SCC Scenario*			
	5% discount rate, average	3% discount rate, average	2.5% discount rate, average	3% discount rate, 95th percentile
5	8.4	38.5	61.3	119.0
Total Emissions				
1	26.1	118.2	187.4	364.5
2	48.7	220.4	349.3	679.5
3	102.3	462.6	733.2	1,426.3
4	136.0	615.1	974.9	1,896.4
5	143.4	648.8	1,028.3	2,000.4

* For each of the four cases, the corresponding SCC value for emissions in 2015 is $11.8, $39.7, $61.2 and $117.0 per metric ton (2012$).

DOE is well aware that scientific and economic knowledge about the contribution of CO_2 and other GHG emissions to changes in the future global climate and the potential resulting damages to the world economy continues to develop rapidly. Thus, any value placed in this NOPR on reducing CO_2 emissions is subject to change. DOE, together with other Federal agencies, will continue to review various methodologies for estimating the monetary value of reductions in CO_2 and other GHG emissions. This ongoing review will consider the comments on this subject that are part of the public record for this NOPR and other rulemakings, as well as other methodological assumptions and issues. However, consistent with DOE's legal obligations, and taking into account the uncertainty involved with this particular issue, DOE has included in this NOPR the most recent values and analyses resulting from the ongoing interagency review process.

DOE also estimated a range for the cumulative monetary value of the economic benefits associated with NO_X emission reductions anticipated to result from amended automatic commercial ice makers standards. Table V.47 presents the present value of cumulative NO_X emissions reductions for each TSL calculated using the average dollar-per-ton values and 7-percent and 3-percent discount rates.

TABLE V.47—PRESENT VALUE OF NO_X EMISSIONS REDUCTION FOR POTENTIAL STANDARDS FOR AUTOMATIC COMMERCIAL ICE MAKERS

TSL	3% Discount rate	7% Discount rate
	million 2012$	
Power Sector and Site Emissions*		
1	−1.8	−1.3
2	−3.4	−2.4
3	−7.2	−5.0
4	−9.5	−6.6
5	−10.1	−7.0
Upstream Emissions		
1	4.3	2.1
2	8.0	3.8
3	16.8	8.0
4	22.3	10.7
5	23.6	11.3
Total Emissions		
1	2.5	0.8
2	4.6	1.4
3	9.6	3.0
4	12.8	4.0
5	13.5	4.3

The NPV of the monetized benefits associated with emission reductions can be viewed as a complement to the NPV of the customer savings calculated for each TSL considered in this NOPR. Table V.48 presents the NPV values that result from adding the estimates of the potential economic benefits resulting from reduced CO_2 and NO_X emissions in each of four valuation scenarios to the NPV of consumer savings calculated for each TSL considered in this rulemaking, at both a 7-percent and a 3-percent discount rate. The CO_2 values used in the table correspond to the four scenarios for the valuation of CO_2 emission reductions presented in section IV.L.

TABLE V.48—AUTOMATIC COMMERCIAL ICE MAKERS TSLS: NET PRESENT VALUE OF CUSTOMER SAVINGS COMBINED WITH NET PRESENT VALUE OF MONETIZED BENEFITS FROM CO_2 AND NO_X EMISSIONS REDUCTIONS

TSL	Consumer NPV at 3% discount rate added with:			
	SCC Value of $11.8/metric ton CO_2* and Medium Value for NO_X**	SCC Value of $39.7/metric ton CO_2* and Medium Value for NO_X**	SCC Value of $61.2/metric ton CO_2* and Medium Value for NO_X**	SCC Value of $117.0/metric ton CO_2* and Medium Value for NO_X**
	billion 2012$			
1	*0.458*	*0.550*	*0.620*	*0.797*
2	*0.859*	*1.031*	*1.160*	*1.490*
3	*1.863*	*2.223*	*2.494*	*3.187*
4	*1.387*	*1.866*	*2.226*	*3.148*

TABLE V.48—AUTOMATIC COMMERCIAL ICE MAKERS TSLS: NET PRESENT VALUE OF CUSTOMER SAVINGS COMBINED WITH NET PRESENT VALUE OF MONETIZED BENEFITS FROM CO_2 AND NO_X EMISSIONS REDUCTIONS—Continued

TSL	Consumer NPV at 3% discount rate added with:			
	SCC Value of $11.8/metric ton CO_2* and Medium Value for NO_X**	SCC Value of $39.7/metric ton CO_2* and Medium Value for NO_X**	SCC Value of $61.2/metric ton CO_2* and Medium Value for NO_X**	SCC Value of $117.0/metric ton CO_2* and Medium Value for NO_X**
5	*1.189*	*1.694*	*2.074*	*3.046*
TSL	**Consumer NPV at 7% discount rate added with:**			
	SCC Value of $11.8/metric ton CO_2* and Medium Value for NO_X**	SCC Value of $39.7/metric ton CO_2* and Medium Value for NO_X**	SCC Value of $61.2/metric ton CO_2* and Medium Value for NO_X**	SCC Value of $117.0/metric ton CO_2* and Medium Value for NO_X**
	billion 2012$			
1	*0.224*	*0.317*	*0.386*	*0.563*
2	*0.418*	*0.590*	*0.719*	*1.049*
3	*0.896*	*1.257*	*1.527*	*2.220*
4	*0.624*	*1.103*	*1.463*	*2.385*
5	*0.518*	*1.023*	*1.403*	*2.375*

* These label values represent the global SCC in 2015, in 2012$. The present values have been calculated with scenario-consistent discount rates. For NO_X emissions, each case uses the medium value, which corresponds to $2,639 per ton.

Although adding the value of customer savings to the values of emission reductions provides a valuable perspective, the following should be considered: (1) the national customer savings are domestic U.S. customer monetary savings found in market transactions, while the values of emission reductions are based on estimates of marginal social costs, which, in the case of CO_2, are based on a global value; and (2) the assessments of customer savings and emission-related benefits are performed with different computer models, leading to different time frames for analysis. For automatic commercial ice makers, the present value of national customer savings is measured for the period in which units shipped (2018–2047) continue to operate. However, the time frames of the benefits associated with the emission reductions differ. For example, the value of CO_2 emission reductions in a given year reflects the present value of all future climate-related impacts due to emitting a ton of CO_2 in that year, out to the year 2100.

7. Other Factors

EPCA allows the Secretary, in determining whether a proposed standard is economically justified, to consider any other factors that the Secretary deems to be relevant. (42 U.S.C. 6295(o)(2)(B)(i)(VII) and 6313(d)(4)) DOE considered LCC impacts on identifiable groups of customers, such as customers of different business types, who may be disproportionately affected by any amended national energy conservation standard level. DOE also considered the reduction in generation capacity that could result from the imposition of any amended national energy conservation standard level.

DOE carried out a RIA, as described in the NOPR TSD chapter 17, to study the impact of certain non-regulatory alternatives that may encourage customers to purchase higher efficiency equipment and, thus, achieve NES. The two major alternatives identified by DOE are customer rebates and customer tax credits. DOE surveyed the various rebate programs available in the United States. Typically, rebates are offered for commercial sector businesses that purchase energy-efficient automatic commercial ice makers, typically, machines that qualify either for ENERGY STAR or CEE certification. Rebates offered range from $40 to several hundred dollars, depending on the size and type of ice maker. Based on the incremental costs DOE estimated for TSL 1 (equivalent to the ENERGY STAR targets that were in existence until early in 2013), the rebates offered are sufficient to cover the incremental costs of meeting the ENERGY STAR levels. Given the range of rebates offered, DOE elected to model rebates of equivalent to 60 percent of the full incremental cost of the upgrades.

For the tax credits scenario, DOE did not find a suitable program to model the scenario. From a consumer perspective, the most important difference between rebate and tax credit programs is that a rebate can be obtained relatively quickly, whereas receipt of tax credits is delayed until income taxes are filed or a tax refund is provided by the IRS. As with consumer rebates, DOE assumed that consumer tax credits paid 60 percent of the incremental product price, but estimated a different response rate. The delay in reimbursement makes tax credits less attractive than rebates; consequently, DOE estimated a response rate that is 80 percent of that for rebate programs.

Table V.49 and Table V.50 show the NES and NPV, respectively, for the non-regulatory alternatives analyzed. For comparison, the table includes the results of the NES and NPV for TSL 3, the proposed energy conservation standard. Energy savings are expressed in quads in terms of primary or source energy, which includes generation and transmission losses from electricity utility sector.

TABLE V.49—CUMULATIVE NES OF NON-REGULATORY ALTERNATIVES COMPARED TO THE PROPOSED STANDARDS FOR AUTOMATIC COMMERCIAL ICE MAKERS

Policy alternatives	Cumulative Primary NES *quads*
No new regulatory action	0
Customer tax credits	0.145
Customer rebates	0.190
Voluntary energy efficiency targets	0
Early replacement	0
Proposed standards, primary energy (TSL 3)	0.281

TABLE V.50—CUMULATIVE NPV OF NON-REGULATORY ALTERNATIVES COMPARED TO THE PROPOSED STANDARDS FOR AUTOMATIC COMMERCIAL ICE MAKERS

Policy alternatives	Cumulative net present value *billion 2012$*	
	7% Discount	3% Discount
No new regulatory action	0	0
Customer tax credits	0.520	1.011
Customer rebates	0.678	1.319
Voluntary energy efficiency targets	0	0
Early replacement	0	0
Proposed standards (TSL 3)	0.791	1.751

As shown above, none of the policy alternatives DOE examined would achieve close to the amount of energy or monetary savings that could be realized under the proposed amended standard. Also, implementing either tax credits or customer rebates would incur initial and/or administrative costs that were not considered in this analysis.

C. Proposed Standard

DOE recognizes that when it considers amendments to the standards, it is subject to the EPCA requirement that any new or amended energy conservation standard for any type (or class) of covered product be designed to achieve the maximum improvement in energy efficiency that the Secretary determines is technologically feasible and economically justified. (42 U.S.C. 6295(o)(2)(A) and 6313(d)(4)) In determining whether a proposed standard is economically justified, the Secretary must determine whether the benefits of the standard exceed its burdens to the greatest extent practicable, in light of the seven statutory factors discussed previously. (42 U.S.C. 6295(o)(2)(B)(i) and 6313(d)(4)) The new or amended standard must also result in a significant conservation of energy. (42 U.S.C. 6295(o)(3)(B) and 6316(d)(4))

DOE considered the impacts of standards at each TSL, beginning with the maximum technologically feasible level, to determine whether that level met the evaluation criteria. If the max-tech level was not justified, DOE then considered the next most-efficient level and undertook the same evaluation until it reached the highest efficiency level that is both technologically feasible and economically justified and saves a significant amount of energy.

DOE discusses the benefits and/or burdens of each TSL in the following sections. DOE bases its discussion on quantitative analytical results for each TSL including NES, NPV (discounted at 7 and 3 percent), emission reductions, INPV, LCC, and customers' installed price increases. Beyond the quantitative results, DOE also considers other burdens and benefits that affect economic justification, including how technological feasibility, manufacturer costs, and impacts on competition may affect the economic results presented. Table V.51, Table V.52, Table V.53 and Table V.54 present a summary of the results of DOE's quantitative analysis for each TSL. Results in Table V.51 are impacts from equipment purchased in the period from 2018–2047. In addition to the quantitative results presented in the tables, DOE also considers other burdens and benefits that affect economic justification of certain customer subgroups that are disproportionately affected by the proposed standards. Section V.B.7 presents the estimated impacts of each TSL for these subgroups.

TABLE V.51—SUMMARY OF RESULTS FOR AUTOMATIC COMMERCIAL ICE MAKERS TSLS: NATIONAL IMPACTS*

Category	TSL 1	TSL 2	TSL 3	TSL 4	TSL 5
Cumulative National Energy Savings 2018 through 2047 *quads*					
Undiscounted values	0.073	0.136	0.286	0.380	0.401
Cumulative National Water Savings 2018 through 2047 *billion gallons*					
Undiscounted values	0.1	6.6	45.4	45.4	45.4
Cumulative NPV of Customer Benefits 2018 through 2047 *2012$ billion*					
3% discount rate	0.430	0.806	1.751	1.238	1.032

TABLE V.51—SUMMARY OF RESULTS FOR AUTOMATIC COMMERCIAL ICE MAKERS TSLS: NATIONAL IMPACTS*—Continued

Category	TSL 1	TSL 2	TSL 3	TSL 4	TSL 5
7% discount rate	0.198	0.368	0.791	0.484	0.370
Industry Impacts					
Change in Industry NPV (2012$ million).	(8.4) to (8.7)	(12.8) to (13.6)	(20.9) to (23.9)	(19.6) to (30.5)	(19.9) to (32.6)
Change in Industry NPV (%)	(8.2) to (8.5)	(12.6) to (13.4)	(20.5) to (23.5)	(19.2) to (30.0)	(19.5) to (32.0)
Cumulative Emissions Reductions 2018 through 2047**					
CO_2 (MMt)	3.72	6.94	14.57	19.37	20.43
NO_X (kt)	2.22	4.14	8.69	11.56	12.19
Hg (t)	0.01	0.01	0.02	0.03	0.03
N_2O (*kt*)	0.08	0.15	0.32	0.42	0.45
N_2O (kt CO_2eq)	24.28	45.26	95.01	126.32	133.25
CH_4 (k*t*)	19.36	36.09	75.77	100.75	106.27
CH_4 (*kt* CO_2eq)	484.06	902.37	1894.29	2518.64	2656.69
SO_2 (*kt*)	5.35	9.98	20.95	27.86	29.38
Monetary Value of Cumulative Emissions Reductions 2018 through 2047†					
CO_2 (2012$ billion)	0.026 to 0.364	0.049 to 0.679	0.102 to 1.426	0.136 to 1.896	0.143 to 2.0
NO_X—3% discount rate (2012$ million).	2.5	4.6	9.6	12.8	13.5
NO_X—7% discount rate (2012$ million).	0.8	1.4	3.0	4.0	4.3
Employment Impacts					
Net Change in Indirect Domestic Jobs by 2022.	100 to 101	192 to 196	431 to 442	506 to 552	518 to 572

* Values in parentheses are negative numbers.

** "MMt" stands for million metric tons; "kt" stands for kilotons; "t" stands for tons. CO_2eq is the quantity of CO_2 that would have the same global warming potential (GWP).

† Range of the economic value of CO_2 reductions is based on estimates of the global benefit of reduced CO_2 emissions. Economic value of NO_X reductions is based on estimates at $2,639/ton.

TABLE V.52—SUMMARY OF RESULTS FOR AUTOMATIC COMMERCIAL ICE MAKERS TSLS: MEAN LCC SAVINGS

[2012$]

Equipment class	Standard level				
	TSL1	TSL2	TSL3	TSL4	TSL5
IMH–W–Small–B	$199	$215	$328	$328	$49
IMH–W–Med–B	464	464	587	405	460
IMH–W–Large–B*	833	833	833	550	582
IMH–W–Large–B1	701	701	701	583	607
IMH–W–Large–B2	1,260	1,260	1,260	442	500
IMH–A–Small–B	254	259	396	170	198
IMH–A–Large–B*	648	633	1,127	994	994
IMH–A–Large–B1	590	572	1,168	1,062	1,062
IMH–A–Large–B2	960	960	908	627	627
RCU–Large–B*	875	875	983	870	897
RCU–Large–B1	847	847	963	857	882
RCU–Large–B2	1,298	1,298	1,277	1,070	1,123
SCU–W–Large–B	483	687	694	143	149
SCU–A–Small–B	103	198	396	106	106
SCU–A–Large–B	140	522	502	240	240
IMH–A–Small–C	315	314	391	307	(237)
IMH–A–Large–C	660	744	1,026	524	500
SCU–A–Small–C	93	140	146	146	(441)

* LCC results for IMH–W–Large–B, IMH–A–Large–B, and RCU–Large–B are a weighted average of the two sub-equipment class level typical units shown on the table, using weights provided in TSD chapter 7.

TABLE V.53—SUMMARY OF RESULTS FOR AUTOMATIC COMMERCIAL ICE MAKERS TSLS: MEDIAN PAYBACK PERIOD

Equipment class	Standard Level *years*				
	TSL1	TSL2	TSL3	TSL4	TSL5
IMH–W–Small–B	1.07	1.26	2.27	2.27	5.42
IMH–W–Med–B	0.63	0.63	0.85	3.33	3.22
IMH–W–Large–B*	0.69	0.69	0.69	3.59	3.60
IMH–W–Large–B1	0.72	0.72	0.72	3.75	3.77
IMH–W–Large–B2	0.58	0.58	0.58	3.10	3.02
IMH–A–Small–B	1.07	1.22	1.42	4.32	4.24
IMH–A–Large–B*	0.46	0.49	0.84	2.16	2.16
IMH–A–Large–B1	0.46	0.50	0.82	2.08	2.08
IMH–A–Large–B2	0.42	0.42	0.94	2.58	2.58
RCU–Large–B*	0.41	0.41	0.65	2.39	2.44
RCU–Large–B1	0.38	0.38	0.62	2.37	2.42
RCU–Large–B2	0.75	0.75	1.00	2.70	2.70
SCU–W–Large–B	0.67	0.76	1.00	3.01	3.00
SCU–A–Small–B	1.40	1.52	1.56	4.79	4.79
SCU–A–Large–B	1.37	1.17	1.49	3.72	3.72
IMH–A–Small–C	0.90	0.90	0.97	2.59	6.83
IMH–A–Large–C	0.52	0.53	0.69	3.25	3.24
SCU–A–Small–C	1.13	1.53	1.85	1.85	19.12

*PBP results for IMH–W–Large–B, IMH–A–Large–B, and RCU–Large–B are weighted averages of the results for the two sub-equipment class level typical units, using weights provided in TSD chapter 7.

TABLE V.54—SUMMARY OF RESULTS FOR AUTOMATIC COMMERCIAL ICE MAKER TSLS: DISTRIBUTION OF CUSTOMER LCC IMPACTS

Category	Standard Level *percentage of customers (%)*				
	TSL1	TSL2	TSL3	TSL4	TSL5
IMH–W–Small–B					
Net Cost (%)	0.0	0.0	3.5	3.5	45.3
No Impact (%)	60.8	34.8	0.0	0.0	0.0
Net Benefit (%)	39.2	65.2	96.5	96.5	54.7
IMH–W–Med–B					
Net Cost (%)	0.0	0.0	0.0	14.9	11.3
No Impact (%)	31.0	31.0	14.3	2.4	2.4
Net Benefit (%)	69.0	69.0	85.7	82.7	86.3
IMH–W–Large–B*					
Net Cost (%)	0.0	0.0	0.0	8.4	7.1
No Impact (%)	37.6	37.6	37.6	25.8	22.1
Net Benefit (%)	62.4	62.4	62.4	65.8	70.8
IMH–W–Large–B1					
Net Cost (%)	0.0	0.0	0.0	0.1	0.2
No Impact (%)	28.6	28.6	28.6	28.6	23.8
Net Benefit (%)	71.4	71.4	71.4	71.3	76.0
IMH–W–Large–B2					
Net Cost (%)	0.0	0.0	0.0	35.2	29.4
No Impact (%)	66.6	66.6	66.6	16.7	16.7
Net Benefit (%)	33.4	33.4	33.4	48.1	53.9
IMH–A–Small–B					
Net Cost (%)	0.0	0.0	0.0	27.0	22.4
No Impact (%)	62.9	31.5	0.0	0.0	0.0
Net Benefit (%)	37.1	68.5	100.0	73.0	77.6
IMH–A–Large–B*					
Net Cost (%)	0.0	0.0	0.0	3.6	3.6
No Impact (%)	59.8	22.8	6.3	2.1	2.1
Net Benefit (%)	40.2	77.2	93.7	94.4	94.4
IMH–A–Large–B1					
Net Cost (%)	0.0	0.0	0.0	1.2	1.2
No Impact (%)	58.6	14.7	0.0	0.0	0.0
Net Benefit (%)	41.5	85.4	100.0	98.8	98.8
IMH–A–Large–B2					
Net Cost (%)	0.0	0.0	0.0	16.5	16.5
No Impact (%)	66.6	66.6	40.0	13.4	13.4
Net Benefit (%)	33.4	33.4	60.0	70.2	70.2
RCU–Large–B*					
Net Cost (%)	0.0	0.0	0.0	5.9	5.2
No Impact (%)	58.1	58.1	18.5	9.5	9.5
Net Benefit (%)	41.9	41.9	81.5	84.6	85.3

TABLE V.54—SUMMARY OF RESULTS FOR AUTOMATIC COMMERCIAL ICE MAKER TSLS: DISTRIBUTION OF CUSTOMER LCC IMPACTS—Continued

Category	Standard Level *percentage of customers (%)*				
	TSL1	TSL2	TSL3	TSL4	TSL5
RCU–Large–B1					
Net Cost (%)	0.0	0.0	0.0	5.8	5.1
No Impact (%)	57.2	57.2	17.9	9.0	9.0
Net Benefit (%)	42.8	42.8	82.1	85.3	85.9
RCU–Large–B2					
Net Cost (%)	0.0	0.0	0.0	7.1	6.2
No Impact (%)	72.7	72.7	27.3	18.2	18.2
Net Benefit (%)	27.3	27.3	72.7	74.7	75.7
SCU–W–Large–B					
Net Cost (%)	0.0	0.0	0.0	49.3	48.8
No Impact (%)	71.4	71.4	57.2	14.3	14.3
Net Benefit (%)	28.6	28.6	42.8	36.4	36.8
SCU–A–Small–B					
Net Cost (%)	0.0	0.0	0.0	31.8	31.8
No Impact (%)	82.9	37.1	11.5	0.0	0.0
Net Benefit (%)	17.1	62.9	88.5	68.2	68.2
SCU–A–Large–B					
Net Cost (%)	0.0	0.0	0.1	34.3	34.3
No Impact (%)	71.4	35.7	7.2	0.0	0.0
Net Benefit (%)	28.6	64.3	92.7	65.7	65.7
IMH–A–Small–C					
Net Cost (%)	0.0	0.0	0.0	7.9	72.7
No Impact (%)	77.2	54.3	40.0	31.4	11.5
Net Benefit (%)	22.8	45.7	60.0	60.7	15.9
IMH–A–Large–C					
Net Cost (%)	0.0	0.0	0.0	21.3	21.1
No Impact (%)	65.0	45.0	15.0	15.0	10.0
Net Benefit (%)	35.0	55.0	85.0	63.7	68.9
SCU–A–Small–C					
Net Cost (%)	0.0	0.0	0.0	0.0	79.8
No Impact (%)	73.4	53.3	36.7	36.7	20.0
Net Benefit (%)	26.6	46.7	63.3	63.3	0.2

* LCC results for IMH–W–Large–B, IMH–A–Large–B, and RCU–Large–B are a weighted average of the two sub-equipment class level typical units shown on the table.

DOE also notes that the economics literature provides a wide-ranging discussion of how consumers trade-off upfront costs and energy savings in the absence of government intervention. Much of this literature attempts to explain why consumers appear to undervalue energy efficiency improvements. This undervaluation suggests that regulation that promotes energy efficiency can produce significant net private gains (as well as producing social gains by, for example, reducing pollution). There is evidence that consumers undervalue future energy savings as a result of (1) a lack of information; (2) a lack of sufficient salience of the long-term or aggregate benefits; (3) a lack of sufficient savings to warrant delaying or altering purchases (*e.g.,* an inefficient ventilation fan in a new building or the delayed replacement of a water pump); (4) excessive focus on the short term, in the form of inconsistent weighting of future energy cost savings relative to available returns on other investments; (5) computational or other difficulties associated with the evaluation of relevant tradeoffs; and (6) a divergence in incentives (*e.g.,* renter versus building owner, builder versus home buyer). Other literature indicates that with less than perfect foresight and a high degree of uncertainty about the future, consumers may trade off these types of investments at a higher-than-expected rate between current consumption and uncertain future energy cost savings.

While DOE is not prepared at present to provide a fuller quantifiable framework for estimating the benefits and costs of changes in consumer purchase decisions due to an amended energy conservation standard, DOE has posted a paper that discusses the issue of consumer welfare impacts of appliance energy efficiency standards, and potential enhancements to the methodology by which these impacts are defined and estimated in the regulatory process.[72] DOE is committed to developing a framework that can support empirical quantitative tools for improved assessment of the consumer welfare impacts of appliance standards. DOE welcomes comments on information and methods to better assess the potential impact of energy conservation standards on consumer choice and methods to quantify this impact in its regulatory analysis in future rulemakings.

TSL 5 corresponds to the max-tech level for all the equipment classes and offers the potential for the highest cumulative energy savings through the analysis period from 2018 to 2047. The estimated energy savings from TSL 5 is 0.401 quads of energy, and potable water savings are 45.4 billion gallons. DOE projects a net positive NPV for customers valued at $0.370 billion at a 7-percent discount rate. Estimated emissions reductions are 20.4 MMt of CO_2, up to 12.2 kt of NO_X and 0.03 tons

[72] Sanstad, A. *Notes on the Economics of Household Energy Consumption and Technology Choice.* 2010. Lawrence Berkeley National Laboratory, Berkeley, CA. *www1.eere.energy.gov/buildings/appliance_standards/pdfs/consumer_ee_theory.pdf.*

of Hg. The CO_2 emissions have a value of up to $2.0 billion and the NO_X emissions have a value of up to $7.8 million at a 7-percent discount rate.

For TSL 5, with the exception of equipment class IMH–A–Small–C and SCU–A–Small–C, the mean LCC savings for all equipment classes are positive, implying a decrease in LCC, with the decrease ranging from $49 for the IMH–W–Small–B equipment class to $945 for the IMH–A–Large–B equipment class.[73] Although the mean LCC decreases indicate a savings potential for commercial ice makers as a whole, the results shown on Table V.54 indicates a large fraction of customers would experience net LCC increases (*i.e.,* LCC costs rather than savings) from adoption of TSL 5, with 30 to nearly 80 percent of customers experiencing net LCC increases in six equipment classes. As shown on Table V.53, customers in 10 equipment classes would experience payback periods of 3 years or longer.

At TSL 5, manufacturers may experience a loss of INPV due to large investments in product development and manufacturing capital as nearly all products will need substantial redesign and existing production lines will need to be adapted to produce evaporators and cabinets, among other components, for the newly compliant designs. Where these designs may differ considerably from those currently available, this TSL also presents a significant testing burden. The projected change in INPV ranges from a decrease of $32.6 million to a decrease of $19.9 million depending on the chosen manufacturer markup scenario. The upper bound of a $19.9 million decrease in INPV is considered an optimistic scenario for manufacturers because it assumes they can maintain the same gross margin (as a percentage of revenue) on their sales. DOE recognizes the risk of large negative impacts on industry if manufacturers' expectations concerning reduced profit margins are realized. TSL 5 could reduce the INPV for automatic commercial ice makers by up to 32.0 percent if impacts reach the lower bound of the range, which represents a scenario in which manufacturers cannot fully mark up the increased equipment costs, and therefore cannot maintain the same overall gross margins (as a percentage of revenue) they would have in the base case.

In addition to the estimated impacts on INPV, the impacts on manufacturing capacity and competition are of concern at TSL 5. While more than half of the manufacturers who produce continuous products, already offer at least one product that complies with TSL 5, only two manufacturers currently produce batch commercial ice makers that comply with the efficiency levels specified at TSL 5. This includes one small business manufacturer whose niche products have among the very largest harvest capacities in their respective equipment classes and are sold in small quantities relative to the rest of the industry. In contrast to this small business manufacturer, the other manufacturer is Hoshizaki, which produces more mainstream batch products and commands substantial market share.

The concentration of current production of batch commercial ice makers at TSL 5 presents two issues. Hoshizaki holds intellectual property covering the design of the evaporator used in their batch equipment, which limits the range of possible alternative paths to achieving the efficiency levels for batch equipment specified at TSL 5. While the engineering analysis identified other means to achieve these high efficiencies, given this limitation on design options, other manufacturers expressed significant doubts regarding their ability to do so. Further, DOE's analysis indicates that these efficiency levels require the use of permanent magnet motors and, for batch equipment, drain water heat exchangers. DOE was able to identify only one supplier of the latter technology, whose design is patented. In addition, there is currently very limited use of permanent magnet motors in commercial ice makers; hence, motor suppliers would be required to develop and initiate production for a broad range of new motor designs suitable for automatic commercial ice makers. These needs could severely impact automatic commercial ice maker manufacturers' ability to procure the required components in sufficient quantities to supply the market.

Assuming the other paths to achieving these efficiency levels prove fruitful, TSL 5 would still require that every other manufacturer retool their entire batch equipment production lines. Further, DOE review of the efficiency levels of available equipment shows that only 13 percent of Hoshizaki's batch products meet the TSL 5 efficiency levels, suggesting that the vast majority of their production lines would also require redesign and retooling. In confidential interviews, one manufacturer cited the possibility of a 3-month to 6-month shutdown in the event that amended standards were set high enough to require retooling of their entire product line. Compounding this effect across the industry could severely impact manufacturing capacity in the interim period between the announcement of the standards and the compliance date.

After carefully considering the analysis results and weighing the benefits and burdens of TSL 5, DOE finds that at TSL 5, the benefits to the Nation in the form of energy savings and emissions reductions plus an increase of $0.370 billion in customer NPV are weighed against a decrease of up to 32.0 percent in INPV. While most individual customers purchasing automatic commercial ice makers built to TSL 5 standards would be better off than in the base case, most would face payback periods in excess of 3 years. The limited number of manufacturers currently producing batch commercial ice makers that meet this efficiency level is cause for additional concern. After weighing the burdens of TSL 5 against the benefits, DOE finds TSL 5 not to be economically justified. DOE does not propose to adopt TSL 5 in this rulemaking.

TSL 4, the next highest efficiency level, corresponds to the highest efficiency level with a positive NPV at a 7-percent discount rate for all equipment classes. The estimated energy savings from 2018 to 2047 are 0.380 quads of energy and 45.4 billion gallons of potable water—amounts DOE deems significant. At TSL 4, DOE projects an increase in customer NPV of $0.484 billion (2012$) at a 7-percent discount rate; estimated emissions reductions of 19.4 MMt of CO_2, 11.6 kt of NO_X, and 0.03 tons of Hg. The monetary value of these emissions was estimated to be up to $1.9 billion for CO_2 and up to $7.4 million for NO_X at a 7-percent discount rate.

At TSL 4, the mean LCC savings are positive for all equipment classes. As shown on Table V.52, mean LCC savings vary from $106 for SCU–A–Small–B to $945 for IMH–A–Large–B, which implies that, on average, customers will experience an LCC benefit. However, as shown on Table V.54, for 11 of the 12 classes, at least some fraction of the customers will experience net costs. Customers in 3 classes would experience net LCC costs of 30 percent or more, with the percentage ranging up to 49 percent for one equipment class. Median payback periods range from 1.9 years up to 4.8 years, with 7 of the 12 directly analyzed classes exhibiting payback periods over 3 years.

At TSL 4, the projected change in INPV ranges from a decrease of $30.5 million to a decrease of $19.6 million.

[73] Two of the typical units modeled for the three large batch classes have higher savings. For this section of the NOPR, the discussion is limited to results for full equipment classes.

The impact on manufacturers at TSL 4 is not significantly different from that at TSL 5 as the individual efficiency levels for each equipment class at TSL 4 are on average not significantly different from those at TSL 5, and in several instances they are the same. DOE recognizes the risk of negative impacts at TSL 4 if manufacturers' expectations concerning reduced profit margins are realized. If the lower bound of −$30.5 million is reached, as DOE expects, TSL 4 could result in a net loss of 30.0 percent in INPV for manufacturers of automatic commercial ice makers.

The impacts on manufacturing capacity and competition are of concern at TSL 4. While every manufacturer who produces continuous equipment offers at least one product that complies with TSL 4, only two manufacturers currently produce batch commercial ice makers that comply with the efficiency levels specified at TSL 4. This includes one small business manufacturer whose niche products have among the very largest harvest capacities in their respective equipment classes and are sold in small quantities relative to the rest of the industry. In contrast to this small business manufacturer, the other manufacturer is a larger manufacturer which produces more mainstream batch products and commands a substantial market share.

The concentration of current production at TSL 4 presents two issues. One large manufacturer holds intellectual property covering the evaporator design used in their batch equipment, which in turn limits the range of possible alternative paths to achieving the efficiency levels specified at TSL 4. While the engineering analysis identified other means to achieve these high efficiencies, given this limitation on design options, other manufacturers expressed significant doubts regarding their ability to do so. Further, DOE's analysis indicates that these efficiency levels require the use of permanent magnet motors and, for most batch equipment, drain water heat exchangers. DOE was able to identify only one supplier of the latter technology, whose design is patented. In addition, there is currently very limited use of permanent magnet motors in commercial ice makers; hence, motor suppliers would be required to develop and initiate production for a broad range of new motor designs suitable for automatic commercial ice makers. These needs could severely impact automatic commercial ice maker manufacturers' ability to procure the required components in sufficient quantities to supply the market.

Assuming other paths to achieving these efficiency levels prove fruitful, TSL 4 would still require that every other manufacturer retool their entire batch equipment production lines. As noted above, only 2 manufacturers currently produce equipment that meets TSL 4 efficiency levels, one of which is a large manufacturer. DOE's review of the efficiency levels of available equipment shows that only 14 percent of the large manufacturer's batch products meet the TSL 4 efficiency levels, suggesting the vast majority of their production lines would also require redesign and retooling. In confidential interviews, another manufacturer cited the possibility of a 3-month to 6-month shutdown in the event that amended standards were set high enough to require retooling of their entire product line. Compounding this effect across the industry could severely impact manufacturing capacity in the interim period between the announcement of the standards and the compliance date.

After carefully considering the analysis results and weighing the benefits and burdens of TSL 4, DOE finds that at TSL 4, the benefits to the Nation in the form of energy savings and emissions reductions plus an increase of $0.484 billion in customer NPV are weighed against a decrease of up to 30.0 percent in INPV. While most individual customers purchasing automatic commercial ice makers built to TSL 4 standards would be better off than in the base case, customers in 7 of 12 equipment classes would face payback periods in excess of 3 years. The limited number of manufacturers currently producing batch commercial ice makers that meet this efficiency level is cause for additional concern. After weighing the burdens of TSL 4 against the benefits, DOE finds TSL 4 not to be economically justified. DOE does not propose to adopt TSL 4 in this notice.

At TSL 3, the next highest efficiency level, estimated energy savings from 2018 to 2047 are 0.286 quads of primary energy and water savings are 45.4 billion gallons—amounts DOE considers significant. TSL 3 was defined as the set of efficiencies with the highest NPV for each analyzed equipment class. At TSL 3, DOE projects an increase in customer NPV of $0.791 billion at a 7-percent discount rate, and an increase of $1.751 billion at a 3-percent discount rate. Estimated emissions reductions are 14.6 MMt of CO_2, up to 8.7 kt of NO_X and 0.02 tons of Hg at TSL 3. The monetary value of the CO_2 emissions reductions was estimated to be up to $1.4 billion at TSL 3, while NO_X emission reductions at a 7-percent discount rate were valued at up to $5.5 million.

At TSL 3, nearly all customers for all equipment classes are shown to experience positive LCC savings. As shown on Table V.54, the percent of customers experiencing a net cost rounds to 0 in all but two classes—SCU–A–Large–B with 0.1 percent and IMH–W–Small–B with 3.5 percent of customers exhibiting a net cost. The payback period for IMH–W–Small–B is 2.3 years, while for all other equipment classes the median payback periods are 1.9 years or less. LCC savings range from $146 for SCU–A–Small–C to over $1,100 for IMH–A–Large–B.

At TSL 3, the projected change in INPV ranges from a decrease of $23.9 million to a decrease of $20.9 million. The three largest manufacturers, who together represent an estimated 95 percent of the market, currently produce a combined 38 compliant batch products at TSL 3. Many of the gains in efficiency needed to meet the standards proposed at TSL 3 can be achieved using higher efficiency components as opposed to the redesign of systems manufactured in-house and as such require little change to existing manufacturing capital. The lack of green-field redevelopment or significant recapitalization mitigates the risk of disruption to manufacturing capacity in the interim period between announcement of the energy conservation standards and the compliance date.

At TSL 3, the monetized CO_2 emissions reduction values range from $0.102 to $1.426 billion. The monetized CO_2 emissions reduction at $39.7 per ton in 2012$ is $0.463 billion. The monetized NO_X emissions reductions calculated at an intermediate value of $2,639 per ton in 2012$ are $3 million at a 7-percent discount rate and $9.6 million at a 3-percent rate. These monetized emissions reduction values were added to the customer NPV at 3-percent and 7-percent discount rates to obtain values of $2.223 billion and 1.257 billion, respectively, at TSL 3. The total customer and emissions benefits are highest at TSL 3.

Nearly all customers are expected to experience net benefits from equipment built to TSL 3 levels. The payback periods for TSL 3 are expected to be 2.3 years, or less.

After carefully considering the analysis results and weighing the benefits and burdens of TSL 3, DOE believes that setting the standards for automatic commercial ice makers at TSL 3 represents the maximum improvement in energy efficiency that is technologically feasible and economically justified. TSL 3 is technologically feasible because the technologies required to achieve these levels already exist in the current market and are available from multiple manufacturers. TSL 3 is economically justified because the benefits to the Nation in the form of energy savings, customer NPV at 3 percent and at 7 percent, and emissions reductions outweigh the costs associated with reduced INPV and potential effects of reduced manufacturing capacity.

Therefore, DOE proposes the adoption of amended energy conservation standards for automatic commercial ice makers at TSL 3.

DOE specifically seeks comment on the magnitude of the estimated decline in INPV at TSL 3 compared to the baseline, and whether this impact could risk industry consolidation. DOE also specifically requests comment on whether DOE should adopt TSL 4 or 5 and why., DOE may reexamine the proposed level depending on the nature of the information it receives during the comment period and adjust its final levels in response to that information.

VI. Procedural Issues and Regulatory Review

A. Review Under Executive Orders 12866 and 13563

Section 1(b)(1) of Executive Order 12866, ''Regulatory Planning and Review,'' 58 FR 51735 (Oct. 4, 1993), requires each agency to identify the problem that it intends to address, including, where applicable, the failures of private markets or public institutions that warrant new agency action, as well as to assess the significance of that problem. The problems that today's standards address are as follows:

1. There is a lack of consumer information and/or information processing capability about energy efficiency opportunities in the automatic commercial ice maker market.

2. There is asymmetric information (one party to a transaction has more and better information than the other) and/or high transactions costs (costs of gathering information and effecting exchanges of goods and services).

3. There are external benefits resulting from improved energy efficiency of automatic commercial ice makers that are not captured by the users of such equipment. These benefits include externalities related to environmental protection and energy security that are not reflected in energy prices, such as reduced emissions of GHGs.

In addition, DOE has determined that today's regulatory action is an ''economically significant regulatory action'' under section 3(f)(1) of Executive Order 12866. Accordingly, section 6(a)(3) of the Executive Order requires that DOE prepare an RIA on today's rule and that OIRA in OMB review this rule. DOE presented to OIRA for review the draft rule and other documents prepared for this rulemaking, including the RIA. DOE has included these documents in the rulemaking record. The assessments prepared pursuant to Executive Order 12866 can be found in the TSD for this rulemaking.

DOE has also reviewed this regulation pursuant to Executive Order 13563, issued on January 18, 2011. 76 FR 3821 (Jan. 21, 2011). Executive Order 13563 is supplemental to and explicitly reaffirms the principles, structures, and definitions governing regulatory review established in Executive Order 12866. To the extent permitted by law, agencies are required by Executive Order 13563 to: (1) propose or adopt a regulation only upon a reasoned determination that its benefits justify its costs (recognizing that some benefits and costs are difficult to quantify); (2) tailor regulations to impose the least burden on society, consistent with obtaining regulatory objectives, taking into account, among other things, and to the extent practicable, the costs of cumulative regulations; (3) select, in choosing among alternative regulatory approaches, those approaches that maximize net benefits (including potential economic, environmental, public health and safety, and other advantages; distributive impacts; and equity); (4) to the extent feasible, specify performance objectives, rather than specifying the behavior or manner of compliance that regulated entities must adopt; and (5) identify and assess available alternatives to direct regulation, including providing economic incentives to encourage the desired behavior, such as user fees or marketable permits, or providing information upon which choices can be made by the public.

DOE emphasizes as well that Executive Order 13563 requires agencies to use the best available techniques to quantify anticipated present and future benefits and costs as accurately as possible. In its guidance, ORIA has emphasized that such techniques may include identifying changing future compliance costs that might result from technological innovation or anticipated behavioral changes. For the reasons stated in the preamble, DOE believes that today's NOPR is consistent with these principles, including the requirement that, to the extent permitted by law, benefits justify costs and that net benefits are maximized.

B. Review Under the Regulatory Flexibility Act

The Regulatory Flexibility Act (5 U.S.C. 601 *et seq.*) requires preparation of an initial regulatory flexibility analysis (IRFA) for any rule that by law must be proposed for public comment, unless the agency certifies that the rule, if promulgated, will not have a significant economic impact on a substantial number of small entities. As required by Executive Order 13272, ''Proper Consideration of Small Entities in Agency Rulemaking'' 67 FR 53461 (Aug. 16, 2002), DOE published procedures and policies on February 19, 2003 to ensure that the potential impacts of its rules on small entities are properly considered during the rulemaking process. 68 FR at 7990. DOE has made its procedures and policies available on the Office of the General Counsel's Web site (*http://energy.gov/gc/downloads/executive-order-13272-consideration-small-entities-agency-rulemaking*).

1. Description and Estimated Number of Small Entities Regulated

For manufacturers of automatic commercial ice makers, the SBA has set a size threshold, which defines those entities classified as ''small businesses'' for the purposes of the statute. DOE used the SBA's small business size standards to determine whether any small entities would be subject to the requirements of the rule. 65 FR 30836, 30848 (May 15, 2000), as amended at 65 FR 53533, 53544 (Sept. 5, 2000) and codified at 13 CFR part 121. The size standards are listed by NAICS code and industry description and are available at: *www.sba.gov/sites/default/files/files/Size_Standards_Table.pdf.*

Manufacturing of automatic commercial ice makers is classified under NAICS 333415, ''Air-Conditioning and Warm Air Heating Equipment and Commercial and Industrial Refrigeration Equipment Manufacturing,'' which includes ice-making machinery manufacturing. The SBA sets a threshold of 750 employees or less for an entity to be considered as a small business in this category.

During its market survey, DOE used available public information to identify potential small manufacturers. DOE's research involved industry trade association membership directories (including AHRI), public databases (*e.g.,* AHRI Directory,[74] the SBA Database [75]), individual company Web sites, and market research tools (*e.g.,* Hoovers reports [76]) to create a list of companies that manufacture or sell equipment covered by this rulemaking. DOE also asked stakeholders and industry representatives if they were aware of any other small manufacturers during manufacturer interviews and at DOE public meetings. DOE reviewed publicly available data and contacted select companies on its list, as necessary, to determine whether they met the SBA's definition of a small business manufacturer of covered automatic commercial ice makers. DOE screened out companies that do not offer equipment covered by this rulemaking, do not meet the definition of a ''small business,'' or are foreign-owned.

DOE identified seven small domestic businesses manufacturers of automatic commercial ice makers operating in the United States. DOE contacted each of these companies, but only one accepted the invitation to participate in a confidential manufacturer impact analysis interview with DOE contractors.

2. Description and Estimate of Compliance Requirements

DOE estimates that the seven small domestic manufacturers of automatic commercial ice makers identified by DOE account for approximately 5 percent of industry shipments. While small business manufacturers of automatic commercial ice makers have small overall market share, some hold substantial market share in specific equipment classes. Several of these smaller firms specialize in producing industrial ice machines and the covered equipment they manufacture are extensions of existing product lines that fall within the range of capacity covered by this rule. Others serve niche markets. Most have substantial portions of their business derived from equipment outside the scope of this rulemaking, but are still considered small businesses based on the SBA limits for number of employees.

At the proposed level, small business manufacturers of automatic commercial ice makers are expected to face negative impacts on INPV that are more than three times as severe as those felt by the industry at large: A loss of 78.6 percent of INPV for small businesses alone as compared to a loss of 23.5 percent for the industry at large. Where conversion costs are driven by the number of platforms requiring redesign at a particular standard level, small business manufacturers may be disproportionately affected. Product conversion costs including the investments made to redesign existing equipment to meet new or amended standards or to develop entirely new compliant equipment, as well as industry certification costs, do not scale with sales volume. As small manufacturers' investments are spread over a much lower volume of shipments, recovering the cost of upfront investments is proportionately more difficult.

Similarly, capital conversion costs may disproportionately affect small business manufacturers of automatic commercial ice makers. Capital conversion costs are projected to be highest in the year preceding standards as manufacturers retrofit production lines to make compliant equipment. In this year, capital conversion costs are estimated to represent 97 percent of typical capital expenditures for small businesses, as compared to 34 percent for the industry as a whole. Where the covered equipment from several small manufacturers are adaptations of larger platforms with capacities above the 4,000 lb ice/24 hour threshold, it may not prove economical for them to retrofit an entire production line to meet standards that only affect one product.

In confidential interviews, manufacturers indicated that many design options evaluated in the engineering analysis (*e.g.,* higher efficiency motors and compressors) would require them to purchase more expensive components. In many industries, small manufacturers typically pay higher prices for components due to smaller purchasing volumes while their large competitors receive volume discounts. However, this effect is diminished for the automatic commercial ice maker manufacturing industry for two distinct reasons. One reason relates to the fact that the automatic commercial ice maker industry as a whole is a low volume industry. In confidential interviews, manufacturers indicated that they have little influence over their suppliers, suggesting the volume of their component orders is similarly insufficient to receive substantial discounts. The second reason relates to the fact that, for most small businesses, the equipment covered by this rulemaking represents only a fraction of overall business. Where small businesses are ordering similar components for non-covered equipment, their purchase volumes may not be as low as is indicated by the total unit shipments for small businesses. For these reasons, it is expected that any volume discount for components enjoyed by large manufacturers would not be substantially different from the prices paid by small business manufacturers.

To estimate how small manufacturers would be potentially impacted, DOE developed specific small business inputs and scaling factors for the GRIM. These inputs were scaled from those used in the whole industry GRIM using information about the product portfolios of small businesses and the estimated market share of these businesses in each equipment class. DOE used this information in the GRIM to estimate the annual revenue, EBIT, R&D expense, and capital expenditures for a typical small manufacturer and to model the impact on INPV. DOE then compared these impacts to those modeled for the industry at large. The results are shown on Table VI.1 and Table VI.2.

TABLE VI.1—COMPARISON OF SMALL BUSINESS MANUFACTURERS OF AUTOMATIC COMMERCIAL ICE MAKER INPV TO THAT OF THE INDUSTRY AT LARGE BY TSL UNDER THE PRESERVATION OF GROSS MARGIN MARKUP SCENARIO*

	TSL 1	TSL 2	TSL 3	TSL 4	TSL 5
Industry at Large—Impact on INPV ($2012)	$(8.4)	$(12.8)	$(20.9)	$(19.6)	$(19.9)
Industry at Large—Impact on INPV (%)	(8.2)%	(12.6)%	(20.5)%	(19.2)%	(19.5)%
Small Businesses—Impact on INPV ($2012)	$(1.8)	$(2.9)	$(3.9)	$(4.1)	$(4.5)
Small Businesses—Impact on INPV (%)	(35.4)%	(57.0)%	(76.6)%	(80.5)%	(88.4)%

*Values in parentheses are negative numbers.

[74] See *www.ahridirectory.org/ahriDirectory/pages/home.aspx.*

[75] See *http://dsbs.sba.gov/dsbs/search/dsp_dsbs.cfm.*

[76] See *www.hoovers.com/.*

TABLE VI.2—COMPARISON OF SMALL BUSINESS MANUFACTURERS OF AUTOMATIC COMMERCIAL ICE MAKER INPV TO THAT OF THE INDUSTRY AT LARGE BY TSL UNDER THE PRESERVATION OF EBIT MARKUP SCENARIO

	TSL 1	TSL 2	TSL 3	TSL 4	TSL 5
Industry at Large—Impact on INPV ($2012)	$(8.7)	$(13.6)	$(23.9)	$(30.5)	$(32.6)
Industry at Large—Impact on INPV (%)	(8.5)%	(13.4)%	(23.5)%	(30.0)%	(32.0)%
Small Businesses—Impact on INPV ($2012)	$(1.8)	$(3.0)	$(4.0)	$(4.6)	$(5.1)
Small Businesses—Impact on INPV (%)	(35.4)%	(58.9)%	(78.6)%	(90.3)%	(100.2)%

*Values in parentheses are negative numbers.

3. Duplication, Overlap, and Conflict With Other Rules and Regulations

DOE is not aware of any rules or regulations that duplicate, overlap, or conflict with the rule being promulgated today.

4. Significant Alternatives to the Rule

The primary alternatives to the proposed rule are the other TSLs besides the one being considered today, TSL 3. DOE explicitly considered the role of manufacturers, including small manufacturers, in its selection of TSL 3 rather than TSLs 4 or 5. Though higher TSLs result in greater energy savings for the country, they would place significant burdens on manufacturers. Chapter 12 of the NOPR TSD contains additional information about the impact of this rulemaking on manufacturers.

In addition to the other TSLs being considered, chapter 17 of the NOPR TSD and Section V.B.7 include reports on a regulatory impact analysis (RIA). For automatic commercial ice makers, the RIA discusses the following policy alternatives: (1) No change in standard; (2) customer rebates; (3) customer tax credits; (4) manufacturer tax credits; and (5) early replacement. While these alternatives may mitigate to some varying extent the economic impacts on small entities compared to the amended standards, DOE determined that the energy savings of these regulatory alternatives could be approximately one-third to one-half less than the savings that would be expected to result from adoption of the amended standard levels. Because of the significantly lower savings, DOE rejected these alternatives and proposes to adopt the amended standards set forth in this rulemaking.

However, DOE seeks comment and, in particular, data on the impacts of this rulemaking upon small businesses. (See Issue 10 under ''Issues on Which DOE Seeks Comment'' in section VII.E of this NOPR.)

C. Review Under the Paperwork Reduction Act

Manufacturers of automatic commercial ice makers must certify to DOE that their equipment comply with any applicable energy conservation standards. In certifying compliance, manufacturers must test their equipment according to the DOE test procedures for automatic commercial ice makers, including any amendments adopted for those test procedures. DOE has established regulations for the certification and recordkeeping requirements for all covered consumer products and commercial/industrial equipment, including automatic commercial ice makers. 76 FR 12422 (March 7, 2011). The collection-of-information requirement for the certification and recordkeeping is subject to review and approval by OMB under the Paperwork Reduction Act (PRA). This requirement has been approved by OMB under OMB Control Number 1910–1400. Public reporting burden for the certification is estimated to average 20 hours per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information.

Notwithstanding any other provision of the law, no person is required to respond to, nor shall any person be subject to a penalty for failure to comply with, a collection of information subject to the requirements of the PRA, unless that collection of information displays a currently valid OMB Control Number.

D. Review Under the National Environmental Policy Act of 1969

Pursuant to the National Environmental Policy Act (NEPA) of 1969, (42 U.S.C. 4321 *et seq.*) DOE has determined that the proposed rule fits within the category of actions included in Categorical Exclusion (CX) B5.1 and otherwise meets the requirements for application of a CX. *See* 10 CFR part 1021, appendix B, B5.1(b); 1021.410(b) and appendix B, B(1)-(5). The proposed rule fits within the category of actions because it is a rulemaking that establishes energy conservation standards for consumer products or industrial equipment, and for which none of the exceptions identified in CX B5.1(b) apply. Therefore, DOE has made a CX determination for this rulemaking, and DOE does not need to prepare an Environmental Assessment or Environmental Impact Statement for this proposed rule. DOE's CX determination for this proposed rule is available at *http://energy.gov/nepa/downloads/cx-008014-categorical-exclusion-determination*.

E. Review Under Executive Order 13132

Executive Order 13132, ''Federalism,'' 64 FR 43255 (Aug. 10, 1999), imposes certain requirements on Federal agencies formulating and implementing policies or regulations that preempt State law or that have Federalism implications. The Executive Order requires agencies to examine the constitutional and statutory authority supporting any action that would limit the policymaking discretion of the States and to carefully assess the necessity for such actions. The Executive Order also requires agencies to have an accountable process to ensure meaningful and timely input by State and local officials in the development of regulatory policies that have Federalism implications. On March 14, 2000, DOE published a statement of policy describing the intergovernmental consultation process it will follow in the development of such regulations. 65 FR at 13735. EPCA governs and prescribes Federal preemption of State regulations as to energy conservation for the products that are the subject of today's proposed rule. States can petition DOE for exemption from such preemption to the extent, and based on criteria, set forth in EPCA. (42 U.S.C. 6297) No further action is required by Executive Order 13132.

F. Review Under Executive Order 12988

With respect to the review of existing regulations and the promulgation of new regulations, section 3(a) of Executive Order 12988, ''Civil Justice Reform,'' imposes on Federal agencies the general duty to adhere to the following requirements: (1) Eliminate drafting errors and ambiguity; (2) write regulations to minimize litigation; and (3) provide a clear legal standard for affected conduct rather than a general standard and promote simplification and burden reduction. 61 FR 4729 (Feb. 7, 1996). Section 3(b) of Executive Order 12988 specifically requires that Executive agencies make every reasonable effort to ensure that the regulation: (1) Clearly specifies the preemptive effect, if any; (2) clearly specifies any effect on existing Federal law or regulation; (3) provides a clear legal standard for affected conduct while promoting simplification and burden reduction; (4) specifies the retroactive effect, if any; (5) adequately defines key terms; and (6) addresses other important issues affecting clarity and general draftsmanship under any guidelines issued by the Attorney General. Section 3(c) of Executive Order 12988 requires Executive agencies to review regulations in light of applicable standards in section 3(a) and section 3(b) to determine whether they are met or it is unreasonable to meet one or more of them. DOE has completed the required review and determined that, to the extent permitted by law, this proposed rule meets the relevant standards of Executive Order 12988.

G. Review Under the Unfunded Mandates Reform Act of 1995

Title II of the Unfunded Mandates Reform Act of 1995 (UMRA) requires each Federal agency to assess the effects of Federal regulatory actions on State, local, and Tribal governments and the private sector. Public Law 104–4, sec. 201 (codified at 2 U.S.C. 1531). For a proposed regulatory action likely to result in a rule that may cause the expenditure by State, local, and Tribal governments, in the aggregate, or by the private sector of $100 million or more in any one year (adjusted annually for inflation), section 202 of UMRA requires a Federal agency to publish a written statement that estimates the resulting costs, benefits, and other effects on the national economy. (2 U.S.C. 1532(a),(b)) The UMRA also requires a Federal agency to develop an effective process to permit timely input by elected officers of State, local, and Tribal governments on a proposed ''significant intergovernmental mandate,'' and requires an agency plan for giving notice and opportunity for timely input to potentially affected small governments before establishing any requirements that might significantly or uniquely affect small governments. On March 18, 1997, DOE published a statement of policy on its process for intergovernmental consultation under UMRA. 62 FR at 12820. DOE's policy statement is also available at *http://energy.gov/gc/downloads/unfunded-mandates-reform-act-intergovernmental-consultation.*

Although today's proposed rule does not contain a Federal intergovernmental mandate, it may require expenditures of $100 million or more on the private sector. Specifically, the proposed rule will likely result in a final rule that could require expenditures of $100 million or more. Such expenditures may include: (1) Investment in research and development and in capital expenditures by automatic commercial ice makers manufacturers in the years between the final rule and the compliance date for the new standards; and (2) incremental additional expenditures by customers to purchase higher efficiency automatic commercial ice makers, starting at the compliance date for the applicable standard.

Section 202 of UMRA authorizes a Federal agency to respond to the content requirements of UMRA in any other statement or analysis that accompanies the proposed rule. (2 U.S.C. 1532(c)) The content requirements of section 202(b) of UMRA relevant to a private sector mandate substantially overlap the economic analysis requirements that apply under section 325(o) of EPCA and Executive Order 12866. The **SUPPLEMENTARY INFORMATION** section of this NOPR and the ''Regulatory Impact Analysis'' section of the NOPR TSD for this proposed rule respond to those requirements.

Under section 205 of UMRA, DOE is obligated to identify and consider a reasonable number of regulatory alternatives before promulgating a rule for which a written statement under section 202 is required. (2 U.S.C. 1535(a)) DOE is required to select from those alternatives the most cost-effective and least burdensome alternative that achieves the objectives of the proposed rule unless DOE publishes an explanation for doing otherwise, or the selection of such an alternative is inconsistent with law. As required by 42 U.S.C. 6295(o) and 6313(d), this proposed rule would establish energy conservation standards for automatic commercial ice makers that are designed to achieve the maximum improvement in energy efficiency that DOE has determined to be both technologically feasible and economically justified. A full discussion of the alternatives considered by DOE is presented in the ''Regulatory Impact Analysis'' section of the TSD for today's proposed rule.

H. Review Under the Treasury and General Government Appropriations Act, 1999

Section 654 of the Treasury and General Government Appropriations Act, 1999 (Pub. L. 105–277) requires Federal agencies to issue a Family Policymaking Assessment for any rule that may affect family well-being. This rule would not have any impact on the autonomy or integrity of the family as an institution. Accordingly, DOE has concluded that it is not necessary to prepare a Family Policymaking Assessment.

I. Review Under Executive Order 12630

DOE has determined, under Executive Order 12630, ''Governmental Actions and Interference with Constitutionally Protected Property Rights,'' 53 FR 8859 (Mar. 18, 1988), that this regulation would not result in any takings that might require compensation under the Fifth Amendment to the U.S. Constitution.

J. Review Under the Treasury and General Government Appropriations Act, 2001

Section 515 of the Treasury and General Government Appropriations Act, 2001 (44 U.S.C. 3516, note) provides for Federal agencies to review most disseminations of information to the public under guidelines established by each agency pursuant to general guidelines issued by OMB. OMB's guidelines were published at 67 FR 8452 (Feb. 22, 2002), and DOE's guidelines were published at 67 FR 62446 (Oct. 7, 2002). DOE has reviewed today's NOPR under the OMB and DOE guidelines and has concluded that it is consistent with applicable policies in those guidelines.

K. Review Under Executive Order 13211

Executive Order 13211, ''Actions Concerning Regulations That Significantly Affect Energy Supply, Distribution, or Use,'' 66 FR 28355 (May 22, 2001), requires Federal agencies to prepare and submit to OIRA at OMB a Statement of Energy Effects for any proposed significant energy action. A ''significant energy action'' is defined as any action by an agency that promulgates or is expected to lead to promulgation of a final rule, and that: (1) Is a significant regulatory action under Executive Order 12866, or any successor order; and (2) is likely to have a significant adverse effect on the supply, distribution, or use of energy, or (3) is designated by the Administrator of OIRA as a significant energy action. For any proposed significant energy action, the agency must give a detailed statement of any adverse effects on energy supply, distribution, or use should the proposal be implemented, and of reasonable alternatives to the action and their expected benefits on energy supply, distribution, and use.

DOE has tentatively concluded that today's regulatory action, which sets forth proposed energy conservation standards for automatic commercial ice makers, is not a significant energy action because the proposed standards are not likely to have a significant adverse effect on the supply, distribution, or use of energy, nor has it been designated as such by the Administrator at OIRA. Accordingly, DOE has not prepared a Statement of Energy Effects on the proposed rule.

L. Review Under the Information Quality Bulletin for Peer Review

On December 16, 2004, OMB, in consultation with the Office of Science and Technology Policy (OSTP), issued its Final Information Quality Bulletin for Peer Review (the Bulletin). 70 FR 2664 (Jan. 14, 2005). The Bulletin establishes that certain scientific information shall be peer-reviewed by qualified specialists before it is disseminated by the Federal Government, including influential scientific information related to agency regulatory actions. The purpose of the Bulletin is to enhance the quality and credibility of the Government's scientific information. Under the Bulletin, the energy conservation standards rulemaking analyses are ''influential scientific information,'' which the Bulletin defines as scientific information the agency reasonably can determine will have, or does have, a clear and substantial impact on important public policies or private sector decisions. 70 FR at 2667 (Jan. 14, 2005).

In response to OMB's Bulletin, DOE conducted formal in-progress peer reviews of the energy conservation standards development process and analyses and has prepared a Peer Review Report pertaining to the energy conservation standards rulemaking analyses. Generation of this report involved a rigorous, formal, and documented evaluation using objective criteria and qualified and independent reviewers to make a judgment as to the technical/scientific/business merit, the actual or anticipated results, and the productivity and management effectiveness of programs and/or projects. The ''Energy Conservation Standards Rulemaking Peer Review Report,'' dated February 2007, has been disseminated and is available at the following Web site: *www1.eere.energy.gov/buildings/appliance_standards/peer_review.html*.

VII. Public Participation

A. Attendance at the Public Meeting

The time, date, and location of the public meeting are listed in the DATES and **ADDRESSES** sections at the beginning of this rulemaking. If you plan to attend the public meeting, please notify Ms. Brenda Edwards at (202) 586–2945 or *Brenda.Edwards@ee.doe.gov*. Please note that foreign nationals visiting DOE Headquarters are subject to advance security screening procedures. Any foreign national wishing to participate in the meeting should advise DOE as soon as possible by contacting Ms. Edwards to initiate the necessary procedures. Please also note that those wishing to bring laptops into the Forrestal Building will be required to obtain a property pass. Visitors should avoid bringing laptops, or allow an extra 45 minutes. Persons can attend the public meeting via webinar.

Webinar registration information, participant instructions, and information about the capabilities available to webinar participants will be published on DOE's Web site at: *www1.eere.energy.gov/buildings/appliance_standards/rulemaking.aspx/ruleid/29*.

Participants are responsible for ensuring their systems are compatible with the webinar software.

B. Procedure for Submitting Prepared General Statements for Distribution

Any person who has plans to present a prepared general statement may request that copies of his or her statement be made available at the public meeting. Such persons may submit requests, along with an advance electronic copy of their statement in PDF (preferred), Microsoft Word or Excel, WordPerfect, or text (ASCII) file format, to the appropriate address shown in the **ADDRESSES** section at the beginning of this notice. The request and advance copy of statements must be received at least one week before the public meeting and may be emailed, hand-delivered, or sent by mail. DOE prefers to receive requests and advance copies via email. Please include a telephone number to enable DOE staff to make follow-up contact, if needed.

C. Conduct of the Public Meeting

DOE will designate a DOE official to preside at the public meeting and may also use a professional facilitator to aid discussion. The meeting will not be a judicial or evidentiary-type public hearing, but DOE will conduct it in accordance with section 336 of EPCA (42 U.S.C. 6306). A court reporter will be present to record the proceedings and prepare a transcript. DOE reserves the right to schedule the order of presentations and to establish the procedures governing the conduct of the public meeting. After the public meeting, interested parties may submit further comments on the proceedings as well as on any aspect of the rulemaking until the end of the comment period.

The public meeting will be conducted in an informal, conference style. DOE will present summaries of comments received before the public meeting, allow time for prepared general statements by participants, and encourage all interested parties to share their views on issues affecting this rulemaking. Each participant will be allowed to make a general statement (within time limits determined by DOE), before the discussion of specific topics. DOE will allow, as time permits, other participants to comment briefly on any general statements.

At the end of all prepared statements on a topic, DOE will permit participants to clarify their statements briefly and comment on statements made by others. Participants should be prepared to answer questions by DOE and by other participants concerning these issues. DOE representatives may also ask questions of participants concerning other matters relevant to this rulemaking. The official conducting the public meeting will accept additional comments or questions from those attending, as time permits. The presiding official will announce any further procedural rules or modification of the above procedures that may be needed for the proper conduct of the public meeting.

A transcript of the public meeting will be included in the docket, which can be viewed as described in the *Docket* section at the beginning of this rulemaking. In addition, any person may buy a copy of the transcript from the transcribing reporter.

D. Submission of Comments

DOE will accept comments, data, and information regarding this proposed rule before or after the public meeting, but no later than the date provided in the DATES section at the beginning of this proposed rule. Interested parties may submit comments, data, and other information using any of the methods described in the **ADDRESSES** section at the beginning of this notice.

Submitting comments via regulations.gov. The regulations.gov Web page will require you to provide your name and contact information. Your contact information will be viewable to DOE Building Technologies staff only. Your contact information will not be publicly viewable except for your first and last names, organization name (if any), and submitter representative name (if any). If your comment is not processed properly because of technical difficulties, DOE will use this information to contact you. If DOE cannot read your comment due to technical difficulties and cannot contact you for clarification, DOE may not be able to consider your comment.

However, your contact information will be publicly viewable if you include it in the comment itself or in any documents attached to your comment. Any information that you do not want to be publicly viewable should not be included in your comment, nor in any document attached to your comment. Otherwise, persons viewing comments will see only first and last names, organization names, correspondence containing comments, and any documents submitted with the comments.

Do not submit to regulations.gov information for which disclosure is restricted by statute, such as trade secrets and commercial or financial information (hereinafter referred to as Confidential Business Information (CBI)). Comments submitted through regulations.gov cannot be claimed as CBI. Comments received through the Web site will waive any CBI claims for the information submitted. For information on submitting CBI, see the Confidential Business Information section below.

DOE processes submissions made through regulations.gov before posting. Normally, comments will be posted within a few days of being submitted. However, if large volumes of comments are being processed simultaneously, your comment may not be viewable for up to several weeks. Please keep the comment tracking number that regulations.gov provides after you have successfully uploaded your comment.

Submitting comments via email, hand delivery/courier, or mail. Comments and documents submitted via email, hand delivery, or mail also will be posted to regulations.gov. If you do not want your personal contact information to be publicly viewable, do not include it in your comment or any accompanying documents. Instead, provide your contact information in a cover letter. Include your first and last names, email address, telephone number, and optional mailing address. The cover letter will not be publicly viewable as long as it does not include any comments.

Include contact information each time you submit comments, data, documents, and other information to DOE. If you submit via mail or hand delivery/courier, please provide all items on a CD, if feasible. It is not necessary to submit printed copies. No facsimiles (faxes) will be accepted.

Comments, data, and other information submitted to DOE electronically should be provided in PDF (preferred), Microsoft Word or Excel, WordPerfect, or text (ASCII) file format. Provide documents that are not secured, that are written in English, and that are free of any defects or viruses. Documents should not contain special characters or any form of encryption and, if possible, they should carry the electronic signature of the author.

Campaign form letters. Please submit campaign form letters by the originating organization in batches of between 50 to 500 form letters per PDF or as one form letter with a list of supporters' names compiled into one or more PDFs. This reduces comment processing and posting time.

Confidential Business Information. According to 10 CFR 1004.11, any person submitting information that he or she believes to be confidential and exempt by law from public disclosure should submit via email, postal mail, or hand delivery/courier two well-marked copies: one copy of the document marked confidential including all the information believed to be confidential, and one copy of the document marked non-confidential with the information believed to be confidential deleted. Submit these documents via email or on a CD, if feasible. DOE will make its own determination about the confidential status of the information and treat it according to its determination.

Factors of interest to DOE when evaluating requests to treat submitted information as confidential include: (1) A description of the items; (2) whether and why such items are customarily treated as confidential within the industry; (3) whether the information is generally known by or available from other sources; (4) whether the information has previously been made available to others without obligation concerning its confidentiality; (5) an explanation of the competitive injury to the submitting person which would result from public disclosure; (6) when such information might lose its confidential character due to the passage of time; and (7) why disclosure of the information would be contrary to the public interest.

It is DOE's policy that all comments may be included in the public docket, without change and as received, including any personal information provided in the comments (except information deemed to be exempt from public disclosure).

E. Issues on Which DOE Seeks Comment

Although DOE welcomes comments on any aspect of this proposal, DOE is particularly interested in receiving comments and views of interested parties concerning the following issues.

1. Standards Compliance Dates

EPCA requires that the amended standards established in this rulemaking must apply to equipment that is manufactured on or after 3 years after the final rule is published in the **Federal Register** unless DOE determines, by rule, that a 3-year period is inadequate, in which case DOE may extend the compliance date for that standard by an additional 2 years. (42 U.S.C. 6313(d)(3)(C))

For the NOPR analyses, DOE assumed a 3-year period to prepare for compliance. DOE requests comments on the January 1, 2018 effective date, and whether a January 1, 2018 effective date provides an inadequate period for compliance and what economic impacts would be mitigated by a later effective date.

DOE also requests comment on whether the 3-year period is adequate for manufacturers to obtain more efficient components from suppliers to meet proposed revisions of standards. More discussion on this topic can be found in Section IV.B.1.g of today's NOPR.

2. Utilization Factors

The utilization factor represents the percent of time that an ice maker actively produces ice. Ice maker usage is measured in terms of kilowatt-hours per 100 lb/24 hours, whereas subsequent analyses require annual energy usage in kilowatt-hours. Thus, a usage factor is required to translate the potential energy usage into estimated annual usage. In the Framework document, the Department presented a series of factors for each type of building that represents an ice maker market segment, and all were set to 0.5, meaning all building types would be modeled with a utilization factor indicating that equipment runs one-half of the time. The Stakeholders pointed out that not all building segments should be at 0.5, but DOE did not receive any data or information that DOE can use to differentiate the utilization factor by building type. DOE requests data for individual building types. More discussion on this topic can be found in Section IV.G.3 of today's NOPR.

3. Baseline Efficiency

For this notice, DOE chose continuous machine baselines at sufficiently high energy use levels that they exclude almost no equipment. DOE based the baselines on online data from the AHRI database. DOE requests comments on the development of continuous type equipment base efficiency levels and on the availability of data on which to create continuous machine baselines. More discussion on this topic can be found in Section IV.D.2.a of today's NOPR.

4. Screening Analysis

DOE requests comment on the screening analysis and, specifically, the design options DOE screened out of the rulemaking analysis.

DOE considered whether design options were technologically feasible; practicable to manufacture, install, or service; had adverse impacts on product utility or product availability; or had adverse impacts on health or safety. See Section IV.C of today's NOPR and chapter 4 of the NOPR TSD for further discussion of the screening analysis.

5. Maximum Technologically Feasible Levels

DOE seeks comments on the Maximum Technologically Feasible levels proposed in Table III.2 and Table III.3 of today's notice. More discussion on this topic can be found in Section IV.D.2.e of today's NOPR.

6. Markups to Determine Price

DOE identified three major distribution channels through which automatic commercial ice maker equipment is purchased by the end-user: (1) Manufacturer to end-user (direct channel); (2) manufacturer to wholesale distributor to end-user (wholesaler channel); and (3) manufacturer to distributor to dealer or contractor to end-user (contractor channel). DOE currently uses mechanical contractor data to estimate the contribution of local dealers or contactors to end-user prices. DOE requests specific input to improve the cost estimation for the local dealer or contractor component of markups. More discussion on this topic can be found in Section IV.E of today's NOPR.

7. Equipment Life

For the NOPR analyses, DOE used an 8.5 years average life for all equipment classes, with analyses based on a lifetime distribution averaging 8.5 years. (TSD chapter 9 discusses the development of the distribution.) In comments on the preliminary analysis, one stakeholder stated that continuous machines might have shorter life spans. DOE requests specific information to determine whether continuous and batch types should be analyzed using different equipment life assumptions, and if so, what they would be. More discussion on this topic can be found in Section IV.G.8 of today's NOPR.

8. Installation Costs

Stakeholders commented that higher efficiency equipment would incur additional installation costs when compared to the baseline equipment. DOE requests specificity with respect to this comment, with specific information on design options that will increase installation costs and specific information to enable DOE to adjust installation costs appropriately. More discussion on this topic can be found in Section IV.G.2.a of today's NOPR.

9. Open- Versus Closed-Loop Installations

Stakeholders commented that some localities in the U.S. have instituted local ordinances or laws precluding installation of ice makers in open-loop configurations. DOE requests stakeholder assistance in quantifying the impact of local regulations on the prevalence of open-loop installations. More discussion on this topic can be found in Section IV.D.3.c of today's NOPR.

10. Ice Maker Shipments by Type of Equipment

DOE's shipments forecast is based on a single snapshot of shipments by the type of equipment. Stakeholders at the preliminary analysis phase suggested that the equipment mix may be changing over time. DOE requests additional data concerning shipment trends/forecasts. More discussion on this topic can be found in Section IV.H.1 of today's NOPR.

11. Intermittency of Manufacturer R&D and Impact of Standards

One manufacturer reported that a previous round of standards required nearly all of the company's engineering resources for between 1 and 2 years. Where manufacturers may divert existing R&D resources to compliance related R&D efforts, DOE requests additional comment on the impact on innovation of compliance related R&D efforts. Specifically, DOE requests comment on how to quantify this impact on innovation. More discussion on this topic can be found in Section IV.J of today's NOPR.

12. INPV Results and Impact of Standards

Based on weighing of data, DOE is recommending TSL 3 for the new and amended automatic commercial ice maker standards. DOE recognizes that new and amended standards will have impacts on industry net present value results. DOE specifically seeks comment on the magnitude of the estimated decline in INPV at TSL 3 compared to the baseline, and what impact this may have on manufacturers. More discussion on this topic can be found in Section V.B.2 of today's NOPR.

13. Small Businesses

During the Framework and February 2012 preliminary analysis public meetings, DOE received many comments regarding the potential impacts of amended energy conservation standards on small business manufacturers of automatic commercial ice makers. DOE incorporated this feedback into its analyses for the NOPR and has presented its results in this notice and the NOPR TSD. However, DOE seeks comment and, in particular, additional data, in its efforts to quantify the impacts of this rulemaking on small businesses. More discussion on this topic can be found in Section IV.J.3.d of today's NOPR.

14. Consumer Utility and Performance

DOE requests comment on whether there are features or attributes of the more energy-efficient automatic commercial ice makers, including any potential changes to the evaporator design that would result in changes to the ice style or changes in the chassis size, that manufacturers would produce to meet the standards in this proposed rule that might affect how they would be used by consumers. DOE requests comment specifically on how any such effects should be weighed in the choice of standards for the automatic commercial ice makers for the final rule. More discussion on this topic can be found in Section V.B.3 of today's NOPR.

15. Analysis Period

For this rulemaking, DOE analyzed the effects of this proposal assuming that the automatic commercial ice makers would be available to purchase for 30 years and undertook a sensitivity analysis using 9 years rather than 30 years of product shipments. The choice of a 30-year period of shipments is consistent with the DOE analysis for other products and commercial equipment. The choice of a 9-year period is a proxy for the timeline in EPCA for the review of certain energy conservation standards and potential revision of and compliance with such revised standards. We are seeking input, information and data on whether there are ways to further refine the analytic timeline. More discussion on this topic can be found in Section IV.H.1 of today's NOPR.

16. Social Cost of Carbon

DOE solicits comment on the application of the new SCC values used to determine the social benefits of CO_2 emissions reductions over the rulemaking analysis period. (The rulemaking analysis period covers from 2018 to 2047 plus the appropriated number of years to account for the lifetime of the equipment purchased between 2018 and 2047.) In particular, the agency solicits comment on the agency's derivation of SCC values after 2050 where the agency applied the average annual growth rate of the SCC estimates in 2040–2050 associated with each of the four sets of values. More discussion on this topic can be found in Section IV.L.1 of today's NOPR.

17. Remote to Rack Equipment

In the preliminary analysis, DOE found that some high-capacity RCU–RC-Large-C ice makers are solely designed to be used with compressor racks and the racks' associated condensers. DOE requests comment and supporting data on the overall market share of these units and any expected market trends. More discussion on this topic can be found in Section IV.B.1.f of today's NOPR.

18. Design Options Associated With Each TSL

Section V.A.1 of today's NOPR discusses the design options associated with each TSL, for each analyzed product class. DOE requests comment and data related to the required equipment size increases associated with the design options at each TSL levels. Chapter 5 of the NOPR TSD contains full descriptions of the design options and DOE's analyses for the equipment size increase associated with the design options selected. DOE also requests comments and data on the efficiency gains associated with each set of design options. Chapter 5 of the NOPR TSD contains DOE's analyses of the efficiency gains for each design option considered. Finally, DOE requests comment and data on any utility impacts associated with each set of design options, such as potential ice-style changes.

19. Standard Levels for Batch-Type Ice Makers Over 2,500 lbs Ice/24 Hours

DOE requests comment and data on the viability of the proposed standard levels selected for batch-type ice makers with harvest capacities from 2,500 to 4,000 lb ice/24 hours. The proposed standard levels are discussed in Section V.A.2 of today's NOPR, and prior comments on standards for batch-type ice makers with harvest capacities from 2,500 to 4,000 lb ice/24 hours are discussed in Section IV.B.1.b of today's NOPR.

VIII. Approval of the Office of the Secretary

The Secretary of Energy has approved publication of today's proposed rule.

List of Subjects in 10 CFR Part 431

Administrative practice and procedure, Confidential business information, Energy conservation, Commercial equipment, Imports, Intergovernmental relations, Reporting and recordkeeping requirements, Small businesses.

Issued in Washington, DC, on March 7, 2014.

David T. Danielson,

Assistant Secretary for Energy Efficiency, Energy Efficiency and Renewable Energy.

For the reasons set forth in the preamble, DOE proposes to amend part 431 of chapter II of title 10, of the Code of Federal Regulations, as set forth below:

PART 431—ENERGY EFFICIENCY PROGRAM FOR CERTAIN COMMERCIAL AND INDUSTRIAL EQUIPMENT

■ 1. The authority citation for part 431 continues to read as follows:

Authority: 42 U.S.C. 6291–6317.

■ 2. Section 431.136 is revised to read as follows:

§ 431.136 Energy conservation standards and their effective dates.

(a) All basic models of commercial ice makers must be tested for performance using the applicable DOE test procedure in § 431.134, be compliant with the applicable standards set forth in paragraphs (b) through (d) of this section, and be certified to the Department of Energy under 10 CFR part 429.

(b) Each cube type automatic commercial ice maker with capacities between 50 and 2,500 pounds per 24-hour period manufactured on or after January 1, 2010 and before [DATE THREE YEARS AFTER PUBLICATION OF FINAL RULE], shall meet the following standard levels:

Equipment type	Type of cooling	Rated harvest rate *lb ice/24 hours*	Maximum energy use *kWh/100 lb ice*	Maximum condenser water use* *gal/100 lb ice*
Ice-Making Head	Water	<500	7.8–0.0055H**	200–0.022H.
		≥500 and <1,436	5.58–0.0011H	200–0.022H.
		≥1,436	4.0	200–0.022H.
	Air	<450	10.26–0.0086H	Not Applicable.
		≥450	6.89–0.0011H	Not Applicable.
Remote Condensing (but not remote compressor)	Air	<1,000	8.85–0.0038H	Not Applicable.
		≥1,000	5.1	Not Applicable.
Remote Condensing and Remote Compressor	Air	<934	8.85–0.0038H	Not Applicable.
		≥934	5.3	Not Applicable.
Self-Contained	Water	<200	11.40–0.019H	191–0.0315H.
		≥200	7.6	191–0.0315H.
	Air	<175	18.0–0.0469H	Not Applicable.
		≥175	9.8	Not Applicable.

* Water use is for the condenser only and does not include potable water used to make ice.
** H = rated harvest rate in pounds per 24 hours, indicating the water or energy use for a given rated harvest rate.
Source: 42 U.S.C. 6313(d).

(c) Each batch type automatic commercial ice maker with capacities between 50 and 4,000 pounds per 24-hour period manufactured on or after [DATE THREE YEARS AFTER

PUBLICATION OF FINAL RULE], shall meet the following standard levels:

Equipment type	Type of cooling	Rated harvest rate *lb ice/24 hours*	Maximum energy use *kWh/100 lb ice**	Maximum condenser water use** *gal/100 lb ice*
Ice-Making Head	Water	<500	5.84–0.0041H	200–0.022H.
		≥500 and <1,436	3.88–0.0002H	200–0.022H.
		≥1,436 and <2,500	3.6	200–0.022H
		≥2,500 and <4,000	3.6	145.
Ice-Making Head	Air	<450	7.70–0.0065H	Not Applicable.
		≥450 and <875	5.17–0.0008H	Not Applicable.
		≥875 and <2,210	4.5	Not Applicable.
		≥2,210 and <2,500	6.89–0.0011H	Not Applicable.
		≥2,500 and <4,000	4.1	Not Applicable.
Remote Condensing (but Not Remote Compressor)	Air	<1,000	7.52—0.0032H	Not Applicable
		≥1,000 and <4,000	4.3	Not Applicable.
Remote Condensing and Remote Compressor	Air	<934	7.52–0.0032H	Not Applicable.
		≥934 and <4,000	4.5	Not Applicable.
Self-Contained	Water	<200	8.55–0.0143H	191–0.0315H.
		≥200 and <2,500	5.7	191–0.0315H.
		≥2,500 and <4,000	5.7	112.
Self-Contained	Air	<175	12.6–0.0328H	Not Applicable.
		≥175 and <4,000	6.9	Not Applicable.

* H = rated harvest rate in pounds per 24 hours, indicating the water or energy use for a given rated harvest rate.
** Water use is for the condenser only and does not include potable water used to make ice.
Source: 42 U.S.C. 6313(d).

(d) Each continuous type automatic commercial ice maker with capacities between 50 and 4,000 pounds per 24-hour period manufactured on or after [DATE THREE YEARS AFTER PUBLICATION OF FINAL RULE], shall meet the following standard levels:

Equipment type	Type of cooling	Rated harvest rate *lb ice/24 hours*	Maximum energy use *kWh/100 lb ice**	Maximum condenser water use** *gal/100 lb ice*
Ice-Making Head	Water	<900	6.08–0.0025H	160–0.0176H.
		≥900 and <2,500	3.8	160–0.0176H.
		≥ 2,500 and 4,000	3.8	116.
Ice-Making Head	Air	<700	9.24–0.0061H	Not Applicable.
		≥700 and <4,000	5.0	Not Applicable.
Remote Condensing (but Not Remote Compressor)	Air	<850	7.50–0.0034H	Not Applicable.
		≥850 and <4,000	4.6	Not Applicable.
Remote Condensing and Remote Compressor	Air	<850	7.65–0.0034H	Not Applicable.
		≥850 and <4,000	4.8	Not Applicable.
Self-Contained	Water	<900	7.28–0.0027H	153–0.0252H.
		≥900 and <2,500	4.9	153–0.0252H.
		≥2,500 and <4,000	4.9	90.
Self-Contained	Air	<700	9.20—0.0050H	Not Applicable.
		≥700 and <4,000	5.7	Not Applicable.

* H = rated harvest rate in pounds per 24 hours, indicating the water or energy use for a given rated harvest rate.
** Water use is for the condenser only and does not include potable water used to make ice.
Source: 42 U.S.C. 6313(d).

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