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10 CFR Part 431

Energy Conservation Program: Energy Conservation Standards for Automatic Commercial Ice Makers; Final Rule

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: Final rule.

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 icemakers (ACIM). EPCA also requires the U.S. Department of Energy (DOE) to determine whether more-stringent standards would be technologically feasible and economically justified, and would save a significant amount of energy. In this final rule, DOE is adopting more-stringent energy conservation standards for some classes of automatic commercial ice makers as well as establishing energy conservation standards for other classes of automatic commercial ice makers. It has determined that the amended energy conservation standards for these products would result in significant conservation of energy, and are technologically feasible and economically justified.

DATES: The effective date of this rule is March 30, 2015. Compliance with the amended standards established for automatic commercial ice makers in this final rule is required on January 28, 2018.

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

A link to the docket Web page can be found at: *http://www.regulations.gov/#!docketDetail;D=EERE-2010-BT-STD-0037.*

The regulations.gov Web page will contain simple instructions on how to access all documents, including public comments, in the docket.

For further information on how to review the docket, contact Ms. Brenda Edwards at (202) 586–2945 or by email: *Brenda.Edwards@ee.doe.gov.*

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SUPPLEMENTARY INFORMATION:

Table of Contents

I. Discussion of the Final Rule and Its Benefits
A. Benefits and Costs to Customers
B. Impact on Manufacturers
C. National Benefits and Costs
D. Conclusion
II. Introduction
A. Authority
B. Background
1. Current Standards
2. History of Standards Rulemaking for Automatic Commercial Ice Makers
III. General Discussion
A. Equipment Classes and Scope of Coverage
B. Test Procedure
C. Technological Feasibility
1. General
2. Maximum Technologically Feasible Levels
D. Energy Savings
1. Determination of Savings
2. Significance of Savings
E. Economic Justification
1. Specific Criteria
a. Economic Impact on Manufacturers and Commercial Customers
b. Savings in Operating Costs Compared to Increase in Price (Life Cycle Costs)
c. Energy Savings
d. Lessening of Utility or Performance of Equipment
e. Impact of Any Lessening of Competition
f. Need of the Nation To Conserve Energy
g. Other Factors
2. Rebuttable Presumption
IV. Methodology and Discussion of Comments
A. General Rulemaking Issues
1. Proposed Standard Levels
2. Compliance Date
3. Negotiated Rulemaking
4. Refrigerant Regulation
5. Data Availability
6. Supplemental Notice of Proposed Rulemaking.
7. Rulemaking Structure Comments
B. Market and Technology Assessment
1. Equipment Classes
a. Cabinet Size
b. Large-Capacity Batch Ice Makers
c. Regulation of Potable Water Use
d. Regulation of Condenser Water Use
e. Continuous Models
f. Gourmet Ice Machines
2. Technology Assessment
a. Alternative Refrigerants
C. Screening Analysis
a. General Comments
b. Drain Water Heat Exchanger
c. Tube Evaporator Design
d. Low Thermal Mass Evaporator Design
e. Microchannel Heat Exchangers
f. Smart Technologies
g. Motors
D. Engineering Analysis
1. Representative Equipment for Analysis
2. Efficiency Levels
a. Baseline Efficiency Levels
b. Incremental Efficiency Levels
c. IMH–A-Large–B Treatment
d. Maximum Available Efficiency Equipment
e. Maximum Technologically Feasible Efficiency Levels
3. Design Options
a. Design Options that Need Cabinet Growth
b. Improved Condenser Performance
c. Compressors
d. Evaporator
e. Interconnectedness of Automatic Commercial Ice Maker System
4. Cost Assessment Methodology
a. Manufacturing Cost
b. Energy Consumption Model
c. Revision of NOPR and NODA Engineering Analysis
E. Markups Analysis
F. Energy Use Analysis
G. Life-Cycle Cost and Payback Period Analysis
1. Equipment Cost
2. Installation, Maintenance, and Repair Costs
a. Installation Costs
b. Repair and Maintenance Costs
3. Annual Energy and Water Consumption
4. Energy Prices
5. Energy Price Projections
6. Water Prices
7. Discount Rates
8. Lifetime
9. Compliance Date of Standards
10. Base-Case and Standards-Case Efficiency Distributions
11. Inputs to Payback Period Analysis
12. Rebuttable Presumption Payback Period
H. National Impact Analysis—National Energy Savings and Net Present Value
1. Shipments
2. Forecasted Efficiency in the Base Case and Standards Cases
3. National Energy Savings
4. Net Present Value of Customer Benefit
I. Customer Subgroup Analysis
J. Manufacturer Impact Analysis
1. Overview
2. Government Regulatory Impact Model
a. Government Regulatory Impact Model Key Inputs
b. Government Regulatory Impact Model Scenarios
3. Discussion of Comments
a. Conversion Costs
b. Cumulative Regulatory Burden

c. SNAP and Compliance Date Considerations
d. ENERGY STAR
e. Request for DOE and EPA Collaboration
f. Compliance With Refrigerant Changes Could Be Difficult
g. Small Manufacturers
h. Large Manufacturers
i. Negative Impact on Market Growth
j. Negative Impact on Non-U.S. Sales
k. Employment
l. Compliance With 12866 and 13563
m. Warranty Claims
n. Impact to Suppliers, Distributors, Dealers, and Contractors
K. Emissions Analysis
L. Monetizing Carbon Dioxide and Other Emissions Impacts
1. Social Cost of Carbon
a. Monetizing Carbon Dioxide Emissions
b. Development of Social Cost of Carbon Values
c. Current Approach and Key Assumptions
2. Valuation of Other Emissions Reductions
M. Utility Impact Analysis
N. Employment Impact Analysis
O. Regulatory Impact Analysis
V. Analytical Results
A. Trial Standard Levels
1. Trial Standard Level Formulation Process and Criteria
2. Trial Standard Level Equations
B. Economic Justification and Energy Savings
1. Economic Impacts on Commercial Customers
a. Life-Cycle Cost and Payback Period
b. Life-Cycle Cost Subgroup Analysis
2. Economic Impacts on Manufacturers
a. Industry Cash Flow Analysis Results
b. Impacts on Direct Employment
c. Impacts on Manufacturing Capacity
d. Impacts on Subgroups of Manufacturers
e. Cumulative Regulatory Burden
3. National Impact Analysis
a. Amount and Significance of Energy Savings
b. Net Present Value of Customer Costs and Benefits
c. Water Savings
d. Indirect Employment Impacts
4. Impact on Utility or Performance of Equipment
5. Impact of Any Lessening of Competition
6. Need of the Nation To Conserve Energy
7. Other Factors
C. Conclusions/Proposed Standard
VI. Procedural Issues and Regulatory Review
A. Review Under Executive Orders 12866 and 13563
B. Review Under the Regulatory Flexibility Act
1. Description and Estimated Number of Small Entities Regulated
2. Description and Estimate of Compliance Requirements
3. Duplication, Overlap, and Conflict With Other Rules and Regulations
4. Significant Alternatives to the Rule
C. Review Under the Paperwork Reduction Act
D. Review Under the National Environmental Policy Act of 1969
E. Review Under Executive Order 13132
F. Review Under Executive Order 12988
G. Review Under the Unfunded Mandates Reform Act of 1995
H. Review Under the Treasury and General Government Appropriations Act, 1999
I. Review Under Executive Order 12630
J. Review Under the Treasury and General Government Appropriations Act, 2001
K. Review Under Executive Order 13211
L. Review Under the Information Quality Bulletin for Peer Review
M. Congressional Notification
VII. Approval of the Office of the Secretary

I. Discussion of the Final Rule and Its Benefits

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 final rule: Automatic commercial ice makers (ACIM).

Pursuant to EPCA, any new or amended energy conservation standard that DOE prescribes for certain products, such as automatic commercial ice makers, shall be designed to achieve the maximum improvement in energy efficiency that DOE determines is both technologically feasible and economically justified. (42 U.S.C. 6295(o)(2)(A)) Furthermore, the new or amended standard must result in significant conservation of energy. (42 U.S.C. 6295(o)(3)(B) and 6313(d)(4))

In accordance with these and other statutory criteria discussed in this final rule, DOE is amending energy conservation standards for automatic commercial ice makers,[3] and new standards for covered equipment not yet subject to energy conservation standards. The amended standards, which consist of maximum allowable energy use 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 the amendments to existing standards set for cube type ice makers at 42 U.S.C. 6313(d)(1), and 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 new standards for continuous type ice-making machines, which were not previously currently covered by DOE's existing standards. The amended standards include, for applicable equipment classes, maximum condenser water usage values in gallons per 100 lb of ice production. These new and amended standards apply to all equipment manufactured in, or imported into, the United States, on or after January 28, 2018. (42 U.S.C. 6313(d)(2)(B)(i) and (3)(C)(i))

TABLE I.1—ENERGY CONSERVATION STANDARDS FOR BATCH TYPE AUTOMATIC COMMERCIAL ICEMAKERS

[Compliance required starting January 28, 2018]

Equipment type	Type of cooling	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	<300	6.88—0.0055H	200—0.022H.
		≥300 and <850	5.80—0.00191H	200—0.022H.
		≥850 and <1,500	4.42—0.00028H	200—0.022H.
		≥1,500 and <2,500	4.0	200—0.022H.
		≥2,500 and <4,000	4.0	145.
Ice-Making Head	Air	<300	10—0.01233H	NA.
		≥300 and <800	7.05—0.0025H	NA.
		≥800 and <1,500	5.55—0.00063H	NA.
		≥1500 and <4,000	4.61	NA.

[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).

[3] EPCA as amended by 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 ice/24 hours. In this rulemaking, DOE is amending the legislated energy use standards for these automatic commercial ice maker types. DOE is not, however, amending the existing condenser water use standards for equipment with existing condenser water standards.

TABLE I.1—ENERGY CONSERVATION STANDARDS FOR BATCH TYPE AUTOMATIC COMMERCIAL ICEMAKERS—Continued

[Compliance required starting January 28, 2018]

Equipment type	Type of cooling	Harvest rate lb ice/24 hours	Maximum energy use kilowatt-hours (kWh)/ 100 lb ice *	Maximum condenser water use gal/100 lb ice **
Remote Condensing (but not remote compressor)	Air	≥50 and <1,000	7.97—0.00342H	NA.
		≥1,000 and <4,000	4.55	NA.
Remote Condensing and Remote Compressor	Air	<942	7.97—0.00342H	NA.
		≥942 and <4,000	4.75	NA.
Self-Contained	Water	<200	9.5—0.019H	191—0.0315H.
		≥200 and <2,500	5.7	191—0.0315H.
		≥2,500 and <4,000	5.7	112.
Self-Contained	Air	<110	14.79—0.0469H	NA.
		≥110 and <200	12.42—0.02533H	NA.
		≥200 and <4,000	7.35	NA.

* H = harvest rate in pounds per 24 hours, indicating the water or energy use for a given 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—ENERGY CONSERVATION STANDARDS FOR CONTINUOUS TYPE AUTOMATIC COMMERCIAL ICE MAKERS

[Compliance required starting January 28, 2018]

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	<801	6.48—0.00267H	180—0.0198H.
		≥801 and <2,500	4.34	180—0.0198H.
		≥2,500 and <4,000	4.34	130.5.
Ice-Making Head	Air	<310	9.19—0.00629H	NA.
		≥310 and <820	8.23—0.0032H	NA.
		≥820 and <4,000	5.61	NA.
Remote Condensing (but not remote compressor)	Air	<800	9.7—0.0058H	NA.
		≥800 and <4,000	5.06	NA.
Remote Condensing and Remote Compressor	Air	<800	9.9—0.0058H	NA.
		≥800 and <4,000	5.26	NA.
Self-Contained	Water	<900	7.6—0.00302H	153—0.0252H.
		≥900 and <2,500	4.88	153—0.0252H.
		≥2,500 and <4,000	4.88	90.
Self-Contained	Air	<200	14.22—0.03H	NA.
		≥200 and <700	9.47—0.00624H	NA.
		≥700 and <4,000	5.1	NA.

* H = harvest rate in pounds per 24 hours, indicating the water or energy use for a given 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 standards set by this final rule 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 for which customers are impacted by the new and amended standards.

TABLE I.3—IMPACTS OF TODAY'S STANDARDS ON CUSTOMERS OF AUTOMATIC COMMERCIAL ICE MAKERS

Equipment class *	Average LCC savings 2013$	Median PBP years
IMH–W–Small–B	214	2.7
IMH–W–Med–B	308	2.1
IMH–W–Large–B **	NA	NA
IMH–W–Large–B–1	NA	NA
IMH–W–Large–B–2	NA	NA
IMH–A–Small–B	77	4.7
IMH–A–Large–B **	361	2.3
IMH–A–Large–B–1	407	1.5
IMH–A–Large–B–2	110	6.9
RCU–Large–B **	748	1.1

[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 amended energy conservation standards when compared to the life-cycle costs of the equipment in the absence of 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. Further discussion can be found in chapter 8 of the final rule TSD.

TABLE I.3—IMPACTS OF TODAY'S STANDARDS ON CUSTOMERS OF AUTOMATIC COMMERCIAL ICE MAKERS—Continued

Equipment class *	Average LCC savings 2013$	Median PBP years
RCU–Large–B–1	743	0.9
RCU–Large–B–2	820	3.0
SCU–W–Large–B	550	1.8
SCU–A–Small–B	281	2.6
SCU–A–Large–B	439	2.1
IMH–A–Small–C	313	1.7
IMH–A–Large–C	626	0.7
RCU–Small–C	505	1.2
SCU–A–Small–C	290	1.5

* 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 final rule 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 [6]

The industry net present value (INPV) is the sum of the discounted cash flows to the industry from 2015 through the end of the analysis period in 2047. Using a real discount rate of 9.2 percent, DOE estimates that the INPV for manufacturers of automatic commercial ice makers is $121.6 million in 2013$. Under the amended standards, DOE expects that manufacturers may lose up to 12.5 percent of their INPV, or approximately $15.1 million.

C. National Benefits and Costs

DOE's analyses indicate that the amended standards for automatic commercial ice makers would save a significant amount of energy. The lifetime energy savings for equipment purchased in the 30-year period that begins in the year of compliance with amended and new standards (2018–2047), [7] relative to the base case without amended standards, amount to 0.18 quadrillion British thermal units (quads) of cumulative energy. This represents a savings of 8 percent relative to the energy use of these products in the base case.

The cumulative national net present value (NPV) of total customer savings of the amended standards for automatic commercial ice makers in 2013$ ranges from $0.430 billion (at a 7-percent discount rate) to $0.942 billion (at a 3-percent discount rate [8]). 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 back to the current year (2014).

In addition, the amended standards are expected to have significant environmental benefits. The energy savings described above are estimated to result in cumulative emission reductions of 10.9 million metric tons (MMt) [9] of carbon dioxide (CO_2), 16.2 thousand tons of nitrogen oxides (NO_X), 0.1 thousand tons of nitrous oxide (N_2O), 47.4 thousand tons of methane (CH_4), 0.03 tons of mercury (Hg),[10] and 9.3 thousand tons of sulfur dioxide (SO_2) based on energy savings from equipment purchased over the period from 2018–2047.[11] The cumulative reduction in CO_2 emissions through 2030 amounts to 4 MMt, which is equivalent to the emissions resulting from the annual electricity use of over half a million homes.

The value of the CO_2 reductions is calculated using a range of values per metric ton of CO_2 (otherwise known as the social cost of carbon, or SCC) developed by a recent Federal interagency process.[12] The derivation of the SCC value is discussed in section IV.L. Using discount rates appropriate for each set of SCC values, DOE estimates the net present monetary value of the CO_2 emissions reduction is between $0.08 and $1.11 billion, expressed in 2013$ and discounted to 2014, with a value of $0.36 billion using the central SCC case represented by $40.5/t in 2015. DOE also estimates the net present monetary value of the NO_X emissions reduction, expressed in 2013$ and discounted to 2014, is between $2.1 and $22.0 million at a 7-percent discount rate, and between $4.2 and $43.4 million at a 3-percent discount rate.[13]

Table I.4 summarizes the national economic costs and benefits expected to result from these new and amended standards for automatic commercial ice makers.

[6] All dollar values presented are in 2013$ discounted back to the year 2014.

[7] 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.

[8] 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 IV.J.

[9] 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.

[10] DOE calculates emissions reductions relative to the *Annual Energy Outlook 2014* (*AEO2014*) Reference Case, which generally represents current legislation and environmental regulations for which implementing regulations were available as of October 31, 2013.

[11] 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 3.9 million metric tons CO_2, 395 thousand tons CO_2eq for CH_4, and 12 thousand tons CO_2eq for N_2O.

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

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

TABLE I.4—SUMMARY OF NATIONAL ECONOMIC BENEFITS AND COSTS OF AMENDED AUTOMATIC COMMERCIAL ICE MAKERS ENERGY CONSERVATION STANDARDS *

Category	Present value million 2013$	Discount rate (%)
Benefits		
Operating Cost Savings	654	7
	1,353	3
CO_2 at 5% dr, average	80	5
CO_2 at 3% dr, average	361	3
CO_2 at 2.5% dr, average	570	2.5
CO_2 at 3% dr, 95th perc	1,113	3
NO_X Reduction Monetized Value (at $2,684/Ton) **	12	7
	24	3
Total Benefits †	1,027	7
	1,738	3
Costs		
Incremental Installed Costs	224	7
	411	3
Net Benefits		
Including CO_2 and NO_X Reduction Monetized Value	803	7
	1,326	3

* The CO_2 values represent global monetized values of the SCC in 2013$ in year 2015 under several scenarios. The values of $12, $40.5, and $62.4 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 $119.0/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 $40.5/t.

The benefits and costs of these new and amended 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 amended 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.[14]

Although adding the values of operating savings to the values of emission reductions provides an important 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, whereas 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 amended standards are shown in Table I.5. (All monetary values below are expressed in 2013$.) 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 2014* (*AEO2014)* 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 *AEO2014* forecast, respectively.[15] Using a 7-percent discount rate for benefits and costs, the cost in the primary estimate of the standards amended in this rule is $22 million per year in increased equipment costs. (Note that DOE used a 3-percent discount rate along with the corresponding SCC series value of $40.5/ton in 2013$ to calculate the monetized value of CO_2 emissions reductions.) The annualized benefits are $65 million per year in reduced equipment operating costs, $20 million in CO_2 reductions, and $1.19 million in reduced NO_X emissions. In this case, the annualized net benefit amounts to $64 million. At a 3-percent discount rate for all benefits and costs, the cost in the primary estimate of the amended standards presented in this rule is $23 million per year in increased equipment costs. The benefits are $75 million per year in reduced operating costs, $20 million in CO_2 reductions, and $1.33 million in reduced NO_X emissions. In this case, the net benefit amounts to $74 million per year.

DOE also calculated the low net benefits and high net benefits estimates

[14] 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 2014, the year used for discounting the NPV of total consumer costs and savings, for the time-series of costs and benefits using discount rates of 3 and 7 percent for all costs and benefits except for the value of CO_2 reductions. For the latter, DOE used a range of discount rates, as shown in Table I.4. From the present value, DOE then calculated the fixed annual payment over a 30-year period (2018 through 2047) that yields the same present value. The fixed annual payment is the annualized value. Although DOE calculated annualized values, this does not imply that the time-series of cost and benefits from which the annualized values were determined is a steady stream of payments.

[15] The *AEO2014* scenarios used are the ''High Economics'' and ''Low Economics'' scenarios.

by calculating the operating cost savings and shipments at the *AEO2014* 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 (%)	Primary estimate* million 2013$	Low net benefits estimate * million 2013$	High net benefits estimate * million 2013$
Benefits				
Operating Cost Savings	7	65	62	68
	3	75	71	80
CO_2 at 5% dr, average **	5	6	6	6
CO_2 at 3% dr, average **	3	20	20	21
CO_2 at 2.5% dr, average **	2.5	29	28	30
CO_2 at 3% dr, 95th perc **	3	62	60	64
NO_X Reduction Monetized Value (at $2,684/Ton) **	7	1.19	1.16	1.22
	3	1.33	1.29	1.36
Total Benefits (Operating Cost Savings, CO_2 Reduction and NO_X Reduction) †	7	86	82	90
	3	97	92	102
Costs				
Total Incremental Installed Costs	7	22	23	21
	3	23	24	22
Net Benefits Less Costs				
Total Benefits Less Incremental Costs	7	64	60	69
	3	74	68	80

* The primary, low, and high estimates utilize forecasts of energy prices from the *AEO2014* Reference Case, Low Economic Growth Case, and High Economic Growth Case, respectively.

** These values represent global values (in 2013$) of the social cost of CO_2 emissions in 2015 under several scenarios. The values of $12, $40.5, and $62.4 per ton are the averages of SCC distributions calculated using 5-percent, 3-percent, and 2.5-percent discount rates, respectively. The value of $119.0 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 ($2,684) of the low ($476) and high ($4,893) 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 $40.5/ton (in 2013$).

D. Conclusion

Based on the analyses culminating in this final rule, DOE found the benefits to the nation of the amended standards (energy savings, consumer LCC savings, positive NPV of consumer benefit, and emission reductions) outweigh the burdens (loss of INPV and LCC increases for some users of this equipment). DOE has concluded that the standards in this final rule represent the maximum improvement in energy efficiency that is both technologically feasible and economically justified, and would result in significant conservation of energy. (42 U.S.C. 6295(o), 6313(d)(4))

II. Introduction

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

A. Authority

Title III, Part C [16] of EPCA, Public Law 94–163 (42 U.S.C. 6311–6317, as codified), added by Public Law 95–619, Title IV, section 441(a), established the Energy Conservation Program for Certain Industrial Equipment, a program covering certain industrial equipment, which includes automatic commercial ice makers, the focus of this rule.[17]

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. For automatic commercial ice makers, DOE is responsible for the entirety of this program. Subject to certain criteria and conditions, DOE is required to develop test procedures to measure the energy efficiency, energy use, or estimated annual operating cost of each type or class of covered equipment. (42 U.S.C. 6314) Manufacturers of covered equipment

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

[17] 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).

must use the prescribed DOE test procedure as the basis for certifying to DOE that their equipment complies with the applicable energy conservation standards adopted under EPCA and when making representations to the public regarding the energy use or efficiency of that equipment. (42 U.S.C. 6315(b), 6295(s)) Similarly, DOE must use these test procedures to determine whether that equipment complies with standards adopted pursuant to EPCA. The DOE test procedure for automatic commercial ice makers currently appears 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 equipment, including automatic commercial ice makers, if no test procedure has been established for the product; or (2) if DOE determines, by rule that such 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 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 if the Secretary finds that the additional cost to the consumer of purchasing a product complying with an energy conservation standard level will be less than three times the value of the energy savings during the first year that the consumer will receive as a result of the standard, as calculated under the applicable test procedure. 42 U.S.C. 6295(o)(2)(B)(iii) and 6313(d)(4) Section III.E.2 presents additional discussion about the rebuttable presumption payback period.

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

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 test procedures and other provisions set forth under 42 U.S.C. 6297(d) and 6316(f).

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 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.

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

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
		≥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)) 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: *http://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.

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.* DOE sought comments concerning other relevant issues that could affect amended standards for automatic commercial ice makers. *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: (1) A market and technology assessment, (2) a screening analysis, (3) an engineering analysis, (4) an energy and water use analysis, (5) a markups analysis, (6) a life-cycle cost analysis, (7) a payback period analysis, (8) a shipments analysis, (9) a national impact analysis (NIA) and (10) a preliminary manufacturer impact analysis (MIA).

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.

On March 17, 2014, DOE published a notice of proposed rulemaking (NOPR) in the **Federal Register** (March 2014 NOPR). 79 FR 14846. In the March 2014 NOPR, DOE addressed, in detail, the comments received in earlier stages of rulemaking, and proposed amended energy conservation standards for automatic commercial ice makers. In conjunction with the March 2014 NOPR, DOE also published on its Web site the complete technical support document (TSD) for the proposed rule, which incorporated the analyses DOE conducted and technical documentation for each analysis. Also published on DOE's Web site were the engineering analysis spreadsheets, the LCC spreadsheet, and the national impact analysis standard spreadsheet. These materials are available at: *http://www1.eere.energy.gov/buildings/appliance_standards/rulemaking.aspx/ruleid/29.*

The standards which DOE proposed for automatic commercial ice makers at the NOPR stage of this rulemaking are shown in Table II.2 and Table II.3. They are provided solely for background informational purposes and differ from the amended standards set forth in this final rule.

TABLE II.2—PROPOSED ENERGY CONSERVATION STANDARDS FOR BATCH TYPE AUTOMATIC COMMERCIAL ICE MAKERS

Equipment type	Type of cooling	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	NA.
		≥2,210 and <2,500	6.89—0.0011H	NA.
		≥2,500 and <4,000	4.1	NA.
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 = Harvest rate in pounds per 24 hours, indicating the water or energy use for a given 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 II.3—PROPOSED ENERGY CONSERVATION STANDARDS FOR CONTINUOUS TYPE AUTOMATIC COMMERCIAL ICE MAKERS

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	<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.
		≥700 and <4,000	5.7	NA.

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

In the March 2014 NOPR, DOE identified nineteen issues on which it was particularly interested in receiving comments and views of interested parties: Standards compliance dates, utilization factors, baseline efficiency, screening analysis, maximum technology feasibility, markups, equipment life, installation costs, open- vs closed loop installations, ice maker shipments by type of equipment, intermittency of manufacturer R&D and impact of standards, INPV results and impact of standards, small businesses, consumer utility and performance, analysis period, social cost of carbon, remote to rack equipment, design options associated with each TSD, and standard levels for batch type ice makers over 2,500 lb ice/hour. 79 FR 14846 at 14947–49. After the publication of the March 2014 NOPR, DOE received written comments on these and other issues. DOE also held a public meeting in Washington, DC, on April 14, 2014, to discuss and receive comments regarding the tools and methods DOE used in the NOPR analysis, as well as the results of the analysis. DOE also invited written comments and announced the availability of a NOPR analysis technical support document (NOPR TSD). The NOPR TSD is available at: *http://www.regulations.gov/#!documentDetail;D=EERE-2010-BT-STD-0037-0061*.

The NOPR TSD described in detail DOE's analysis of potential standard levels for automatic commercial ice makers. The document also described the analytical framework used in considering standard levels, including a description of the methodology, the analytical tools, and the relationships between the various analyses. In addition, the NOPR TSD presented each analysis that DOE performed to evaluate automatic commercial ice makers, including descriptions of inputs, sources, methodologies, and results. DOE included the same analyses that were conducted at the preliminary analysis stage, with revisions based on comments received and additional research.

At the public meeting held on April 14, 2014, DOE presented the methodologies and results of the analyses set for in the NOPR TSD. Interested parties provided comments. Key issues raised by stakeholders included: (1) Whether the energy model accurately predicts efficiency improvements; (2) the size restrictions and applications of 22-inch wide ice makers; (3) the efficiency distributions assumed for shipments of icemakers; and (4) the impact on manufacturers relating to design of icemaker models, in light of the proposed compliance date of 3 years after publication of the final rule.

In response to comments regarding the energy model used in the analysis, DOE held a public meeting on June 19, 2014 in order to facilitate an additional review of the energy model, gather additional feedback and data on the energy model, and to allow for a more thorough explanation of DOE's use of the model in the engineering analysis. 79 FR 33877 (June 13, 2014). At that meeting, DOE presented the energy model, demonstrated its operations, and described how it was used in the rulemaking's engineering analysis. DOE indicated in this meeting that it was considering modifications to its NOPR analyses based on the NOPR comments and additional research and information gathering.

On September 11, 2014, DOE published a notice of data availability (NODA) in the **Federal Register** (September 2014 NODA). 79 FR 54215. The purpose of the September 2014 NODA was to notify industry, manufacturers, customer groups, efficiency advocates, government agencies, and other stakeholders of the publication of the updated rulemaking analysis for new and/or amended energy conservation standards for automatic ice makers. The comments received since the publication of the March 2014 NOPR, including those received at the April 2014 and the June 2014 public meetings, provided inputs which led DOE to revise its analysis. Stakeholders also submitted additional information to DOE's consultant pursuant to non-disclosure agreements regarding efficiency gains and costs of potential design options. DOE reviewed additional market data, including published ratings of available ice makers, to recalibrate its engineering analysis. Generally, the revisions to the NOPR analysis as specified in the NODA include modifications of inputs for its engineering, LCC, and NIA analyses, adjustments of its energy model calculations, and more thorough considerations of size-constrained ice maker applications. The analysis revisions addressing size-constrained applications include development of engineering analyses for three size-constrained equipment categories and restructuring of the LCC and NIA analyses to consider size constraints for applicable equipment classes. DOE encouraged stakeholders to provide comments and additional information in response to the September NODA publication.

This final rule responds to the issues raised by commenters for the March 2014 NOPR and the September 2014 NODA.[18]

III. General Discussion

A. Equipment Classes and Scope of Coverage

When evaluating and establishing energy conservation standards, DOE divides covered equipment into equipment classes by the type of energy use or by capacity or other performance-related features that justifies a different standard. In making a determination whether a performance-related feature justifies a different standard, DOE must consider such factors as the utility to the consumer of the feature and other factors DOE determines are appropriate. (42 U.S.C. 6295(q)) and 6316(a))

Throughout this rulemaking, DOE's analysis has been based on a set of equipment classes derived from the existing DOE batch commercial ice maker standards, effective as of January 1, 2010 (42 U.S.C. 6313(d)(1)) and review of the existing ice maker market. These equipment classes form the basis of analysis and public comments. In this final rule, equipment class names are frequently abbreviated. These abbreviations are shown on Table III.1.

TABLE III.1—LIST OF EQUIPMENT CLASS ABBREVIATIONS

Abbreviation	Equipment type	Condenser type	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.

[18] A parenthetical reference at the end of a quotation or paraphrase provides the location of the item in the public record.

TABLE III.1—LIST OF EQUIPMENT CLASS ABBREVIATIONS—Continued

Abbreviation	Equipment type	Condenser type	Harvest rate lb ice/24 hours	Ice type
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 final analyses as two different units, one at the lower end of the harvest range and one near the high end of the 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 rule, DOE analyzed this class as two ranges, 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.

B. Test Procedure

On December 8, 2006, DOE published a final rule in which it incorporated by reference 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. 71 FR 71340. 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 ice produced. *Id.* at 71350. 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 also 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. 77 FR 1591. The 2012 test procedure final rule included an amendment to incorporate by reference Air-Conditioning, Heating, and Refrigeration Institute (AHRI) Standard 810–2007 with Addendum 1 [19] as the DOE test procedure for this equipment. AHRI Standard 810–2007 with Addendum 1 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, provide a definition for ice hardness factor, and incorporate several new or amended definitions regarding how water consumption and capacity are measured, particularly for continuous type machines. 77 FR at 1592–93. The 2012 test procedure final rule also included an amendment to incorporate by reference the updated ANSI/ASHRAE Standard 29–2009. *Id.* at 1613.

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.[20] DOE also adopted

[19] 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.''

[20] EPCA defines *automatic commercial ice maker* under 42 U.S.C. 6311(19) as ''a factory-made assembly (not necessarily shipped in 1 package) that—(A) Consists of a condensing unit and ice-making section operating as an integrated unit, with means for making and harvesting ice; and (B) May include means for storing ice, dispensing ice, or storing and dispensing ice.'' 42 U.S.C. 6313(d)(1) explicitly sets standards for cube type ice makers up to 2,500 lb ice/24 hours, however, 6313(d)(2) establishes authority to set standards for other equipment types, such as those with capacities greater than 2,500 lb ice/24 hours, provided the equipment types meet the EPCA definition of an automatic commercial ice maker.

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 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 1591.

The test procedure amendments established in the 2012 test procedure final rule are required to be used in conjunction with new and amended standards promulgated as a result of this standards rulemaking. Thus, manufacturers must use the amended test procedure to demonstrate compliance with the new and amended energy conservation standards on the compliance date of any energy conservation standards established as part of this rulemaking. 77 FR at 1593 (Jan. 11, 2012).

C. Technological Feasibility

1. General

In each energy conservation standards rulemaking, DOE conducts a screening analysis, which is based on information that the Department has gathered on all current technology options and prototype designs that could improve the efficiency of the products or equipment that are the subject of the rulemaking. As the first step in such analysis, DOE develops a list of design options for consideration, in consultation with manufacturers, design engineers, and other interested parties. DOE then determines which of these options for improving efficiency are technologically feasible. DOE considers a design option to be technologically feasible if it is used by the relevant industry or if a working prototype has been developed. Technologies incorporated in commercially available equipment or in working prototypes were 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 the market.

Once DOE has determined that particular design options are technologically feasible, DOE 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 equipment 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 final rule 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 considered in this rulemaking.

2. Maximum Technologically Feasible Levels

When DOE adopts (or does 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, DOE determined the maximum technologically feasible (''max-tech'') improvements in energy efficiency for automatic commercial ice makers in the engineering analysis using the design options that passed the screening analysis.

As indicated previously, whether efficiency levels exist or can be achieved in commonly used equipment is not relevant to whether they are considered max-tech levels. DOE considers technologies to be technologically feasible if they are incorporated in any currently available equipment or working prototypes. Hence, a max-tech level results from the combination of design options predicted to result in the highest efficiency level possible for an equipment class, with such design options consisting of technologies already incorporated in automatic commercial ice makers or working prototypes. DOE notes that it reevaluated the efficiency levels, including the max-tech levels, when it updated its results for the NODA and final rule. See chapter 5 of the final rule TSD for the results of the analyses and a list of technologies included in max-tech equipment. Table III.2 and Table III.3 shows the max-tech levels determined in the engineering analysis for batch and continuous type automatic commercial ice makers, respectively.

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

Equipment type *	Energy use lower than baseline
IMH–W–Small–B	23.9%, 21.5% (22-inch wide).
IMH–W–Med–B	18.1%.
IMH–W–Large–B	8.3% (at 1,500 lb ice/24 hours), 7.4% (at 2,600 lb ice/24 hours).
IMH–A–Small–B	25.5%, 18.1% (22-inch wide).
IMH–A–Large–B	23.4% (at 800 lb ice/24 hours), 15.8% (at 590 lb ice/24 hours, 22-inch wide), 11.8% (at 1,500 lb ice/24 hours).
RCU–Small–B	Not directly analyzed.
RCU–Large–B	17.3% (at 1,500 lb ice/24 hours), 13.9% (at 2,400 lb ice/24 hours).
SCU–W–Small–B	Not directly analyzed.
SCU–W–Large–B	29.8%.
SCU–A–Small–B	32.7%.
SCU–A–Large–B	29.1%.

* 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.

Note: 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—FINAL RULE "MAX-TECH" LEVELS FOR CONTINUOUS AUTOMATIC COMMERCIAL ICE MAKERS

Equipment type *	Energy use lower than baseline
IMH–W–Small–C	Not directly analyzed.
IMH–W–Large–C	Not directly analyzed.
IMH–A–Small–C	25.7%.
IMH–A–Large–C	23.3% lb ice.
RCU–Small–C	26.6%.
RCU–Large–C	Not directly analyzed.
SCU–W–Small–C	Not directly analyzed.
SCU–W–Large–C *	No units available.
SCU–A–Small–C	26.6%.
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 final rule).

Note: 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 Savings

1. Determination of Savings

For each TSL, DOE projected energy savings from automatic commercial ice makers purchased during a 30-year period that begins in the year of compliance with amended standards (2018–2047). The savings are measured over the entire lifetime of products purchased in the 30-year period. DOE used the NIA model to estimate the national energy savings (NES) for equipment purchased over the period 2018–2047. The model forecasts total energy use over the analysis period for each representative equipment class at efficiency levels set by each of the considered TSLs. DOE then compares the energy use at each TSL to the base-case energy use to obtain the NES. The NIA model is described in section IV.H of this rule and in chapter 10 of the final rule TSD.

DOE used its NIA spreadsheet model to estimate energy savings from amended standards for automatic commercial ice makers. The NIA spreadsheet model (described in section IV.H of this preamble) calculates energy savings in site energy, which is the energy directly consumed by products 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 the energy that is used to generate and transmit the site electricity. To calculate this quantity, DOE derives annual conversion factors from the model used to prepare the Energy Information Administration's (EIA) *AEO.*

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

2. Significance of Savings

EPCA prohibits DOE from adopting a standard that would not result in significant additional energy savings. (42 U.S.C. 6295(o)(3)(B) and 6313(d)(4)While the term "significant" is not defined in EPCA, the U.S. Court of Appeals for the District of Columbia in *Natural Resources Defense Council* v. *Herrington,* 768 F.2d 1355, 1373 (D.C. Cir. 1985), indicated that Congress intended significant energy savings to be savings that were not "genuinely trivial." The energy savings for all of the TSLs considered in this rulemaking (presented in section V.B.3.a) are nontrivial, and, therefore, DOE considers them "significant" within the meaning of section 325 of EPCA.

E. Economic Justification

1. Specific Criteria

As discussed in section III.E.1, 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 this rule.

a. Economic Impact on Manufacturers and Commercial Customers

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

For individual customers, measures of economic impact include the changes in LCC and the PBP associated with new or amended standards. These measures are discussed further in the following section. For consumers in the aggregate, DOE also calculates the national net present value of the economic impacts applicable to a particular rulemaking.

DOE also evaluates the LCC impacts of potential standards on identifiable subgroups of consumers that may be affected disproportionately by a national standard.

b. Savings in Operating Costs Compared To Increase in Price (Life Cycle Costs)

EPCA requires DOE to consider the savings in operating costs throughout the estimated average life of the covered product compared to any increase in the price of the covered product that are likely to result from the imposition of the standard. (42 U.S.C. 6295(o)(2)(B)(i)(II) and 6313(d)(4) DOE conducts this comparison in its LCC and PBP analysis.

The LCC is the sum of the purchase price of equipment (including the cost of its installation) and the operating costs (including energy and maintenance and repair costs) discounted over the lifetime of the equipment. To account for uncertainty and variability in specific inputs, such as product lifetime and discount rate, DOE uses a distribution of values, with probabilities attached to each value. For its analysis, DOE assumes that consumers will purchase the covered products in the first year of compliance with amended standards.

The LCC savings and the PBP for the considered efficiency levels are calculated relative to a base-case scenario, which reflects likely trends in the absence of new or amended standards. DOE identifies the percentage of consumers estimated to receive LCC savings or experience an LCC increase, in addition to the average LCC savings associated with a particular standard level. DOE's LCC and PBP analysis is discussed in further detail in section IV.G.

c. Energy Savings

While significant conservation of energy is a statutory requirement for imposing an energy conservation standard, EPCA also requires DOE, in determining the economic justification of a standard, to consider the total projected energy savings that are expected to result directly from the standard. (42 U.S.C. 6295(o)(2)(B)(i)(III) and 6313(d)(4)) DOE uses NIA spreadsheet results in its consideration of total projected savings. For the results of DOE's analyses related to the potential energy savings, see section IV.H of this preamble and chapter 10 of the final rule TSD.

d. Lessening of Utility or Performance of Equipment

In establishing classes of equipment, and in evaluating design options and the impact of potential standard levels, DOE seeks to develop standards that would not lessen the utility or performance of the equipment under consideration. DOE has determined that none of the TSLs presented in today's final rule would reduce the utility or performance of the equipment considered in the rulemaking. (42 U.S.C. 6295(o)(2)(B)(i)(IV) and 6313(d)(4)) During the screening analysis, DOE eliminated from consideration any technology that would adversely impact customer utility. For the results of DOE's analyses related to the potential impact of amended standards on equipment utility and performance, see section IV.C of this preamble and chapter 4 of the final rule TSD.

e. Impact of Any Lessening of Competition

EPCA requires DOE to consider any lessening of competition that is likely to result from setting new or amended standards for covered equipment. Consistent with its obligations under EPCA, DOE sought the views of the United States Department of Justice (DOJ). DOE asked DOJ to provide a written determination of the impact, if any, of any lessening of competition likely to result from the amended standards, together with an analysis of the nature and extent of such impact. 42 U.S.C. 6295(o)(2)(B)(i)(V) and (B)(ii). DOE transmitted a copy of its proposed rule to the Attorney General with a request that the Department of Justice (DOJ) provide its determination on this issue. DOJ's response, that the proposed energy conservation standards are unlikely to have a significant adverse impact on competition, is reprinted at the end of this rule.

f. Need of the Nation To Conserve Energy

Another factor that DOE must consider in determining whether a new or amended standard is economically justified is the need for national energy and water conservation. (42 U.S.C. 6295(o)(2)(B)(i)(VI) and 6313(d)(4))) The energy savings from new or amended standards are likely to provide improvements to the security and reliability of the Nation's energy system. Reductions in the demand for electricity may also result in reduced costs for maintaining the reliability of the Nation's electricity system. DOE conducts a utility impact analysis to estimate how new or amended standards may affect the Nation's needed power generation capacity, as discussed in section IV.M.

Amended standards also are likely to result in environmental benefits in the form of reduced emissions of air pollutants and greenhouse gases associated with energy production and use. DOE conducts an emissions analysis to estimate how standards may affect these emissions, as discussed in section IV.K. DOE reports the emissions impacts from each TSL it considered, in section V.B.6 of this rule. DOE also estimates the economic value of emissions reductions resulting from the considered TSLs, as discussed in section IV.L.

g. Other Factors

EPCA allows the Secretary, in determining whether a new or amended standard is economically justified, to consider any other factors that the Secretary deems to be relevant. (42 U.S.C. 6295(o)(2)(B)(i)(VII) and 6313(d)(4)) There were no other factors considered for this final rule.

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 energy (and, as applicable, water) savings resulting from the standard, as calculated under the applicable DOE test procedure. DOE's LCC and PBP analyses generate values that calculate the PBP for customers of potential new and amended energy conservation standards. These analyses include, but are not limited to, the 3-year PBP contemplated under the rebuttable presumption test. However, DOE routinely conducts a full economic analysis that considers the full range of impacts to the customer, manufacturer, Nation, and environment, as required under 42 U.S.C. 6295(o)(2)(B)(i) and 6313(d)(4). The results of these analyses serve as the basis for DOE to evaluate the economic justification for a potential standard level (thereby supporting or rebutting the results of any preliminary determination of economic justification). The rebuttable presumption payback calculation is discussed in section IV.G.12 of this rule and chapter 8 of the final rule TSD.

IV. Methodology and Discussion of Comments

A. General Rulemaking Issues

During the April 2014 and June 2014 public meetings, and in subsequent written comments in response to the NOPR and NODA, stakeholders provided input regarding general issues pertinent to the rulemaking, such as issues regarding proposed standard levels and the compliance date. These issues are discussed in this section.

1. Proposed Standard Levels

In response to the level proposed in the NOPR (TSL 3), Manitowoc commented that there are significant deficiencies in the models and cost assumptions that were used to arrive at the proposed efficiency levels and that, consequently, the selected levels are not optimal from a life-cycle cost standpoint. (Manitowoc, Public Meeting Transcript, No. 70 at p. 24–26) Follett commented that DOE is recommending efficiency levels that are neither technologically nor economically justified. (Follett, No. 84 at p. 8)

Hoshizaki and Scotsman both recommended DOE select NOPR TSL 1 (Hoshizaki, No. 86 at p. 5–6; Scotsman, Public Meeting Transcript, No. 70 Public Meeting Transcript, at p. 44–46) Scotsman stated that doing so effective 2020 is technologically feasible, economically justified, consistent with past regulations, and will save a significant amount of energy. (Scotsman, Public Meeting Transcript, Public Meeting Transcript, No. 70 at p. 44–46) Although the following comment regarding choosing a standard level mentioned ''ELs,'' efficiency levels, DOE believes Hoshizaki intended that this comment refer to ''TSLs,'' trial standard levels levels and DOE has interpreted the comment accordingly. Hoshizaki stated that NOPR EL1 (interpreted as TSL1) would garner similar savings as NOPR EL3 (interpreted as TSL3) while reducing the burden on the industry to meet such stringent standards in such a short amount of time. (Hoshizaki, No. 86 at p. 5–6)

Scotsman stated that they have not identified technology combinations that are suitable for achieving any efficiency level beyond NOPR TSL 1. (Scotsman, No. 85 at p. 8b) Scotsman added that they do not have data indicating that their machines will be able to meet NOPR TSL 3 using the design options under consideration. (Scotsman, No. 85 at p. 7b)

Pacific Gas and Electric Company (PG&E) and San Diego Gas and Electric Company (SDG&E), commenting jointly, and a group including the Appliance Standards Awareness Project (ASAP), the American Council for an Energy-Efficient Economy (ACEEE), the Alliance to Save Energy, Natural Resources Defense Council (NRDC), and the Northwest Power and Conservation Council (NPCC) (Joint Commenters) both recommended that DOE adopt a higher TSL for ACIMs. (Joint Commenters, No. 87 at p. 1–2; PG&E and SDG&E, No. 89 at p. 1–2) ASAP noted that based on their review of the certification database, there are products existing on the market today that meet the proposed standard levels. (ASAP, Public Meeting Transcript, No. 70 at p. 50–52) Joint Commenters urged DOE to adopt TSL 5 for batch type equipment and TSL 4 for continuous type equipment. (Joint Commenters, No. 87 at p. 1–2) PG&E and SDG&E recommended that DOE adopt the maximum cost-effective TSL for each equipment class noting that DOE could adopt TSLs higher than TSL 3 while maintaining a net benefit to U.S. consumers. (PG&E and SDG&E, No. 89 at p. 1–2)

Although the NODA only provided data regarding the updated analysis and did not propose a standard level, several interested parties provided comment regarding the appropriateness of setting the ACIM energy conservation standard at a given NODA TSL.

In their written comment, Manitowoc stated that the NODA analysis was an improvement over the original NOPR analysis. Manitowoc stated that they did not believe the standard should be set at a single TSL level for all equipment classes and suggested a different TSL level for each equipment class. Although the following comments regarding specific classes mention ''ELs,'' efficiency levels, DOE believes Manitowoc intended that these comments apply to ''TSLs,'' trial standard levels and DOE has interpreted the comment accordingly. For IMH–A batch equipment with package widths less than 48 inches (the 48-inch corresponds to the 1,500 lb ice/24 hour representative capacity), Manitowoc supported an efficiency level no higher than EL 3 (interpreted as TSL3). Manitowoc suggested that DOE adopt a standard that would be limited to 5% improvement in efficiency over baseline for the IMH–A–B2 (48-inch wide) equipment. DOE believes Manitowoc's third point in the comments, citing the ''IMH-small'' class refers to IMH–W–Small–B, for which Manitowoc indicated that the standard level should be set no higher than EL 3 (interpreted as TSL3). Manitowoc also suggested DOE adopt standards with efficiency gains no greater than 4.7% and 3.7% efficiency gains, respectfully, for the MH–W–Large–B1 (1,500 lb ice/24 hours representative capacity) and IMH–W–Large–B2 (2,600 lb ice/24 hours representative capacity) equipment. Manitowoc suggested that DOE adopt EL 2 (interpreted as TSL2) for the RCU–NRC–B1 (1,500 lb ice/24 hours representative capacity) and RCU–NRC–B2 (2,400 lb ice/24 hours representative capacity) equipment, as well as the SCU–A–Small and SCU–A–Large equipment classes and for 22-inch IMH equipment. For the RCU–NRC–Large–B1, Manitowoc indicated that the 20 percent improvement in compressor energy efficiency ratio (EER) used in DOE's analysis for this equipment is unrealistic. For the RCU–NRC–Large–B2, Manitowoc mentioned that the increase in condenser size considered in the DOE analysis would present significant issues with refrigerant charge management. For the SCU–A–Small–B class, Manitowoc indicated that the 40% improvement in compressor EER considered in DOE's analysis is not likely to be achieved and adding a tube row to the condenser may not be possible. For the SCU–A–Large–B class, Manitowoc similarly commented that the compressor EER improvement and condenser size increases considered in DOE's analyses are unrealistic. For the 22-inch IMH equipment, Manitowoc indicated that some of the considered design options (increase in evaporator size and/or a drain water heat exchanger) would not be feasible due to the compact nature of these units. Manitowoc suggested that DOE select EL 3 (interpreted as TSL3) for IMH–A–B small and large-1 batch equipment classes (not including 48″ models), as well as the IMH-Small equipment class and all other equipment classes not specifically mentioned. (Manitowoc, No. 126 at p. 1–2)

Ice-O-Matic requested that DOE select NODA TSL 3. (Ice-O-Matic, No. 121 at p. 1) Scotsman suggested that DOE select NODA TSL 2. (Scotsman, No. 125 at p. 3) Hoshizaki suggested that DOE select NODA TSL 2 for batch units. (Hoshizaki, No. 124 at p. 3)

ASAP encouraged DOE to adopt NODA TSL 5 for batch type remote condensing equipment and NODA TSL 4 for all other equipment classes, noting that these choices would be cost effective. (ASAP, No. 127 at p. 1) CA IOU suggested that DOE adopt the NODA TSL for each equipment class that saves the most energy and has a positive NPV. CA IOU noted that DOE could adopt a level more stringent than NODA TSL 3 for all equipment classes while maintaining a net benefit to US consumers. (CA IOU, No. 129 at p. 1)

DOE understands the concerns voiced by stakeholders regarding their future ability to meet standard levels as proposed in the NOPR. DOE must adhere to the EPCA guidelines for determining the appropriate level of standards that were outlined in sections III.E.1. In this Final Rule, DOE selected the TSL that best meets the EPCA requirements for establishing that a standard is economically justified. (42 U.S.C. 6295(o)(2)(B)(i) and 6313(d)(4)). Since the publication of the NOPR, DOE has revised and updated its analysis based on stakeholders comments received at the NOPR public meeting, comments made during the June 19 meeting, and in written comments received in response to the NOPR and NODA. These updates included changes in its approach to calculating the energy use associated with groups of design options, changes in inputs for calculations of energy use and equipment manufacturing cost, and consideration of space-constrained applications. After applying these changes to the analyses, the efficiency levels that DOE determined to be cost effective changed considerably. The NODA comments described above reveal partial industry support for the standard levels chosen by DOE in the final rule.

DOE notes that much of the commentary regarding the selection of efficiency levels for the standard are based on more detailed comments regarding the feasibility of design options, the savings that these design options can achieve, and their costs. DOE response regarding many of these comments is provided in section IV.D.3.

2. Compliance Date

In the March 2014 NOPR analysis, DOE assumed a 3-year period for manufacturers to prepare for compliance. DOE requested comments as to 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.

Following the publication of the NOPR, several manufacturers and NAFEM expressed an expected inability to meet the proposed standard levels within the three year compliance period. (Manitowoc, No. 92 at p. 2–3, Scotsman, No. 85 at p. 2b, Hoshizaki, No. 86 at p. 2, NAFEM, No. 82 at pg. 2–3) Manitowoc and Hoshizaki both commented that a 5-year compliance period would be necessary for this rulemaking. (Manitowoc, No. 92 at p. 2–3; Hoshizaki, No. 86 at p. 2) Scotsman commented that an 8-year compliance period would be more feasible for the technology specification, R&D investment, performance evaluation, reliability evaluation, and manufacturing required for product redesign. Scotsman added that the negative economic impacts of the rule would be mitigated by a later effective date. (Scotsman, No. 85 at p. 2b–3)

AHRI, Manitowoc, and NAFEM commented that a three year compliance period is not adequate for this rulemaking and that DOE should extend the compliance period to allow time for manufacturers to obtain new components. (AHRI, Public Meeting Transcript, No. 70 at p. 18; NAFEM, No. 82 at pg. 2–3; Manitowoc, No. 92 at p. 2 –3) NAFEM and AHRI commented that DOE should extend the compliance period by two years. (AHRI, No. 93 at p. 2; NAFEM, No. 82 at pg. 2–3) AHRI and Manitowoc noted that there is a potential for Environmental Protection Agency (EPA) Significant New Alternatives Policy (SNAP) regulations to force further product redesign and extending the compliance period would provide relief should refrigerant regulatory issues not be finalized in time.[21] (AHRI, No. 93 at p. 2; Manitowoc, No. 126 at p. 3) Emerson urged DOE to wait until after EPA finalizes its decision on refrigerants before starting the 3-year period given to manufacturers to meet the new standards so manufacturers can re-design for both energy efficiency and low global warming potential (GWP) refrigerants in one design cycle. (Emerson, No. 122, p. 1)

NAFEM stated that manufacturers will only be able to achieve energy efficiency gains up to the level of NOPR TSL 1 within the five-year compliance timeline and that the current proposal will result in the unavailability of ice makers with the characteristics, sizes, capacities, and volumes that are generally available in the U.S. (NAFEM, No. 82 at p. 2) NAFEM's comment mentions a five-year compliance timeline, although DOE proposed a three-year timeline in the NOPR. 79 FR at 14949 (March 17, 2014).

Another concern amongst manufacturers was the belief that the proposed standard levels were based on technology that was currently not available. At the April 2014 NOPR public meeting, Ice-O-Matic commented that they did not believe that the technology exists to achieve the proposed standards in the allotted time frame. (Ice-O-Matic, Public Meeting Transcript, No. 70 at p. 33)

Joint Commenters noted that, in balancing the stringency of the standards with the compliance dates and manufacturer impacts, they believe that the stringency of the standard is more important for national energy savings than the compliance dates. (Joint Commenters, No. 87 at p. 4)

[21] Details regarding EPA SNAP regulations are discussed in section IV.A.4.

In response to the assertion that DOE's standard levels were not based upon currently available technologies, DOE maintains that all technology options and equipment configurations included in its NOPR reflect technologies currently in use in automatic commercial ice makers. For example, DOE considered use only of compressors that are currently commercially available and which manufacturers have indicated are acceptable for use in ice makers in confidential discussions with DOE's contractor. Moreover, the proposed standard levels are exceeded by the ratings of some products that are currently commercially available. However, the standard levels established in this final rule are significantly less stringent than the standard levels proposed in the NOPR, and a greater percentage of currently-available products already meet these efficiency levels. DOE expects that this reduction in stringency and the reduced number of products requiring redesign means that the time required for manufacturers to achieve compliance would be reduced.

In response to the NODA, Scotsman, Manitowoc, NAFEM, and Ice-O-Matic all requested that the effective date for the new efficiency standard for ACIMs be extended to 5 years after the publication of the final rule. (Scotsman, No. 125 at p. 3; Manitowoc, No. 126 at p. 3; NAFEM, No. 123 at p. 2; Ice-O-Matic, No. 121 at p. 1) NAFEM stated that even with the more realistic assumptions presented in the NODA, manufactures still require an extended timeline to obtain new components needed to meet higher efficiency levels.

In response to the request that DOE extend the compliance date period for automatic commercial ice makers beyond the 3 years specified by the NOPR, DOE notes that 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 believes that the modifications to the analysis, relative to the NOPR, it announced in the NODA and made to the final rule will reduce the burden on manufacturers to meet requirements established by this rule, because the standard levels are less stringent and fewer ice maker models will require redesign to meet the new standard. Therefore, DOE has determined that the

3-year period is adequate and is not extending the compliance date for ACIMs.

3. Negotiated Rulemaking

Stakeholders AHRI, Hoshizaki, Manitowoc, and the North American Association of Food Equipment Manufactures (NAFEM) both suggested that DOE use a negotiated rulemaking to develop ACIM standards. (AHRI, Public Meeting Transcript, No. 70 at p. 15–16; AHRI, Public Meeting Transcript, No. 128 at p. 1; Hoshizaki, Public Meeting Transcript, No. 70 at p. 38–39; Hoshizaki, Public Meeting Transcript, No. 124 at p. 3; Manitowoc, Public Meeting Transcript, No. 70 at p. 344–345; NAFEM, No. 82 at p. 2; NAFEM, No. 123 at p. 1) NAFEM stated that a negotiated rulemaking would ensure the level of enhanced dialogue needed for DOE to effectively assess the rule's impact on end-users. (NAFEM, No. 82 at p. 2) AHRI stated that there are significant issues in the analysis, that the current direction of this rulemaking will place significant burden on the industry, and that the completion of this rulemaking under the current process will be difficult, expensive, and not timely. (AHRI, Public Meeting Transcript, No. 70 at p. 15–16)

In response to the manufacturers' suggestion to use a negotiated rulemaking to develop ACIM standards, DOE notes that this issue was raised before the Appliance Standards and Rulemaking Federal Advisory Committee (ASRAC) on June 6, 2014 and the ASRAC membership declined to establish a working group to negotiate a final rule for ACIM energy conservation standards. Several ASRAC members voiced concern of using ASRAC at such a late stage in the rulemaking when it would be more appropriate to raise these concerns in the normal public comment process. (See public transcript at: *http://www.regulations.gov/#!documentDetail;D=EERE-013-BT-NOC-0005-0025*)

4. Refrigerant Regulation

Manitowoc noted that the EPA has proposed delisting R–404A, the refrigerant used in nearly all currently available ice makers, for commercial refrigeration applications. Manitowoc stated that while commercial ice makers are not within the current scope for the SNAP NOPR, it seems likely that ice makers could be affected by a subsequent rulemaking. (Manitowoc, No. 126 at p. 3) Several interested parties, including AHRI, NAFEM, Hoshizaki, Manitowoc, and Howe requested that DOE consider the hardships associated with refrigerant choice uncertainty caused by potential future EPA SNAP regulations in the analysis (AHRI, Public Meeting Transcript, No. 70 at p. 16–18; NAFEM, No. 82 at p. 7; Hoshizaki, No. 86 at p. 6–7; Howe, No. 88 at p. 2–3; Manitowoc, Public Meeting Transcript, No. 70 at p. 286–287; Manitowoc, No. 126 at p. 3) Manitowoc suggested that DOE do a sensitivity analysis that examines what would happen to life-cycle costs, etc. if manufacturers had to re-engineer twice. (Manitowoc, Public Meeting Transcript, No. 70 at p. 286–287)

AHRI commented that the potential for SNAP rulemakings to require a refrigerant change will necessitate major redesigns just to maintain current efficiency levels. (AHRI, Public Meeting Transcript, No. 70 at p. 16–18) Manitowoc and Hoshizaki also expressed concern regarding the redesign work that would be needed if the EPA were to ban R–404A. (Manitowoc, Public Meeting Transcript, No. 70 at p. 286–287; Hoshizaki, No. 86 at p. 6–7) AHRI added that the burden of the potential EPA SNAP rulemaking must be taken into account in the engineering and life-cycle cost analyses. AHRI requested that DOE put a hold on the ACIM rulemaking until after the next SNAP rollout is completed. (AHRI, Public Meeting Transcript, No. 70 at p. 16–18)

AHRI also commented that the DOE should make an effort to look at refrigerants because its cost-benefit analysis is based solely on a refrigerant that may not exist three years from now. (AHRI, Public Meeting Transcript, No. 70 at p. 284–285) AHRI noted that, because low-GWP refrigerants also have lower heat transfer capability than R–404A, coil sizes may need to further increase in order to maintain the performance with other refrigerants, which could be infeasible if the proposed standards are already calling for an increased coil size for units using R–404A. (AHRI, Public Meeting Transcript, No. 70 at p. 293–294)

Scotsman and Hoshizaki suggested that DOE and EPA collaborate so that both the energy conservation rulemaking and the SNAP rulemaking don't promulgate standards that are unduly burdensome. (Scotsman, No. 125 at p. 2; Hoshizaki, No. 86 at p. 6–7)

Manitowoc stated that even if the EPA takes no action on ice makers in the next 3 years, the component supplier industry (compressors, expansion valves, heat exchangers, etc.) will focus its efforts on supporting the transition to hydrocarbons, HFO blends, and other acceptable refrigerants for the refrigeration industry as the volume of display case, reach-in, walk-in, and vending is significantly larger than that for commercial ice machines. (Manitowoc, No. 126 at p. 3)

ASAP commented that the way that DOE is dealing with the refrigerants issue is consistent with how it has dealt with it in all other rulemakings. (ASAP, Public Meeting Transcript, No. 70 at p. 52–53) Joint Commenters commented that DOE's approach of conducting their analysis based on the most commonly-used refrigerants today is appropriate and that it does not appear that a phase-out of R–404A would negatively impact ice maker efficiency, given the fact that propane, DR–33, and N–40 all have lower GWP and similar efficiency compared to R–404A. (Joint Commenters, No. 87 at p. 4) NEEA expressed their support for DOE's current refrigerant-neutral position. (NEEA, No. 91 at p. 2)

In response to these comments, DOE notes that the EPA SNAP NOPR mentioned by Manitowoc (see 79 FR 46149 (Aug. 6, 2014)) did not propose to delist the use of R–404A for ACIMs. EPA proposed to delist R–404A for certain retail food refrigeration applications including condensing units. However, ACIMs do not qualify as retail food refrigeration equipment and therefore will not be subject to SNAP regulations that pertain to retail refrigeration applications. Further, alternate refrigerants have not been proposed by the SNAP program for use in ACIMs.[22] DOE recognizes that the engineering analysis is based on the use of R–404A, the most commonly used refrigerant in ACIMs, and that a restriction of R–404A in ACIMs would have impacts on the design options selected in the engineering analysis. However, DOE cannot speculate on the outcome of a rulemaking in progress and can only consider in its rulemakings rules that are currently in effect. Therefore, DOE has not included possible outcomes of a potential EPA SNAP rulemaking in the engineering or LCC analysis. This position is consistent with past DOE rulings, such as in the 2011 direct final rule for room air conditioners. 76 FR 22454 (April 21, 2011). DOE is aware of stakeholder concerns that EPA may broaden the uses for which R–404A is phased out at some point in the future. DOE is confident

[22] EPA on July 9, 2014 proposed new alternative refrigerants for several applications, but not ACIMs. 79 FR 38811. EPA also, on August 6, 2014, proposed delisting of refrigerants for several applications, but not ACIMs. 79 FR 46126 (Aug. 6, 2014). The notice did indicate that EPA is considering whether to delist use of R–404A for ACIMs, but did not propose such action. 79 FR at 46149.

that there will be an adequate supply of R–404A for compliance with the standards being finalized in today's rule, however, consistent with EO 13563, Improving Regulation and Regulatory Review, DOE will prioritize its review of the potential effects of any future phase-out of the refrigerant R–404A (should there be one) on the efficiency standards set by this rulemaking.

DOE does not have reason to believe that EPA's SNAP proposal to delist R–404A for commercial refrigeration applications will have a deleterious impact on the availability of components for ACIMs. Although the component supplier industry may focus efforts on supporting the transition to alternative refrigerants for the commercial refrigeration industry as suggested by Manitowoc, the design options included in this final rule are based on existing component technology and do not assume an advancement in such components. Therefore, DOE believes that those components currently on the market will remain available for use by ACIM manufactures. DOE wishes to clarify that it will continue to consider ACIM models meeting the definition of automatic commercial ice makers to be part of their applicable covered equipment class, regardless of the refrigerant that the equipment uses. If a manufacturer believes that its design is subjected to undue hardship by regulations, the manufacturer may petition DOE's Office of Hearing and Appeals (OHA) for exception relief or exemption from the standard pursuant to OHA's authority under section 504 of the DOE Organization Act (42 U.S.C. 7194), as implemented at subpart B of 10 CFR part 1003. OHA has the authority to grant such relief on a case-by-case basis if it determines that a manufacturer has demonstrated that meeting the standard would cause hardship, inequity, or unfair distribution of burdens.

DOE investigated ice makers which it believes use refrigerants other than R–404A, specifically refrigerants HFC–134a and R–410A. While these refrigerants are also HFCs, their GWP is significantly lower than that of R–404A,[23] and for this reason may be less likely to be delisted for use in ice makers under future SNAP rule revisions. Based on the available information, DOE concludes that compliance challenges for these alternative refrigerants are not greater than for R–404A. Table IV.1 below presents performance data of alternative-refrigerant ice makers and compares their energy use to the energy use associated with TSL3 for their equipment class and capacity. Thirteen of these 31 ice makers meet the TSL3 level.

TABLE IV.1—ICE MAKERS USING ALTERNATIVE REFRIGERANTS

Refrigerant	Equipment class	Harvest capacity rate (lb ice/24 hr)	Energy use (kWh/100 lb)	Energy use percent below baseline	TSL3 Energy use (kWh/100 lb)
HFC–134a	SCU–A–Small–B	121	8.4	31.8	9.4
R–410A	IMH–W–Small–B *	302	6.1	0.6	5.2
R–410A	IMH–W–Small–B	305	5.2	15.1	5.2
R–410A	IMH–W–Small–B	310	5.2	14.7	5.2
R–410A	IMH–W–Small–B	428	4.7	13.7	5.0
R–410A	IMH–W–Small–B	430	4.7	13.5	5.0
R–410A	IMH–W–Small–B	494	5	1.6	4.9
R–410A	IMH–W–Med–B	510	5	0.4	4.8
R–410A	IMH–W–Med–B *	730	4.75	0.6	4.4
R–410A	IMH–W–Med–B *	1,200	4.1	3.8	4.1
R–410A	IMH–A–Small–B	222	7.5	10.2	7.3
R–410A	IMH–A–Small–B	300	6.2	19.3	6.3
R–410A	IMH–A–Small–B	305	6.8	11.0	6.3
R–410A	IMH–A–Small–B	388	6	13.3	6.1
R–410A	IMH–A–Large–B	485	6	5.6	5.8
R–410A	IMH–A–Large–B	714	6.1	0.1	5.3
R–410A	IMH–A–Large–B	230	7.5	9.4	6.5
R–410A	IMH–A–Large–B	320	6.2	17.4	6.3
R–410A	IMH–A–Large–B	310	6.8	10.5	6.3
R–410A	IMH–A–Large–B	405	5.8	14.4	6.0
R–410A	IMH–A–Large–B	538	6	4.7	5.7
R–410A	IMH–A–Large–B	714	6.1	0.1	5.3
R–410A	IMH–A–Large–B *	1,100	5.3	6.7	4.9
R–410A	RCU–NRC–Small–B	724	5.4	11.5	5.5
R–410A	RCU–NRC–Small–B	720	5.4	8.8	5.5
R–410A	RCU–NRC–Small–B *	1,200	5	2.0	4.6

* Two ice makers with these ratings, one each for full-cube and half-cube ice.

5. Data Availability

AHRI, PGE/SDG&E, and NAFEM requested that DOE make data available for stakeholder review. (AHRI, Public Meeting Transcript, No. 70 at p. 349; PG&E and SDG&E, No. 89 at p. 3; NAFEM, No. 82 at p. 2) Specifically, AHRI requested that DOE's test results be made available to manufacturers for review. (AHRI, Public Meeting Transcript, No. 70 at p. 349) NAFEM suggested that DOE identify the model and serial number of components used in the engineering analysis in order to enhance transparency. (NAFEM, No. 82 at p. 2)

AHRI and Danfoss both suggested that DOE facilitate more informal dialog to discuss data and assumptions for the department to receive feedback. (AHRI, Public Meeting Transcript, No. 70 at p. 342–343; Danfoss, No. 72 at p. 1–2)

[23] *See http://www.epa.gov/ozone/snap/subsgwps.html.*

Danfoss recommended that DOE publish the list of all persons, companies and organizations they have contacted in regards to this rulemaking. (Danfoss, No. 72 at p. 1–2)

In response to stakeholders, DOE held a public meeting on June 19 to provide stakeholders with more information about the energy modeling used in developing the NOPR analysis. 79 FR 33877 (June 13, 2014). In addition, DOE published a NODA presenting analyses revised based on stakeholder comments and additional research conducted after the NOPR. 79 FR 54215 (Sept. 11, 2014). DOE's contractor also engaged in additional discussions with manufacturers under non-disclosure agreements after publication of the NOPR in order to collect additional information relevant to the analyses. DOE generally does not publish test data to avoid revealing information about product performance that may be considered trade secrets. Also for this reason, DOE does not intend to publish the model and serial number of equipment or components obtained, tested, and reverse-engineered during the analysis. DOE also does not reveal the identity of companies and organizations from which its contractor has collected information under non-disclosure agreement.

In their written response to the NODA, AHRI expressed their belief that DOE's current process in this rulemaking is not compliant with the objective of using transparent and robust analytical methods producing results that can be explained and reproduced, as required by DOE's process rule and guidelines. AHRI expressed their belief that it has been difficult to analyze and provide feedback on this rulemaking as important portions such as the energy model have not been disclosed to the public. (AHRI, No. 128 at p. 6–8)

AHRI and NAFEM requested that DOE publically release the FREEZE model for stakeholder review. NAFEM and AHRI stated that DOE was unable to show that the FREEZE model functioned and was unable to produce accurate results at the June 2014 public meeting. (AHRI, No. 128 at p. 2–3; NAFEM, No. 123 at p. 1–2) AHRI stated that given the results of the limited runs model at the June 19th meeting, they believe that there are serious concerns about the quality and reproducibility of the information that is not in accordance with the applicable guidelines for ensuring and maximizing the quality, objectivity, utility and integrity of information disseminated to the public by the Department of Energy. AHRI added that without public release of the model, DOE cannot demonstrate sufficient transparency about the data and methods such that an independent reanalysis can be undertaken by a qualified member of the public. AHRI noted that if DOE had compelling interests that prohibit public access to the model, DOE must identify those interests and describe and document the rigorous checks it has undertaken to ensure reproducibility. (AHRI, No. 128 at p. 6–8)

DOE notes that stakeholders have placed great emphasis on the FREEZE model in their responses, but this model is only part of the analysis. Moreover, DOE has published output of the engineering analysis on which stakeholders have had the opportunity to comment, for both the NOPR and NODA phases. As part of the final rule documentation, DOE presents the revised engineering analysis output.

Over the course of the rulemaking, DOE has attained additional information regarding the efficiency improvements associated with different design options, through public comments as well as through confidential information exchange between DOE's contractor and manufacturers. As a result the efforts made by all parties in preparing and providing this additional information, the projections of efficiency improvements associated with the design options considered in the analysis are based more on test data than theoretical analysis. For example, in the NODA and final rule analysis, the energy use reduction in a batch ice maker as a result of compressor EER improvement is based on test data provided both in written comments and through confidential information exchange.

In the NOPR and the NODA phases, DOE has published engineering spreadsheets that show projected energy savings associated with specific design options for the analyses of energy use for the ice maker models representing most of the ice maker equipment classes. These results document the analysis and have allowed stakeholders to review details of the analysis as a check on accuracy. DOE's calibration of the energy use analysis results at the highest commercially-available efficiency levels, described in section IV.D.4.b, provides a check of the analysis, specifically ensuring that the group of design options required to attain these highest available efficiency levels (as predicted by the analysis) is consistent with actual equipment. The section presents examples of maximum available commercial units against which the energy use calculations are calibrated for the highest analyzed efficiency levels not using permanent magnet motors and drain water heat exchangers. DOE conducted calibration at this efficiency level because these design options are not generally used in commercially available units, thus preventing calibration with commercialized units at higher efficiency levels. These calibration comparisons, which are discussed in section IV.D.4.b and in Chapter 5 of the TSD, show (a) that the efficiency levels attainable without use of permanent magnet motors and drain water heat exchangers have not been overestimated by the analysis, and (b) the design options that are projected to be required to attain these maximum available efficiency levels are consistent with or conservative (more costly) as compared with the design options used in maximum-available ice makers that are available for purchase.

DOE is not at liberty to release the FREEZE energy model to the public because it does not own the modeling tool.

AHRI stated that DOE did not publically provide the information necessary for affected parties to have adequate notice and ability to comment on the results of the public meeting. AHRI stated that DOE failed to publically state a timeframe for collecting the data it has requested. AHRI added that the public statement issued after the public meeting did not indicate to whom the data should be sent. AHRI stated their belief that without the clarity of a defined comment period, or the knowledge of the next steps in the process DOE is not following its own process rule and the notice and comment requirements for federal agency rulemaking. (AHRI, No. 128 at p. 6–8)

In response to AHRI's comment, DOE expressed willingness during the NOPR public meeting, subject to potential legal restrictions, to allow additional information exchange by stakeholders with DOE's contractor under non-disclosure agreement. DOE also expressed willingness to possibly publish a NODA which would allow stakeholders additional opportunity to comment. (DOE, NOPR Public Meeting Transcript, No. 70 at pp. 341–344) In general, any information exchange regarding a rulemaking is strictly limited after publication of a NOPR, in order to limit the potential for undue influence on the process from any particular interested party. DOE allowed additional information exchange with stakeholders and published a NODA to allow additional opportunity for input. 79 FR 54215 (Sept. 11, 2014). Thus, contrary to AHRI's comment, with the additional public meeting and with the issuance of the NODA, stakeholders have had several opportunities to provide input beyond the opportunities normally provided for an energy conservation standard rulemaking.

6. Supplemental Notice of Proposed Rulemaking

NAFEM stated that DOE should not issue a final rule because the revisions in the NODA did not address each issue raised in response to the NOPR analysis. (NAFEM, No. 123 at p. 1) NAFEM and AHRI both requested that the department issue a supplemental notice of proposed rulemaking (SNOPR) to allow manufacturers and end users enough time to address the substantial changes in the analysis made between the NOPR and NODA phases. (NAFEM, No. 123 at p. 1; AHRI, No. 128 at p. 2) NAFEM stated that there are many unknowns regarding the changes made in the NODA analysis and noted that DOE did not identify a technologically feasible and economically justified standard level. NAFEM also requested that DOE release the model used to determine TSL standards. (NAFEM, No. 123 at p. 1)

In response to AHRI and NAFEM, DOE notes that the modifications made to the analyses in the NODA were based on stakeholder participation, and each issue raised in response to the NOPR and NODA have been addressed in this final rule. The objective of the NODA was to enable stakeholders to understand the changes made in the basic analyses as a result of input received during the NOPR phase, and DOE believes that was accomplished. Therefore, DOE does not believe that an SNOPR is necessary for this rulemaking. In response to NAFEM's request for DOE to release the model used to determine the TSL standard, DOE assumes that this refers to the FREEZE model, which is discussed in section IV.A.5. DOE is not at liberty to release the FREEZE energy model to the public because it does not own the modeling tool. Regarding NAFEM's comment concerning identification of a technologically feasible and economically justified standard level, DOE notes that the NODA did not propose a standard level. Rather the NODA's purpose was to provide stakeholders the opportunity to comment on revisions in DOE's analysis.

7. Rulemaking Structure Comments

A Policy Analyst at the George Washington University Regulatory Studies Center commented on basic underpinnings of the DOE energy conservation standards rulemaking process. Policy Analyst commented that DOE does not explain why sophisticated, profit-motivated purchasers of ACIMs would suffer from informational deficits or cognitive biases that would cause them to purchase products with high lifetime costs without demanding higher-price, higher-efficiency products. (Policy Analyst, No. 75 at p. 5)

Policy Analyst indicated that two of the three problems identified by DOE, lack of access to information and information asymmetry, are not addressed by the rule, indicating that DOE's rule is flawed. (Policy Analyst, No. 75 at p. 6) Policy Analyst added that only one of the problems identified by DOE is addressed by any of the metrics stated in the proposed rule: Internalizing the externality of greenhouse gas emissions. (Policy Analyst, No. 75 at p. 7)

Policy Analyst suggested that the proposed rule should include DOE's plans for how it will gather information to assess the success of the rule and whether its assumptions were accurate. (Policy Analyst, No. 75 at p. 8) Policy Analyst added that DOE should include a timeframe for retrospective review in its final rule. (Policy Analyst, No. 75 at p. 8)

Policy Analyst stated that DOE should pay attention to the linkages between the rule and the measured outcomes in order to increase its awareness of mediating factors that may have accomplished or undermined the stated metrics absent the rule. (Policy Analyst, No. 75 at p. 8)

In response, DOE believes there are two main reasons that purchasers of ACIM equipment would lack complete information, causing them to, in Policy Analyst's words, ''purchase products with high lifetime costs without demanding higher-price, higher-efficiency products.'' The first reason is the time involved in collection and processing of information and the second is that the available information is incomplete. ACIM purchasers have access only to information that is readily available, and would not have ready access to information about additional efficiency options that could be made available to the market. The information that is available is dispersed in many sources, and the cost of querying all information sources takes the form of time taken away from the primary business of the purchaser, whether running a hotel or provision of medical care. By virtue of simply undertaking the energy conservation standard rulemaking, DOE provides significant information to all who are interested via the analyses undertaken by the rulemaking.

As the energy conservation standard rulemaking has proceeded from the initial framework phase through to the final rule phase, DOE has solicited information, purchased, examined and tested actual ACIM products, and performed numerous analyses to ensure assumptions are as accurate as possible. Once a rule is finalized, DOE continues collecting information as well as interacting with the industry, and such activities will enable DOE to measure whether the rule is achieving its intended results—namely increasing the efficiency of automatic commercial ice makers.

DOE will undertake subsequent analyses of ACIM equipment in order to meet legislative requirements for reviewing the standard by a date no later than 5 years after the effective date of new and amended standards established by this rulemaking. DOE follows a standard process in energy conservation standards rulemakings, and believes as such, that establishing plans within this final rule for gathering information for the next proceeding is unnecessary.

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 final rule TSD for further discussion of the market and technology assessment.

1. Equipment Classes

In evaluating and establishing energy conservation standards, DOE generally divides covered equipment into classes by the type of energy used, or by capacity or other performance-related feature that justifies a different standard for equipment having such a feature. (42 U.S.C. 6295(q) and 6316(a)) In deciding whether a feature justifies a different standard, DOE considers factors such as the utility of the feature to users. 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 (an ice maker consisting of an ice-making head in which the ice is produced—but also without an ice storage bin—and a separate condenser assembly that can be remotely installed,)
    - With remote compressor (compressor packaged with the condenser)
    - Without remote compressor (compressor packaged with the evaporator in the ice-making head)
  - Self-contained (with storage bin included)
- Condenser cooling
  - Air-cooled
  - Water-cooled
- Capacity range

Table IV.2 shows the 25 automatic commercial ice maker equipment classes that DOE used for its analysis in this rulemaking. These equipment classes were derived from existing DOE standards and commercially available products. The final rule adjusts these capacity ranges, based on this analysis, as a result of setting appropriate energy use standards across the overall capacity range (50 to 4,000 lb ice/24 hours) for a given type of equipment, such as all batch air-cooled ice-making head units.

TABLE IV.2—FINAL RULE AUTOMATIC COMMERCIAL ICE MAKER EQUIPMENT CLASSES USED FOR ANALYSIS

Type of ice maker	Equipment type	Type of condenser cooling	Harvest capacity 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
	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'' ice or ''nugget'' ice, which can both be 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 therefore were not regulated by existing DOE energy conservation standards.

Existing 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 water that is left in the sump at the end of the icemaking part of the cycle is purged (drained from the unit), removing with it the impurities that could decrease ice clarity form scale (the result of dissolved solids in the incoming water coming out of solution) on the ice maker surfaces. 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 with both freeze and harvest periods similar to the process used for 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 machines 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 April 2014 NOPR 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

In the March 2014 NOPR, DOE indicated that it was not proposing to create separate equipment classes for space-constrained units. DOE requested comment on this issue in the preliminary analysis phase. Few stakeholders commented on whether DOE should consider establishing equipment classes based on cabinet size. Earthjustice supported such an approach, while Manitowoc suggested that such an approach would be complicated. (Earthjustice, Preliminary Analysis Public Meeting Transcript, No. 42 at pp. 90–91; Manitowoc, (Manitowoc, Preliminary Analysis Public Meeting Transcript, No. 42 at p. 91)) DOE also reviewed size/efficiency trends of commercially available ice makers and concluded that the data do not show a definitive trend suggesting specific size limits for space-constrained classes. 79 FR 14846, at 14862 (March 17, 2014).

In response to the March 2014 NOPR, AHRI and NAFEM commented that DOE did not conduct analysis for the full range of product offerings in the market. (AHRI, No. 93 at p. 12–13; NAFEM, No. 82 at p. 4) AHRI, NAFEM, and Manitowoc commented that DOE's analysis did not take into account the difficulty associated with increasing cabinet volume for 22-inch models (*i.e.* ice makers that are 22 inches wide). (AHRI, No. 93 at p. 12–13; Manitowoc, No. 92 at p. 2; NAFEM, No. 82 at p. 4) Manitowoc added that the engineering analysis focused on 30-inch cabinets and that the design options may not all fit within the 22-inch cabinet models. (Manitowoc, No. 92 at p. 2 and p. 26–27) AHRI stated that they had data showing that 22-inch units cannot accommodate evaporator or condenser growth without chassis growth which is not possible for these size-restricted units. AHRI noted that DOE included chassis size increases for some equipment classes without taking into account in the engineering analysis the special case of 22-inch ice makers. (AHRI, No. 93 at p. 12–13) NAFEM specifically requested that DOE differentiate between 22-inch and 30-inch IMH–A–Small–B machines, since 22-inch models cannot achieve increases in cabinet volume and 30-inch models cannot be substituted for 22-inch models. (NAFEM, No. 82 at p. 4) Hoshizaki also urged DOE to take 22-inch units into special consideration in the analysis. (Hoshizaki, No. 86 at p. 8)

Manitowoc commented that 22-inch air-cooled ice-making heads are growing in importance due to the shrinking size of restaurant kitchens and that such machines cannot grow in height because they are already very tall. Manitowoc asserted that this product category may disappear if efficiency standards require significant chassis size growth. (Manitowoc, Public Meeting Transcript, No. 70 at p. 162–164)

However, the Northwest Energy Efficiency Alliance (NEEA) stated that they believe that DOE appropriately considered the issues concerning increased chassis size, citing DOE's consideration of chassis size increase only for three of the twenty-two classes analyzed, and the fact that DOE considered only increases in height, not increases in footprint. (NEEA, No. 91 at p. 1–2)

DOE has maintained its position from the NOPR and has not created a new equipment class for 22-inch ACIMs. However, in response to commenters DOE revised the NOPR analysis to consider the size restrictions and applications of 22-inch wide ice makers in its revised analysis. Specifically, DOE has developed cost-efficiency curves for 22-inch width units in the IMH–A–Small–B, IMH–A–Large–B, and IMH–W–Small–B equipment classes. These curves were used in the LCC and NIA analyses in the evaluation of efficiency levels for classes for which 22-inch ACIMs are an important category. The LCC and NIA analyses were also revised to more carefully consider the impact of size restrictions in applications for 30-inch units—this is discussed in greater detail in section IV.G.2. Ultimately these revisions in the analyses led to selection of less stringent efficiency levels for some of the affected classes.

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 capacities above 4,000 lb ice/24 hours as industrial rather than commercial. Since the publication of the framework 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. 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). To be consistent with the majority of the framework comments, during the preliminary analysis DOE discussed setting 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 3404 (Jan. 24, 2012) DOE proposed in the March 2014 NOPR to set efficiency standards that include all ice makers in this extended capacity range and has maintained this position in this final rule.

PG&E and SDG&E commented that they support the inclusion of previously unregulated equipment classes into the scope of this rulemaking, including equipment with a capacity range up to 4,000 lb/24 hour. (PG&E and SDG&E,

No. 89 at p. 1) However, Hoshizaki, NAFEM, and AHRI commented that DOE should refrain from regulating products with capacities above 2,500 lb ice/24 hours, if there are not enough models in this category for DOE to directly evaluate. (Hoshizaki, No. 86 at p. 9; Hoshizaki, No. 124 at p. 2; AHRI, No. 93 at p. 16; NAFEM, No. 123 at p. 2) Hoshizaki commented that large units perform differently than small units in the ways that their compressors and condensers interact. Hoshizaki requested that DOE not add higher levels to the standard extended beyond 2,000 lb ice/24 hours, but have a flat level no more stringent than the standard at 2,000 lb ice/24 hours for higher capacity equipment. (Hoshizaki, No. 124 at p. 2)

DOE acknowledges that there are currently few automatic commercial ice makers with harvest capacities above 2,500 lb ice/24 hours. However, AHRI has extended the applicability of its test standard, AHRI Standard 810–2007 with Addendum 1, ''Performance Rating of Automatic Commercial Ice Makers,'' to ice makers up to 4,000 lb ice/24 hours. Likewise, DOE extended the applicability of its test procedure to the same range. 77 FR 1591 (January 11, 2012). Stakeholders have not cited reasons that ice makers with capacities greater than 2,000 lb ice/24 hours would not be able to achieve the same efficiency levels as those producing 2,000 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. In response to Hoshizaki's comment, DOE notes that each product class has flat levels, *i.e.* efficiency levels that do not vary with harvest capacity, beyond 2,000 lb ice/24 hours.

c. 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 ice. Batch type ice makers use an additional 3 to 38 gallons of water in the process of making 100 lb 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.

As indicated in the preliminary analysis and NOPR, DOE is not setting potable water limits for automatic commercial ice makers.

The Natural Resource Defense Council (NRDC) commented that they previously urged the Department to propose standards for potable water use in batch type ice makers and that failure to do so is short-sighted, given the increasing severity of drought conditions in many states, and may cause states to consider their own water use standards for ice makers. (NRDC, No. 90 at p. 54–1) NRDC urged DOE to reconsider its decision not to evaluate and set standards for potable water use. NRDC noted that EPCA was amended in 1992 explicitly to include water conservation as one of its purposes. (NRDC, No. 90 at p. 1)

PG&E and SDG&E also recommended that DOE establish a maximum potable water use requirement. PG&E and SDG&E also added that in the event that DOE maintains that there is ambiguity in EPACT 2005 on whether DOE is required to regulate water usage and uses its discretion not to mandate a potable water standard PG&E and SDG&E request that DOE comment whether states are preempted from establishing such a standard. (PG&E and SDG&E, No. 89 at p. 4)

In response to comments from NRDC, and PG&E and SDG&E, 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)), dishwashers (42 U.S.C. 6295(g)(10)), 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 at 42 U.S.C. 6313(d)(1) only for condenser water and noted in a footnote to the table setting the standards that potable water use was not included.[24] 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.[25] 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, and DOE has chosen to use its discretion not to mandate a standard in this case. Pursuant to 42 U.S.C. 6297(b) and (c), preemption applies with respect to covered products and no State regulation concerning energy efficiency, energy use, or water use of such covered product shall be effective with respect to such product unless the State regulation meets the specified criteria under these provisions.

DOE elected to not set potable water limits for automatic commercial ice makers in order to allow manufacturers to retain flexibility in this aspect of ice maker design. The regulation of ice maker energy use does in itself make high levels of potable water use untenable because energy use does increase as potable water use increases, since the additional water must be cooled down, diverting refrigeration capacity from the primary objective of cooling and freezing the water that will be delivered from the machine as ice.

DOE notes that ENERGY STAR has adopted potable water limits for ENERGY STAR-compliant ice makers at 15 gal/100 lb ice for continuous equipment classes, 20 gal/100 lb ice for IMH and RCU batch classes, and 25 gal/100 lb ice for SCU batch classes.[26]

d. Regulation of Condenser Water Use

As previously noted in section II.B.1, EPACT 2005 prescribes maximum condenser water use levels for water-cooled cube type automatic commercial ice makers. (42 U.S.C. 6313(d))[27] 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.

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

[25] *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)).

[26] *http://www.energystar.gov/index.cfm?c=comm_ice_machines.pr_crit_comm_ice_machines.*

[27] 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.

In the preliminary analysis and the NOPR, DOE indicated its intent to primarily focus the automatic commercial ice maker rulemaking on energy use. DOE also noted 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.

In the preliminary analysis, 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 in response to the preliminary analysis, 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 (DOE interprets the comment to mean technologically) 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)

In the NOPR DOE maintained that the 42 U.S.C. Sec. 6295(o)(1) anti-backsliding provisions apply to water in only a limited set of residential appliances and fixtures. Therefore, an increase in condenser water use would not be considered backsliding under the statute. Nevertheless, the DOE did not include increases in condenser water use as a technology option for the NOPR, NODA, and final rule.

In response to the NOPR, NRDC stated that they disagree that DOE may lawfully relax water use standards. NRDC added that even if DOE were correct in stating that EPCA's anti-backsliding provision does not apply, as explored in EarthJustice's comment, DOE cannot relax the water efficiency levels set by Congress itself. (NRDC, No. 90 at p. 1)

In this rule, DOE is not revising its NOPR position regarding the application of anti-backsliding to ACIM condenser water use. Nevertheless, DOE did not consider design options that would represent increase in condenser water use in its final rule analysis.

e. Continuous Models

The EPACT 2005 amendments to EPCA did not set standards for continuous type ice makers. 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))

Hoshizaki stated that due to their small market share, continuous models should be considered separately from batch machines. (Hoshizaki, No, 124 at p. 1)

DOE notes that it has conducted analysis for continuous models as part of separate equipment classes than batch type models and has set different energy standards for them.

f. Gourmet Ice Machines

AHRI stated that this rulemaking has ignored the niche market of gourmet ice cubes. AHRI stated that gourmet ice cubes are two to three times larger than standard ice cubes. They are also harder and denser than conventional machine-made ice and require more energy to produce. AHRI noted that this issue impacts small business manufacturers. (AHRI, No. 128 at p. 5)

In response to AHRI's comment regarding gourmet ice makers, DOE has not conducted separate analysis for such equipment. DOE has, however, considered small business impacts, as discussed in section IV.J.3.f. DOE notes that the ACIM rulemaking has provided stakeholders many opportunities to provide comment on the issues that would be important to consider in the analysis, including potential equipment classes associated with different types of ice, whether different types of ice provide specific utility that would be the basis of considering separate equipment classes, and any other issues associated with such ice that might affect the analysis. DOE does not have nor did it receive in response to requests for comments sufficient specific information to evaluate whether larger ice has specific consumer utility, nor to allow separate evaluation for such equipment of costs and benefits associated with achieving the efficiency levels considered in the rulemaking. In the absence of information, DOE cannot conclude that this type of ice has unique consumer utility justifying consideration of separate equipment classes. DOE notes that manufacturers of this equipment have the option seeking exception relief pursuant to 41 U.S.C. 7194 from DOE's Office of Hearings and Appeals.

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.3. Chapter 3 of the final rule 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, which is discussed in section IV.C.

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Table IV.3 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	√		

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The section below addresses the potential consideration of another technology option.

a. Alternative Refrigerants

The Environmental Investigation Agency (EIA Global) urged DOE to include hydrocarbon refrigerants as an ACIM technology option. EIA Global expressed their concern that DOE's analysis will be incomplete without the inclusion of hydrocarbon refrigerants and that the high global warming potential (GWP) of current ACIM refrigerants will further damage the stability of the climate, thus offsetting the efficiency gains associated with standards. (EIA Global, No. 80 at p. 1)

EIA Global commented that it is likely that EPA will include hydrocarbons as acceptable ACIM refrigerants in the near future and urged DOE to bring a SNAP petition to do so. EIA Global added that accepting hydrocarbons for use in ACIMs with charge sizes of 150g or less is highly likely and that according to a United Nations Environment Programme (UNEP) report, such refrigerants have lower viscosity, resulting in improved cooling efficiency and reducing energy consumption by 18 percent. (EIA Global, No. 80 at p. 2) EIA Global noted that DOE should set standards that anticipate future alternatives, rather than being limited to what is available today. (EIA Global, No. 80 at p. 4–5)

EIA Global stated that including hydrocarbon refrigerants in the analysis will be of little burden to DOE because Scotsman, Hoshizaki, and Manitowoc already sell hydrocarbon machines throughout Europe and other international markets and noted that these three manufacturers have observed energy savings associated with use of these refrigerants. (EIA Global, No. 80 at p. 1–4)

In response to EIA Global's comments, DOE notes that 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 HFC refrigerants currently used in automatic commercial ice makers may be restricted by future rules, DOE cannot speculate on the outcome of a rulemaking in progress and can only consider in its rulemakings rules that are currently in effect. Therefore, DOE has not included possible outcomes of a potential EPA SNAP rulemaking. This position is consistent with past DOE rulings, such as in the 2014 final rule for commercial refrigeration equipment. 79 FR 17725 (March 28, 2014) DOE notes that recent proposals by the EPA to allow use of hydrocarbon refrigerants or to impose new restrictions on the use of HFC refrigerants do not address automatic commercial ice maker applications. 79 FR 46126 (August 6, 2014) 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. As mentioned in section IV.A.4, if a manufacturer believes that its design is subjected to undue hardship by regulations, the manufacturer may petition DOE's Office of Hearing and Appeals (OHA) for exception relief or exemption from the standard pursuant to OHA's authority under section 504 of the DOE Organization Act (42 U.S.C. 7194), as implemented at subpart B of 10 CFR part 1003. OHA has the authority to grant such relief on a case-by-case basis if it determines that a manufacturer has demonstrated that meeting the standard would cause hardship, inequity, or unfair distribution of burdens.

C. Screening Analysis

In the technology assessment section of this final rule, 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, section (4)(a)(4). See chapter 4 of the final rule TSD for further discussion of the screening analysis. Another consideration is whether a design option provides a unique pathway towards increasing energy efficiency and that pathway is a proprietary design that a manufacturer can only get from one source. In this instance, such design option would be eliminated from consideration because it would require manufacturers to procure it from a sole source. Table IV.4 shows the EPCA criteria and additional criteria used in this screening analysis, and the design options evaluated using the screening criteria.

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Table IV.4 Justification for Eliminating Technology Options from Further Consideration

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	Sole-Source 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.5 contains the list of technologies that remained after the screening analysis.

Table IV.5 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 (Drain water heat exchanger)	√		

* Higher efficiency motors considered in the analysis include permanent split capacitor (PSC) motors and/or permanent magnet motors (e.g. such as electronically-commutated motors (ECMs)).

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a. General Comments

Manitowoc expressed its agreement with the screening analysis. (Manitowoc, No. 92 at p. 3) However, Scotsman requested that the following additional criteria be used in the screening analysis: Impact on end-user facility and operations, impact on end-user profit-generating beverage sales, impact on machine footprint, impact on end-user ''repair existing'' or ''purchase new'' decision hierarchy, impact on ACIM service and installation network support capability, and impact on manufacturer component tooling/fixture obsolescence prior to depreciation. (Scotsman, No. 85 at p. 3b–4b)

In response to Scotsman comment, DOE notes that while DOE's screening analysis specifically focuses on the four criteria identified in the process rule (see 10 CFR part 430, subpart C, appendix A, section (4)(a)(4)), some of the suggested screening criteria outlined in Scotsman's comment are taken into account in other parts of the analysis. Specifically, impacts to end user facility and operations, including installations costs, are considered in the life cycle cost analysis described in section IV.G. Impacts regarding manufacturing tooling are examined in the manufacturing impact analysis described in section IV.J.

b. 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.

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.

In response to the NODA, Manitowoc stated that drain water heat exchangers have not been proven in the industry (DOE assumes that this comment addresses issues such as their reliability rather than their potential for energy savings) and their use is likely to result in lower reliability due to issues with fouling and clogging associated with mineral particles that naturally accumulate in the dump water for batch cycle machines. Manitowoc also added that the high costs for drain water heat exchangers are not justified by their efficiency gains. (Manitowoc, No. 126 at p. 2) AHRI stated that a drain water heat exchanger cannot reasonably be implemented in a 22-inch IMH–A–Small–B unit. (AHRI, No. 128 at p. 2)

DOE notes that drain water heat exchangers have been discussed as a possible technology option from the framework stage of this rulemaking. DOE has investigated the feasibility of drain water heat exchangers through review of product literature, patents, reports on installations, and product teardowns, and has also conducted testing to evaluate the claims of efficiency improvement for the technology. While fouling of the heat exchanger is a potential concern based on the higher mineral concentration in dump water, heat exchangers designed for use with ice makers have been designed with electrically insulated gaskets to substantially reduce deposition of particulates on heat exchanger surfaces.[28] Moreover, drain water heat exchangers would also benefit from typical maintenance of ice machines that includes dissolution of such mineral deposits on all components that come into contact with potable water. DOE is not aware of data showing that the units sold have substantial reliability issues as a consequence of fouling in retrofit applications. Further, Manitowoc has not provided information or test data showing that they would reduce reliability. DOE also notes that answering the question of whether the inclusion of a drain water heat exchanger is cost-effective is a goal of the DOE analyses and is not considered during the screening analysis. DOE has examined the added cost of a drain water heater along with the energy savings resulting from its use and has found drain water heat exchangers to be cost justified for certain equipment classes.

In response to AHRI's comment suggesting that drain water heat exchangers may not fit in a 22-inch IMH–A–Small–B cabinet, DOE notes that the heat exchanger would be mounted outside the unit, rather than enclosed within the cabinet. If AHRI's comment did not mean to indicate that the objection was to placement of the heat exchanger within the unit, the comment also did not make clear why such a component could not be implemented specifically for a 22-inch wide unit.

In response to AHRI's comment suggesting that drain water heat exchangers may not fit in a 22-inch IMH–A–Small–B cabinet, DOE notes that the heat exchanger would be mounted outside the unit, rather than enclosed within the cabinet. If AHRI's comment did not mean to indicate that the objection was placement of the heat exchanger within the unit, the comment also did not make clear why such a component could not be implemented

[28] Welch, D.L., et al., U.S. Patent No. 5,555,734, Sep. 17, 1996.

specifically for a 22-inch wide unit. DOE did screen in this technology.

c. 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 ice makers (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.

d. Low Thermal Mass Evaporator Design

DOE's 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 has not altered its decision to screen out this technology in its analysis.

e. Microchannel Heat Exchangers

Through discussions with manufacturers, DOE has determined that there are 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 energy 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

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 DOE test procedure. Since the scope of this rulemaking is to consider energy conservation standards that increase the energy efficiency of automatic commercial ice makers this technology option has been screened out because it does not save energy as measured by the test procedure.

g. Motors

Manufacturers Follett and Manitowoc provided comment regarding the use of higher efficiency motors in ACIMs. Follett stated that they are not aware of gear motors more efficient than the hypoid motors they use. (Follett, No. 84 at p. 5) Manitowoc stated that they do not consider brushless direct-current (DC) fan motors to be cost effective. (Manitowoc, Public Meeting Transcript, No. 70 at p. 157–159)

In response to Follett's comment, DOE notes that its consideration of motor efficiency applies to the prime mover portion of the motor, not the gear drive. Gear motor assemblies include both a motor which converts electricity to shaft power and a gear drive, which converts the high rotational speed of the motor shaft to the rotational speed required by the auger. DOE screened in higher efficiency options for the motor, but did not consider higher-efficiency gear drives. In response to Manitowoc, the cost-effectiveness of a given technology, such as DC fan motors, is not a factor that is considered when screening technologies.

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, preliminary analysis, and NOPR analysis, DOE conducted the engineering analyses for this rulemaking using an approach that combines the efficiency level, design option, and reverse engineering approaches to develop 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 engineering analysis is based on illustrating a typical design path to achieving the specified percentage efficiency improvements at each level through the incorporation of a group of design options. Finally, DOE developed manufacturing cost models based on reverse engineering of products to develop baseline manufacturer production costs (MPCs) and to supplement incremental cost estimate associated with efficiency improvements.

DOE directly analyzed 19 ice maker configurations representing different classes, capacities, and physical sizes. To develop cost-efficiency curves, DOE collected information from multiple sources to characterize the manufacturing cost and energy use reduction of each of the design options or grouping of design options. DOE conducted an extensive review of product literature on hundreds of ice makers and selected 50 of them for testing and reverse engineering.

To gather cost and performance information of different ice maker design strategies, DOE conducted interviews with ice maker manufacturers and component vendors of compressors and fan motors during the preliminary, NOPR, NODA, and final phases of the rulemaking 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 vendor information, discussion with manufacturers, and the cost model. DOE calculated energy use reduction based on test data, data provided in comments, data provided in manufacturer interviews, and using the FREEZE program, The reverse engineering, equipment testing, vendor interviews, and manufacturer interviews provided input for the energy analysis. Information about specific ice makers also provided equipment examples against which the modeling results could be calibrated. The final incremental cost estimates and the energy modeling results together constitute the energy efficiency curves presented in the final rule TSD chapter 5.

The cost-efficiency relationships were derived from current market designs so that efficiency calculations could be verified by ratings or testing. Another benefit of using market designs is that the efficiency performance can be associated with the use of particular design options or design option groupings. The cost of these design option changes can then be isolated and also verified. In earlier stages of the rule DOE had limited information on current market designs and relied on the FREEZE model to supplement and extend its design-option energy modeling analysis. For the NODA and Final Rule, DOE has expanded its knowledge base of market designs through its own program of testing and reverse engineering, but also received test and design information from ice maker manufacturers. The cost-efficiency curves are now based on these market designs, test data obtained both through DOE testing and from manufacturers, specific information about component performance (*e.g.* motor efficiency) on which stakeholders have been able to comment, and in some instances use of the FREEZE model. DOE limited the projected efficiency levels for groups of design options found in available equipment to the maximum available efficiency levels associated with the specific classes. The groups of design options that DOE's analysis predicted would be required to attain these maximum efficiency levels were consistent with those of the maximum available ice makers or were found to provide a conservative estimate of cost compared to the market designs of equal efficiency employing different design option groups to attain the level.

Additional details of the engineering analysis are available in chapter 5 of the final rule TSD.

1. Representative Equipment for Analysis

In performing its engineering analysis, DOE selected representative units within specific equipment types to serve as analysis points in the development of cost-efficiency curves. DOE selected models that were representative of the typical offerings within a given equipment class. DOE sought to select models having features and technologies typically found in both the minimum and maximum efficiency equipment currently available on the market.

DOE received several comments from interested parties regarding those equipment classes not directly analyzed in the NOPR. Follett commented that they object to the fact that only one RCU–Large–C was purchased for testing, given that it represents nearly half of Follett's sales. Follett added that they also object to the fact that DOE did not analyze IMH–W–Small–C, IMH–W–Large–C, RCU–Small–C, and RCU–Large–C, which comprise a significant portion of Follett's revenue. Follett expressed its fear that DOE's approach could require Follett to enact design changes that are neither technologically feasible nor economically justified. (Follett, No. 84 at p. 7–8) Follett added that all manufacturers have unique designs that should be noted during reverse engineering analyses. (Follett, No. 84 at p. 8) Similarly, Hoshizaki commented that DOE only analyzed less than 1% of available units and that analysis did not include testing to validate proposed design changes. (Hoshizaki, No. 86 at p. 1)

Ice-O-Matic noted that half cube machines represent a significant portion of the industry and expressed concern that DOE did not attempt to analyze half cube machines. (Ice-O-Matic, No. 121 at p. 3)

In response to Ice-o-Matic, DOE notes that it focused its analysis on full cube machines based on the observation that half cube machines may have an efficiency advantage over full cube machines. For some models that are available in both versions, the energy use ratings are different, and generally the half-dice version has lower energy. This is consistent with the fact that the additional copper strips that divide the full-cube cells into two half-cube cells also provide additional heat transfer surface area that can enhance ice maker performance.

In response to Follett and Hoshizaki's comments, DOE is limited in time and resources, and as such, cannot directly analyze all models. DOE responded to NOPR comments regarding lack of analysis of continuous RCU units by adding direct analysis of a continuous RCU configuration with capacity of 800 lb ice/24 hours. This capacity is near the border between the small and large RCU continuous classes, hence it provides representation for both capacity ranges. DOE reviewed Follett's available continuous RCU ice maker data, as listed in the ENERGY STAR© database, and found that nearly all of the models meet the standard set in this rule. Of the two that don't, one has adjusted energy use within 1 percent of the standard, and one has energy use within 6 percent.

DOE disagrees with Hoshizaki's statement that DOE analyzed less than one percent of available units and believes it mischaracterizes DOE's analysis. DOE identified 656 current ice maker models in its research of available databases and Web sites. DOE did not analyze Hoshizaki batch ice makers, due to their proprietary evaporator design—hence the 91 Hoshizaki batch models would not have been considered in DOE's analysis for this reason. DOE developed 19 analyses, 3.4 percent of the remaining 565 models. Moreover, DOE asserts that the range of models analyzed provides a good representation of ice maker efficiency trends. DOE carefully selected the analyzed units to represent 13 of the 25 ice maker equipment classes listed in Table IV.2 representing roughly 93 percent of ice maker shipments.

DOE does not generally conduct prototype testing to verify the energy savings projections associated with specific design changes. For this, DOE has requested data from stakeholders who have done such work. DOE received such test data, some of it through confidential information exchange with its contractor, and considered this data in the analysis. Further, DOE also considered test data and design details of commercially available ice makers, which it used to calibrate its projections of energy reductions associated with groups of design options.

In many cases, DOE leveraged information found by directly analyzing similar product classes to supplement the analysis of those secondary equipment classes which were not directly analyzed. These similar equipment classes are listed in Table IV.6. The details of why these equipment classes were chosen can be found in chapter 5 of the final rule TSD.

TABLE IV.6—DIRECTLY ANALYZED EQUIPMENT CLASSES USED TO DEVELOP STANDARDS FOR SECONDARY CLASSES

Secondary equipment class	Analyzed equipment class associated with efficiency level for secondary equipment 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–Small–C.
IMH–W–Large–C	IMH–A–Large–C.
RCU–NRC–Large–C	RCU–NRC–Small–C.
RCU–RC–Small–C	RCU–NRC–Small–C.
RCU–RC–Large–C	RCU–NRC–Small–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.

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.7, 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.

As noted in section IV.B.1.d DOE is not proposing adjustment of maximum condenser water use standards for batch type ice makers. The section also generally discusses DOE regulation of condenser water. 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 final rule 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 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.7—BASELINE EFFICIENCY LEVELS FOR BATCH ICE MAKERS

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	7.80—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 = harvest rate in pounds per 24 hours, indicating the water or energy use for a given harvest rate.
Source: 42 U.S.C. 6313(d).

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, using ice hardness assumptions of 70 for flake ice makers and 85 for nugget ice makers, since ice hardness data was not available at the time. For the NOPR analysis, DOE used 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''). The AHRI published equipment ratings including ice hardness data, measured as prescribed by ASHRAE 29–2009, which is incorporated by reference in the DOE test procedure. DOE recreated its baseline efficiency levels for continuous type ice makers based on the available AHRI data, considering primarily the ice makers for which ice hardness data were available. DOE also adjusted the harvest capacity break points for the continuous equipment classes based on the new data.

The baseline efficiency levels used in the NOPR analysis for continuous type ice makers are presented in Table IV.8. 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 for the large batch classes.

TABLE IV.8—NOPR BASELINE EFFICIENCY LEVELS FOR CONTINUOUS ICE MAKER EQUIPMENT CLASSES

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	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	
		Large (≥700)	7.1	

* H = harvest capacity in lb ice/24 hours

After the publication of the NOPR and the NOPR public meeting, DOE received two comments from interested parties regarding its establishment of baseline models.

In response to the NOPR, Scotsman commented that there is not sufficient historical data (greater than 1 year) to establish continuous type baselines with statistical confidence. Scotsman added that the current ASHRAE standard is biased against low-capacity machines, and therefore does not accurately represent the energy usage of the machine when corrected for hardness factor. (Scotsman, No. 85 at p. 3b)

DOE has found multiple sources of information regarding the energy efficiency of continuous ice machines on the market. As noted previously, DOE investigated information published in the AHRI Directory of Certified Product Performance, the California Energy Commission, the ENERGY STAR program, and vendor Web sites to inform the establishment of a baseline for continuous models. In regards to Scottsman's comment that the standard is biased against low capacity machines, DOE has set its baseline levels while considering continuous model energy use that has been adjusted using the current ASHRAE test standard. If the test is biased against low-capacity machines, this bias should be reflected in the data and already be accounted for in the selected baseline levels.

Hoshizaki stated that they believe the baseline levels presented in the NOPR are too harsh for continuous equipment as it leaves many ENERGY STAR units unable to meet the minimum energy efficiency baseline. Hoshizaki noted that DOE based its analysis on the 2012 AHRI listing. Hoshizaki requested that DOE reassess the baseline data for all current continuous models as many more units have since been listed on AHRI's Web site. (Hoshizaki, No. 86 at p. 2–3) Similarly, Follett commented that some of the data on continuous type ice makers were not available in 2012, since they were not a part of the ENERGY STAR program until 2013, and that the baseline line might move up if recent data was added to the plot. (Follet, Public Meeting Transcript, No. 70 at p. 76–78) PGE/SDG&E commented that they support DOE's updating their database with new data from all sources, including the CEC, AHRI, and NRCan databases. (PG&E and SDG&E, No. 89 at p. 3)

In response to Hoshizaki's comment about ENERGY STAR-rated continuous models, for which there are currently no federal standard levels that would clearly represent the baseline efficiency levels, DOE revised its continuous class baselines so that no ENERGY STAR-rated continuous models have energy use higher than the baseline. The revised baseline efficiency levels for the continuous SCU classes are shown in Table IV.9 below. However, DOE notes that baseline efficiency levels are not required to be set at a level with which all commercially available equipment would be compliant. There are some IMH–W models and some IMH–A models that have energy use higher than the selected baseline levels—this is illustrated in the comparison of equipment data and efficiency levels in Chapter 3 of the TSD. DOE selected baseline efficiency levels that provide a good representation of the highest energy use exhibited by models available on the market with the exclusion of a few outliers (*i.e.* models exhibiting very different energy use than the majority of models).

TABLE IV.9—MODIFIED BASELINE EFFICIENCY LEVELS FOR SCU CONTINUOUS ICE MAKER EQUIPMENT CLASSES

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
Self-Contained	Water	Small (<900)	9.5—0.00378H	153—0.0252H.
		Large (≥900)	6.1	≤2,500: 153—0.0252H >2,500: 90.
	Air	Small (<200)	16.3—0.03H	Not Applicable.
		Large (≥200 and < 700)	11.84—0.0078H	Not Applicable.
		Extended (≥ 700)	6.38	Not Applicable.

* H = harvest capacity in lb ice/24 hours.

In response to the comments related to data sources DOE notes that it has continued to update the analysis with new data as it becomes available. This includes new information published in the AHRI Directory of Certified Product Performance, the California Energy Commission and the ENERGY STAR program.

In response to the NODA analysis, Hoshizaki again stated that DOE has not conducted enough analysis to accurately portray the baseline efficiency levels of continuous models (Hoshizaki, No. 124 at p. 1) NAFEM also stated that the NODA continuous unit baselines do not reflect the current models in the marketplace. (NAFEM, No. 123 at p. 2)

DOE has evaluated all available data sources in its determination of the baseline efficiency levels for continuous units. However, as stated above, DOE notes that the baseline level selected is not necessarily the least efficient equipment on the market. As part of this review of data sources, DOE has modified the baseline condenser water use levels for IMH–W continuous classes such that they are 10 percent below the IMH–W batch baseline water use levels.

b. Incremental Efficiency Levels

For each of the 11 analyzed batch type ice-maker equipment classes and the four analyzed continuous ice maker equipment classes, DOE established a series of incremental efficiency levels for which it has calculated incremental costs. DOE chose these classes to be representative of all ice-making equipment classes, and grouped non-analyzed equipment classes with similar analyzed equipment classes accordingly in the downstream analysis. Table IV.10 shows the selected incremental efficiency levels considered in the final rule analysis for batch ice makers, and Table IV.11 shows the incremental efficiency levels considered for continuous ice makers.

TABLE IV.10—INCREMENTAL EFFICIENCY LEVELS FOR BATCH ICE MAKER EQUIPMENT CLASSES CONSIDERED IN THE FINAL RULE ANALYSIS

Equipment type *	Harvest capacity rate lb ice/24 hours		EL 2 ** (%)	EL 3 EL 3A *** (%)	EL 4 EL 4A *** (%)	EL 5 (%)	EL 6 (%)	EL 7 (%)
	Range	Representative capacity						
IMH–W–Small–B	<500	300	10	15	20	24		
					22			
IMH–W–Med–B	≥500 and <1,436	850	10	15	18			
IMH–W–Large–B	≥1,436	1,500	8					
IMH–W–Large–B	≥1,436	2,600	7					
IMH–A–Small–B	<450	300	10	15	20	25	26	
				18				
IMH–A–Large–B	≥450	800	10	15	20	23		
				16				
IMH–A–Large–B	≥450	1,500	10	12				
RCU–NRC–Small–B		Not Directly Analyzed						
RCU–NRC–Large–B	≥1,000	1,500	10	15	17			
RCU–NRC–Large–B	≥1,000	2,400	10	14				
RCU–RC–Small–B	<934	Not Directly Analyzed						
RCU–RC–Large–B	≥934	Not Directly Analyzed						
SCU–W–Small–B	>200	Not Directly Analyzed						
SCU–W–Small–B	≥200	300	10	15	20	25	30	
SCU–A–Small–B	<175	110	10	15	20	25	30	33

TABLE IV.10—INCREMENTAL EFFICIENCY LEVELS FOR BATCH ICE MAKER EQUIPMENT CLASSES CONSIDERED IN THE FINAL RULE ANALYSIS—Continued

Equipment type *	Harvest capacity rate lb ice/24 hours		EL 2 ** (%)	EL 3 EL 3A *** (%)	EL 4 EL 4A *** (%)	EL 5 (%)	EL 6 (%)	EL 7 (%)
	Range	Representative capacity						
SCU–A–Large–B	≥175	200	10	15	20	25	29	....

* 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 7 represent increased efficiency levels.
*** DOE considered intermediate efficiency levels 3A and 4A for some equipment classes.

TABLE IV.11—INCREMENTAL EFFICIENCY LEVELS FOR CONTINUOUS TYPE ICE MAKER EQUIPMENT CLASSES CONSIDERED IN THE FINAL RULE ANALYSIS

Equipment Type *	Harvest capacity lb ice/24 hours		EL 2 ** (%)	EL 3 (%)	EL 4 (%)	EL 5 (%)	EL 6 (%)
	Range	Representative capacity					
IMH–W–Small–C	<900	Not Directly Analyzed					
IMH–W–Large–C	≥900	Not Directly Analyzed					
IMH–A–Small–C	<700	310	10	15	20	25	26
IMH–A–Large–C	≥700	820	10	15	20	23	....
RCU–Small–C	<850	800	10	15	20	25	27
RCU–Large–C	≥850	Not Directly Analyzed					
SCU–W–Small–C	<900	Not Directly Analyzed					
SCU–W–Large–C	≥900	No existing products on the market					
SCU–A–Small–C	<700	220	10	15	20	25	27
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.

In response to the NODA, Hoshizaki stated that ''there are no models that achieve the NODA levels in SCU–A, IMH–W large, or RCU–A large'' equipment classes. Hoshizaki added that these same levels were not analyzed for cost curves. (Hoshizaki, No. 124 at p. 1)

As discussed above in section IV.D.1, DOE's analysis for the RCU class was at a representative capacity of 800 lb ice/24 hours, intended to provide representation for both small and large classes, by being at a capacity level in the large range but within 100 lb ice/24 hours of the small range. Continuous ice maker data that DOE collected from publicly available sources does show that nearly all ice makers meet the baseline efficiency levels considered in the analysis. Not all meet the efficiency levels eventually designated as TSL 3 for the final rule, but some ice makers over a broad capacity range in each of the cited classes (SCU–A–C, IMH–W–C, RCU–RC–C, and RCU–NRC–C) do meet this level, shown in Table IV.12 through Table IV.15. A comparison of the levels achieved by commercially available ice makers with the considered TSL levels is shown graphically in Chapter 3 of the TSD.

TABLE IV.12—AIR-COOLED, SELF-CONTAINED, CONTINUOUS UNITS MEETING THE FINAL RULE STANDARD

Manufacturer	Model	Harvest capacity (lb ice/24 hours)	Adjusted energy use (kWh/100 lb ice)	Standard (kWh/100 lb ice)	Hardness factor
Hoshizaki	F–330BAH–C	222	7.99	8.08	84.5
Hoshizaki	F–330BAH	238	7.56	7.98	69.8
Manitowoc	RNS0385A–161	248	7.75	7.92	86
Scotsman	MDT5N25WS–1#	455	4.99	6.63	75
Hoshizaki	DCM–751BWH	631	5.21	5.53	88.9

TABLE IV.13—WATER-COOLED, ICE MAKING HEAD, CONTINUOUS UNITS MEETING THE FINAL RULE STANDARD

Manufacturer	Model	Harvest capacity (lb ice/24 hours)	Adjusted energy use (kWh/100 lb ice)	Standard (kWh/100 lb ice)	Hardness factor
Ice-O-Matic	GEM0450W	429	4.66	5.33	(*)
Follet	HC *700W **	535	4.43	5.05	(*)
Ice-O-Matic	GEM0655W	578	4.2	4.94	(*)
Ice-O-Matic	MFI0805W	604	4.26	4.87	(*)
Hoshizaki	F–801MWH	635	4.48	4.78	75.1
Ice-O-Matic	GEM0650W	633	3.86	4.79	(*)
Ice-O-Matic	MFI0800W	740	3.93	4.50	(*)
Ice-O-Matic	GEM0956W	877	3.54	4.34	(*)
Ice-O-Matic	GEM0955W	927	3.71	4.34	(*)
Ice-O-Matic	MFI1256W	959	3.54	4.34	(*)
Ice-O-Matic	MFI1255W	1000	3.41	4.34	(*)
Follet	HCE1400W**	1150	4.31	4.34	(*)
Ice-O-Matic	RN–1409W	1318	4.27	4.34	(*)
Ice-O-Matic	RN1409W–261	1318	4.15	4.34	88
Follet	HCC1400W ***	1374	4.28	4.34	(*)

* Ice hardness factor assumed to be 70 for flake ice makers and 85 for nugget ice makers.

TABLE IV.14—REMOTE CONDENSING, NOT REMOTE COMPRESSOR, CONTINUOUS UNITS MEETING THE FINAL RULE STANDARD

Manufacturer	Model	Harvest capacity (lb ice/24 hours)	Adjusted energy use (kWh/100 lb ice)	Proposed standard (kWh/100 lb ice)	Hardness factor
Ice-O-Matic	GEM0650R	550	6.41	6.51	(*)
Ice-O-Matic	GEM0956R	825	4.77	4.915	(*)
Ice-O-Matic	MFI1256R	950	4.79	5.06	(*)
Scotsman	N1322R–32#	1030	5.04	5.06	74
Scotsman	F1222R–32#	1050	4.97	5.06	60

* Ice hardness factor assumed to be 70 for flake ice makers and 85 for nugget ice makers.

TABLE IV.15—REMOTE CONDENSING, REMOTE COMPRESSOR, CONTINUOUS UNITS MEETING THE FINAL RULE STANDARD

Manufacturer	Model	Harvest capacity (lb ice/24 hours)	Adjusted energy use (kWh/100 lb ice)	Standard (kWh/100 lb ice)	Hardness factor
Follet	HCD700RBT	566	5.44	6.62	88
Manitowoc	RFS1278C–261	958	5.11	5.26	72
Follet	HCD1400R ***	1184	4.87	5.26	(*)
Follet	HCF1400RBT	1195	4.59	5.26	89.4
Follet	HCD1650R ***	1284	5.24	5.26	(*)
Follet	HCF1650RBT	1441	4.14	5.26	89.9
Manitowoc	RFS2378C–261	1702	5.18	5.26	68
Ice-O-Matic	MFI2406LS	2000	4.27	5.26	(*)
Scotsman	FME2404RLS	2000	3.54	5.26	(*)

* Ice hardness factor assumed to be 70 for flake ice makers and 85 for nugget ice makers.

c. IMH–A–Large–B Treatment

The existing 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. In the NOPR, DOE proposed efficiency levels for this class that maintain a constant energy use in kwh per 100 pounds of ice at large capacities to the extent that this approach does not violate EPCA's anti-backsliding provision. 79 FR at 14877 (March 17, 2014).

DOE did not receive any comments on the approach described in the NOPR. Therefore, DOE maintained this approach for the final rule.

d. Maximum Available Efficiency Equipment

DOE considered the most-efficient equipment available on the market, known as maximum available equipment. For many batch equipment classes, the maximum available equipment uses proprietary or screened-out technology options that DOE did not consider in its engineering analysis, such as low thermal-mass evaporators and tube evaporators for batch type ice makers. Hence, DOE considered only batch maximum available equipment that does not include these technologies. These maximum available efficiency levels are shown in Table IV.16. This information is based on DOE's icemaker ratings database (see data in chapter 3 of the final rule TSD). The efficiency levels are represented as an energy use percentage reduction compared to the energy use of baseline-efficiency equipment. For some batch equipment classes, DOE has presented maximum available efficiency levels at different capacity levels or for 22-inch wide ice makers.

TABLE IV.16—EFFICIENCY LEVELS FOR MAXIMUM AVAILABLE EQUIPMENT WITHOUT SCREENED TECHNOLOGIES IN BATCH ICE MAKER EQUIPMENT CLASSES

Equipment class	Energy use lower than baseline
IMH–W–Small–B	19.2%, 16.9% (22-inch wide).
IMH–W–Med–B ...	14.3%.
IMH–W–Large–B	5% (at 1,500 lb ice/24 hours), 2.5% (at 2,600 lb ice/24 hours).
IMH–A-Small–B ...	19.3%, 16.6% (22-inch wide).
IMH–A–Large–B ..	16.1% (at 800 lb ice/24 hours) 5.5% (at 590 lb ice/24 hours, 22-inch wide) 6.0% (at 1,500 lb ice/24 hours).
RCU–Small–B	25.8%.
RCU–Large–B	15.7% (at 1,500 lb ice/24 hours), 14.9% (at 2,400 lb ice/24 hours).
SCU–W–Small–B	26.2%.
SCU–W–Large–B	27.6%.
SCU–A–Small–B	24.9%.
SCU–A–Large–B	26.4%.

Efficiency levels for maximum available equipment in the continuous type ice-making equipment classes are shown in Table IV.17. This information is based on a survey of product databases and manufacturer Web sites (see data in chapter 3 of the final rule TSD). The efficiency levels are represented as an energy use percentage reduction compared to the energy use of baseline-efficiency equipment.

TABLE IV.17—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 ..	28.0%.
IMH–A–Large–C	35.7% (at 820 lb ice/24 hours), lb ice.
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	29.3%.
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.

In response to the maximum available efficiency levels presented in the NODA AHRI suggested that DOE review the max available unit for the 22-inch IMH–A–Small–B equipment class which is cited at 17% as they believe the unit may contain proprietary design options. (AHRI, No. 128 at p. 3)

DOE maintains that the representative 22-inch unit for the IMH–A–Small–B equipment class did not contain any proprietary designs—specifically, the model analyzed does not include any proprietary or screened options such as low-thermal-mass evaporators or tube-ice evaporators. Table IV.18 lists 22-inch ice makers of this class that are in DOE's ice maker database. DOE calculated an efficiency level equal to 12.3% for such a unit with design options included in maximum available equipment. There are three available units with higher efficiency level. Therefore, DOE has maintained the maximum available level for this equipment class in the final rule engineering analysis.

TABLE IV.18—22-INCH IMH–A–SMALL–B MODELS

Harvest capacity rate (lb ice/24 hours)	Rated energy use (kWh/100 lb ice)	Percent efficiency level	Contains proprietary or screened technology (*e.g.*, low-thermal-mass or tube evaporators)?
249	8.10	0.2	No.
290	7.23	6.9	No.
225	7.49	10.0	No.
335	6.64	10.0	No.
360	6.45	10.0	No.
310	6.80	10.5	No.
305	6.80	11.0	No.
230	7.32	11.6	No.
278	6.90	12.3	Yes.
214	7.20	14.5	No.
370	5.90	16.6	No.
255	6.60	18.2	No.
324	5.80	22.4	Yes.

e. Maximum Technologically Feasible Efficiency Levels

When DOE adopts 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)) DOE determined maximum technologically feasible (''max-tech'') efficiency levels for automatic commercial ice makers in the engineering analysis by considering efficiency improvement beyond the maximum available levels associated with two design options that are generally not used in commercially available equipment, brushless DC motors and drain water heat exchangers. DOE has not screened out these design options—cost-effectiveness is not one of the screening criteria (see section IV.C). Table IV.19 and Table IV.20 show the max-tech levels determined in the NOPR engineering analysis for batch and continuous type automatic commercial ice makers, respectively. These max-tech levels do not consider use of screened technology, specifically low-thermal-mass evaporators and tube ice evaporators.

TABLE IV.19—FINAL RULE MAX-TECH LEVELS FOR BATCH AUTOMATIC COMMERCIAL ICE MAKERS

Equipment type *	Percent energy use lower than baseline
IMH–W–Small–B	23.9%, 21.5% (22 inch wide).
IMH–W–Med–B	18.1%.
IMH–W–Large–B	8.3% (at 1,500 lb ice/24 hours), 7.4% (at 2,600 lb ice/24 hours).
IMH–A–Small–B	25.5%, 18.1% (22 inch wide).
IMH–A–Large–B	23.4% (at 800 lb ice/24 hours), 15.8% (at 590 lb ice/24 hours, 22 inch wide), 11.8% (at 1,500 lb ice/24 hours).
RCU–Small–B	Not directly analyzed.
RCU–Large–B	17.3% (at 1,500 lb ice/24 hours), 13.9% (at 2,400 lb ice/24 hours).
SCU–W–Small–B	Not directly analyzed.
SCU–W–Large–B	29.8%.
SCU–A–Small–B	32.7%.
SCU–A–Large–B	29.1%.

* 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.

Note: 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 IV.20—FINAL RULE MAX-TECH LEVELS FOR CONTINUOUS AUTOMATIC COMMERCIAL ICE MAKERS

Equipment type	Percent energy use lower than baseline
IMH–W–Small–C	Not directly analyzed.
IMH–W–Large–C	Not directly analyzed.
IMH–A–Small–C	25.7% †.
IMH–A–Large–C	23.3% (at 820 lb ice/24 hours).
RCU–Small–C	26.6% †.
RCU–Large–C	Not directly analyzed.
SCU–W–Small–C	Not directly analyzed.
SCU–W–Large–C *	No units available.
SCU–A–Small–C	26.6% †.
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

† Percent energy use lower than baseline.

Several stakeholders provided comment regarding the maximum technological efficiency levels presented in the NOPR.

PG&E recommended that DOE continue to update its product database to ensure that max-tech levels are set appropriately. (PG&E and SDG&E, No. 89 at p. 3–4) Manitowoc stated that examples of currently available models that are near the max-tech levels are not generally representative of the full range of models in each equipment class, explaining that small-capacity ice makers can attain higher efficiency levels than large-capacity ice makers built using the same package size. (Manitowoc, No. 92 at p. 3) AHRI commented that the maximum technologically feasible efficiency levels presented in the NOPR analysis were overestimated by up to 13% for at least 10 equipment classes. AHRI added that the FREEZE energy model has been proven invalid through testing, citing two examples of testing to evaluate the efficiency improvement associated with switching to a higher-EER compressor in which the observed efficiency improvement was significantly less than the NOPR projections of efficiency improvement associated with compressor switching. (AHRI, No. 93 at p. 5–6)

In response to the comment provided by PGE DOE notes that it has continued to update the product database with new data as it becomes available.

In response to Manitowoc, DOE notes that its analysis has considered multiple capacity levels for key classes. Also, although DOE agrees that higher efficiency levels may be more difficult to attain by higher-capacity ice makers, DOE has investigated the trend of efficiency level as a function of harvest capacity and package size and concluded that there are no consistent trends in the available data that would indicate which capacities should be analyzed for each specific package size. 79 FR at 14871–3 (March 17, 2014). DOE notes that while Manitowoc's comment indicates that higher efficiency levels may be easier to attain for a smaller-capacity unit in a given package size, the comment does not indicate which classes and capacities in DOE's analysis represent capacities for which attaining higher efficiency would be so much easier that equipment with these characteristics would not be representative of their classes. An example review of the relationship of harvest capacity rate, efficiency level, and package size in volume (cubic feet) is shown in Table IV.21 for IMH air-cooled batch ice makers. The data shown does not include ice makers with proprietary evaporator technology, nor does it include ice makers that produce large-size (gourmet) ice cubes. The data show that higher efficiency levels do not necessarily correlate either with larger package sizes or the smallest harvest capacity rates—the maximum 20.7% efficiency level is associated with a relatively small 8.3 cubic foot volume and a 530 lb ice/24 hour capacity rate.

TABLE IV.21—RELATIONSHIP BETWEEN HARVEST CAPACITY RATE, EFFICIENCY LEVEL, AND VOLUME FOR IMH AIR-COOLED BATCH ICE MAKERS BETWEEN 300 AND 600 LB ICE/24 HOURS

Harvest capacity rate (lb ice/24 hours)	Energy use (kWh/100 lb ice)	Percent efficiency level * (%)	Volume (cu ft)
305	6.80	11.0	6.7
310	6.80	10.5	6.7
335	6.64	10.0	6.7
360	6.45	10.0	6.7
370	5.90	16.6	7.0
380	6.70	4.2	7.0
404	6.10	10.1	7.3
357	6.30	12.4	8.3
358	5.95	17.1	8.3
368	6.10	14.0	8.3

TABLE IV.21—RELATIONSHIP BETWEEN HARVEST CAPACITY RATE, EFFICIENCY LEVEL, AND VOLUME FOR IMH AIR-COOLED BATCH ICE MAKERS BETWEEN 300 AND 600 LB ICE/24 HOURS—Continued

Harvest capacity rate (lb ice/24 hours)	Energy use (kWh/100 lb ice)	Percent efficiency level * (%)	Volume (cu ft)
448	6.10	4.8	8.3
448	6.10	4.8	8.3
530	5.00	20.7	8.3
530	5.00	20.7	8.3
366	6.00	15.6	8.5
459	5.80	9.2	8.5
590	5.90	5.5	8.9
300	6.20	19.3	9.1
316	6.36	15.7	9.1
320	6.20	17.4	9.1
335	5.97	19.1	9.1
370	5.94	16.1	9.1
388	6.00	13.3	9.1
390	5.79	16.2	9.1
405	5.80	14.4	9.1
410	5.73	14.9	9.1
485	6.00	5.6	9.1
490	5.41	14.8	9.1
538	6.00	4.7	9.1
555	5.29	15.8	9.1
300	6.50	15.4	9.6
380	5.80	17.0	9.6
400	6.40	6.2	9.6
528	6.00	4.9	9.6
486	5.30	16.6	17.6

* Percent energy use less than baseline energy use.

In response to AHRI, DOE notes that modifications have been made to the engineering analysis to incorporate new data provided by interested parties regarding the expected energy savings resulting from the incorporation of design options. These modifications have resulted in a reevaluation of max-tech levels for several equipment classes. See chapter 5 of the final rule TSD for the results of the analyses and a list of technologies included in max-tech equipment. Table IV.22 below compares the max-tech levels of AHRI's NOPR comment to DOE's NOPR phase max-tech levels, the maximum available efficiency levels, and the max-tech levels of DOE's final rule analysis. The final-rule max-tech levels are higher than the AHRI max-tech levels in only three classes, IMH–W–Small–B, IMH–A–Small–B, and RCU–NRC–Large–B1 (1,500 lb ice/24 hour representative capacity). AHRI's comment mentions that certain design options were removed from consideration as part of AHRI's ''correction'' of the DOE analysis. These design option changes are described in Exhibit 3 of the comment. (AHRI, No. 93 at p. 24).

For IMH–A–Small–B, AHRI eliminated ''increase in evaporator area by 51% (with chassis growth)''. Efficiency improvement of 12.8 percent is attributed to this design option in the final rule analysis, accounting for more than the 7 percent difference between the DOE and AHRI max-tech projections. For IMH–W–Small–B, AHRI similarly eliminated design options involving increase in chassis size. AHRI indicated that design options that increase package size should not be considered for these classes because they include 22-inch units, which AHRI claimed to be space-constrained. DOE retained consideration of these design options for the final rule analysis, conducting additional analysis for 22-inch wide models, and considering the installation cost impacts of the larger chassis size for a representative population of units where some rebuilding of the surrounding space would be required to accommodate the larger size (see section IV.G.2) DOE considers package size increase a potential for added cost, rather than a reduction in utility that must be screened out of the analysis, since added cost is not one of the four screening criteria. (see 10 CFR 430, subpart C, appendix A, section (4)(a)(4)) For RCU–NRC–Large–B1, DOE's final rule max-tech efficiency level is only 1 percent higher than the AHRI max-tech level, and the maximum available efficiency levels is equal to the AHRI max-tech level. For this class, AHRI modified the performance improvement associated with higher-EER compressors. DOE's analysis uses ice maker efficiency improvement attributable to compressor improvement slightly better than assumed by AHRI—DOE's estimate is based on a larger dataset of test data, evaluating the ice maker efficiency improvement possible by using improved compressors.

TABLE IV.22—COMPARISON OF AHRI MAX TECH LEVELS WITH DOE NOPR AND FINAL RULE MAX TECH LEVELS

Equipment class	Representative capacity (lb ice/24 hours)	AHRI max tech (% below baseline)	DOE NOPR max tech (% below baseline)	Max available (% below baseline)	DOE final rule max tech (% below baseline)
IMH–W–Small–B	300	18	29	19	24

TABLE IV.22—COMPARISON OF AHRI MAX TECH LEVELS WITH DOE NOPR AND FINAL RULE MAX TECH LEVELS—Continued

Equipment class	Representative capacity (lb ice/24 hours)	AHRI max tech (% below baseline)	DOE NOPR max tech (% below baseline)	Max available (% below baseline)	DOE final rule max tech (% below baseline)
IMH–W–Med–B	850	18	21	14	18
IMH–W–Large–B–1	1500	15	17	5	8
IMH–W–Large–B–2	2600	14	15	2.5	7
IMH–A–Small–B	300	19	31	19	26
IMH–A–Large–B–1	800	25	29	16	16
IMH–A–Large–B–2	1500	18	20	6	12
RCU–NRC–Large–B–1	1500	16	21	16	17
RCU–NRC–Large–B–2	2400	18	21	15	14
SCU–W–Large–B	300	30	30	28	30
SCU–A–Small–B	110	39	39	31	33
SCU–A–Large–B	200	35	35	26	29
IMH–A–Small–C	310	26	31	28	26
IMH–A–Large–C	820	30	30	36	23
SCU–A–Small–C	110	28	28	24	27

In response to AHRI's comment that the FREEZE model has been proven to be invalid, DOE notes that this comment is based on tests illustrating the ice maker efficiency improvement associated with two examples of switch to higher-EER compressors. AHRI points to only one of the design options considered in the DOE's analysis, for which DOE updated its analysis. DOE has modified its treatment of compressors in the analysis, basing the calculation of ice maker efficiency improvement on test data provided both by the AHRI comment and other data provided confidentially by manufacturers to DOE's contractor. Based on the data DOE reviewed, the ice maker energy use reduction associated with improvement in compressor EER averages 57 percent of the compressor energy use reduction expected based on the EER improvement—DOE used this ratio for its analysis of batch ice makers for the final rule. Hence, this particular issue with the engineering analysis has been addressed through changes in DOE's approach in both the NODA and final rule analyses.

3. Design Options

After conducting the screening analysis and removing from consideration the technologies described above, DOE considered the inclusion of the remaining technologies as design options in the final rule engineering analysis. The technologies that were considered in the engineering analysis are listed in Table IV.23, with indication of the equipment classes to which they apply.

Table IV.23 Final Rule 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 Directly Analyzed								
	IMH-A-C	√	√		√	√			√	
	RCU-C	Not Directly Analyzed								
	SCU-W-C	Not Directly Analyzed								
	SCU-A-C	√	√		√	√			√	

a. Design Options That Need Cabinet Growth

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. However, in the NOPR DOE changed the approach and considered design options that increase cabinet size for certain equipment classes: IMH–W–Small–B, IMH–A–Small–B, IMH–A–Large–B (800 lb ice/24 hours representative capacity), and IMH–A–Small–C. DOE only 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. DOE also considered size increase for the remote condensers of RCU classes.

In response to the March 2014 NOPR, several manufacturers noted that the size of icemakers is limited in certain applications. Manitowoc commented that not all end users can accept larger or taller ice-making cabinets. (Manitowoc, Public Meeting Transcript, No. 70 at p. 133) Ice-O-Matic commented that customers want ice machines that are able to produce more ice in a smaller physical space and that such ice makers will be difficult to make if standards necessitate design options that require cabinet growth. (Ice-O-Matic, Public Meeting Transcript, No. 70 at p. 29–31)

Scotsman and AHRI both noted that cabinet size increases would require users to either enlarge the space in the kitchen to accommodate a larger unit or to repair older ice makers rather than buying new ones or to make due with a smaller capacity ice maker. (AHRI, No. 93 at p. 7–8; Scotsman, Public Meeting Transcript, No. 70 at p. 126–127) Manitowoc, Ice-O-Matic, and AHRI each stated that incorporating design options that may increase the size of automatic commercial ice makers will increase the likelihood that consumers refurbish rather than replace their existing units. (Manitowoc, Public Meeting Transcript, No. 70 at p. 129–130; Ice-O-Matic, Public Meeting Transcript, No. 70 at p. 32–33; AHRI, No. 93 at p. 7–8) Scotsman, Manitowoc and Follett all agreed that large ice makers would have an impact in installation costs. (Scotsman, No. 85 at p. 5b–6b; Manitowoc, No. 92 at p. 3; Follett, No. 84 at p. 6) Follett commented that maintenance costs will increase because larger components will reduce serviceability and energy-efficient components, such as a lower horsepower auger motor, may not be as robust. (Follet, No. 70 at p. 132–133)

AHRI commented that design options which increase chassis size should not be considered for IMH–A–Small–B, IMH–A–Large–B, IMH–W–Small–B, and IMH–W–Med–B classes, as 22-inch units wide units account for 18% of all ice makers sold in the US. AHRI added that if design options which increase cabinet size are not screened out for these product classes, there will likely be an adverse impact on product availability. (AHRI, No. 93 at p. 4)

In contrast, PGE/SDG&E commented that they support DOE's decision to include in the engineering analysis design options that increase chassis size. (PG&E and SDG&E, No. 89 at p. 3) The Joint Commenters expressed their belief that DOE has appropriately considered size increases in their engineering analysis and that those customers who have smaller units today could purchase a taller unit with the same capacity, a smaller-capacity unit, or two smaller-capacity units. (Joint Commenters, No. 87 at p. 3)

In response to the NODA analysis, CA IOU stated their support of DOE including technically (DOE interprets this to mean technologically) feasible design options that may increase chassis sizes in certain cases. (CA IOU, No. 129 at p. 2)

DOE recognizes that the size of ice makers is limited in certain applications. DOE notes that many of the equipment classes analyzed do not require any cabinet growth to reach higher efficiency levels. DOE considered design options involving package size increase for IMH–A–Large–B, IMH–A–Small–B, and IMH–W–Med units. For the final rule analyses, DOE did not consider design options which necessitate a cabinet size increase for IMH–A–Small–C units. DOE adjusted the analysis of installation costs to consider the impact of added costs associated with renovation to accommodate size increase for the few equipment classes for which DOE did consider size increase. The life cycle cost analysis, described in section IV.G.2 details how these added installation costs were considered in the analysis.

Table IV.24 lists the equipment classes for which DOE considered design options that involve increase in chassis size in the final rule analysis.

TABLE IV.24—ANALYZED EQUIPMENT CLASSES WHERE DOE ANALYZED SIZE-INCREASING DESIGN OPTIONS IN THE FINAL RULE ANALYSIS

Unit	Harvest capacity 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.

Note: "XXX" refers to "RC" or "NRC" for each of the entries with "XXX".

b. Improved Condenser Performance

During the NOPR 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.

Follet commented that 10 °F is the practical limit for the temperature difference between the ambient air and the hot gas in the condenser. Follet added that it is possible to increase the surface area, but either no meaningful efficiency is gained, or the size of the condenser would have to increase to the point that it would not fit into tight spaces. (Follet, No. 84 at p. 5)

DOE did not consider any condenser sizes that would result in condensing temperatures as close as 10 °F to the ambient temperatures for air-cooled icemakers.

Stakeholders AHRI, Hoshizaki, Follet, and Ice-O-Matic noted that improved condenser performance would likely require an increase in cabinet size. (AHRI, No. 93 at p. 4; Hoshizaki, Public Meeting Transcript, No. 70 at p. 128–129; Ice-O-Matic, Public Meeting Transcript, No. 70 at p. 32–33; Follet, No. 84 at p. 5)

In response to concerns about the potential need to increase cabinet size to make space for larger condensers, DOE agrees that increasing condenser size may require also increasing cabinet size. DOE has limited cabinet size increases to just three equipment classes, IMH–A–Large–B, IMH–A–Small–B, and IMH–W–Small–B. Furthermore, the specific size increases considered for these ice makers do not involve size increase beyond the size of ice makers that are currently being sold. The specific size increases considered are presented in Chapter 5 of the TSD. In addition, the life cycle cost analysis considers additional installation cost associated with a proportion of ice makers sold as replacements that, with the new larger sizes, will not fit in the existing spaces where the old ice makers are located (see section IV.G.2.a).

Manitowoc commented regarding condenser size increase for water-cooled ice makers that increasing water-cooled surface area can reduce the condensing temperature and cause the ice machine to be unable to harvest the ice at low inlet water temperature conditions, which affects the performance of models in northern regions. (Manitowoc, Public Meeting Transcript, No. 70 at p. 108–110)

DOE is aware that increasing condenser surface area may have an impact on the ice machine's ability to harvest ice. As discussed in the NOPR, DOE generally avoided consideration of very low condensing temperatures in its analysis, using 101 °F as a guideline lower limit. The analysis also considered the increase in harvest cycle energy use—Section IV.D.4 describes how the longer harvest times were addressed in the engineering analysis.

Manitowoc noted that the NODA EL3 level for the RCU–NRC–B2 equipment class assumes a 19-inch increase in condenser width with an additional condenser row. Manitowoc asserted that an increase this large could lead to significant refrigerant charge issues. Therefore, Manitowoc suggested that NODA EL2 be selected for this equipment class. (Manitowoc, No. 126 at p. 2)

In the final rule DOE modified the engineering analysis for this class and has eliminated one of the two condenser size increase steps in the final rule engineering analysis. DOE notes that the final condenser size is still smaller on the basis of refrigerant volume per harvest capacity rate than the largest remote condenser for an RCU ice maker observed in DOE's review of units purchased for reverse engineering. Therefore, DOE has confidence that the refrigerant management challenges are manageable for the maximum condenser size considered in the analysis.

Manitowoc also noted that adding a condenser row in the SCU–A–Small–B class may not be possible due to the small volume available in the compact chassis required for these models. Similarly, a 9'' increase in condenser width for the SCU–A–Large–B may be unrealistic. (Manitowoc, No. 126 at p. 2) In selecting these design options, DOE reviewed the spatial constraints and condenser sizes within both reverse-engineered units used as the basis for energy use calculations for these classes. While the space underneath the ice storage bins of these units is limited in height, there is sufficient room for the width and depth increases that DOE considered. Based on data gathered from these teardowns, DOE concluded that these condenser size design options were feasible for these units.

c. Compressors

Several interested parties provided comment regarding the feasibility of incorporating more efficient compressors in ACIMs. AHRI urged DOE to reevaluate the feasibility of implementing more efficient compressors into the IMH–A–Small–C product class, which Follett has found are too small to fit larger compressors. (AHRI, No. 93 at p. 4) Follett also individually commented that they independently evaluated a more efficient compressor for IMH–A–Small–C and that its size made it infeasible given the restrictions of the Follett chassis. (Follet, No. 84 at p. 8)

In response to AHRI and Follet's assertion that higher efficiency compressors may not fit within the chassis of IMH–A–Small–C, DOE's analysis of this class was based on use of a Copeland RST45C1E–CAV compressor, which is no larger than the compressor used in the model upon which DOE based the analysis. Hence, DOE concluded that use of this higher-efficiency compressor would not require an increase in the package size. DOE notes that it did avoid consideration of the highest-efficiency compressors for 22-inch wide classes when these compressors clearly are physically larger than the available space allows. In particular, DOE did not consider use of high-efficiency Bristol compressor in these cases, because Bristol compressors are generally larger than other available compressors.

Several commenters, including AHRI, NEEA, Danfoss, and Ice-O-Matic each noted that the harvest process of automatic commercial ice makers needs to be considered when evaluating increased compressor efficiency as a design option. (AHRI, No. 93 at p. 4; NEEA, No. 91 at p.1; Danfoss, Public Meeting Transcript, No. 70 at p. 152–153; Ice-O-Matic, Public Meeting Transcript, No. 70 at p. 160–161) Danfoss and Ice-O-Matic commented that ice machines differ significantly from other compressor-based applications in that, when harvesting ice, it is desirable to have a less efficient compressor because the waste heat helps harvest the ice. (Danfoss, Public Meeting Transcript, No. 70 at p. 152–153; Ice-O-Matic, Public Meeting Transcript, No. 70 at p. 160–161)

In response, DOE has adjusted its calculation of energy savings associated with improved compressor efficiency in the NODA and final rule analyses. Specifically, DOE considered all available data for tests involving compressor replacement for batch ice makers. This included the two examples provided in AHRI's NOPR comment. (AHRI, No. 93 at pp. 25–30) It also included information provided confidentially to DOE's contractor. DOE reviewed the data to determine if it could be used to robustly predict any trends of ice maker performance impacts compared with compressor EER improvements that might vary as a function of key parameters such as ice maker class, capacity, compressor manufacturer, but no such trends were evident. DOE used the data to develop an estimate of ice maker energy use reduction as a fraction of compressor energy use reduction—this value averaged 0.57 for the data set. DOE used this factor to calculate ice maker energy use reduction for all of the batch analyses for the NODA and final rule. Applying this approach significantly reduced the energy savings associated with improved-EER compressors for batch ice makers in the NODA and final rule analyses.

Howe commented that variable-speed compressors are most effective at saving energy under part-load conditions, which is not taken into account in the DOE test procedure. Therefore, such components would be operating at or near maximum capacity during DOE tests, thus canceling their positive measurable benefit. (Howe, No. 88 at p. 1)

In response to Howe's comment regarding variable speed compressors, DOE did not consider the use of variable-speed compressors in the analysis.

Several interested parties submitted additional concerns about the feasibility of implementing design options involving increases in compressor efficiency. NAFEM commented that high-efficiency compressor motors for automatic commercial ice makers will not be available for the foreseeable future and that the investment required was not available for products with shipments as low as automatic commercial ice makers (150,000/year) and that DOE must account for their unavailability in its analysis. (NAFEM, No. 82 at p. 10)

In response, DOE considered only compressors that are currently offered for use by compressor manufacturers. All of the compressors considered in the analysis are currently commercially available and are acceptable for use in ice makers as indicated by manufacturers in confidential discussions with DOE's contractor. Hence, DOE does not need to consider the development of new compressors with higher-efficiency motors. The compressors considered in the analysis are listed in the compressor database. (Compressor Database, No. 135)

In response to the NODA, Manitowoc noted that the RCU–NRC–B1 equipment class assumes an increase in compressor EER of 20% which Manitowoc stated could not be achieved without resorting to radical design changes and possibly the use of permanent magnet motor technology. (Manitowoc, No. 126 at p. 3) Additionally, Manitowoc stated that for SCU–A–Small–B and SCU–Large–B, increases in compressor EER of 40% and 25%, respectively, are unlikely to be achieved. (Manitowoc, No. 126 at p. 2)

For the RCU–NRC–Large–B–1 class, DOE based the analysis on a unit with a compressor having a rated EER of 7.16 Btu/Wh. In order to represent baseline performance, a less-efficient available compressor was used in the analysis. For the final rule, DOE modified its analysis to reflect a lower efficiency level for the unit which is the basis of the analysis. Hence, DOE has reduced the compressor EER improvement considered for this class from 20 percent to 10.7 percent.

For the SCU–A–Small–B class, DOE based the analysis on an ice maker having a compressor with a rated EER of 3.3 Btu/Wh. The analysis considered use of an available compressor having a rated EER of 4.6 Btu/Wh, a 39 percent improvement. Compressors having both these levels of EER exist, and hence the 39 percent improvement in EER from 3.3 to 4.6 can be achieved.

For the SCU–A–Large–B class, DOE based the analysis on an ice maker model having a compressor with a rated EER of 4.68 Btu/Wh. DOE modeled the baseline by considering a lower EER of 4.23 Btu/Wh. Compressors within the appropriate capacity range at this EER level do exist. The highest-EER considered for this analysis is 5.2 Btu/Wh, which is achieved by an available compressor of appropriate capacity—this represents 23 percent improvement in EER, slightly less than the cited 25 percent. Compressors having both these levels of EER considered in the analysis exist, and hence the 23 percent improvement in EER from 4.23 to 5.2 can be achieved.

In response to the NODA analysis for equipment class SCU–A–Small–C, AHRI noted that DOE increased the ''percent energy use reduction'' from 8.5% in the NOPR to 10.91% in the NODA for the same design option, ''Changed compressor EER from 4.7 to 5.5''. AHRI requested that DOE provide justification for this change. (AHRI, No. 128 at p.3) In the NODA, DOE had calculated continuous ice maker percentage savings as 75% of the compressor energy savings ($0.75 \times (1 - 4.7/5.5) = 0.109$), rather than using the results of the FREEZE model to represent the compressor energy savings. However, the ice maker upon which the SCU–A–Small–C analysis was based has a greater proportion of auger and fan energy use than typical continuous units. Hence, DOE agrees that an increase in the savings projection to 10.9% is unrealistic, and has changed the projection.

For the final rule analysis, DOE also did not use the FREEZE model, and instead assumed that the compressor energy use reduction would be 5% less than would be expected, based on the EER increase. The compressor energy use for the unit started at 72% of unit energy use, and the design options considered prior to consideration of the improved-EER compressor already reduced energy use to 90.7% of baseline energy use. Hence, DOE recalculated the savings for this design option as $0.95 \times (1 - 4.7/5.5) \times 0.72 \times 0.907 = 0.09 = 9\%$.

d. Evaporator

Follett commented that increasing the length or width of continuous type evaporators would increase cabinet size. (Follet, Public Meeting Transcript, No. 70 at p. 90–91) Follett also commented that increasing the height of the continuous type evaporator is not feasible because, in 75% of Follett's automatic commercial ice makers, the evaporator is horizontal. Therefore, any evaporator growth would increase the icemaker footprint so that it could no longer fit on standard beverage dispensers. (Follett, No. 84 at p. 5–6)

DOE notes that it did not consider evaporator size increase as a design option for continuous ice makers in the final rule engineering analysis.

In response to the NODA, AHRI noted that IMH–W–Small–C units typically use the same chassis as their IMH–A–Small–B counterparts and should also be considered as space constrained units. Specifically, AHRI recommended screening out the increased evaporator size for this product class on the basis that the chassis could not withstand the corresponding 4-inch increase in width. AHRI added that if evaporator size increase option is kept for IMH–W–Small–C units, a more realistic cost must be associated with this design option. (AHRI, No. 128 at p. 2)

In response to AHRI's comment, DOE notes that the typical use of the same cabinet as IMH–A–Small–B does not mean there is no possible cabinet size increase. Nevertheless DOE has eliminated this design option step from the analysis for the IMH–A–Small–C. The evaporator size increase was considered in the NOPR analysis in conjunction with a condenser size increase. In the final rule analysis, this step in the analysis now considers only the condenser size increase.

AHRI stated in its NODA comments that an 18 percent size increase in evaporator area cannot reasonably be implemented in 22-inch IMH–A–Small–B units. (AHRI, No. 128 at p. 2). DOE developed its 22-inch IMH–A–Small–B analysis by removing from the 30-inch chassis analysis for IMH–A–Small–B those design options that would not fit in a 22-inch chassis. The baseline evaporator used in the model upon which DOE based this analysis has a plate area that is relatively small. Hence, the 18 percent size increase can fit within the chassis of a 22-inch unit. In fact, the maximum-available 22-inch unit of this class has an evaporator that is somewhat larger than the largest evaporator size considered for the analysis. Hence, DOE concludes that it did not consider excessive increase in evaporator size for the 22-inch IMH–A–Small–B analysis.

In response to the NODA, Manitowoc stated that for IMH–A–Small–B units, a 51% increase in evaporator surface area is not always possible in the chassis sizes used in the industry and concluded that the max efficiency level that should be considered is EL3. (Manitowoc, No. 126 at p. 1)

DOE agrees that the design option mentioned by Manitowoc, a 51% increase in evaporator surface area for IMH–A–Small–B units would require a growth in cabinet size. Consequently, DOE considered such a growth in the engineering analysis. DOE notes that the NODA TSL 3 efficiency level for this class, 18% less energy than baseline, can be achieved with an evaporator growth less than 51%—DOE estimates that this would require evaporator size growth of 38%.

Manitowoc stated that the IMH-small class would likely require chassis growth to add evaporator area. (Manitowoc, No. 126 at p. 2). DOE assumes that this refers to the IMH–W–Small–B class and agrees that some increase in chassis size may be required to support increases in evaporator size. DOE notes that IMH–W–Small–B is one of the classes for which DOE considered increase in chassis size.

e. Interconnectedness of Automatic Commercial Ice Maker System

Several commenters noted that the addition of a certain design option may necessitate an alteration in the remaining automatic commercial ice maker components. AHRI stated their concern with DOE's component analysis, noting that a change in one component impacts other components and therefore the entire price and efficiency of the entire automatic commercial ice maker system. (AHRI, No. 128 at p. 2) Similarly, Scotsman stated that the manufacture product cost increase estimates do not account for system impacts when components are changed. In most cases it is inaccurate to estimate product cost changes by specific component as changing any component within the refrigeration system will require changes to other components in order to optimize performance efficiency. (Scotsman, No. 125 at p. 2) Similarly, Howe commented that component efficiency increases are not additive and not necessarily proportional when used in combination. (Howe, No. 88 at p. 2)

As explained in the NOPR, DOE had attempted to conduct an efficiency-level analysis rather than a design-option approach. However, the efficiency-level analysis did not produce consistent results, in some cases indicating that higher-efficiency units are less expensive. Therefore, DOE went forward with the design option approach and solicited comments from interested parties regarding the impact a specific design option may have on the entire system. DOE's contractor received some information regarding the potentially higher costs associated with change of some components, for which it may have underestimated overall cost increase in the NOPR phase—this information has been incorporated into the final rule analysis. However, absent more specific information regarding these interactions, DOE cannot speculate on other changes that may have been appropriate to address this issue.

Manitowoc commented that putting a larger evaporator in an ice machine would increase refrigerant charge, thus necessitating an accumulator, or rendering a compressor unreliable during harvest. Such a change would also increase the mass of the evaporator, thus requiring more energy to heat it up and cool it back down. (Manitowoc, Public Meeting Transcript, No. 70 at p. 142–143)

DOE has not considered evaporator sizes (on the basis of evaporator size per ice maker capacity in lb ice/24 hours) larger than those of ice makers on the market. DOE has not observed use of accumulators and hence concludes that the evaporator sizes considered would not require one. While Manitowoc commented in the NOPR public meeting on the potential for added harvest time or harvest energy use for larger evaporators, they did not provide details in written comments showing how this effect might impact savings associated with larger evaporators. DOE notes that a larger evaporator would operate with warmer evaporating temperature during the freeze cycle, and this effect would reduce the heat required to warm the evaporator during the harvest cycle. Without data to quantify this effect, DOE's analysis assumed that harvest energy use would scale proportionally with evaporator area. Hence, the increase in mass of the evaporator has been accounted for in the estimation of the energy use reduction associated with the design option.

Follett commented that the evaporator, auger motor, and compressor must all be sized to balance one another and that these components cannot easily be swapped out for other off-the-shelf components. (Follett, No. 84 at p. 5) Follett noted that increasing evaporator diameter is not feasible because it will increase the required torque, necessitating a larger motor that will draw more power and negate any efficiency gains. (Follet, No. 84 at p. 6)

DOE is no longer considering evaporator size increase as a design option for continuous ice makers. However, DOE notes that the engineering analysis has attempted to consider the interconnectedness of the system components wherever possible. For example, for air cooled condenser growth, fan power was increased to maintain a constant airflow through a larger condenser.

Hoshizaki commented that there is a lot of trial and error involved in pairing compressors with condensers while maintaining machine reliability. (Hoshizaki, Public Meeting Transcript, No. 70 at p. 159–160)

DOE realizes that there may be trial and error when pairing components. DOE solicited feedback from manufactures regarding the appropriateness of the use of specific compressors in the analysis. DOE did not identify any specific limitations in compressor/condenser pairings that it considered in its analysis in any comments or in interviews with manufacturers.

4. Cost Assessment Methodology

In this rulemaking, DOE has adopted a combined efficiency level, design option, and reverse engineering approaches to develop cost-efficiency curves. To support this effort, DOE developed manufacturing cost models based heavily on reverse engineering of products to create a baseline MPC. DOE estimated the energy use of different design configurations using an energy model with input data 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 to the extent possible on baseline-efficiency equipment selected to represent their equipment classes (in some cases, analyses were based on equipment with efficiency levels higher than baseline). 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 Manufacturer Selling Price (MSP)-based curves.

The engineering analyses are summarized in an ''Engineering Results'' spreadsheet, developed initially for the NOPR phase (NOPR Engineering Results Spreadsheet, No. 59). This document was modified for the NODA (Engineering Analysis Spreadsheet—NODA, No. 112) and subsequently for the final rule (Final Rule Engineering Analysis Spreadsheet, No. 134)

Stakeholder comments regarding DOE's NOPR and NODA 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.

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

a. Manufacturing Cost

In response to the manufacturer costs presented in the NOPR, several stakeholders indicated that the incremental costs presented in the NOPR were optimistic. Specifically, AHRI, Follet, Manitowoc, and Danfoss stated the belief that DOE underestimated the incremental costs of its proposed design options. (AHRI, No. 93 at p. 4; Follet, No. 84 at p. 5; Danfoss, No. 72 at p. 3; Manitowoc, No. 98 at p. 1–2)

Scotsman commented that their data on the efficiency and costs associated with compressor upgrade, BLDC motors, larger heat exchangers, and drain water heat exchangers do not match the assumptions used by DOE in its analysis. (Scotsman, No. 85 at p. 4b)

Manitowoc commented that DOE significantly underestimates the cost associated with heat exchanger growth, higher compressor EER, and high-efficiency fan and pump motors. (Manitowoc, No. 98 at p. 1–2) Manitowoc also noted that their costs were not consistent with those found in the TSD, particularly in cases involving evaporator or cabinet growth (Manitowoc, Public Meeting Transcript, No. 70 at p. 116–117)

DOE has revised and updated its analysis based on data provided in comments and made available through non-disclosure agreements. These updates included changes in its approach to calculating the energy use associated with groups of design options, changes in inputs for calculations of energy use, and changes in calculated equipment manufacturing cost. Comments related to the manufacturing costs of specific design options are described in the sections below.

NAFEM and Hoshizaki stated that the cost curves were not analyzed to demonstrate what can be achieved in five years. (NAFEM, No. 123 at p. 2; Hoshizaki, No. 123 at p. 1)

In response to NAFEM and Hoshizaki's comment, DOE notes that the costs in the cost curves are intended to be representative of today's technology and current market prices.

Compressor Costs

AHRI, Danfoss, and Hoshizaki stated that DOE's assumption that a 10% compressor efficiency increase could be achieved for a 5% price increase is flawed. (AHRI, Public Meeting Transcript, No. 70 at p. 20–21; Danfoss, No. 72 at p. 3; Hoshizaki, No. 86 at p. 9) AHRI and Danfoss stated that a more realistic assumption would be a 1–2% efficiency improvement for a 5% price increase. (Danfoss, No. 72 at p. 3; AHRI, Public Meeting Transcript, No. 70 at p. 20–21) AHRI and NAFEM both requested that the relationship between cost and compressor EER should be corrected to reflect the approach adopted by the final CRE rulemaking. (AHRI, No. 93 at p. 15; NAFEM, No. 82 at p. 4–5) Follet also asserted that it is unrealistic to assume that the full efficiency gain of a more efficient compressor will be realized at the costs assumed by DOE in the NOPR. (Follet, No. 84 at p. 5) In response to the NODA, AHRI stated that there was no explanation as to why the compressor costs changed as compared to the NOPR. AHRI noted that the NODA compressor costs were still not consistent with the approach used in the CRE rulemaking. (AHRI, No. 128 at p. 2)

DOE maintains its position that the cost-EER relationship used in the CRE rulemaking was based on future improvements over existing EER levels. For example, the CRE final rule indicates that ''manufacturers and consumers expressed concern over DOE's assumptions regarding the advances in compressor technology anticipated before the compliance date.'' 79 FR 17726, 17760 (March 28, 2014). Compressor suppliers and OEMs commented that, ''if a 10% compressor efficiency improvement were possible for a 5% cost increase, then it is most likely that manufacturers would have already adopted this technology''. *Id.* The statement implies that manufacturers have not adopted the technology. In the automatic commercial ice maker NOPR public meeting, Danfoss, a compressor supplier, commented, ''these are mature technologies. They've been around 50 or 60 years. If that sort of efficiency improvement could be made available, it would have . . . we would have already done it.'' The comments insinuate that DOE was contemplating use of a technology that is not available and that the compressor manufacturers have not used. For the automatic commercial ice maker analysis, DOE did not consider future technologies. Rather, it considered only compressor options that are currently being offered by compressor suppliers. In some cases, baseline ice makers are using compressors with relatively low efficiencies compared to the levels that are available. It is for these cases that DOE has been projecting the possibility of large potential for compressor efficiency improvements. DOE has requested compressor cost data that would allow evaluation of the relationship between actual prices paid by automatic commercial ice maker manufacturers for the compressors and the EER levels of the compressors, indicating that this data might be provided confidentially to DOE's contractor. However, sufficient cost data to allow a regression analysis to determine the efficiency-cost relationship has not been made available. Based on limited data supplied confidentially to DOE's contractor during the NOPR phase, DOE initially concluded that cost does not vary significantly with EER. In addition, DOE received some feedback during interviews with manufacturers that the 10% improvement for 5% cost relationship is reasonable. DOE at that time adopted this relationship in order to avoid projecting zero cost increase associated with EER increase.

Nevertheless, DOE has modified its approach to calculating improvement in compressor efficiency to consider the stakeholders' comments. The analysis calculates the cost associated with compressor EER improvement in two ways and uses the higher of these costs. The first approach is the 10% improvement for 5% cost used in the NOPR analysis. The second approach applies the 5% cost associated with the

2% improvement that the commenters cited, which DOE applied to the analysis as if the last 2% of compressor efficiency improvement is future efficiency improvement that would cost the cited 5%. For example, if the compressor efficiency improvement is 10%, this approach treated the first 8% of efficiency improvement to be associated with currently available compressors with no cost differences, and the last 2% (from 8% to 10% improvement) as being associated with future compressor improvement with a 5% cost premium.

Follett disputed the NOPR engineering result that showed a 20% decrease in energy use at a cost of $61 for the IMH–A–Large–C class. Follet noted that at an incremental cost of $60, they tested a unit utilizing an ECM motor and a compressor with a 5% increase in efficiency, but were only able to achieve a 9% decrease in energy use. (Follet, No. 84 at p. 8) AHRI also noted this work, indicating that Follett experienced less than half the efficiency gain predicted by DOE in the NOPR when switching from an SPM to an ECM motor and using a compressor with a 5% higher EER. AHRI further noted that, while DOE's analysis considered a 24% improvement in compressor EER, the best compressor that Follett was able to find improved the EER only 5%. (AHRI, No. 93 at p. 4)

DOE notes that these comments do not indicate the initial energy use of the tested unit, only that the 9 percent efficiency improvement was insufficient to attain the NOPR-proposed efficiency level. Further, the comments do not indicate the initial EER of the compressor used in the Follett product. Since the NOPR phase, DOE has adjusted both its energy modeling as well as its cost estimates, so as to mitigate this issue. Based on new data collected through the NODA and final rule phases, DOE has completed new cost efficiency curves, such that the MSP increase for the final rule analysis associated with a 20% decrease in energy use for the IMH–A–Large–C class is $488. The increase is so large because, for the final rule analysis, use of design options other than a permanent magnet gear motor to power the auger increase efficiency less than 20% (roughly 18%), and the estimated cost of the higher-efficiency auger motor is very high. While it is difficult to determine whether the analysis is fully consistent with Follett's test data, DOE believes that its revised analysis sufficiently addresses this issue (the cost per percent improvement for the analysis is now $24/% ($488/20%), whereas the cost per percent improvement for Follett's cited experience is $7/% ($60/9%)). DOE does note that this Follett example does show that continuous ice machines experience energy use reductions at least consistent with the compressor efficiency improvements—Follett did not indicate the reduction in motor input wattage when switching from the shaded pole to the ECM motor, but if the ice maker energy use reduction for the motor change was 5%, one would conclude that the energy use reduction for the compressor change was 4%, or 80% of the 5% improvement in compressor EER—this contrasts markedly with some of the information provided in stakeholder comments about the relationship between batch ice maker energy use and compressor EER improvement. (see, *e.g.,* AHRI, No. 93 at pp. 25–30)

Evaporator Costs

Hoshizaki and Manitowoc stated the DOE underestimated the cost of increasing the evaporator size in the NOPR analysis, for both batch and continuous ice makers. Specifically, regarding the 50% evaporator size increase considered for the IMH–A–Small–B analysis, Hoshizaki commented that a 50% increase in evaporator height would result in a 50% MPC increase. (Hoshizaki, No. 86 at p. 9) For this design option, DOE calculated a $48 cost increase to the initial evaporator cost of $88 in the NOPR analysis. Manitowoc stated that the cost presented in the NOPR for a 50% larger evaporator is half of what they would see as a manufacturer. Manitowoc noted that this is partially because they only make 4000–5000 models per year of a particular cabinet size and thus do not have as much purchasing power as an appliance manufacturer. (Manitowoc, Public Meeting Transcript, No. 70 at p. 171–174)

In the NODA and final rule analyses, DOE adjusted the costs related to increasing the size of the evaporator. DOE received information from manufacturers through non-disclosure agreements regarding the expected costs associated with increasing the size of the evaporator and has adjusted the analysis to reflect the new data. DOE's MPC increase projection for the same evaporator size increase for the IMH–A–Small–B class is now $101.

As noted in section IV.D.3.d, AHRI commented that a more realistic cost estimate is required for the evaporator increase design option for IMH–W–Small–C units as they often use the same chassis as their IMH–A–Small counterparts. Specifically, AHRI stated that manufacturers have conservatively estimated that a 17% increase in evaporator size should be 117% percent of the original evaporator's cost. (AHRI, No. 128 at p. 2) DOE believes this comment may apply to the IMH–A–Small–C class rather than IMH–W–Small–C, since the 17% evaporator growth was considered in the NOPR analysis for the air-cooled class. In the NOPR phase, DOE calculated an MPC increase of $153 for the evaporator size increase and a condenser size increase considered in the same step of the analysis. Seventeen percent of the $1,252 contribution to MPC of the initial evaporator is $213.

DOE acknowledges that the 17% evaporator growth would require chassis size increase for the specific model upon which the IMH–A–Small–C analysis is based, if implemented by increasing the length of the auger/evaporator. As noted previously, DOE modified the analysis and is no longer considering evaporator size increases as a design option for any continuous units, including IMH–W–Small–C.

In response to the NODA analysis, Hoshizaki, AHRI, Manitowoc, and NAFEM stated that increasing the evaporator by 18% with no chassis growth is not possible for 22-inch IMH–A–Small–B machines. (Hoshizaki, No. 124 at p. 2; AHRI, No. 128 at p. 2; Manitowoc, No. 126 at p. 2; NAFEM, No. 123 at p. 2) Hoshizaki added that such a change would require tooling, panel changes, and kits to fit on the machine. Hoshizaki and NAFEM noted that these changes would cost more than the $34 stated in the NODA. (Hoshizaki, No. 124 at p. 2; NAFEM, No. 123 at p. 2)

DOE reviewed the cabinet size of the representative 22-inch IMH–A–Small–B unit and found that it had space for an 18% evaporator increase. DOE notes that the final size of the 18% larger evaporator considered in the analysis is still smaller than evaporators found in some 22-inch units of the same equipment class. Hence, DOE believes that an 18% growth in evaporator size is possible and has maintained this design option in the final rule.

Condenser Costs

Commenting on the NODA analysis for the IMH–W–Small–B, Hoshizaki and NAFEM stated that increasing the water-cooled condenser length by 48% would require a larger cost increase than $40 stated in the NODA. (Hoshizaki, No. 124 at p. 2; NAFEM, No. 123 at p. 2) Hoshizaki noted that they currently are using the largest condenser offered by their supplier, and increasing its size would necessitate a special design. (Hoshizaki, No. 124 at p. 2)

In the NODA phase, DOE evaluated a 48% condenser size increase for the representative IMH–W–Small–B unit of 22-inch width—based on a review of typical coaxial water-cooled condenser offerings from typical suppliers of these units, DOE has concluded that this might be a non-standard size water-cooled condenser. In the final rule analysis for this unit, DOE has adjusted its water-cooled condenser options to be more consistent with standard condenser sizes, based on review of commercially available components. Therefore, for the IMH–W–Small–B, 22 inch wide unit, DOE adjusted the analysis to instead utilize a 59% larger condenser. The estimated MPC increase for this design option in the final rule analysis is $58.

Regarding the NODA analysis for the IMH–A–Small–C, Hoshizaki stated that cost of increasing the evaporator area by 17% and the condenser height by 4 inches would be much higher than the $150 presented in the NODA. Hoshizaki added that 22-inch wide machines could not accommodate 4 inches of height growth and would require a change in chassis. Hoshizaki noted that condensers are standard parts from the catalogs of suppliers and there are no condensers that would match this change. (Hoshizaki, No. 124 at p. 2)

DOE is no longer considering evaporator growth for continuous units. The representative unit for this equipment class has a condenser with core height of 10 inches, width of 12 inches and a depth of 3 inches. The chassis height is 21⅞ inches and the chassis width is 22 inches. The representative unit has space for the condenser size increases considered in the analysis. Based on discussions with manufacturers and heat exchanger suppliers, DOE has found that there is flexibility in the design of air-cooled condensers, as long as the design conforms to the use of standard tube pitch (distances between the tubes) patterns, fin style, and fin densities. The analysis considered no change in these design parameters that would make the condenser a non-standard design.

In response to the NODA analysis for the SCU–W–Large–B class, AHRI commented on the changes in condenser size and the associated efficiency improvement as compared to the NOPR analysis. AHRI noted that in the NOPR analysis, DOE considered a size increase of 39%, which was estimated to reduce energy us use 11.2%, while in the NODA a condenser size increase of 112% led to estimated energy savings of 16.7%. AHRI stated that such an increase in condenser size would cause issues with performance outside of rating conditions due to the large increase in refrigerant charge. AHRI recommended that DOE reconsider this design option. (AHRI, No. 128 at p. 3)

In response, DOE modified the analysis for the SCU–W–Large–B for the final rule analysis, in which DOE considers a condenser size increase of 50%, with associated energy savings of 5.5%.

Purchasing Power and Component Costs

Several commenters noted that the scale of the ice maker industry is too small to qualify for the price discounts seen by the appliance markets on specialized parts. (Hoshizaki, No. 86 at p. 7–8; Danfoss, Public Meeting Transcript, No. 70 at p. 175–176) Danfoss stated that the small scale of the industry is a barrier to implementing new technologies and that the investment necessary to produce high-efficiency compressors in these volumes is not feasible in the foreseeable future. (Danfoss, No. 72 at p. 3–4)

Scotsman commented that their vendors provide ECM motors at 200–300% over the cost of baseline motors and high-efficiency compressors at up to 30% over the cost of baseline compressors. Scotsman added that they have not successfully proven the performance and reliability of such components in different applications. (Scotsman, No. 85 at p. 2)

Joint Commenters urged DOE to determine whether fan, pump, and auger motors use ''off-the-shelf'' or custom motors if the former, this would suggest that permanent magnet motor availability should not be a concern. (Joint Commenters, No. 87 at p. 2–3)

In response to these comments DOE notes that it considers the purchasing power of manufacturers in its estimation of component cost pricing. DOE has significantly revised its component cost estimates for the engineering analysis for the NODA and ultimately final rule phase based on additional information obtained in discussions with manufacturers as well as in stakeholder comments. DOE used the detailed feedback to update its cost estimates for all ice maker components.

b. Energy Consumption Model

As part of the preliminary analysis, DOE worked with the developer of the FREEZE energy consumption model to adapt the model to updated correlations for refrigerant heat exchanger performance correlations and operation in a Windows computer environment. Analysis of ice maker performance during the preliminary analysis was primarily based on the model. During the course of the rulemaking, DOE has received numerous comments describing some of the shortcomings of the model. In response, DOE has modified its energy use analysis to rely less on the FREEZE model and more on direct calculation of energy use and energy reductions, based on test data and on assumptions about the efficiency of components such as motors. DOE requested that stakeholders provide information and data to guide the analysis, and also requested comments on the component efficiency assumptions. DOE received additional information through comments and confidential information exchange with DOE's contractor that helped guide adjustments to the analysis.

After the NOPR and NODA publications, stakeholders continued to express concerns about the FREEZE model. AHRI questioned the accuracy of the FREEZE model. (AHRI, No. 93 at p. 5–6, 16) Scotsman noted that the FREEZE simulation program may not be able to model performance of automatic commercial ice makers upon revision of the EPA SNAP initiative, which may result in use of different refrigerants than are currently used in ice makers. (Scotsman, No. 125 at p. 2)

Ice-O-Matic commented that the analysis is based on faulty assumptions from unrelated rulemakings such as commercial refrigeration, and that the cycles of ice machines do not resemble the cycles of commercial refrigeration products. (Ice-O-Matic, Public Meeting Transcript, No. 70 at p. 32) Scotsman and Manitowoc stated that the energy model may yield unrealistic efficiency gains for some of the design options. (Manitowoc, Public Meeting Transcript, No. 70 at p. 154–156; Scotsman, No. 125 at p. 2). Specifically, Manitowoc noted that the energy use model significantly over-predicts the efficiency gains associated with design options, due to its inability to account for the harvest portion of the icemaking cycle. Manitowoc added that many design options that reduce freeze-cycle energy use increase harvest-cycle energy use. (Manitowoc, No. 92 at p. 1; Manitowoc, No. 126 at p. 1)

Ice-O-Matic noted that that the FREEZE model was designed for full-size ice cubes and does not work for half-size ice cube machines. (Ice-O-Matic, No. 121 at p. 2) Full-size cubes of the ice maker models primarily considered in the analysis generally are cubes with dimensions ⅞ x ⅞ x ⅞ inches. Half-size cubes have dimensions ⅞ x ⅞ x ⅜ inches.

Howe and Hoshizaki both stated that DOE should test its component design options in actual units in order to validate the FREEZE model. (Howe, No. 88 at p. 2; Hoshizaki, No. 86 at p. 6) AHRI also expressed its concern that DOE has not conducted thorough testing to validate the efficiency gains associated with design options and requested that DOE prove the claims made in the engineering analysis. (AHRI, Public Meeting Transcript, No. 70 at p. 20–21)

DOE used the FREEZE energy model as a basis to estimate energy savings potential associated with design options in the early stages of the analysis when DOE had limited information. As more information was made available to DOE through public comments as well as non-disclosure agreements with manufacturers, DOE modified or replaced the results garnered from the FREEZE energy model to better reflect the new data collected.

In response to Scotsman's comment regarding the FREEZE model's ability to model the performance of automatic commercial ice makers which use alternative refrigerants, DOE notes that, as described in section IV.A.4, it has not conducted analysis on the use of alternative refrigerants in this rule.

In response to comments regarding the FREEZE model's ability to model the harvest cycle, DOE notes that while the FREEZE model does not simulate the harvest period analytically, the harvest energy is an input for the program that DOE adjusted consistent with test data. In short, the model's ability to accurately calculate the energy use associated with harvest is limited only by the availability of data showing the trends of harvest cycle energy use as different design options are considered. DOE requested information regarding this aspect of ice maker performance, received some information through comments and information exchange with manufacturers, and modified the energy use calculations accordingly.

DOE notes that the harvest cycle energy use issue associated with the calculation of energy use for batch ice makers does not apply to continuous ice makers, which do not have a harvest cycle. DOE concludes that the inability to measure harvest cycle energy use cannot be a reason to question the energy use calculations made for continuous ice makers. DOE notes that stakeholders have not identified similar aspects of continuous ice maker operation that could potentially be cited as reasons for inaccuracies in the energy use calculations associated with these ice makers.

In response to Ice-O-matic's comment regarding the FREEZE model's ability to model half cube ice machines, DOE notes that the FREEZE model is capable of modeling such units. However, as indicated in section IV.D.1 DOE has chosen to base the analysis on full-cube ice machines which, as explained in section IV.D.1, may have an efficiency disadvantage as compared to half- dice machines. Hence, focus on full-cube ice makers makes the analysis more conservative.

Expected Savings for Specific Design Options

Several commenters questioned the energy model's assumptions regarding the relationship between compressor EER improvement and ice maker efficiency improvement. AHRI stated that the assumed relationship should be verified with laboratory tests. (AHRI, No. 93 at p. 15)

Manitowoc and Hoshizaki each stated that they tested a compressor with 12% higher EER compared to baseline and that it yielded a 3% efficiency improvement. (Manitowoc, Public Meeting Transcript, No. 70 at p. 138–142; Hoshizaki, Public Meeting Transcript, No. 70 at p. 152) Ice-O-Matic commented that they tested a compressor with 10% higher EER and that it yielded only a 2% improvement in efficiency. Ice-O-Matic noted that this is due to the unique circumstances of the harvest cycle, which removes a lot of the improvements that are typically seen with compressor efficiency gains in other refrigeration equipment. (Ice-O-Matic, Public Meeting Transcript, No. 70 at p. 148–149) Follett noted that they observed a 9% efficiency gain with a compressor that was 5% more efficient and an ECM fan in an IMH–A–Large–C ice maker. Follett indicated that these design options would increase cost $60, a cost for which the DOE NOPR analysis predicted 20% improvement. (Follet, No. 84 at p. 8)

AHRI stated that the FREEZE energy model results during the June 19th public meeting did not support the findings DOE published in the NOPR when swapping an upgraded compressor. Rather the model simulation predicted that the unit with the upgraded compressor would produce more ice and consume more energy. AHRI stated that they submitted actual test data for this unit which showed modest efficiency savings for upgrading the compressor. AHRI noted that this finding is contradictory to the significant energy savings DOE claimed would be possible in the NOPR. (AHRI, No. 128 at p. 6–7) DOE responds that accurate modeling with any analysis requires careful validation of the input data and that no conclusions can be drawn regarding the results that emerged during the meeting because there was no time to ensure consistency of the input and to review the output to understand whether there was a valid reason for any unexpected results. One could argue, contrary to the AHRI position, that the results showed that the FREEZE model predicts higher energy use than would actually be consumed—DOE realizes that such a conclusion would be meaningless. The only real conclusion is that the program is not easy to operate and requires careful review of both input and output in order to ensure that results are meaningful.

To address the stakeholder concerns that the FREEZE model cannot adequately model the effects of increased compressor efficiency on ACIM energy consumption, DOE modified the outputs of the energy model based on data received in the comments as well as from manufacturers under non-disclosure agreements. DOE also performed testing on several ice-making units and used the test data to further inform the relationship between increased compressor efficiency and ACIM efficiency.

Operating Conditions

NAFEM, Emerson, Manitowoc, Scotsman commented that DOE's engineering analysis is flawed because it only examines compressor ratings at AHRI conditions, rather than over the wide range of operating conditions experienced by ACIMs in the field. (NAFEM, No. 82 at p. 10, Emerson, Public Meeting Transcript, No. 70 at p. 144; Manitowoc, Public Meeting Transcript, No. 70 at p. 144–146; Scotsman, No. 85 at p. 2) Emerson noted that the AHRI rating point for compressors is not typically where an ice machine operates which may contribute to the issues with DOE's modeling. (Emerson, Public Meeting Transcript, No. 70 at p. 144) Manitowoc stated that they typically use a 10–105 condition for compressors, whereas the cost curves used a 15/95 condition,[29] which does not match operating conditions that occur in ice machines. Manitowoc also noted that the

[29] Compressor performance depends on suction (inlet) and discharge (outlet) pressures. These pressures are often represented as the saturated refrigerant temperatures that correspond to the pressures. For the 15/95 conditions, the saturated evaporator temperature is 15 °F and the saturated condensing temperature is 95 °F (to be technically correct, these are represented as dew point temperatures for the refrigerant in question, R–404A—because there is a range of temperatures at a given pressure over which the refrigerant can coexist in equilibrium in both liquid and vapor phases, the temperature at the high end of this range often used).

compressor maps cannot model what happens during the harvest event or the pre-chill time and that the coefficient models do not include these operating regions. (Manitowoc, Public Meeting Transcript, No. 70 at p. 144–146) Danfloss also stated that compressor maps are not useful in developing assumptions about ice maker compressor performance. (Danfoss, Public Meeting Transcript, No. 70 at p. 152–153)

AHRI noted that DOE did not take operation changes into account, such as different batch times or energy use, when upgrading to a more efficient compressor. (AHRI, No. 128 at p. 2)

In response to the comment that compressors operate under a wide range of conditions in the field, DOE requested information that could be used to guide the analysis with respect in regards to what compressors are not suitable for use in ice makers, and/or what other guidelines could be used to avoid consideration of ice maker designs that are not viable in the field. DOE did not receive from stakeholders specific guidelines that could be used to limit the degree to which a design option might be applied for a given ice maker model in its analysis. In response to Emerson's comment about compressor rating conditions not being the typical operating conditions during ice maker testing, DOE notes that the calculation of compressor performance during the test was done at more typical compressor operating conditions during ice maker testing, based on the full set of performance data for the compressor—not at the compressor rating conditions. In response to the comment regarding the 15/95 conditions associated with the cost curves, the performance calculations for the compressors had nothing to do with the 15/95 conditions—the 15/95 conditions were simply an intermediate step in assigning a representative cost for a given compressor. This assignment of cost involved converting the rated AHRI 20/120 capacity for the compressor into a 15/95 condition by multiplying the capacity by 1.29. DOE then used this result as described in Chapter 5 of the TSD to determine an initial nominal cost using the relationship described in the TSD. DOE further increased the cost based on feedback obtained about compressor costs from manufacturers throughout the rulemaking.

DOE received data showing the trends in ice maker energy use reduction with improved compressor EER, including data received as part of the AHRI NOPR comment, as well as additional data received by DOE's contractor under non-disclosure agreement. The data showed that for batch ice makers, the ice maker energy use reduction is a fraction of the expected energy use reduction when considering just the compressor EER improvement. DOE applied this reduction in efficiency improvement to its NODA and final rule analyses.

Analysis Calibration

DOE calibrated the engineering analysis by comparing the energy use predictions associated with given sets of design options with energy usage and design data collected from existing ice maker models. DOE revisited these calibrations in the final rule phase. In general, DOE's analysis for a given ice maker class is based on an existing ice maker model with an efficiency level at or near baseline. Hence, the analysis is calibrated to this particular ice maker model at its efficiency level, which is based on either its rating or a combination of its rating and the results of DOE testing. The analysis considers the energy use impact of adding design options to improve efficiency. In order to represent the baseline, the analysis may consider removing a design option (or more than one if necessary) to allow representation of a design that is at the baseline efficiency level.

DOE also calibrated its analysis using units at maximum available efficiency levels (or in some cases, efficiency levels less than the maximum available), specifically equipment without proprietary technologies, such as low-thermal-mass or tube-type evaporators for batch ice makers. DOE chose design options to reach the maximum available efficiency levels of existing equipment. Importantly design options involving electronically commutate motors and drain water heat exchangers were excluded from calibration, as these were not considered to be commonly used in current ice makers. In some cases, the set of design options chosen to represent the maximum efficiency level matched the designs of the maximum available efficiency level equipment. In other cases, the designs did not match exactly, and the design of the DOE analysis may have had more improvement in one component, while the maximum available ice maker had more improvement in another component. In order to ensure that DOE was not underestimating the costs associated with the overall design improvements, DOE estimated the cost differential between changing the major components of the analyzed max efficiency unit to match those of the maximum available equipment. Major components considered in this estimate were the compressor, evaporator, condenser, and condenser fan. Table IV.25 shows this calibration, listing: The maximum efficiency reached by each directly analyzed equipment class, without considering ECM or drain water heat exchanger (DWHX) design options; the efficiency of the maximum available unit; and the cost difference associated with modifying the major components of to match those in the maximum available. A negative cost differential indicates that the DOE analysis predicted a higher cost at that efficiency level compared with the maximum available unit. The computed cost differentials are zero or negative in all but one case, showing that the DOE analysis does not underestimate the cost of reaching these higher efficiency levels. For the one case in which the differential is positive, $4 for the IMH–A–Small–B 22-Inch ice maker, the maximum available efficiency level is 5% higher than the level predicted by DOE's energy use analysis for a comparable set of design options. The calibration is presented in more detail in Chapter 5 of the TSD.

TABLE IV.25—MAXIMUM AVAILABLE CALIBRATION

Equipment class	Representative capacity (lb ice/24 hours)	DOE Analysis maximum efficiency level (% below baseline)	Maximum available efficiency level (% below baseline)	Cost differential moving from analyzed to maximum available ($)
IMH–W–Small–B	300	19.2	19.2	−29
IMH–W–Small–B (22-inch wide)	300	16.9	16.9	−34
IMH–A–Small–B	300	19.3	19.3	−27
IMH–A–Small–B (22-inch wide)	300	11.6	16.6	+4

TABLE IV.25—MAXIMUM AVAILABLE CALIBRATION—Continued

Equipment class	Representative capacity (lb ice/24 hours)	DOE Analysis maximum efficiency level (% below baseline)	Maximum available efficiency level (% below baseline)	Cost differential moving from analyzed to maximum available ($)
IMH–A–Large–B–Medium	800	16.1	16.1	−74
IMH–A–Large–B (22-inch wide)	590	5.5	5.5	−13
IMH–A–Large–B–Large	1500	6.2	6.0	−130
IMH–W–Med–B	850	10.4	14.3	−240
IMH–W–Large–B–2	2600	2.5	2.5	0
RCU–NRC–Large–B–Med	1500	15.7	15.7	−62
RCU–NRC–Large–B–Large	2400	14.9	14.9	−329
SCU–A–Small–B	110	26.6	24.9	−61
SCU–A–Large–B	200	23.5	26.4	−28
SCU–W–Large–B	300	27.6	27.6	0
IMH–A–Small–C	310	19.8	28.0	−30
IMH–A–Large–C	820	17.0	35.7	−11
SCU–A–Small–C	220	21.8	30.1	−62
RCU–NRC–Small–C	610	17.9	18.4	−40

c. Revision of NOPR and NODA Engineering Analysis

DOE developed the final engineering analysis by updating the NOPR and NODA analyses. This included making adjustments to the manufacturing cost model as described in section IV.D.4.a. It also included adjustments to energy modeling as described in section IV.D.4.

DOE made several changes to the engineering analysis throughout the course of this rulemaking. Specifically, in response to the concerns raised by stakeholders, DOE adjusted its analysis to rely more on test data based on input received in manufacturers' public and confidential comments than on theoretically analysis. These changes included:

• Based on new data, DOE made changes to the energy use reductions associated with individual design options;

• Based on new cost data, DOE made changes to the costs associated with individual design options. Design options were changed as a result of new data obtained through non-disclosure agreements with DOE's engineering contractor and comments made during the NOPR comment period developing an approach based on test data to determine the condensing temperature reductions associated with use of larger water-cooled condensers;

• Based on comments made during the NOPR period, DOE added additional cost-efficiency curves for 22-inch width units in the IMH–A–Small–B, IMH–A–Large–B, and IMH–W–Small–B equipment classes, and an additional cost-efficiency curve for the RCU–Small–C equipment class.

DOE calibrated the results of its calculations with maximum available ice makers that are available in the market and which do not incorporate proprietary technologies. This calibration at the maximum available levels shows that the costs DOE assigned to the maximum available level is generally higher than suggested by the compared maximum available equipment.

DOE believes that these changes help ensure that analysis accurately reflect technology behavior in the market. Further details on the analyses are available in chapter 5 of the final rule TSD.

E. Markups Analysis

DOE applies multipliers called ''markups'' to the manufacturer selling price (MSP) to calculate the customer purchase price of the analyzed equipment. These markups are in addition to the manufacturer markup (discussed in section IV.J.2.b) 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.26 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 TSD for more details on DOE's methodology for markups analysis.

TABLE IV.26—DISTRIBUTION CHANNEL MARKET SHARES

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)
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 NOPR.

In written comments, Manitowoc, Hoshizaki, NAFEM, Follett and AHRI commented that baseline and incremental markups should be equal, set at the level of the baseline markups. (Manitowoc, No. 92 at p. 2; Hoshizaki, No. 86 at p. 3; NAFEM, No. 82 at p. 5; Follett, No. 84 at p. 6; and AHRI, No. 93 at p. 6–7)

Some stakeholders at the NOPR public meeting commented that DOE should not use incremental markups for incremental equipment costs arising from the imposition of new standards and that DOE should instead use one set of markups, that corresponds to the baseline markups. Danfoss commented that wholesalers did not ask which part of prices were baseline and which were incremental. (Danfoss, Public Meeting Transcript, No. 70 at p. 197–198) Manitowoc stated that if they change list prices, their channel partners simply add a markup, and Manitowoc was not sure they would adopt another approach because a regulatory change drove up costs. (Manitowoc, Public Meeting Transcript, No. 70 at p. 192–193)

Danfoss suggested DOE go back and review the results of earlier rulemakings and identify how markups worked in those equipment markets. Doing so could add some credibility to the DOE markups methodology, maybe not in time for the ACIM rulemaking but in time for later rulemakings. (Danfoss, Public Meeting Transcript, No. 70 at p. 195) AHRI agreed that DOE should go back and try to verify the numbers at some point, maybe not for this rulemaking but for the next one. (AHRI, Public Meeting Transcript, No. 70 at p. 199–200) NAFEM and Manitowoc also suggested validation studies. (NAFEM, Public Meeting Transcript, No. 70 at p. 198; Manitowoc, Public Meeting Transcript, No. 70 at p. 190)

ASAP stated that DOE implemented markups where every dollar spent got the same markup in rulemakings before the year 2000. ASAP argued that the real world does not work that way because businesses cover fixed costs in a certain fashion, and variable costs in a certain fashion. ASAP has done some work examining the question of how good DOE's methods are at predicting prices. ASAP found that DOE's predicted prices tend to be higher than they should be, based on retrospective analysis. ASAP welcomes more retrospective analysis but notes that such analysis won't help this docket. (ASAP, Public Meeting Transcript, No. 70 at p. 195–197)

Scotsman provided suggestions for price estimation services, and commented that the cumulative impact on the supply chain of training, store design modifications, maintenance, costs associated with passing along manufacturer adjusted pricing, and retrofit of existing locations would add significantly to the costs of the standards. (Scotsman, No. 95 at page 5)

DOE acknowledges that a detailed review of results following compliance with prior rulemakings could provide information on wholesaler and contractor pricing practices, and agrees that such results would not be timely for this rulemaking. In the absence of such information, DOE has concluded that its approach, which is consistent with expected business behavior in competitive markets, is reasonable to apply. If the cost of goods sold increases due to efficiency standards, DOE continues to assume that markups would decline slightly, leaving profit unchanged, and, thus, it uses lower markups on the incremental costs of higher-efficiency products. This approach is consistent with behavior in competitive markets wherein market participants are expected to be able to recover costs and reasonable levels of profit. If the markup remains constant while the cost of goods sold increases, as Manitowoc, Hoshizaki, NAFEM, Follett, and AHRI suggest, the wholesalers' profits would also increase. While this might happen in the short run, DOE believes that the wholesale market is sufficiently competitive that there would be pressure on margins. DOE recognizes that attempting to capture the market response to changing cost conditions is difficult. However, DOE's approach is consistent with the mainstream understanding of firm behavior in a competitive market.

With respect to Manitowoc and Danfoss comments related to differential pricing based on efficiency improvements, DOE's approach for wholesaler markups does not imply that wholesalers differentiate markups based on the technologies inherently present in the equipment. Rather, it assumes that the average markup declines as the wholesalers' cost of goods sold increases due to the higher cost of more-efficient equipment for the reasons explained in the previous paragraph.

With respect to Scotsman's comments, DOE reviewed the suggested price quote services and, while appreciative of the information, found them to not provide the type of information needed for estimating markups on a national or state average basis. As for the costs mentioned, DOE believes costs such as passing along the manufacturer pricing and personnel training are already embodied in markups as such costs would be included in the data used to estimate markups and no evidence has been entered into the record to demonstrate that the costs caused by the proposed standards would be extraordinary. Other costs such as building renovation and retrofit costs were included in installation costs, as appropriate.

F. Energy Use Analysis

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. For the NOPR, 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.

Hoshizaki asked about the basis for the 50 percent usage factor. (Hoshizaki, Public Meeting Transcript, No. 70 at p. 204) NEEA referred to the usage factor as a best estimate, and noted that the 50 percent factor had not been improved upon in response to earlier rulemaking stages. (NEEA, Public Meeting Transcript, No. 70 at p. 204–205)

With its written comments, AHRI supplied monitored results collected by two manufacturers and recommended that DOE revise the utilization factor to 38%, based on the average of the data collected from stores, cafeterias, and restaurants in a variety of states. (AHRI, No. 93 at p. 2–3) Follett commented that its data shows that ice makers run an average of 38% of the time and that DOE should modify its analysis accordingly. (Follett, No. 84 at p. 3) Manitowoc commented that a more accurate average duty cycle for ACIMs is 40% based on data it had collected. (Manitowoc, No. 92 at p. 3)

NEEA recommended that DOE adjust the energy use on a weighted sales average to reflect a higher duty cycle for ice makers that are replacements as compared to new units, where ice demand may not be accurately known. (NEEA, No. 91 at p. 2)

Based on the monitored results submitted by AHRI and similar monitored results found in a report posted online,[30] DOE utilized a 42 percent capacity factor to estimate energy usage for the LCC and NIA models. With respect to NEEA's comment, given that DOE has no information on new versus replacement units and that the sample of monitored results does not include all relevant business types, DOE used the factor based on monitored results for new and replacement shipments for all business types.

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 a 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. 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,[31] 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 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 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 two 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[32] in which certain inputs were expressed as a range of values and probability distributions that account

[30] Karas, A. and D. Fisher. *A Field Study to Characterize Water and Energy Use of Commercial Ice-Cube Machines and Quantify Saving Potential.* December 2007. Fisher-Nickel, Inc. San Ramon, CA.

[31] 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.

[32] 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.

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 TSD chapter 10).

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.[33]

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 survival functions, with an average value of 8.5 years.

Using monitored data on the percentage of potential ice-making capacity that is actually used in real world installations (referred herein as utilization factor, but also referred to as duty cycle), the electricity and water usage of ice makers were also varied in the LCC analysis.

Another factor influencing the LCC analysis is the physical location in which the automatic commercial ice maker is installed. Location is captured by using state-level inputs, including 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 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 NOPR 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 NOPR analysis also indicated an approximately 1.7 percent decline from the MSP values estimated in 2012 to the end of the 30-year NIA analysis period used in the NOPR.

AHRI questioned where the price trend data came from and asked how confident DOE was of the numbers. (AHRI, Public Meeting Transcript, No. 70 at p. 216) In written comments, AHRI expressed concern with the experiential learning analysis and use of a producer price index and urged DOE to assume the MSP remain constant. (AHRI, No. 93 at p. 16–17)

PG&E and SDG&E expressed their support of DOE's use of experiential price learning in life-cycle cost analysis. (PG&E and SDG&E, No. 89 at p. 4)

DOE acknowledges the PG&E and SDG&G comment. In response to the AHRI comments that the data do not support the price trends, DOE agrees that it would be better to have data very specific to automatic commercial ice maker price trends. However, such is not available. The PPI used in the analysis of price trends embodies the price trends of automatic commercial ice makers as well as related technologies, including those used as inputs to the manufacturing process. DOE would also note that a sensitivity analysis was performed with price trends held constant, and doing such would not have impacted the selection of efficiency levels for TSLs. (See appendix 10B of the final rule TSD.) Because DOE believes there is evidence that price learning exists, DOE continued to use price learning for the final rule.

As is customary between phases of a rulemaking, DOE re-examined the data available and updated the price trend analysis. DOE continued to use a subset of the air-conditioning, refrigeration, and forced air heating equipment Producer Price Index (PPI) that 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 2.4 percent over the period of 2013 (the year for which MSP was estimated) through 2047. For the LCC model, between 2013 and 2018, the price decline is 0.5 percent.

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. Most automatic commercial ice makers are installed in fairly standard configurations. For the NOPR,

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

DOE assumed that the installation costs vary from one equipment class to another, but not by efficiency level within an equipment class. For the NOPR, DOE tentatively concluded that the engineering design options did not impact the installation cost within an equipment class. DOE therefore assumed that the installation cost for automatic commercial ice makers did 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.

During the public meeting manufacturers commented that not all customers can accommodate increased unit sizes, and that DOE must consider additional costs incurred from modifying facilities to accommodate ice makers with potential changes including plumbing and/or electrical work, relocating existing equipment, and/or building renovations. (Scotsman, Public Meeting Transcript, No. 70 at p. 126–127; Manitowoc, Public Meeting Transcript, No. 70 at p. 133 and p. 209; Ice-O-Matic, Public Meeting Transcript, No. 70 at p. 208 and p. 210)

In written comments, AHRI stated it was incorrect to assume installation cost would not increase with the efficiency improvement. (AHRI, No. 93 at p. 4) AHRI and Follett stated that larger ice makers will require installation space modification and would result in higher installation costs. (AHRI, No. 93 at p. 7–8; Follett, No. 84 at p. 6) Hoshizaki stated that the current installation cost range considerations may be correct for ice makers without size increases but agreed with AHRI and Follett that the installation cost would increase if the cabinet size went up, and that drain water heat exchangers would further increase installation costs. (Hoshizaki, No. 86 at p. 3–4) Manitowoc provided written comments, adding that remote condenser and remote condenser with compressor units that have larger condenser coils will require larger roof curbs or stronger mounting, depending on whether footprint or height is affected. (Manitowoc, No. 92 at p. 3) Scotsman stated in response to the NOPR and to the NODA that customers with space constraints could incur costs including but not limited to building renovation, water and wastewater service relocation, and electric service and countertop renovations. (Scotsman, No. 85 at p. 5b–6b; No. 125 at p. 2) Scotsman also stated that any efficiency improvement greater than 5 percent would cause cabinet size increases. (Scotsman, No. 125 at p. 2) Policy Analyst stated that DOE should assess whether commercial ice maker installation costs are affected by its proposed standards. (Policy Analyst, No. 75, p. 10)

Joint Commenters commented that DOE appropriately considered design options that increased package sizes, noting the options consumers have for purchases and noting the opportunity consumers might have to select smaller units given the low utilization factors used in the analysis. (Joint Commenters, No. 87, p. 3) NEEA similarly stated that DOE appropriately considered all the factors related to chassis size increase (NEEA, No. 91, pp. 1–2) PG&E and SDG&E, and CA IOU noted that it is unclear that insufficient space exists to increase chassis sizes in all situations. (PG&E and SDG&E, No. 89, p. 3, and CA IOU, No. 129, p. 4)

As suggested by Policy Analyst and manufacturers, DOE investigated further the question of installation costs varying by efficiency levels. In particular, DOE investigated the issue around increased cabinet sizes for ice makers and modified the installation cost calculation methodology to reflect increased installation costs for equipment classes that are size constrained. In response to stakeholder comments and data supplied by stakeholders, DOE revised the analysis for three equipment classes with significant shipment volumes of 22-inch-wide units and where height increases in the cabinets were considered in DOE's engineering analysis. In the engineering analysis for the final rule, DOE examined design options and efficiency level improvements for 22-inch units for three equipment classes under a scenario where no increase in equipment size was considered, resulting in two separate cost-efficiency curves (space constrained and non-space constrained) for each of these three classes (IMH–A–Small–B, IMH–A–Large–B, and IMH–W–Small–B). Each of these equipment classes is designed for mounting on bins, ice dispensers, or fountain dispensers, and in the case of dispensers, generally the combination is mounted on a counter or table. For the LCC/PBP analysis and the NIA, DOE integrated the two curves for these equipment classes. To do so, at the efficiency level where the 22-inch engineering cost curves end, DOE researched the additional installation costs customers would incur in order to raise ceilings or move walls to make it possible for the customers to install the larger, non-22-inch units. As PG&E, SDG&E and CA IOU stated, not all installations lack sufficient space to accommodate increased chassis sizes. Based on the research performed for the final rule, DOE identified percentages of customers of the non-space constrained equipment who also face size constraints, and estimated additional installation costs imposed by the need to raise ceilings or address other height constraints to facilitate cabinet size increases. Chapter 8 of the final rule TSD describes the process for including building renovation costs in the ACIM installation costs, and the inputs used in the analysis.

In response to Hoshizaki and Manitowoc comments, DOE researched DWHX installation costs, and the cost to install larger remote condensers. In both cases, DOE identified incremental installation costs for these design options and added such to the installation costs at the efficiency levels that include these options.

In response to Scotsman and Ice-O-Matic comments that the design options might cause customers to need to increase the size of electrical or water services, the specific technologies underlying the design options studied by DOE would not require increased electrical or water services. In performing the engineering analyses, DOE analyzed design options for each equipment class at the same voltage levels as existing typical units. As such, there is no reason to believe that meeting the energy conservation standard for any specific equipment class would require an increased electrical service. Similarly, there is reason to believe meeting the energy conservation standard would require greater water service, because no design options were analyzed which would increase water usage. Water or wastewater services relocations or countertop renovations would be required if customers move ice makers, but DOE's belief is that moving ice makers would not be a requirement imposed by the small cabinet size increases envisioned in this rulemaking.

Additional information regarding the estimation of installation costs is presented in TSD chapter 8.

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. For the NOPR, DOE approximated repair costs based on an assessment of the components likely to fail within the lifetime of an automatic commercial ice maker in combination with the estimated cost of these components developed in the engineering analysis. Under this methodology, repair and replacement costs are based on the original 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.

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 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.

AHRI commented that it is incorrect to assume that changes in maintenance and repair will be negligible for more efficient equipment, and that DOE should contact parts distributors to find the price difference between permanent split-capacitor (PSC) and ECM motors and between 2-stage and 1-stage compressors. AHRI noted that dealers usually double their costs when invoicing equipment owners. (AHRI, No. 93 at p. 4) Similarly, Scotsman commented that the supply-chain cost impact of the standards would be nearly equal in percentage to the manufactured product cost increase. (Scotsman, No. 85 at p. 5b)

Scotsman commented that the expedited product development timeline would affect manufacturers by impeding the traditional product development process, resulting in a higher product failure rate, additional training burden, and increased repair costs and that this cost should be included in the analysis (Scotsman, Public Meeting Transcript, No. 70 at p. 212, p. 218, p. 219–220).

In the final rule analysis released for the NODA, DOE added a ''repair labor cost'' to the original repair cost, reflective of the cost of replacing individual components. DOE's research did not identify studies or data indicating that the failure rates, and in turn maintenance and repair costs, of energy-efficient equipment is significantly higher than traditional equipment. In response to AHRI's comments about contacting distributors about motors and compressors, DOE did collect labor information directly from service companies upon which to base the estimated labor hours. In response to AHRI's note about the doubling of costs, the total repair chain markup underlying DOE's estimated repair costs is 250 percent of direct equipment costs.

In response to AHRI's comment about compressors, DOE did not include 2-stage compressors in the engineering analysis, and so the comment does not apply.

In response to the Scotsman comment about warranty costs, DOE has no information indicating whether or how much failure rates will change as a result of standards implementation. To the extent that training and warranty costs are born by manufacturers and identified in the data collection efforts, such costs are included in the manufacturer impact analysis.

3. Annual Energy and Water Consumption

Chapter 7 of the final rule 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 final rule TSD). The development of energy and water usage inputs is discussed in section IV.F 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.[34] The EIA data are the 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 April 2014 NOPR public meeting or in written comments.

5. Energy Price Projections

To estimate energy prices in future years for the NOPR and for the final rule, DOE multiplied the average state-level energy prices described in the previous paragraph by the forecast of annual average commercial energy price indices developed in the Reference Case from *AEO2014*.[35] *AEO2014* 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 April 2014 public meeting or in written comments.

6. Water Prices

To estimate water prices in future years for the NOPR, DOE used price data from the 2008,[36] 2010,[37] and 2012 American Water Works Association (AWWA) Water and Wastewater Surveys.[38] 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)[39] in developing a real growth rate for water and wastewater price forecasts.

In written comments, the Alliance stated that DOE looked only at energy savings for air-cooled and water-cooled ACIM equipment, and that DOE should include water and wastewater cost in the LCC analysis. The Alliance notes that when such costs are included, air-cooled equipment is more cost-effective than water-cooled equipment. (Alliance, No. 73 at p. 3) The Alliance further recommended that DOE should reflect the rising costs water and wastewater cost in its life cycle analysis. (Alliance, No. 73 at p. 3) The Alliance also

[34] U.S. Energy Information Administration. *Sales and revenue data by state, monthly back to 1990 (Form EIA–826).* (Last accessed May 19, 2014). *www.eia.gov/electricity/data.cfm#sales.*

[35] 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.

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

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

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

[39] 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.*

commented that DOE did not take into account the embedded energy needed to pump, tread and distribute water and to collect and treat wastewater, noting that the end user does not pay this cost and that it is paid by the water and wastewater user. (Alliance, No. 73 at p. 3, 18–19)

DOE includes water and wastewater cost in the LCC analysis and notes that real electric prices (2013$) escalate at roughly 0.4 percent between 2013 and 2047, while real water and wastewater prices escalate at roughly 2.0 percent over the same time period. DOE disagrees with the Alliance's comment that the end user of ice does not pay for the cost of energy embedded in the water used to make ice. This statement implies that the hotels, restaurants and other entities that use automatic commercial ice makers and pay the water and wastewater bills charge prices that do not fully recover all of their costs of doing business. DOE would agree that the end user of ice does not perceive the cost of the ice or any of the factors of production that went into the provision of the ice or the beverage served with the ice. However, DOE included water and wastewater costs in the LCC analyses, thereby capturing the cost of embedded energy in the analysis.

In response to the Alliance's comparison of equipment types, DOE's final rule and final rule TSD present LCC results for all equipment classes. As discussed in section II.A of this preamble, DOE's rulemaking authority required DOE to promulgate standards that do not eliminate features or reduce customer utility. Because the existing standards established by Congress made water-cooled equipment separate equipment classes differentiated by the use of water in the condenser, DOE considers the use of water in the condenser to be a feature. For these reasons, DOE has no reason to make determinations that one equipment type is more cost-effective than another type.

For the final rule, DOE updated the calculation of State-level water prices with the inclusion of 2013 consumer price index values.

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.

DOE received no comments at the April 2014 public meeting or in written form related to discount rates.

To estimate the WACC of automatic commercial ice maker purchasers for the final rule, DOE used a sample of over 1,400 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 7,765 U.S. companies presented on the Damodaran Online Web site.[40] 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 the increased 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. 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 (>20 years) tax-exempt municipal bonds.[41] [42] 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.[43]

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.[44]

Chapter 8 of the final rule TSD provides more information on the derivation of discount rates. The average discount rate by business type is shown on Table IV.27.

TABLE IV.27—AVERAGE DISCOUNT RATE BY BUSINESS TYPE

Business type	Average discount rate (real) (%)
Health Care	3.4
Lodging	7.9
Foodservice	7.1
Retail	5.8
Education	4.0
Food Sales	6.9
Office	6.2

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. For the NOPR analyses, DOE elected to use an 8.5-year average life for all equipment classes.

DOE received written comments on the typical lifetime. Scotsman stated continuous units might have a shorter typical lifetime than batch type units but did not provide estimates of the difference. (Scotsman, No. 85 at p. 5b) Hoshizaki commented that 8.5 years is a good average lifetime assumption. (Hoshizaki, No. 86 at p. 3) AHRI commented that the average lifespan of continuous type ice makers is 7 years based on warranty data. (AHRI, No. 93 at p. 7) NAFEM commented that DOE did not use adequate data to justify its assumed lifetime of 8.5 years and that DOE should study the difference in lifetimes between batch type and continuous type ice makers. (NAFEM, No. 82 at p. 4)

AHRI and NAFEM both commented that the proposed rule will increase the size and the cost of automatic commercial ice makers, and both pointed to the example of air

[40] Damodaran financial data is available at *http://pages.stern.nyu.edu/~adamodar/* (Last accessed June 6, 2014).

[41] Federal Reserve Bank of St. Louis, *State and Local Bonds—Bond Buyer Go 20-Bond Municipal Bond Index.* (Last accessed April 6, 2012). Annual 1974–2011 data were available at *http://research.stlouisfed.org/fred2/series/MSLB20/downloaddata?cid=32995.*

[42] Rates for 2012 and 2013 calculated from monthly data. Data source: U.S. Federal Reserve (Last accessed July 10, 2014.) Available at *http://www.federalreserve.gov/releases/h15/data.htm.*

[43] Rate calculated with 1974–2013 data. Data source: U.S. Federal Reserve (Last accessed July 10, 2014.) Available at *http://www.federalreserve.gov/releases/h15/data.htm.*

[44] Small Business Administration data on loans between $10,000 and $99,000 compared to AAA Corporate Rates. (Last accessed on June 10, 2013.) Available at *http://www.sba.gov/advocacy/7540/6282.*

conditioners, where efficiency standards led to larger and more expensive units. The two stakeholders went on to state that annual air conditioner industry sales dropped about 18% while repair parts sales sharply increased. (NAFEM, No. 82 at p. 6 and p. 10; AHRI, No. 93 at p. 8) Follett commented that the proposed rule is so stringent that it would create significant hardship for manufacturers and could require compromises to reliability and serviceability, adding that the rule could incent end-users to repair rather than replace their machines. (Follett, No. 84, at p. 1)

With respect to NAFEM's comment about the adequacy of data, in the framework and preliminary analysis phases of this rulemaking, DOE surveyed the available literature and found a range of estimates of 7 to 10 years, with 8.5 being the average. Literature cited on Table IV.28 suggested lifetimes of up to 20 years or more for automatic commercial ice makers, and this range was supported by discussion with experts.

TABLE IV.28—ESTIMATES FOR AUTOMATIC COMMERCIAL ICE MAKER LIFETIMES

Life	Reference
7 to 10 years	Arthur D. Little, 1996.[45]
8.5 years	California Energy Commission, 2004.[46]
8.5 years	Fernstrom, G., 2004.[47]
8.5 years	Koeller J., and H. Hoffman, 2008.[48]
7 to 10 years	Navigant Consulting, Inc. 2009.[49]

With regard to the Scotsman's suggestion that continuous type ice makers might have shorter life spans, DOE found the comment lacking sufficient specific information to act on the comment. With respect to the AHRI comment that continuous equipment has a 7-year life, DOE notes that the phrase ''based on warranty data'' provided no information that DOE could analyze to determine whether to revise the assumed equipment lifetime. In addition, warranty claims do not necessarily correlate with product lifetime. For this reason, DOE decided based on the previous, generally high level of agreement with the 8.5-year lifetime to retain that lifetime as the basic assumption, and to use the 7-year continuous product life for sensitivity analyses.

With respect to the AHRI, NAFEM, and Follett comments about refurbishment, DOE acknowledges that the increased size and prices of automatic commercial ice makers arising from new and amended standards could lead to equipment refurbishing or the purchase of used equipment. DOE lacks sufficient information to explicitly model the extent of such refurbishment but believes that it would not be significant enough to change the rankings of TSLs. When DOE performed additional and recent research on repair costs before issuance of the NODA, contractors provided estimates of the hours to replace failed components such as compressors, but some also stated that they recommended replacing the ice maker instead of repairing it. In some cases the contractor recommendations were based on relative repair or replacement costs and warranties while in other cases they were based on the time it would take to get the required, specific ice maker components. DOE also notes that, given the engineering cost curves prepared for the final rule, when the baseline efficiency distribution of current shipments is taken into account, the average total cost increase faced by customers at TSL 3 is less than 3 percent. For these reasons, DOE believes that the degree of refurbishing would not be significant enough to change the rankings of the TSLs considered in this rule.

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)) 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 assumed that the most likely compliance date for the standards set by this rulemaking would be January 1, 2018. As discussed in section IV.A.2, DOE received comments about the compliance date, including requests to provide manufacturers 5 years to meet the new and amended standards. As stated in section IV.A.2, DOE believes that the modifications it made in the final rule analysis, relative to the NOPR, will reduce the burden on manufacturers to meet requirements established by this rule. Therefore, DOE has determined that the 3-year period is adequate and is not extending the compliance date for ACIMs. For the final rule, a compliance date of January 1, 2018 was used for the LCC and PBP analysis.

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.

For the NOPR, DOE estimated market shares of each efficiency level within each equipment class based on an analysis of the automatic commercial ice makers available for purchase by customers. DOE analyzed all models available as of November 2012, 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.

At the NOPR public meeting ASAP noted that the efficiency distribution used by DOE showed manufacturers can manufacture machines meeting the efficiency levels proposed in the NOPR.

[45] Arthur D. Little, Inc. Energy Savings for Commercial Refrigeration. Final Report. June, 1996. Submitted to the U.S. Department of Energy's Energy Efficiency and Renewable Energy Building Technologies Program. Washington, DC.

[46] California Energy Commission. *Update of Appliance Efficiency Regulations.* 2004. Sacramento, CA.

[47] Fernstrom, G. B. Analysis of Standards Options For Commercial Packaged Refrigerators, Freezers, Refrigerator-Freezers and Ice Makers: Codes and Standards Enhancement Initiative For PY2004: Title 20 Standards Development. 2004. Prepared by the American Council for an Energy-Efficient Economy for Pacific Gas & Electric Company, San Francisco, CA.

[48] Koeller J., and H. Hoffman. A report on Potential Best Management Practices. 2008. Prepared by Koeller and Company for the California Urban Water Conservation Council, Sacramento, CA.

[49] Navigant Consulting, Inc. Energy Savings Potential and R&D Opportunities for Commercial Refrigeration. Final Report. 2009. Submitted to the U.S. Department of Energy's Energy Efficiency and Renewable Energy Building Technologies Program, Washington, DC.

(ASAP, Public Meeting Transcript, No. 70 at p. 256–257) Ice-O-Matic and Manitowoc stated that the distribution showed available equipment, but the equipment at the higher efficiencies might have small shipments relative to other efficiency levels. (Ice-O-Matic, Public Meeting Transcript, No. 70 at p. 260; Manitowoc, Public Meeting Transcript, No. 70 at p. 261–263) Hoshizaki commented that DOE's shipments analysis would be more accurate if DOE requested actual shipment data under NDA from manufacturers each year. (Hoshizaki, No. 86 at p. 4) At the public meeting, manufacturers and AHRI agreed to compile shipments information by efficiency level.

In written comments, AHRI supplied such information for batch type equipment. AHRI also stated that DOE should not use available models in the AHRI database to estimate shipment-weighted market shares by efficiency levels for batch type units, because by doing so, DOE overestimates potential energy savings by 11.3% or more. (AHRI, No. 93 at p. 8–9)

For the final rule, DOE used the efficiency distribution for batch type equipment provided by AHRI. While DOE did not analyze AHRI's statement of the overestimate of savings, DOE does consider the shipment-based distribution superior to the available-unit-based distribution. Lacking a similar shipment-based distribution for continuous equipment classes, DOE used an available-unit-based distribution for continuous equipment classes for the final rule.

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.

In written comments, Earthjustice stated that DOE inappropriately used a 3-year payback period as an upper limit for an acceptable customer impact without providing a justification for such, and that DOE should revise its approach for using payback period. (Earthjustice, No. 81, pp. 1–2) DOE acknowledges the comment and notes that, for the NOPR, DOE intended the use of the payback period as an illustration of the relatively significant differences between the impacts of TSLs.

12. Rebuttable Presumption Payback Period

EPCA (42 U.S.C. 6295(o)(2)(B)(iii) and 6313(d)(4)) established a rebuttable presumption that 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 that the consumer will receive during the first year 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) and 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 new and 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 new or 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. Final rule TSD chapter 10 and appendix 10A explain the models and how to use them, and interested parties can review DOE's analyses by interacting with these spreadsheets. The models and documentation are available at: *http://www1.eere.energy.gov/buildings/appliance_standards/rulemaking.aspx/ruleid/29.*

The NIA spreadsheet model uses average values as inputs (rather than 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 *AEO2014* Reference Case. In addition, DOE analyzed scenarios that used inputs from the *AEO2014* 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 final rule TSD.

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

1. Shipments

Comments related to the shipment analysis received at the April 2014 public meeting were all questions for clarification. The following description of the shipments projection presents the shipments analysis for the final rule. The process described in this section was documented and released for comments in the NODA.

DOE obtained data from AHRI, ENERGY STAR, 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 data provided to DOE also included an 11-year history of total shipments from 2000 to 2010. DOE also collected total automatic commercial ice maker shipment data for the period of 1973 to 2009 from the CIR. Additionally, DOE collected 2008–2012 data on ACIM shipments under the ENERGY STAR program. The ENERGY STAR data consisted of numbers of units meeting ENERGY STAR efficiency levels and the percent of the total market represented, from which the total market could be estimated. ENERGY STAR shipments only pertained to air-cooled batch equipment.

In the preliminary analysis phase, DOE relied extensively on the CIR shipments data for the shipments projection. Subsequent to receiving comments on the preliminary analysis shipments, DOE relied more heavily on AHRI data for the NOPR and for the final rule shipments projections. After the NOPR analyses were completed, analysis of ENERGY STAR data led DOE to conclude that the AHRI data understates shipments by approximately 9 percent and that the difference was likely due to a greater number of manufacturers represented in the ENERGY STAR results. However, the AHRI data gives significantly greater detail than the ENERGY STAR data. Therefore, the final rule and the NOPR methodologies are identical except for an upward adjustment of the historical AHRI data by 9 percent to correct for the presumed under-reporting of non-AHRI-members.

To determine the percentage of shipments going to replace existing stock and the percentage represented by new installations, DOE used the CIR data to create a series of estimates 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 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 used the historical AHRI shipments to create a 2010 stock estimate. The 2010 stock and 2010 shipments from AHRI, disaggregated between new installations and shipments for existing stock replacement, were combined with projections of new construction activity from *AEO2014* to generate a forecast of shipments for new installations. Stock and shipments were first disaggregated to individual business types based on data developed for DOE on commercial ice maker stocks.[50] The business types and share of stock represented by each type are shown in Table IV.29. Using a Weibull distribution assuming that 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 AHRI historical series. Using the estimated 2010 shipments to new installations, and year-to-year changes in new commercial sector floor space additions from *AEO2014,* DOE estimated future shipments for new installations. (For the NOPR, DOE used *AEO2013* projections of floor space additions.) The *AEO2014* floor space additions by building type are shown in Table IV.30. The combination of the replacement and new installation 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.31 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.29—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.30—AEO2014 FORECAST OF NEW BUILDING SQUARE FOOTAGE

Year	New construction million ft^2						
	Health Care	Lodging	Foodservice	Retail	Education	Food sales	Office
2013	66	147	31	279	247	21	174
2018	67	164	51	428	209	36	411
2020	65	176	47	404	197	33	451
2025	63	181	48	444	169	34	392
2030	71	150	55	515	190	39	276
2035	72	207	57	527	228	40	415
2040	76	188	56	565	252	40	403
Annual Growth Factor, 2031–2040	2.4%	2.5%	2.4%	2.5%	1.7%	2.3%	2.1%

[50] 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. p. 41.

TABLE IV.31—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.

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 final rule 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.32 shows the shipment-weighted market shares by efficiency level in the base-case scenario.

TABLE IV.32—SHIPMENT-WEIGHTED MARKET SHARES BY EFFICIENCY LEVEL, BASE CASE

Equipment class	Market share by efficiency level Percent								
	Level 1	Level 2	Level 3	Level 3A	Level 4	Level 4A	Level 5	Level 6	Level 7
IMH–W–Small–B	37.1	15.6	44.8	....	2.5	0.0	0.0	....	....
IMH–W–Med–B	55.8	20.0	15.3	....	8.9	....	....	....	....
IMH–W–Large–B									
IMH–W–Large–B–1	87.2	12.8	....	....	....	....	....	....	....
IMH–W–Large–B–2	87.2	12.8	....	....	....	....	....	....	....
IMH–A–Small–B	23.7	29.5	46.8	0.0	0.0	....	0.0	0.0	....
IMH–A–Large–B									
IMH–A–Large–B–1	34.1	27.8	35.1	0.3	2.7	....	....	....	....
IMH–A–Large–B–2	16.8	22.5	60.8	....	....	....	....	....	....
RCU–Large–B									
RCU–Large–B–1	43.9	36.4	18.8	....	1.0	....	....	....	....
RCU–Large–B–2	43.9	36.4	18.8	....	1.0	....	....	....	....
SCU–W–Large–B	71.6	0.6	0.0	....	22.5	....	5.4	0.0	....
SCU–A–Small–B	51.8	15.3	12.9	....	8.0	....	12.0	0.0	0.0
SCU–A–Large–B	62.6	14.8	21.5	....	0.0	....	1.1	0.0	....
IMH–A–Small–C	30.6	11.1	19.4	....	5.6	....	19.4	13.9	....
IMH–A–Large–C	43.5	21.7	17.4	....	8.7	....	8.7	....	....
RCU–Small–C	27.8	27.8	33.3	....	5.6	....	0.0	5.6	....
SCU–A–Small–C	44.1	8.8	14.7	....	17.6	....	14.7	0.0	....

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 little or no perception of or personal stake in the cost of the ice and rather are using the ice to serve a specific need. Given this, DOE believes there is very little or no potential for a rebound effect. For the NIA, DOE used a rebound factor of 1, or no effect, for automatic commercial ice makers.

At the NOPR phase, the only comment regarding rebound effect was from the Policy Analyst. Policy Analyst stated that DOE should evaluate whether there was a rebound effect caused by the previous standard. (Policy Analyst, No. 75 at p. 10) As stated above, DOE believes that the users of ACIM equipment would not perceive the price effects, so DOE believes rebound effect should not be present for this equipment and does not believe further analysis is necessary.

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 input at the energy generation station required to convert and deliver the energy required at the site of consumption). These site-to-source conversion factors account for the energy used at power plants to generate electricity and for the 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.

For this final rule, DOE used conversion factors based on the U.S. energy sector modeling using the National Energy Modeling System (NEMS) Building Technologies (NEMS–BT) version that corresponds to *AEO2014* 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 held constant beyond 2040 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) 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.[51]

The approach used for this final rule, and the FFC multipliers that were applied are described in appendix 10D of the final rule 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 I.C.

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 customer 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. DOE used the 3-percent rate to capture the potential effects of the new and amended standards on private consumption. This rate represents the ''societal rate of time preference,'' which is the rate at which society discounts future consumption flows to their present.

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

DOE received one comment from Ice-O-Matic stating that the 7-percent discount rate was too high when the current prime rate is 3.25 percent and the current Treasury bill rate is 3.67 percent. (Ice-O-Matic, No. 120, p. 1; Ice-O-Matic, No. 121, p. 1) Ice-O-Matic also indicated that the use of 7-percent discount rate inflated the rate of return experienced by customers. (Ice-O-Matic, No. 120, p. 1)

As Ice-O-Matic noted, the discount rate is high relative to current interest rates. However, DOE suspects that the comments misinterpreted the use of the discount rate. In this case, the discount rate is used to express a given number of future dollars as an equivalent number of dollars today, whereas the comments seemed to assume the discount rate was used as an interest rate to express a given number of dollars today as a future value equivalent. Since the 7-percent discount rate that DOE used in the NIA is used in accordance with OMB guidelines, DOE will continue using it in the NIA.

As discussed in section IV.G.1, DOE included a projection of price trends in the 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 final rule TSD appendix 10B.

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. 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. 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. Chapter

8 of the 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 LCC 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.

Three written comments specifically focused on the customer subgroups, all three specifically focusing on the food service industry. U.S. Senator Toomey commented that the proposed rule will negatively impact employment in the food services industry, which is dominated by small businesses, and that restaurant owners would already purchase efficient products if they were going to be able to recoup the higher prices through savings. (U.S. Senator Toomey, No. 79 at p. 1) NRA commented that the cost of new standards could be greater for small businesses, due to increased capital, maintenance, repair, and installation costs, thus affecting their payback period. (NRA, No. 69 at p. 2–3) NAFEM commented that the proposed rule will affect the food service industry, which is also dominated by small businesses, because they will not be able to afford equipment upgrades and will choose to extend the life of used equipment. (NAFEM, No. 82 at p. 5)

With respect to the issue of negative employment impacts, if the standard has a positive LCC benefit to the food service customer, such an impact should not reduce employment. DOE notes that the LCC analysis looks strictly at the net economic impact of a hypothetical purchase of equipment and does not look specifically at employment. However, if the analysis shows a net LCC benefit, the food service customer should be better off and presumably such result should not negatively impact employment. DOE agrees with the NRA comment that the cost of new standards could be greater for small businesses and notes the analysis of the impacts is precisely the point of the customer subgroup analysis.

With respect to NAFEM's comment regarding small business's inability to afford the equipment upgrades, if the results indicate positive LCC benefits the presumption is that the customer's financial situation is improved with the more efficient equipment when compared to less efficient equipment. DOE lacks information with which to estimate the extent to which customers might choose to extend the life of equipment, but believes that given the relatively modest average price increase of the proposed standard (approximately 3 percent) in combination with the customer energy savings, the proportion of customers who would choose life extension is small.

DOE estimated the impact on the identified customer subgroups using the LCC spreadsheet model. The standard LCC and PBP analyses (described in section IV.F) 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 to 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 TSD.

J. Manufacturer Impact Analysis

1. Overview

DOE performed an MIA to estimate the impacts of new and 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. A key GRIM output is the INPV, which is the sum of industry annual cash flows over the analysis period, discounted using the industry weighted average cost of capital. Another key output is 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 final rule 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,[52] corporate annual reports, the U.S. Census Bureau's Economic Census,[53] and Hoover's reports.[54]

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

[52] U.S. Securities and Exchange Commission. Annual 10–K Reports. Various Years. *http://sec.gov*.

[53] U.S.Census Bureau, Annual Survey of Manufacturers: General Statistics: Statistics for Industry Groups and Industries. *http://factfinder2.census.gov/faces/nav/jsf/pages/searchresults.xhtml?refresh=t*.

[54] Hoovers Inc. Company Profiles. Various Companies. *http://www.hoovers.com*.

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. 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 30836 (May 15, 2000), as amended by 65 FR 53533 (Sept. 5, 2000) and 67 FR 52597 (Aug. 13, 2002), as codified at 13 CFR part 121. The Small Business Administration (SBA) defines a small business for North American Industry Classification System (NAICS) 333415, ''Air-Conditioning and Warm Air Heating Equipment and Commercial and Industrial Refrigeration Equipment Manufacturing,'' which includes commercial ice maker manufacturing, as having 750 or fewer 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 final rule 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 in 2015 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, based on the weighted average cost of capital as derived from industry financials and 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 each TSL. 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 final rule TSD.

a. Government Regulatory Impact Model Key Inputs

Manufacturer Production Costs

Manufacturing higher efficiency equipment is typically more expensive than manufacturing baseline equipment due to the use of more complex, and typically more costly, components. The changes in the MPCs of the analyzed equipment can affect the revenues, gross margins, and cash flow of the industry, making production 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.B and further detailed in chapter 5 of the final rule 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 reverse engineering analysis, described in section IV.D.4, 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 the base-case analysis, the GRIM uses the NIA's annual shipment forecasts from 2015, the base year, to 2047, the end of the analysis period. See chapter 9 of the final rule TSD for additional details.

Product Conversion Costs, Capital Conversion Costs, and Stranded Assets

New and 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.

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.4. 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 preamble. For additional information on the estimated product conversion and capital conversion costs, see chapter 12 of the final rule TSD.

b. Government Regulatory Impact Model Scenarios

Markup Scenarios

As discussed in section IV.J.2.b 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 new and amended energy conservation standards, it represents a lower bound of industry impacts (higher industry profitability) under new and amended energy conservation standards.

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

During the NOPR public meeting, interested parties commented on the assumptions and results of the analyses in the NOPR TSD. In addition, interested parties submitted written comments on the assumptions and results of the NOPR TSD and NODA. DOE summarizes the MIA related comments below:

a. Conversion Costs

At the NOPR Stage, several stakeholders pointed out high capital costs and intense redesign efforts would be required by the proposed standards. Hoshizaki commented that many of the design options suggested in this rulemaking would require manufacturers to modify or buy new tooling and grow packaging, pallets, and conveyor belts to accommodate larger machines. Hoshizaki noted that these costs would compound to over $20 million in the first year. (Hoshizaki, No. 86 at p. 7–8) Ice-O-Matic commented that DOE should directly consider the capital expenditures associated with tooling changes as it is a discrete expense that is not planned from year to year. (Ice-O-Matic, Public Meeting Transcript, No. 70 at p. 88)

As suggested by Ice-O-Matic, DOE does consider conversion expenses to be one-time expenditures that are not planned from year-to-year. DOE models conversion investments, including capital expenditures, as occurring between the announcement year and standards year. These investments result in decreases in operating profit, free cash flow, and INPV. DOE's conversion cost estimates account for all production line modifications associated with the design options considered in the engineering analysis including changes in conveyor, equipment, and tooling. For the final rule, DOE made changes to the considered design options based on feedback from the industry. DOE believes the changes in design options will reduce the capital requirements on industry.

Several manufacturers noted that a significant portion of their product lines would require redesign in order to meet the standard levels proposed in the NOPR. Specifically, Manitowoc commented that 90% of its models would require a major redesign to meet the proposed standards. (Manitowoc, No. 92 at p. 2–3) Similarly, Hoshizaki commented that about 80% of their continuous type units would not be able to meet the proposed standards. (Hoshizaki, Public Meeting Transcript, No. 70 at p. 74) Hoshizaki noted in a written comment that over 75% of units on the market will be unable to meet the proposed standard. (Hoshizaki, No. 86 at p. 1) Scotsman commented that 97% of their product line would need to be replaced in order to achieve the proposed efficiency levels. (Scotsman, No. 85 at p. 2b) Emerson estimated 70% of the batch ice machines would need some amount of redesign in order to meet the proposed minimum efficiency levels at the NOPR stage. (Emerson, No. 122 at p. 1) AHRI commented that 99% of the existing batch type market would be eliminated if the proposed TSL 3 became effective and that the impact of NOPR TSL 3 would lead to industry consolidation, loss of jobs, and loss of international sales. (AHRI, No. 93 at p. 10–12) NAFEM noted general concerns about product obsolescence at the NOPR levels. (NAFEM, No. 82 at p. 2)

Between the NOPR and the Final Rule, DOE revised and updated its analysis based on stakeholders comments received at the NOPR public meeting, in additional manufacturer interviews, and in written responses to the NOPR and NODA. These updates included changes in its approach to calculating the energy use associated with groups of design options, changes in inputs for calculations of energy use and equipment manufacturing cost, and consideration of space-constrained applications. In response to the NOPR and NODA comments, DOE adjusted the design options it considered to reduce impacts on the industry. A discussion of these changes can be found in section IV.D.3. After applying the change to the analyses, the efficiency levels that DOE determined to be cost-effective changed considerably. These revised TSLs are presented in section V.A.

When compared to the NOPR levels, DOE believes the revised levels proposed in section V.A will reduce the burdens on industry. Table IV.33 below presents the portion of model that DOE estimates would require redesign at the various final rule TSLs.

TABLE IV.33—PORTION OF INDUSTRY MODELS REQUIRING REDESIGN AT FINAL RULE TSLS

	Percent of models failing at each TSL					
	TSL 1	TSL 2	TSL 3	TSL 4	TSL 5	Total
Batch	27%	39%	51%	66%	84%	100%
Continuous	29	41	55	55	78	100
Total	28	40	52	63	82	100

b. Cumulative Regulatory Burden

NRA and NAFEM both commented that DOE should consider the impacts of the cumulative regulatory burden of rulemakings, including energy conservation standards for CRE and walk-in units as well as EPA rulemakings on refrigerants, and standards imposed nearly simultaneously on equipment manufacturers. (NRA, No. 69 at pp. 3–4) (NAFEM, No. 82 at pp. 6–7)

DOE is instructed to consider all Federal, product-specific burdens that go into effect within 3 years of the compliance date of this final rule. The list of other standards considered in the cumulative regulatory burden analysis can be found in section V.B.2.g. DOE has included the energy conservation standard final rules for walk-in coolers and freezers final rule and the commercial refrigeration equipment final rule. DOE has not included the EPA SNAP rulemaking in this analysis. Because that rulemaking is in the NOPR stage and is not finalized at this time, any estimation of the impact or effective dates would be speculative.

c. SNAP and Compliance Date Considerations

AHRI stated that the burden imposed by a potential changes in refrigerants is significant and will require major redesign just to maintain current efficiency levels. (AHRI, No. 168 at p. 5) AHRI urged DOE to extend the compliance period to five years or put a hold on the ACIM standards rulemaking until the SNAP refrigerants are finalized in order to avoid another redesign during the compliance period of the amended ACIM energy conservation standard. (AHRI, No. 70 at p. 16) Emerson also supported the idea of DOE starting the three-year compliance period after EPA finalizes a decision on refrigerants, allowing manufactures of components and equipment to re-design for both energy efficiency and low-GWP refrigerants in one design cycle. (Emerson, No. 122 at p.1) Ice-O-Matic proposed either a five year compliance period for the NODA TSL 3 or that DOE chose a lower standard level. (Ice-O-Matic, No. 121 at p. 2) Manitowoc stated that commercial ice makers are not within the current scope of the SNAP NOPR, however it believes that ice makers could be affected by a subsequent rulemaking. Furthermore, Manitowoc noted that even if there is no action on ice makers, the component suppliers to the ice maker industry (including suppliers of compressors, expansion valves, and heat exchangers) will be focusing their efforts on supporting the transition to SNAP refrigerants. Consequently, the commercial ice maker industry will be affected even if it is not directly covered by EPA rules. Manitowoc also supported a course of action to reduce the risk of multiple redesigns due to the refrigerant changes and an amended energy conservation standard. (Manitowoc, No. 126 at p. 3) NEEA expressed their support for DOE's current refrigerant-neutral position. (NEEA, No. 91 at p. 2)

Since the SNAP rulemaking is in the NOPR stage and not finalized at this time, any estimation of the impact or effectives dates would be speculative, however in its August 6, 2014 proposal, EPA did not list ACIM as a product that would be impacted by forthcoming regulations (82 FR 46126). DOE cannot speculate on the outcome of a rulemaking in progress and can only consider in its rulemakings regulations that are currently in effect. Therefore, DOE has not included possible outcomes of a potential EPA SNAP rulemaking.

In response to the request that DOE extend the compliance date period for automatic commercial ice makers beyond the 3 years specified by the NOPR, as stated in section IV.A.2, DOE has determined that the 3 year compliance period is adequate and is not extending the compliance date for ACIMs. In response to AHRI's comment that DOE should put a hold on the ACIM standards rulemaking until the SNAP refrigerants are finalized, EPCA prescribes that DOE must issue a final rule establishing energy conservation standards for automatic commercial ice makers not later than January 1, 2015 and DOE does not have the authority to alter this statutory mandate. (42 U.S.C. 6313(d)(3))

d. ENERGY STAR

Manitowoc and Hoshizaki noted that the proposed standard bypasses the ENERGY STAR level (Manitowoc, Public Meeting Transcript, No. 70 at p. 74; Hoshizaki, No. 86 at p. 1) Manitowoc expressed concern that, if efficiency standards were raised to the level proposed in the NOPR, there would be no more room for an ENERGY STAR category, which would be disruptive to the industry. (Manitowoc, Public Meeting Transcript, No. 70 at p. 74)

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 technologically feasible and economically justified. The standard level considered in this final rule is estimated to reduce cumulative source energy usage by 8% percent over the baseline, for products purchased in 2018–2047. Comparatively, the max-tech level is estimated to reduce cumulative source energy usage by 14% percent over the baseline for the same time period (refer to section V.B.3 for a complete discussion of energy savings). As such, the standard level continues to leave room for ENERGY STAR rebate programs, and therefore new ENERGY STAR levels could be reestablished once compliance with these standards is required.

e. Request for DOE and EPA Collaboration

Hoshizaki commented that during a previous round of refrigerant changeovers, it took over five years to make the appropriate changes to their product line and that it would take even longer this time due to the highly flammable refrigerant alternatives under consideration that would require additional redesign work. Hoshizaki requested that DOE and EPA work together to ensure that manufacturers are not unduly burdened with standards from both agencies. (Hoshizaki, No. 86 at p. 6–7)

DOE recognizes that the combined effects of recent or impending regulations may have serious consequences for some manufacturers, groups of manufacturers, or an entire industry. As such, DOE conducts an analysis of the cumulative regulatory burden as part of its rulemakings pertaining to equipment efficiency. As stated previously, however, DOE cannot speculate on the outcome of a rulemaking in progress and can only consider in its rulemakings regulations that are currently in effect. If a manufacturer believes that its design is subjected to undue hardship by regulations, the manufacturer may petition DOE's Office of Hearing and Appeals (OHA) for exception relief or exemption from the standard pursuant to OHA's authority under section 504 of the DOE Organization Act (42 U.S.C. 7194), as implemented at subpart B of 10 CFR part 1003. OHA has the authority to grant such relief on a case-by-case basis if it determines that a manufacturer has demonstrated that meeting the standard would cause hardship, inequity, or unfair distribution of burdens.

f. Compliance With Refrigerant Changes Could Be Difficult

NAFEM commented that municipal and state regulations and codes may make it difficult to comply with proposed EPA refrigerant regulations in some localities and could create hardship for manufacturers. (NAFEM, No. 82 at p. 7)

This comment relates to proposed EPA refrigerant regulations, and is beyond the scope of this rulemaking. DOE has forwarded the comment to EPA's Stratospheric Protection Division.

g. Small Manufacturers

NAFEM notes that the proposed rule has a disparate impact on small businesses because commercial ice makers are largely manufactured by small businesses. (NAFEM, No. 82 at p. 5) AHRI agreed that this rulemaking has impacts on small businesses and requested DOE account for all small ACIM manufacturers. (AHRI, No. 93 at p. 12)

DOE recognizes the potential for this rule to affect small businesses. As a result, DOE presented a small business manufacturer sub-group analysis in the NOPR stage and in this final rule notice. DOE used industry trade association membership directories, public product databases, individual company Web sites, and other market research tools to establish a draft list of covered small manufacturers. DOE presented its draft list of covered small manufacturers to stakeholders and industry representatives and asked if they were aware of any other small manufacturers that should be added to the list during manufacturer interviews and at DOE public meetings. DOE identified seven small manufacturers at the NOPR stage. Stakeholders did not provide any information in interviews or comments that identified additional small manufacturers of automatic commercial ice makers. As discussed in section VI.B, DOE applied the small business size standards published by the SBA to determine whether a company is considered a small manufacturer. The SBA defines a small business for NAICS 333415 ''Air-Conditioning and Warm Air Heating Equipment and Commercial and Industrial Refrigeration Equipment Manufacturing'' as having 750 or fewer employees. The 750-employee threshold includes all employees in a business's parent company and any other subsidiaries. Given the lack of additional new information, DOE maintains that there are seven small business manufacturers of the covered product in the Final Regulatory Flexibility Analysis, found in section VI.B.

NAFEM did not provide any data supporting the suggestion that the majority of domestic ice maker sales are from small manufacturers. Based on a 2008 study by Koeller & Company,[55] DOE understands that the ACIM market is dominated by four manufacturers who produce approximately 90 percent of the automatic commercial ice makers for sale in the United States. The four major manufacturers with the largest market share are Manitowoc, Scotsman, Hoshizaki, and Ice-O-Matic; none of which are consider small business manufacturers. The remaining 12 large and small manufacturers account for ten percent of domestic sales. Thus, DOE disagrees with NAFEM's statement that a majority of sales are from small manufacturers.

h. Large Manufacturers

Scotsman commented that DOE's INPV analysis ignores manufacturers' current financial stability and noted that the impacts on large manufacturers could be significantly more severe than the average. (Scotsman, No. 85 at p.6b)

The MIA does not forecast the financial stability of individual manufacturers. The MIA is an industry-level analysis. Inherent to this analysis is that fact that not all industry participants will perform equally.

i. Negative Impact on Market Growth

Follett and Hoshizaki commented that more stringent standards have an adverse impact on innovation and development of new products. Follett commented that DOE's analysis must account for the lost opportunity to initiate growth projects that would expand the market. (Follett, No. 84 at p.10) (Hoshizaki, No.86 at p.4) NRA commented that the cost of R&D would be passed on to end-users, causing them to delay purchasing new equipment and thus negatively affecting the ice machine industry. (NRA, No. 69 at p. 4)

The MIA uses the annual shipments forecast from the Shipment's Analysis as an input in the GRIM. The Shipments Analysis provides the base case shipments as well as standards case shipments. The analysis uses data from AHRI, ENERGY STAR, and U.S. Census Bureau's Current Industrial Reports (CIR) to estimate historical shipments for automatic commercial ice makers. Future shipments are broken down into replacement units based on a stock accounting model; new sales based on

[55] Koeller, John, P.E., and Herman Hoffman, P.E. A Report on Potential Best Management Practices. Rep. The California Urban Water Conservation Council, n.d. Web. 19 May 2014.

projections of new construction activity from AEO2014. More detail on this methodology can be found in section IV.H.1. DOE's analysis does not speculate on additional shipments that are the result of ''growth projects.'' Manufacturers did not provide estimations of these growth levels or justification for such growth levels. Thus, DOE was not able to include such growth factors in its models.

j. Negative Impact on Non-U.S. Sales

Follett added that the additional cost of efficient components would impact non-U.S. sales. (Follett, No. 84 at p.7) Ice-O-Matic commented that they can't afford designs that can only be sold in North America and that they will lose global busines. (Ice-O-Matic, No. 70 at p.308) Scotsman stated it will be a challenge to meet DOE efficiency thresholds, the EPA SNAP regulations and EU regulations with common equipment platforms. Scotsman continued that the regulations will make it difficult for domestic manufacturers to compete in the global market, where the customers' primary decision criterion is sales price. (Scotsman, No.125 at p. 2–3) Scotsman requested DOE's analysis account for the impact that regulations will have on manufacturers' ability to compete in a global market against cheaper products not governed by DOE standards. (Scotsman, No.70 at p.43–44)

The standards in this final rule only cover equipment placed into commerce in the domestic market, and as such, do not restrict manufacturers from selling products below the new and amended standards in foreign markets. DOE notes that manufacturers make products today that meet the standard set by the 2005 energy conservation standard for automatic commercial ice makers and are able to compete against manufacturers with production lines in lower cost countries. In their comments, manufacturers did not provide any information as to which product models or which efficiencies are sold into international markets. If the models sold internationally have efficiencies that exceed the amended standard, then manufacturers will likely see a production cost decrease as sales roll-up to the new standard and production volumes increase. It is also possible that manufacturer production costs could increase marginally due to small production runs. However, stakeholders did not provide enough information for DOE to model the price-sensitivity of the foreign market.

k. Employment

Ice-O-Matic commented that, if the market loses net present value, companies are not going to accept less profit, and so there's no way they can employ the same number of people unless they reduce their pay. (Ice-O-Matic, No. 70 at p.313) In the NOPR public meeting, AHRI, Scotsman, and Ice-o-matic noted concerns about DOE direct employment estimates being too low. (No. 70 at p.320–330)

DOE analyzes the potential impacts of the energy conservation standard on direct production labor in section V.B.2.d. This analysis estimates the production head count, including production workers up to the line-supervisor level who are directly involved in fabricating and assembling a product within an original equipment manufacturer (OEM) facility. It does not account for sales, engineering, management, and all other workers who are not directly producing and assembling product. DOE presents an upper and lower bound for direct employment. DOE does not assert that employment will remain steady throughout the analysis period.

In the NOPR, DOE clearly stated the assumptions that contributed to its estimate of direct production employment. These assumptions included: Unit sales, labor content per unit sold, average hourly wages for production workers, and annual hours worked by production workers. The calculation of production employment is discussed in detail in chapter 12 of the TSD, section 12.7. In the NOPR and NODA comments, DOE did not receive any comments on these key production employment assumptions. However, DOE updated its final rule analysis based on a revised engineering analysis, shipments analysis, and trial standard levels.

l. Compliance With 12866 and 13563

NAFEM commented that DOE is in violation of Executive Orders 12866 and 13563. (NAFEM, No. 82 at p.8) DOE has fulfilled the obligations required by Executive Orders 12866 and 13563. Additional information can be found in section VI of this preamble.

m. Warranty Claims

Scotsman noted concern that the MIA results had not ''accurately accounted for warranty increases''. (Scotsman, No.125 at p.3) Specifically, it noted that an ECM condenser fan motor would cost significantly more than its current component.

DOE did not explicitly factor in changes in warranty set-asides or payments. In interviews, DOE requested manufacturers highlight key concerns related to the rulemaking. Warranty concerns were not cited as a key issue. In order for DOE to account for changes in warranty costs, manufacturers would need to provide data on current product failure rates, causes of failure and related repair costs, expected future warranty rates, and changes in expected repair costs. Insufficient information was provided to model a change in warranty reserve and warranty pay out. Aside from the Scotsman data point on the cost of ECM fan motors, no other manufacturer supplied hard data related to warranty expenses. As a result, DOE did not incorporate a change in warranty rate in its analysis.

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

AHRI commented that DOE must perform analyses to assess the impacts of the final rule on component suppliers, distributors, dealers, and contractors. Policy Analyst also suggested that DOE assess whether suppliers are affected by the proposed standard. (Policy Analyst, No. 75 at p. 10) The MIA assesses the impact of amended energy conservation standards on manufacturers of automatic commercial ice makers. Analysis of the impacts on distributors, dealers, and contractors as a result of energy conservation standards on manufacturers of automatic commercial ice makers 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 in sales orders following new or amended standards. In public comments and in confidential interviews, 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. (Manitowoc, Preliminary Analysis Public Meeting Transcript, No. 42 at pp. 14–15). 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.

K. Emissions Analysis

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

DOE primarily conducted the emissions analysis using emissions factors for CO_2 and most of the other gases derived from data in the *AEO2014*. Combustion emissions of CH_4 and N_2O were estimated using emissions intensity factors published by the Environmental Protection Agency (EPA), GHG Emissions Factors Hub.[56] 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 final rule TSD.

For CH_4 and N_2O, DOE calculated emissions reduction in tons and also in terms of units of carbon dioxide equivalent (CO_2eq). Gases are converted to CO_2eq by multiplying the physical units by the gases' global warming potential (GWP) over a 100-year time horizon. Based on the Fourth Assessment Report of the Intergovernmental Panel on Climate Change,[57] DOE used GWP values of 28 for CH_4 and 265 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. *AEO2014* generally represents current legislation and environmental regulations, including recent government actions, for which implementing regulations were available as of October 31, 2013.

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.[58] In 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 D.C. Circuit issued a decision to vacate CSAPR.[59] The court ordered EPA to continue administering CAIR. The emissions factors used for this final rule, which are based on *AEO2014,* assume that CAIR remains a binding regulation through 2040.[60]

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 2016, 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. *AEO2014* assumes that, in order to continue operating, coal plants must have either flue gas desulfurization or dry sorbent injection systems installed by 2016. Both technologies are used to reduce acid gas emissions, and also reduce SO_2 emissions. Under the MATS, 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 2016 and beyond.

CAIR established a cap on NO_X emissions in 28 eastern States and the District of Columbia.[61] 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 this final rule 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 *AEO2014,* which incorporates the MATS.

In response to the NOPR, DOE received one comment specifically about measuring environmental benefits. Policy Analyst stated that DOE should commit to measuring environmental benefits and reductions in energy usage as a result of these standards. (Policy Analyst, No. 75 at p. 10) DOE has invested a great deal of time and effort in quantifying the energy reductions and environmental benefits of this rule, as described in this section and as described in the discussion of the

[56] *http://www.epa.gov/climateleadership/inventory/ghg-emissions.html.*

[57] Intergovernmental Panel on Climate Change. *Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change.* 2013. Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley (eds.). Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA. Chapter 8.

[58] 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).

[59] See *EME Homer City Generation, LP* v. *EPA,* 696 F.3d 7, 38 (D.C. Cir. 2012).

[60] On April 29, 2014, the U.S. Supreme Court reversed the judgment of the D.C. Circuit and remanded the case for further proceedings consistent with the Supreme Court's opinion. The Supreme Court held in part that EPA's methodology for quantifying emissions that must be eliminated in certain states due to their impacts in other downwind states was based on a permissible, workable, and equitable interpretation of the Clean Air Act provision that provides statutory authority for CSAPR. See *EPA* v. *EME Homer City Generation,* No 12–1182, slip op. at 32 (U.S. April 29, 2014). Because DOE is using emissions factors based on *AEO2014* for today's final rule, the analysis assumes that CAIR, not CSAPR, is the regulation in force. The difference between CAIR and CSAPR is not relevant for the purpose of DOE's analysis of SO_2 emissions.

[61] CSAPR also applies to NO_X and it would supersede the regulation of NO_X under CAIR. As stated previously, the current analysis assumes that CAIR, not CSAPR, is the regulation in force. The difference between CAIR and CSAPR with regard to DOE's analysis of NO_X emissions is slight.

NIA (IV.H). Given the dispersed nature of automatic commercial ice makers on customer premises across the country, actual physical measurement of the energy savings and environmental benefits would be a large and costly undertaking which would likely not yield useful results. However, DOE is committed to working with other governmental agencies to continue developing tools for quantifying the environmental benefits of proceedings such as this ACIM rulemaking. The discussion that follows of the development of the social cost of carbon (SCC) is the prime example of these efforts.

L. Monetizing Carbon Dioxide and Other Emissions Impacts

As part of the development of the standards in this final 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 this final rule, DOE is relying on a set of values for the social cost of carbon (SCC) that was developed by an interagency process. The basis for these values is summarized below, and a more detailed description of the methodologies used is provided as an appendix to chapter 14 of the final rule 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 CO_2. A domestic SCC value is meant to reflect the value of damages in the United States resulting from a unit change in CO_2 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. 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 CO_2 emissions, the analyst faces a number of serious challenges. A report from the National Research Council [62] 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 limits of both quantification and monetization, SCC estimates can be useful in estimating the social benefits of reducing CO_2 emissions. 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.

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. Development of Social Cost of Carbon Values

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

c. Current Approach and Key Assumptions

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

Each model takes a slightly different approach to model how changes in

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

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.34 presents the values in the 2010 interagency group report,[63] which is reproduced in appendix 14A of the TSD.

TABLE IV.34—ANNUAL SCC VALUES FROM 2010 INTERAGENCY REPORT, 2010–2050

[2007 dollars per metric ton CO_2]

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

The SCC values used for this rulemaking were generated using the most recent versions of the three integrated assessment models that have been published in the peer-reviewed literature.[64] (See appendix 14–B of the final rule TSD for further information.) Table IV.35 shows the updated sets of SCC estimates in 5-year increments from 2010 to 2050. The full set of annual SCC estimates between 2010 and 2050 is reported in appendix 14–B of the final rule 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.35—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
2045	24	66	92	206
2050	26	71	97	220

[63] *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.*

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

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 in section IV.L.1.a 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 analytic challenges that are being 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 2013$ using the Gross Domestic Product price deflator. For each of the four cases of SCC values, the values for emissions in 2015 were $12.0, $40.5, $62.4, and $119 per metric ton of CO_2 avoided. 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.

In responding to the NOPR, many commenters questioned why DOE quantified the emissions. Commenters also questioned the scientific and economic basis of the SCC values.

Scotsman stated they did not understand the logic of predicting emissions reductions associated with a product with such a limited population relative to national average energy consumption. (Scotsman, No. 95 at page 7) As stated earlier in the SCC discussion, DOE quantifies emissions reductions as one of the societal impacts of all standards in accordance with section 1(b) of Executive Order 12866.

A number of stakeholders stated that DOE should not use SCC values to establish monetary figures for emissions reductions until the SCC undergoes a more rigorous notice, review, and comment process. (AHRI, No. 93 at pp. 13–14; The Associations, No. 77 at p. 4) The Cato Institute commented that SCC should be barred from use until its deficiencies are rectified. (Cato Institute, No. 74 at p. 1) Similarly, IER stated that SCC should no longer be used in Federal regulatory analysis and rulemakings. (IER, No. 83 at p. 2) In contrast, IPI et al. affirmed that current SCC values are sufficiently robust and accurate for continued use in regulatory analyses. (IPI, No. 78 at p. 1)

In conducting the interagency process that developed the SCC values, 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. Key uncertainties and model differences transparently and consistently inform the range of SCC estimates. These uncertainties and model differences are discussed in the interagency working group's reports, which are reproduced in appendix 14A and 14B of the TSD, as are the major assumptions. The 2010 SCC values have been used in a number of Federal rulemakings upon which the public had opportunity to comment. In November 2013, the OMB announced a new opportunity for public comment on the TSD underlying the revised SCC estimates. *See* 78 FR 70586 (Nov. 26, 2013). OMB is currently reviewing comments and considering whether further revisions to the 2013 SCC estimates are warranted. DOE stands ready to work with OMB and the other members of the interagency working group on further review and revision of the SCC estimates as appropriate.

IER commented that the SCC is inappropriate for use in federal rulemakings because it is based on subjective modeling decisions rather than objective observations and because it violates OMB guidelines for accuracy, reliability, and freedom from bias. (IER, No. 83 at p. 2) The General Accounting Office (GAO) was asked to review the Interagency Working Group's (IWG) development of SCC estimates,[65] and noted that OMB and EPA participants reported that the IWG documented all major issues consistent with Federal standards for internal control. The GAO also found, according to its document review and interviews, that the IWG's development process followed three principles: (1) It used consensus-based decision making; (2) it relied on existing academic literature and models; and (3) it took steps to disclose limitations and incorporate new information. Further, DOE has sought to ensure that the data and research used to support its policy decisions—including the SCC values—are of high scientific and technical quality and objectivity, as called for by the Secretarial Policy Statement on Scientific Integrity.[66] See section VI.L for DOE's evaluation of this final rule and supporting analyses under the DOE and OMB information quality guidelines.

The Cato Institute stated that the determination of the SCC is discordant with the best scientific literature on the equilibrium climate sensitivity and the fertilization effect of CO_2—two critically important parameters for establishing the net externality of CO_2 emissions. (Cato Institute, No. 74 at pp. 1, 12–15) The revised estimates that were issued in November 2013 are based on the best available scientific information on the impacts of climate change. The issue of equilibrium climate sensitivity is addressed in section 14A.4 of appendix 14A in the TSD. The EPA, in collaboration with other Federal agencies, continues to investigate potential improvements to the way in which economic damages associated with changes in CO_2 emissions are quantified.

AHRI commented that the GHG emissions reductions benefits may be overestimated because the DOE's analysis does not take into consideration EPA's planned regulation of GHG emissions from power plants, which would affect the estimated carbon emissions. AHRI suggested DOE conduct additional research on the impact of EPA's regulations on SCC values. (AHRI, No. 93 at p. 14) As noted in section IV.L.1, DOE participates in the IWG process. DOE believes that if necessary and appropriate the IWG will perform research as suggested by AHRI, but notes that results from any such research will not be timely for inclusion in this rulemaking. With respect to AHRI's comment about accounting for EPA's planned regulations, DOE cannot account for regulations that are not currently in effect because whether such regulations will be adopted and their final form are matters of speculation at this time.

The Cato Institute commented that the IWG appears to violate the directive in OMB Circular A–4, which states, ''Your analysis should focus on benefits and costs that accrue to citizens and residents of the United States. Where you choose to evaluate a regulation that

[65] *www.directives.doe.gov/directives-documents/400-series/0411.2-APolicy.*

[66] *www.gao.gov/products/GAO-14-663.*

is likely to have effects beyond the borders of the United States, these effects should be reported separately.'' The Cato Institute stated that instead of focusing on domestic benefits and separately reporting any international effects, the IWG only reports the global costs and makes no determination of the domestic costs. (Cato Institute, No. 74 at pp. 2–3) IER expressed similar concerns about the IWG's use of a global perspective in reporting SCC estimates. (IER, No. 83 at pp. 16–17) AHRI commented that either domestic or global costs and benefits should be considered, but not both. (AHRI, No. 93 at p. 14)

Although the relevant analyses address both domestic and global impacts, the interagency group has determined that it is appropriate to focus on a global measure of SCC because of the distinctive nature of the climate change problem, which is highly unusual in at least two respects. First, it involves a global externality: Emissions of most greenhouse gases contribute to damages around the world when they are emitted in the United States. Second, climate change presents a problem that the United States alone cannot solve. The issue of global versus domestic measures of the SCC is further discussed in appendix 14A of the TSD.

AHRI stated that the costs of the proposed rule are calculated over the course of a 30-year period, while avoided SCC benefit is calculated over a 300-year period. AHRI further commented that longer-term (*i.e.,* 30–300 years) impacts of regulations on businesses are unknown, and should be studied. (AHRI, No. 93 at p. 14) For the analysis of national impacts of standards, DOE considers the lifetime impacts of equipment shipped in a 30-year period, with energy and cost savings impacts aggregated until all of the equipment shipped in the 30-year period is retired. With respect to the valuation of CO_2 emissions reductions, the SCC estimates developed by the IWG are meant to represent the full discounted value (using an appropriate range of discount rates) of emissions reductions occurring in a given year. Thus, DOE multiplies the SCC values for achieving the emissions reductions in each year of the analysis by the carbon reductions estimated for each of those same years. Neither the costs nor the benefits of emissions reductions outside the analytic time frame are included in the analysis.

2. Valuation of Other Emissions Reductions

As noted in section IV.K, DOE has taken into account how new or amended energy conservation standards would reduce NO_X emissions in those 22 States not affected by emissions caps. DOE estimated the monetized value of NO_X emissions reductions resulting from each of the TSLs considered for this final rule based on estimates found in the relevant scientific literature. Estimates of monetary value for reducing NO_X from stationary sources range from $476 to $4,893 per ton (2013$).[67] DOE calculated monetary benefits using a medium value for NO_X emissions of $2,684 per short ton (in 2013$), 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 such monetization in the current analysis.

M. Utility Impact Analysis

The utility impact analysis estimates several effects on the power generation industry that would result from the adoption of new or amended energy conservation standards. 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,[68] 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,[69] 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 final rule TSD describes the utility impact analysis.

DOE received one comment about the utility impact analysis. Policy Analyst commented that DOE should commit to measuring the effects of these energy savings on the security, reliability, and costs of maintaining the nation's energy system. (Policy Analyst, No. 75 at p. 10) As discussed in Chapter 15 of the TSD, DOE does quantify the effects of the energy savings on the nation's energy system. Given the widely dispersed nature of automatic commercial ice makers on customer premises across the country, physically measuring the impacts would be time-consuming and costly and would likely not result in useful measurements of the effects. DOE has over the course of many energy conservation standards rulemakings developed the tools and processes used in this rulemaking to estimate the impacts on the electric utility system, and those impacts are discussed in Chapter 15 of the TSD.

N. Employment Impact Analysis

Employment impacts from new or amended energy conservation standards include direct and indirect impacts. Direct employment impacts, which are addressed in the MIA, are any changes in the number of employees of manufacturers of the equipment subject to standards. Indirect employment impacts, which are assessed as part of the employment impact analysis, 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 equipment. 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 equipment; 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

[67] 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. Available at: *www.whitehouse.gov/sites/default/files/omb/assets/omb/inforeg/2006_cb/2006_cb_final_report.pdf.*

[68] 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.

[69] 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).

economy.[70] There are many reasons for these differences, including wage differences and the fact that the utility sector is more capital-intensive and less 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 standard levels considered in this final rule, 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).[71] 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 overestimate actual job impacts over the long run. For the final rule, DOE used ImSET only to estimate short-term (through 2022) employment impacts.

DOE received no comments specifically on the indirect employment impacts. Comments received were related to manufacturing employment impacts, and DOE reiterates that the indirect employment impacts estimated with ImSET for the entire economy differ from the direct employment impacts in the ACIM manufacturing sector estimated using the GRIM in the MIA, as described at the beginning of this section. The methodologies used and the sectors analyzed in the ImSET and GRIM models are different.

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

O. Regulatory Impact Analysis

DOE prepared a regulatory impact analysis (RIA) for this rulemaking, which is described in chapter 17 of the final rule TSD. The RIA is subject to review by the Office of Information and Regulatory Affairs (OIRA) in the OMB. The RIA consists of (1) a statement of the problem addressed by this regulation and the mandate for government action; (2) a description and analysis of policy alternatives to this regulation; (3) a 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. See chapter 17 of the final rule TSD for further details.

In response to the NOPR, DOE received comments from NAFEM stating that NAFEM commented that DOE failed to consider the positive role of ENERGY STAR in the marketplace, that the Federal Energy Management Program (FEMP) already encourages manufacturers to innovate and create energy savings, the effects of local and state initiatives, and the effects of voluntary building standards that require high efficiency products in the marketplace. (NAFEM, No. 82 at pp. 8–9)

In response to the NAFEM comment, DOE notes first that FEMP and other voluntary programs tend to use ENERGY STAR as the efficiency target levels for equipment classes covered by ENERGY STAR. DOE recognizes that the market has achieved a roughly 60-percent success rate in reaching the ENERGY STAR criteria for the time that ENERGY STAR has covered automatic commercial ice makers. The market-driven accomplishments are reflected in the distribution of shipments by efficiency level for the base conditions, and very much influence the results of the analysis. The selected TSL 3 yields a shipments-weighted average efficiency improvement of approximately 8 percent. If all customers purchased efficiency level 1 equipment (*i.e.,* baseline equipment), the shipments-weighted average efficiency improvement would be over 18 percent. The difference is attributable to the combination of ENERGY STAR, FEMP, utility incentive programs, incentive programs operated by governmental entities and others, and customer economic decision making.

In deciding what efficiency targets to model in the RIA, DOE noted that modeling the new ENERGY STAR criteria would show modest energy savings and NPV results because, as noted above, the baseline already reflects the market-driven accomplishments. Further, ENERGY STAR changes their criteria periodically. The first set of automatic commercial ice maker criteria was in effect for approximately 5 years, and the second set became effective February 1, 2013. If the ENERGY STAR criteria are updated again after a 5-year period, the criteria will be revised by the compliance date of this rule. Because future ENERGY STAR criteria are unknown, DOE performed the regulatory impact analysis using TSL 3 efficiency levels matched with the 60-percent ENERGY STAR success rate. DOE believes that in performing the analysis in this fashion, DOE was acknowledging the ability of the ENERGY STAR program to reach customers and impact their decision-making.

V. Analytical Results

A. Trial Standard Levels

1. Trial Standard Level Formulation Process and Criteria

DOE selected between two and seven efficiency levels for all equipment

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

[71] 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.*

classes for analysis. For all equipment classes, the first efficiency level is the baseline efficiency level. Based on the results of the NIA and other analyses, 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 as the max-tech level for all equipment classes. At this level, DOE's analysis considered that equipment would require use of design options that generally are not used by ice makers, but that are currently commercially available; specifically drain water heat exchangers for batch ice makers and ECM motors for all ice maker classes. The range of energy use reduction at the max-tech level varies widely with the equipment class, from 7% for IMH–W–Large–B to 33% for SCU–A–Small–B.

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 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 efficiency levels that overlap with both TSLs 1 and 3. The intent of TSL 2 is to provide an intermediate level that examines in efficiency options between TSLs 1 and 3.

TSL 1 was set equal to efficiency level 2. In the NOPR analysis, DOE set efficiency level 2 to be equivalent to ENERGY STAR in effect at the time DOE started the analysis for products rated by ENERGY STAR and to an equivalent efficiency improvement for other equipment classes. However, the ENERGY STAR level for automatic commercial ice makers has since been revised.[72] Therefore, in the NODA and final rule analysis DOE has instead used a more consistent 10-percent level for efficiency level 2, representing energy use 10 percent lower than the baseline energy use. This level reflects but is not fully consistent with the former ENERGY STAR level for those classes covered by ENERGY STAR. The new ENERGY STAR level, defined for all air-cooled equipment classes (i.s. IMH–A, RCU, and SCU–A classes for both batch and continuous ice makers) does not consistently align with any of the TSLs selected by DOE. For example, for IMH–A batch classes, the current ENERGY STAR level corresponds roughly to TSL 1 at 300 lb ice/24 hours, TSL 3 at 800 lb ice/24 hours, and is more stringent than TSL 5 at 1,500 lb ice/24 hours. Graphical comparison of the TSLs, ENERGY STAR, and existing products is providing in Chapter 3 of the TSL.

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 2	Level 3	Level 3	Level 5.
IMH–W–Med–B	Level 2	Level 2	Level 2	Level 3	Level 4.
IMH–W–Large–B †					
IMH–W–Large–B–1	Level 1	Level 1	Level 1	Level 1	Level 2.
IMH–W–Large–B–2	Level 1	Level 1	Level 1	Level 1	Level 2.
IMH–A–Small–B	Level 2	Level 3	Level 3A	Level 3A	Level 6.
IMH–A–Large–B †					
IMH–A–Large–B1	Level 2	Level 3	Level 3A	Level 4	Level 5.
IMH–A–Large–B2	Level 2	Level 2	Level 3	Level 3	Level 3.
RCU–Large–B†					
RCU–Large–B1	Level 2	Level 2	Level 2	Level 3	Level 4.
RCU–Large–B2	Level 2	Level 2	Level 2	Level 2	Level 3.
SCU–W–Large–B	Level 2	Level 4	Level 5	Level 6	Level 6.
SCU–A–Small–B	Level 2	Level 4	Level 5	Level 6	Level 7.
SCU–A–Large–B	Level 2	Level 4	Level 5	Level 6	Level 6.
IMH–A–Small–C	Level 2	Level 3	Level 4	Level 4	Level 6.
IMH–A–Large–C	Level 2	Level 2	Level 3	Level 3	Level 5.
RCU–Small–C	Level 2	Level 3	Level 4	Level 4	Level 6.
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 model the low and the high portions of the applicable range with greater accuracy. 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.

[72] ENERGY STAR Version 2.0 for Automatic Commercial Ice Makers became effective on February 1, 2013.

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

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%	10.0%	15.0%	15.0%	23.9%
IMH–W–Med–B	10.0	10.0	10.0	15.0	18.1
IMH–W–Large–B	0.0	0.0	0.0	0.0	8.1
IMH–W–Large–B1	0.0	0.0	0.0	0.0	8.3
IMH–W–Large–B2	0.0	0.0	0.0	0.0	7.4
IMH–A–Small–B	10.0	15.0	18.1	18.1	25.5
IMH–A–Large–B	10.0	14.2	15.2	18.7	21.6
IMH–A–Large–B1	10.0	15.0	15.8	20.0	23.4
IMH–A–Large–B2	10.0	10.0	11.8	11.8	11.8
RCU–Large–B	10.0	10.0	10.0	14.7	17.1
RCU–Large–B1	10.0	10.0	10.0	15.0	17.3
RCU–Large–B2	10.0	10.0	10.0	10.0	13.9
SCU–W–Large–B	10.0	20.0	25.0	29.8	29.8
SCU–A–Small–B	10.0	20.0	25.0	30.0	32.7
SCU–A–Large–B	10.0	20.0	25.0	29.1	29.1
IMH–A–Small–C	10.0	15.0	20.0	20.0	25.7
IMH–A–Large–C	10.0	10.0	15.0	15.0	23.3
RCU–Small–C	10.0	15.0	20.0	20.0	26.6
SCU–A–Small–C	10.0	15.0	20.0	20.0	26.6

* 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 this final rule and in chapter 5 of the 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—TSL 5 includes all preceding options)						
IMH–W–Small–B	No BW Fill SPM PM	+ Comp EER + Cond	Same EL as TSL 1.	+ Cond	Same EL as TSL 3.	BW Fill + Evap ECM PM DWHX.
IMH–W–Small–B (22 inch wide).	No BW Fill SPM PM	+ Comp EER + Cond	Same EL as TSL 1.	+ Cond BW Fill	Same EL as TSL 3.	N/A for 22-inch.
IMH–W–Med–B	BW Fill SPM PM	+ Comp EER ECM PM	Same EL as TSL 1.	Same EL as TSL 1.	+ Cond	DWHX.
IMH–W–Large–B1	BW Fill SPM PM	Same EL as Baseline.	Same EL as Baseline.	Same EL as Baseline.	Same EL as Baseline.	+ Comp EER + Cond ECM PM DWHX.
IMH–W–Large–B2	BW Fill SPM PM	Same EL as Baseline.	Same EL as Baseline.	Same EL as Baseline.	Same EL as Baseline.	+ Comp EER + Cond ECM PM DWHX.
IMH–A–Small–B	BW Fill SPM PM SPM FM	+ Comp EER + Cond + Evap ECM FM	+ Evap	+ Evap	Same EL as TSL 3.	+ Evap ECM PM DWHX.
IMH–A–Small–B (22 inch wide).	BW Fill SPM PM SPM FM	+ Comp EER + Cond + Evap ECM FM	+ Evap	ECM PM DWHX	Same EL as TSL 3.	N/A for 22-inch.
IMH–A–Large–B1	No BW Fill SPM PM SPM FM	+ Comp EER PSC FM	ECM FM BW Fill	BW Fill	BW Fill ECM PM + Cond	DWHX.
IMH–A–Large–B1 (22 inch wide).	No BW Fill SPM PM SPM FM	+ Comp EER ECM FM BW Fill	BW Fill ECM PM DWHX	DWHX	N/A for 22-inch	N/A for 22-inch.
IMH–A–Large–B2	BW Fill SPM PM SPM FM	+ Comp EER ECM FM ECM PM + Cond DWHX	Same EL as TSL 1.	DWHX	Same EL as TSL 3.	Same EL as TSL 3.

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
RCU–Large–B1	BW Fill SPM PM PSC FM	+ Cond + Comp EER	Same EL as TSL 1.	Same EL as TSL 1.	ECM FM ECM PM + Cond DWHX	DWHX.
RCU–Large–B2	BW Fill SPM PM PSC FM	+ Comp EER ECM FM + Cond ECM PM	Same EL as TSL 1.	Same EL as TSL 1.	Same EL as TSL 1.	DWHX.
SCU–W–Large–B	No BW Fill SPM PM	BW Fill + Evap	+Evap + Cond	+ Cond	+ Cond	DWHX.
SCU–A–Small–B	No BW Fill SPM PM SPM FM	+ Cond + Comp EER	+ Comp EER	PSC FM BW Fill	BW Fill ECM PM ECM FM	ECM FM DWHX.
SCU–A–Large–B	No BW Fill SPM PM SPM FM	+Cond + Comp EER	+ Comp EER BW Fill	BW Fill ECM FM	ECM PM DWHX	Same EL as TSL 4.
RCU–Small–C	PSC AM SPM FM	+ Comp EER PSC FM	ECM FM	ECM FM + Cond	Same EL as TSL3.	+ Cond ECM AM.
IMH–A–Small–C	PSC AM SPM FM	+ Comp EER + Cond	+ Cond ECM FM	ECM FM + Cond	Same EL as TSL 3.	ECM AM.
IMH–A–Large–C	PSC AM SPM FM	+ Comp EER	Same EL as TSL 1.	+ Comp EER + Cond	Same EL as TSL 3.	+ Cond ECM FM ECM AM.
SCU–A–Small–C	PSC AM SPM FM	+ Cond + Comp EER	+ Comp EER	+ Comp EER ECM FM	Same EL as TSL 3.	ECM FM ECM AM.

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

Chapter 5 of the TSD contains full descriptions of the design options, DOE's analyses for the equipment size increase associated with the design options selected, and DOE's analyses of the efficiency gains for each design option considered.

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 batch classes, while Table V.5 provides the potential energy consumption standards for the continuous classes. Note that the size nomenclature for the classes (Small, Medium, Large, and Extended) in many cases designate different capacity ranges than the current class sizes. However, the discussion throughout this preamble is based primarily on the current class capacity ranges—the alternative designation is made in Table V.4 and Table V.5 for future use when the new energy conservation standards take effect.

TABLE V.4—EQUATIONS REPRESENTING THE TSLS FOR BATCH EQUIPMENT CLASSES

[Maximum energy use in kWh/100 lb ice]

Batch equipment class	Capacity range lb ice/24 hours	TSL 1	TSL 2	TSL 3	TSL 4	TSL 5
IMH–W–Small–B	<300	7.19–0.0055H	7.19–0.0055H	6.88–0.0055H	6.88–0.0055H	6.32–0.0055H
IMH–W–Med–B	≥300 and <850	6.28–0.00247H	6.28–0.00247H	5.8–0.00191H	5.9–0.00224H	5.17–0.00165H
IMH–W–Large–B	≥850 and <1500	4.42–0.00028H	4.42–0.00028H	4.0	4.0	3.86–0.00012H
IMH–W–Extended–B	≥1,500 and <2,600	4.0	4.0	4.0	4.0	3.62 + 0.00004H
	≥2,600	4.0	4.0	4.0	4.0	3.72
IMH–A–Small–B	<300	10.09–0.0106H	10.05–0.01173H	10–0.01233H	10–0.01233H	9.38–0.01233H
IMH–A–Medium–B	≥300 and <800	7.81–0.003H	7.38–0.00284H	7.05–0.0025H	7.19–0.00298H	6.31–0.0021H
IMH–A–Large–B	≥800 and <1,500	6.21–0.00099H	5.56–0.00056H	5.55–0.00063H	5.04–0.00029H	4.65–0.00003H

TABLE V.4—EQUATIONS REPRESENTING THE TSLS FOR BATCH EQUIPMENT CLASSES—Continued

[Maximum energy use in kWh/100 lb ice]

Batch equipment class	Capacity range lb ice/24 hours	TSL 1	TSL 2	TSL 3	TSL 4	TSL 5
IMH–A–Extended–B	>1,500	4.73	4.72	4.61	4.61	4.61
RCU–NRC–Small–B	<988 *	7.97–0.00342H	7.97–0.00342H	7.97–0.00342H	7.52–0.00323H	7.35–0.00312H
RCU–NRC–Large–B	≥988 * and <1,500	4.59	4.59	4.59	4.34	4.23
RCU–NRC–Extended–B	≥1,500 and <2,400	4.59	4.59	4.59	3.92 + 0.00028H	3.96 + 0.00018H
	≥2,400	4.59	4.59	4.59	4.59	4.39
RCU–RC–Small–B	<930 **	7.97–0.00342H	7.97–0.00342H	7.97–0.00342H	7.52–0.00323H	7.35–0.00312H
RCU–RC–Large–B	≥930 ** and <1,500	4.79	4.79	4.79	4.54	4.43
RCU–RC–Extended–B	≥1,500 and < 2,400	4.79	4.79	4.79	4.12 + 0.00028H	4.16 + 0.00018H
	≥2,400	4.79	4.79	4.79	4.79	4.59
SCU–W–Small–B	<200	10.64–0.019H	9.88–0.019H	9.5–0.019H	9.14–0.019H	9.14–0.019H
SCU–W–Large–B	≥200	6.84	6.08	5.7	5.34	5.34
SCU–A–Small–B	<110	16.72–0.0469H	15.43–0.0469H	14.79–0.0469H	14.15–0.0469H	13.76–0.0469H
SCU–A–Large–B	≥110 and <200	14.91–0.03044H	13.24–0.027H	12.42–0.02533H	11.47–0.02256H	10.6–0.02
SCU–A–Extended–B	≥200	8.82	7.84	7.35	6.96	6.96

* 985 for TSL4, 1,000 for TSL5
** 923 for TSL4, 936 for TSL5

TABLE V.5—EQUATIONS REPRESENTING THE TSLS FOR CONTINUOUS EQUIPMENT CLASSES

[Maximum energy use in kWh/100 lb ice]

Continuous equipment class	Capacity range lb ice/24 hours	TSL 1	TSL 2	TSL 3	TSL 4	TSL 5
IMH–W–Small–C	<801	7.29–0.003H	6.89–0.00283H	6.48–0.00267H	6.48–0.00267H	5.75–0.00237H
IMH–W–Large–C	≥801	4.59	4.59	4.34	4.34	3.93
IMH–A–Small–C	<310	10.1–0.00629H	9.64–0.00629H	9.19–0.00629H	9.19–0.00629H	8.38–0.00629H
IMH–A–Large–C	≥310 and <820	9.49–0.00433H	8.75–0.00343H	8.23–0.0032H	8.23–0.0032H	7.25–0.00265H
IMH–A–Extended–C	≥820	5.94	5.94	5.61	5.61	5.08
RCU–NRC–Small–C	<800	9.85–0.00519H	9.78–0.0055H	9.7–0.0058H	9.7–0.0058H	9.26–0.0058H
RCU–NRC–Large–C	≥800	5.7	5.38	5.06	5.06	4.62
RCU–RC–Small–C	<800	10.05–0.00519H	9.98–0.0055H	9.9–0.0058H	9.9–0.0058H	9.46–0.0058H
RCU–RC–Large–C	≥800	5.9	5.58	5.26	5.26	4.82
SCU–W–Small–C	<900	8.55–0.0034H	8.08 0.0032H	7.6–0.00302H	7.6–0.00302H	6.84–0.00272H
SCU–W–Large–C	≥900	5.49	5.19	4.88	4.88	4.39
SCU–A–Small–C	<200	15.26–0.03	14.73–0.03H	14.22–0.03H	14.22–0.03H	13.4–0.03H
SCU–A–Large–C	≥200 and 700	10.66–0.00702H	10.06–0.00663H	9.47–0.00624H	9.47–0.00624H	8.52–0.00562H
SCU–A–Extended–C	≥700	5.75	5.42	5.1	5.1	4.59

In developing TSLs, DOE analyzed representative units for each equipment class group, defined for the purposes of this discussion by the ''Type of Ice Maker,'' ''Equipment Type,'' and ''Type of Condenser Cooling'' (see Table IV.2—within each class group, further segregation into equipment classes involves only specification of harvest capacity rate). DOE first established a percentage reduction in energy use associated with each TSL for the representative units. DOE calculated the energy use (in kWh/100 lb ice) associated with this reduction for the harvest capacity rates associated with the representative units (called representative capacities). This provided one or more points with which to define a TSL curve for the entire equipment class group as a function of harvest capacity rate. DOE selected the TSL curve to (a) pass through the points defining energy use for the TSL at the representative capacities; (b) be continuous, with no gaps at the representative capacities or at any other capacities; and (c) be consistent with the energy and capacity trends for commercialized products of the equipment class group.

For the IMH–A–B equipment classes, DOE sought to set efficiency levels that do not vary with harvest capacity for the largest-capacity equipment, but doing so would have violated EPCA's anti-backsliding provisions. As a result, the efficiency levels for large-capacity equipment for this class in the range up to 2,500 lb ice/24 hours were set using multiple segments. This is discussed in section IV.D.2.c.

For the RCU–RC–Large–B, RCU–RC–Small–C, and RCU–RC–Large–C equipment classes, the efficiency levels are 0.2 kWh/100 lb of ice higher than those of the RCU–NRC–Large–B, RCU–NRC–Small–C, and RCU–NRC–Large–C equipment classes, respectively, as discussed in section IV.D.2.a. The RCU–RC–Small–B and RCU–NRC–Small–B efficiency levels are equal, and the harvest capacity break points for the RCU–NRC classes have been set to avoid gaps in allowable energy usage at the breakpoints.

The TSL energy use levels calculated for the representative capacities of the directly-analyzed equipment classes are presented Table V.6.

TABLE V.6—ENERGY CONSUMPTION BY TSL FOR THE REPRESENTATIVE AUTOMATIC COMMERCIAL ICE MAKER UNITS

Equipment class	Representative harvest rate lb ice/24 hours	Representative automatic commercial ice maker unit kWh/100 lb				
		TSL 1	TSL 2	TSL 3	TSL 4	TSL 5
IMH–W–Small–B	300	5.54	5.54	5.23	5.23	4.67
IMH–W–Med–B	850	4.18	4.18	4.18	4.00	3.76
IMH–W–Large–B–1	1,500	4.00	4.00	4.00	4.00	3.68
IMH–W–Large–B–2	2,600	4.00	4.00	4.00	4.00	3.72
IMH–A–Small–B	300	6.91	6.53	6.30	6.30	5.68
IMH–A–Large–B–1	800	5.41	5.11	5.05	4.81	4.63
IMH–A–Large–B–2	1,500	4.72	4.72	4.61	4.61	4.61
RCU–NRC–Large–B–1	1,500	4.59	4.59	4.59	4.34	4.23
RCU–NRC–Large–B–2	2,400	4.59	4.59	4.59	4.59	4.39
SCU–W–Large–B	300	6.84	6.08	5.70	5.34	5.34
SCU–A–Small–B	110	11.56	10.27	9.63	8.99	8.60
SCU–A–Large–B	200	8.82	7.84	7.35	6.96	6.96
IMH–A–Small–C	310	8.15	7.69	7.24	7.24	6.43
IMH–A–Large–C	820	5.94	5.94	5.61	5.61	5.08
RCU–Small–C	800	5.70	5.38	5.06	5.06	4.62
SCU–A–Small–C	220	9.11	8.61	8.10	8.10	7.29

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.F, DOE calculated the LCC savings and PBPs for the TSLs considered in this final rule. The LCC analysis is carried out in the form of Monte Carlo simulations, and the results of LCC analysis are distributed over a range of values. DOE presents the mean or median values, as appropriate, calculated from the distributions of results.

Table V.7 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 five equipment classes have positive LCC savings values at TSL 5, while the remaining classes have negative LCC savings. 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 four of the five classes, the TSL 5 level is not negative, but the LCC savings are less than one-third the TSL 3 savings. All of these results indicate that 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 the design options embodied in TSL 5 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 two cases, the highest LCC savings are at TSL 2: IMH–A–Large–B1 and SCU–W–Large–B. In one case, IMH–A–Small–B, the highest LCC savings occur at TSL1. Two of the three classes with LCC savings maximums below TSL 3 have high one-time installation cost adders for building renovations expected to take place when existing units are replaced, causing the TSL3 LCC savings to be depressed relative to the lower levels. 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 considered TSL, 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 a 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 two exceptions, nearly all customers either benefit or are unaffected by setting standards at TSLs 1, 2, or 3, with 0 to 2 percent of customers experiencing a net cost in all but two classes. Some customers purchasing IMH–A–Small–B (21 percent) and IMH–A–Large–B2 (10 percent) equipment will experience net costs at TSL3. In almost all cases, a portion of the market would experience net costs starting with TSL 4, although in several equipment classes the percentage is below 10 percent. At TSL 5, only in IMH–A–Large–B2 (10 percent) and SCU–W–Large–B (44 percent) do less than 50 percent of customers show a net cost, while in the other classes the percentage of customers with a net cost ranges as high as 96 percent.

The median PBP values for TSLs 1 through 3 are generally less than 3 years, except for IMH–A–Small–B where the TSL 3 PBP is 4.7 years and IMH–A–Large–B2 with a PBP of 6.9 years. The median PBP values for TSL 4 range from 0.7 years to 6.9 years.

PBP values for TSL 5 range from 4.9 years to nearly 12 years. In eight cases, the the PBP exceeds the expected 8.5-year equipment life.

TABLE V.7—SUMMARY LCC AND PBP RESULTS FOR IMH–W–SMALL–B EQUIPMENT CLASS

TSL	Energy usage kWh/yr	Life-cycle cost, all customers 2013$			Life-cycle cost savings				Payback period, median years
		Installed cost	Discounted operating cost	LCC	Affected customers' average savings 2013$	% of customers that experience: Net cost %	No impact %	Net benefit %	
1	2,551	2,476	9,533	12,009	175	0	63	37	2.5
2	2,551	2,476	9,533	12,009	175	0	63	37	2.5
3	2,411	2,537	9,381	11,918	214	1	47	52	2.7
4	2,411	2,537	9,381	11,918	214	1	47	52	2.7
5	2,162	3,371	9,200	12,571	(534)	96	0	4	13.4

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

TSL	Energy usage kWh/yr	Life-cycle cost, all customers 2013$			Life-cycle cost savings				Payback period, median years
		Installed cost	Discounted operating cost	LCC	Affected customers' average savings 2013$	% of customers that experience: Net cost %	No impact %	Net benefit %	
1	5,439	4,325	21,470	25,795	308	0	44	56	2.1
2	5,439	4,325	21,470	25,795	308	0	44	56	2.1
3	5,439	4,325	21,470	25,795	308	0	44	56	2.1
4	5,138	4,607	21,251	25,857	165	28	24	47	5.0
5	4,951	4,943	21,115	26,058	(63)	65	9	26	7.6

TABLE V.9—SUMMARY LCC AND PBP RESULTS FOR IMH–W–LARGE–B EQUIPMENT CLASS

TSL	Energy usage kWh/yr	Life-cycle cost, all customers 2013$			Life-cycle cost savings				Payback period, median years
		Installed cost	Discounted operating cost	LCC	Affected customers' average savings 2013$	% of customers that experience: Net cost %	No impact %	Net benefit %	
1	10,750	6,129	42,992	49,121	0	NA	NA	NA	NA
2	10,750	6,129	42,992	49,121	0	NA	NA	NA	NA
3	10,750	6,129	42,992	49,121	0	NA	NA	NA	NA
4	10,750	6,129	42,992	49,121	0	NA	NA	NA	NA
5	9,891	6,913	42,381	49,294	(172)	67	13	20	10.6

TABLE V.10—SUMMARY LCC AND PBP RESULTS FOR IMH–W–LARGE–B1 EQUIPMENT CLASS

TSL	Energy usage kWh/yr	Life-cycle cost, all customers 2013$			Life-cycle cost savings				Payback period, median years
		Installed cost	Discounted operating cost	LCC	Affected customers' average savings 2013$	% of customers that experience: Net cost %	No impact %	Net benefit %	
1	9,166	5,004	37,051	42,055	0	NA	NA	NA	NA
2	9,166	5,004	37,051	42,055	0	NA	NA	NA	NA

TABLE V.10—SUMMARY LCC AND PBP RESULTS FOR IMH–W–LARGE–B1 EQUIPMENT CLASS—Continued

TSL	Energy usage kWh/yr	Life-cycle cost, all customers 2013$			Life-cycle cost savings				Payback period, median years
		Installed cost	Discounted operating cost	LCC	Affected customers' average savings 2013$	% of customers that experience Net cost %	No impact %	Net benefit %	
3	9,166	5,004	37,051	42,055	0	NA	NA	NA	NA
4	9,166	5,004	37,051	42,055	0	NA	NA	NA	NA
5	8,405	5,747	36,509	42,256	(200)	70	13	17	11.1

TABLE V.11—SUMMARY LCC AND PBP RESULTS FOR IMH–W–LARGE–B2 EQUIPMENT CLASS

TSL	Energy usage kWh/yr	Life-cycle cost, all customers 2013$			Life-cycle cost savings				Payback period, median years
		Installed cost	Discounted operating cost	LCC	Affected customers' average savings 2013$	% of customers that experience Net cost %	No impact %	Net benefit %	
1	15,868	9,763	62,182	71,945	0	NA	NA	NA	NA
2	15,868	9,763	62,182	71,945	0	NA	NA	NA	NA
3	15,868	9,763	62,182	71,945	0	NA	NA	NA	NA
4	15,868	9,763	62,182	71,945	0	NA	NA	NA	NA
5	14,693	10,681	61,346	72,027	(80)	59	13	29	8.9

TABLE V.12—SUMMARY LCC AND PBP RESULTS FOR IMH–A–SMALL–B EQUIPMENT CLASS

TSL	Energy usage kWh/yr	Life-cycle cost, all customers 2013$			Life-cycle cost savings				Payback period, median years
		Installed cost	Discounted operating cost	LCC	Affected customers' average savings 2013$	% of customers that experience Net cost %	No impact %	Net benefit %	
1	3,184	2,539	8,420	10,959	136	1	76	22	3.4
2	3,009	2,655	8,293	10,948	72	21	47	32	4.8
3	2,901	2,695	8,214	10,909	77	21	0	79	4.7
4	2,901	2,695	8,214	10,909	77	21	0	79	4.7
5	2,640	3,331	8,048	11,379	(393)	95	0	5	11.9

TABLE V.13—SUMMARY LCC AND PBP RESULTS FOR IMH–A–LARGE–B EQUIPMENT CLASS

TSL	Energy usage kWh/yr	Life-cycle cost, all customers 2013$			Life-cycle cost savings				Payback period, median years
		Installed cost	Discounted operating cost	LCC	Affected customers' average savings 2013$	% of customers that experience Net cost %	No impact %	Net benefit %	
1	7,272	4,337	14,598	18,935	382	1	69	30	2.2
2	6,964	4,418	14,230	18,648	501	1	45	53	2.4
3	6,881	4,435	14,170	18,605	361	2	12	86	2.3
4	6,622	4,711	13,988	18,699	265	31	12	57	3.9
5	6,411	5,068	13,834	18,902	55	53	10	37	5.6

TABLE V.14—SUMMARY LCC AND PBP RESULTS FOR IMH–A–LARGE–B1 EQUIPMENT CLASS

TSL	Energy usage kWh/yr	Life-cycle cost, all customers 2013$			Life-cycle cost savings				Payback period, median years
		Installed cost	Discounted operating cost	LCC	Affected customers' average savings 2013$	% of customers that experience Net cost %	No impact %	Net benefit %	
1	6,617	4,172	13,943	18,115	439	0	66	34	1.2
2	6,251	4,269	13,506	17,775	580	0	38	62	1.5
3	6,192	4,275	13,464	17,738	407	0	3	97	1.5
4	5,885	4,602	13,247	17,850	294	35	3	63	3.4
5	5,636	5,025	13,066	18,091	45	61	0	39	5.4

TABLE V.15—SUMMARY LCC AND PBP RESULTS FOR IMH–A–LARGE–B2 EQUIPMENT CLASS

TSL	Energy usage *kWh/yr*	Life-cycle cost, all customers 2013$			Life-cycle cost savings				Payback period, median years
		Installed cost	Discounted operating cost	LCC	Affected customers' average savings 2013$	% of customers that experience			
						Net cost %	No impact %	Net benefit %	
1	10,802	5,222	18,129	23,350	76	9	83	8	7.4
2	10,802	5,222	18,129	23,350	76	9	83	8	7.4
3	10,591	5,298	17,975	23,273	110	10	61	29	6.9
4	10,591	5,298	17,975	23,273	110	10	61	29	6.9
5	10,591	5,298	17,975	23,273	110	10	61	29	6.9

TABLE V.16—SUMMARY LCC AND PBP RESULTS FOR RCU–LARGE–B EQUIPMENT CLASS

TSL	Energy usage *kWh/yr*	Life-cycle cost, all customers 2013$			Life-cycle cost savings				Payback period, median years
		Installed cost	Discounted operating cost	LCC	Affected customers' average savings 2013$	% of customers that experience			
						Net cost %	No impact %	Net benefit %	
1	10,908	6,423	14,588	21,012	748	0	56	44	1.1
2	10,908	6,423	14,588	21,012	748	0	56	44	1.1
3	10,908	6,423	14,588	21,012	748	0	56	44	1.1
4	10,362	6,813	14,213	21,026	418	23	22	55	3.3
5	10,066	7,207	14,000	21,206	144	55	2	42	5.0

TABLE V.17—SUMMARY LCC AND PBP RESULTS FOR RCU–LARGE–B1 EQUIPMENT CLASS

TSL	Energy usage *kWh/yr*	Life-cycle cost, all customers 2013$			Life-cycle cost savings				Payback period, median years
		Installed cost	Discounted operating cost	LCC	Affected customers' average savings 2013$	% of customers that experience			
						Net cost %	No impact %	Net benefit %	
1	10,514	6,220	14,190	20,410	743	0	56	44	0.9
2	10,514	6,220	14,190	20,410	743	0	56	44	0.9
3	10,514	6,220	14,190	20,410	743	0	56	44	0.9
4	9,931	6,635	13,790	20,425	391	25	20	55	3.4
5	9,664	6,985	13,595	20,580	161	55	1	44	4.9

TABLE V.18—SUMMARY LCC AND PBP RESULTS FOR RCU–LARGE–B2 EQUIPMENT CLASS

TSL	Energy usage *kWh/yr*	Life-cycle cost, all customers 2013$			Life-cycle cost savings				Payback period, median years
		Installed cost	Discounted operating cost	LCC	Affected customers' average savings 2013$	% of customers that experience			
						Net cost %	No impact %	Net benefit %	
1	16,807	9,465	20,540	30,005	820	1	56	43	3.0
2	16,807	9,465	20,540	30,005	820	1	56	43	3.0
3	16,807	9,465	20,540	30,005	820	1	56	43	3.0
4	16,807	9,465	20,540	30,005	820	1	56	43	3.0
5	16,077	10,516	20,046	30,562	(109)	57	20	23	7.0

TABLE V.19—SUMMARY LCC AND PBP RESULTS FOR SCU–W–LARGE–B EQUIPMENT CLASS

TSL	Energy usage *kWh/yr*	Life-cycle cost, all customers 2013$			Life-cycle cost savings				Payback period, median years
		Installed cost	Discounted operating cost	LCC	Affected customers' average savings 2013$	% of customers that experience			
						Net cost %	No impact %	Net benefit %	
1	3,151	3,540	10,617	14,158	444	0	28	72	1.1
2	2,804	3,620	10,364	13,984	613	0	28	72	1.6
3	2,630	3,664	10,238	13,902	550	0	5	94	1.8
4	2,464	4,114	10,117	14,231	192	44	0	56	5.1
5	2,464	4,114	10,117	14,231	192	44	0	56	5.1

TABLE V.20—SUMMARY LCC AND PBP RESULTS FOR SCU–A–SMALL–B EQUIPMENT CLASS

TSL	Energy usage *kWh/yr*	Life-cycle cost, all customers 2013$			Life-cycle cost savings				Payback period, median years
		Installed cost	Discounted operating cost	LCC	Affected customers' average savings 2013$	% of customers that experience: Net cost %	No impact %	Net benefit %	
1	1,962	2,799	7,193	9,992	110	0	48	52	2.2
2	1,747	2,845	7,051	9,896	161	1	20	79	2.4
3	1,639	2,918	6,843	9,761	281	1	12	87	2.6
4	1,532	3,000	6,778	9,778	230	16	0	84	3.5
5	1,473	3,416	6,737	10,153	(145)	77	0	23	8.9

TABLE V.21—SUMMARY LCC AND PBP RESULTS FOR SCU–A–LARGE–B EQUIPMENT CLASS

TSL	Energy usage *kWh/yr*	Life-cycle cost, all customers 2013$			Life-cycle cost savings				Payback period, median years
		Installed cost	Discounted operating cost	LCC	Affected customers' average savings 2013$	% of customers that experience: Net cost %	No impact %	Net benefit %	
1	2,713	3,275	10,070	13,344	163	0	37	63	1.8
2	2,414	3,345	9,685	13,030	400	0	1	99	1.6
3	2,265	3,402	9,590	12,992	439	0	1	99	2.1
4	2,141	3,854	9,500	13,355	71	54	0	46	6.5
5	2,141	3,854	9,500	13,355	71	54	0	46	6.5

TABLE V.22—SUMMARY LCC AND PBP RESULTS FOR IMH–A–SMALL–C EQUIPMENT CLASS

TSL	Energy usage *kWh/yr*	Life-cycle cost, all customers 2013$			Life-cycle cost savings				Payback period, median years
		Installed cost	Discounted operating cost	LCC	Affected customers' average savings 2013$	% of customers that experience: Net cost %	No impact %	Net benefit %	
1	3,872	6,674	8,869	15,543	245	0	69	31	1.5
2	3,658	6,709	8,723	15,432	292	0	58	42	1.6
3	3,445	6,745	8,572	15,317	313	0	39	61	1.7
4	3,445	6,745	8,572	15,317	313	0	39	61	1.7
5	3,201	7,264	8,552	15,816	(165)	68	14	18	8.8

* Values in parentheses are negative values.

TABLE V.23—SUMMARY LCC AND PBP RESULTS FOR IMH–A–LARGE–C EQUIPMENT CLASS

TSL	Energy usage *kWh/yr*	Life-cycle cost, all customers 2013$			Life-cycle cost savings				Payback period, median years
		Installed cost	Discounted operating cost	LCC	Affected customers' average savings 2013$	% of customers that experience: Net cost %	No impact %	Net benefit %	
1	7,445	5,538	14,275	19,813	539	0	57	43	0.7
2	7,445	5,538	14,275	19,813	539	0	57	43	0.7
3	7,033	5,568	13,979	19,547	626	0	35	65	0.7
4	7,033	5,568	13,979	19,547	626	0	35	65	0.7
5	6,348	6,310	13,705	20,015	28	54	9	37	5.9

TABLE V.24—SUMMARY LCC AND PBP RESULTS FOR RCU–SMALL–C EQUIPMENT CLASS

TSL	Energy usage *kWh/yr*	Life-cycle cost, all customers 2013$			Life-cycle cost savings				Payback period, median years
		Installed cost	Discounted operating cost	LCC	Affected customers' average savings 2013$	% of customers that experience: Net cost %	No impact %	Net benefit %	
1	6,966	5,690	8,588	14,278	498	0	72	28	0.7
2	6,580	5,758	8,319	14,078	448	0	44	55	1.2
3	6,195	5,808	8,046	13,854	505	0	11	89	1.2
4	6,195	5,808	8,046	13,854	505	0	11	89	1.2
5	5,688	6,523	7,878	14,402	(73)	64	6	31	5.8

* Values in parentheses are negative values.

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 2013$			Life-cycle cost savings				Payback period, median years
		Installed cost	Discounted operating cost	LCC	Affected customers' average savings 2013$	% of customers that experience			
						Net cost %	No impact %	Net benefit %	
1	3,077	3,622	8,175	11,797	224	0	56	44	0.8
2	2,907	3,646	8,059	11,705	278	0	47	53	1.1
3	2,738	3,685	7,948	11,633	290	1	32	67	1.5
4	2,738	3,685	7,948	11,633	290	1	32	67	1.5
5	2,515	4,224	7,950	12,174	(268)	86	0	14	11.4

* 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-owned 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 final rule TSD, but with certain modifications. This included fixing the input for business type 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 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 to place a lower value on future savings and a higher value on the upfront equipment purchase costs. The LCC subgroup analysis is described in chapter 11 of the 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 TSD). For TSLs 1–3, in most equipment classes, the LCC savings for the small business subgroup are only slightly different from the average, with some slightly higher and others slightly lower. 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 1–3, the differences range from −7 percent for IMH–A–Large–B2 at TSLs 1 and 2, to +3 percent for the same class at TSL 3 and IMH–A–Small–B at TSL 2. For most equipment classes in Table V.27, the percentage change ranges from a decrease in LCC savings of less than 2 percent to an increase of 2 percent. In summary, the differences are minor at TSLs 1–3.

Table V.28 presents the comparison of median PBPs for the small business subgroup in the foodservice sector with national median values (median PBPs from chapter 8 of the TSD). The PBP values are the same as or shorter than 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. However, 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 the lodging sector (hotels and casinos) with the national average values (LCC savings results from chapter 8 of the TSD). Table V.30 presents the percentage difference between LCC savings of the lodging sector customer subgroup and national average values. For lodging sector small business, LCC savings are lower across the board. For TSLs 1–3, 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 value of future operating and maintenance benefits as well as the present value of the benefits, thus resulting in lower LCC savings. For IMH–A–Small–B the difference exceeds 20 percent, which is likely due to the higher installation cost for this class in combination with the much higher than average discount rate. The IMH–A–Large–B2 class is also significantly lower, in percentage terms. DOE notes that the difference is relatively small in terms of dollars; however, because the national average savings are small, the difference is significant in percentage terms. The lodging subgroup savings for IMH–A–Large–B2 are 88 percent lower than the average at TSLs 1 and 2, and 37 percent lower at TSL 3—the level recommended for the standard.

Table V.31 presents the comparison of median PBPs for the small business subgroup in the lodging sector with national median values (median PBPs from chapter 8 of the TSD). The PBP values are slightly longer or the same for all equipment classes in the lodging small business subgroup at all TSLs. As noted above, the energy savings would be lower 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 2013$*				
		TSL 1	TSL 2	TSL 3	TSL 4	TSL 5
IMH–W–Small–B	Small Business	174	174	212	212	(535)
	All Business Types	175	175	214	214	(534)
IMH–W–Med–B	Small Business	312	312	312	168	(60)
	All Business Types	308	308	308	165	(63)
IMH–W–Large–B	Small Business	NA	NA	NA	NA	(169)
	All Business Types	NA	NA	NA	NA	(172)
IMH–W–Large–B1	Small Business	NA	NA	NA	NA	(198)
	All Business Types	NA	NA	NA	NA	(200)
IMH–W–Large–B2	Small Business	NA	NA	NA	NA	(77)
	All Business Types	NA	NA	NA	NA	(80)
IMH–A–Small–B	Small Business	139	75	78	78	(390)
	All Business Types	136	72	77	77	(393)
IMH–A–Large–B	Small Business	387	498	359	264	54
	All Business Types	382	501	361	265	55
IMH–A–Large–B1	Small Business	444	575	404	292	43
	All Business Types	439	580	407	294	45
IMH–A–Large–B2	Small Business	81	81	114	114	114
	All Business Types	76	76	110	110	110
RCU–Large–B	Small Business	754	754	754	424	150
	All Business Types	748	748	748	418	144
RCU–Large–B1	Small Business	749	749	749	397	166
	All Business Types	743	743	743	391	161
RCU–Large–B2	Small Business	832	832	832	832	(99)
	All Business Types	820	820	820	820	(109)
SCU–W–Large–B	Small Business	431	601	541	184	184
	All Business Types	444	613	550	192	192
SCU–A–Small–B	Small Business	112	162	276	226	(148)
	All Business Types	110	161	281	230	(145)
SCU–A–Large–B	Small Business	164	392	432	65	65
	All Business Types	163	400	439	71	71
IMH–A–Small–C	Small Business	248	296	317	317	(155)
	All Business Types	245	292	313	313	(165)
IMH–A–Large–C	Small Business	544	544	630	630	44
	All Business Types	539	539	626	626	28
RCU–Small–C	Small Business	503	453	509	509	(57)
	All Business Types	498	448	505	505	(73)
SCU–A–Small–C	Small Business	225	281	293	293	(257)
	All Business Types	224	278	290	290	(268)

*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	−1	−1	−1	−1	0
IMH–W–Med–B	1	1	1	2	5
IMH–W–Large–B	NA	NA	NA	NA	1
IMH–W–Large–B1	NA	NA	NA	NA	1
IMH–W–Large–B2	NA	NA	NA	NA	4
IMH–A–Small–B	2	3	2	2	1
IMH–A–Large–B	1	−1	−1	−1	−2
IMH–A–Large–B1	1	−1	−1	−1	−4
IMH–A–Large–B2	7	7	3	3	3
RCU–Large–B	1	1	1	1	4
RCU–Large–B1	1	1	1	1	3
RCU–Large–B2	1	1	1	1	9
SCU–W–Large–B	−3	−2	−2	−4	−4
SCU–A–Small–B	1	1	−2	−2	−2
SCU–A–Large–B	1	−2	−2	−9	−9
IMH–A–Small–C	1	1	1	1	6
IMH–A–Large–C	1	1	1	1	57
RCU–Small–C	1	1	1	1	22
SCU–A–Small–C	1	1	1	1	4

*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	2.3	2.3	2.7	2.7	12.7
	All Business Types	2.5	2.5	2.7	2.7	13.4
IMH–W–Med–B	Small Business	2.0	2.0	2.0	4.8	7.2
	All Business Types	2.1	2.1	2.1	5.0	7.6
IMH–W–Large–B	Small Business	NA	NA	NA	NA	10.0
	All Business Types	NA	NA	NA	NA	10.6
IMH–W–Large–B1	Small Business	NA	NA	NA	NA	10.5
	All Business Types	NA	NA	NA	NA	11.1
IMH–W–Large–B2	Small Business	NA	NA	NA	NA	8.4
	All Business Types	NA	NA	NA	NA	8.9
IMH–A–Small–B	Small Business	3.2	4.5	4.4	4.4	11.4
	All Business Types	3.4	4.8	4.7	4.7	11.9
IMH–A–Large–B	Small Business	2.1	2.3	2.2	3.7	5.3
	All Business Types	2.2	2.4	2.3	3.9	5.6
IMH–A–Large–B1	Small Business	1.1	1.4	1.4	3.2	5.1
	All Business Types	1.2	1.5	1.5	3.4	5.4
IMH–A–Large–B2	Small Business	7.0	7.0	6.5	6.5	6.5
	All Business Types	7.4	7.4	6.9	6.9	6.9
RCU–Large–B	Small Business	1.0	1.0	1.0	3.2	4.8
	All Business Types	1.1	1.1	1.1	3.3	5.0
RCU–Large–B1	Small Business	0.9	0.9	0.9	3.2	4.7
	All Business Types	0.9	0.9	0.9	3.4	4.9
RCU–Large–B2	Small Business	2.8	2.8	2.8	2.8	6.7
	All Business Types	3.0	3.0	3.0	3.0	7.0
SCU–W–Large–B	Small Business	1.1	1.5	1.7	4.9	4.9
	All Business Types	1.1	1.6	1.8	5.1	5.1
SCU–A–Small–B	Small Business	2.0	2.2	2.5	3.3	8.4
	All Business Types	2.2	2.4	2.6	3.5	8.9
SCU–A–Large–B	Small Business	1.7	1.6	2.0	6.2	6.2
	All Business Types	1.8	1.6	2.1	6.5	6.5
IMH–A–Small–C	Small Business	1.4	1.5	1.6	1.6	8.3
	All Business Types	1.5	1.6	1.7	1.7	8.8
IMH–A–Large–C	Small Business	0.6	0.6	0.7	0.7	5.5
	All Business Types	0.7	0.7	0.7	0.7	5.9
RCU–Small–C	Small Business	0.7	1.1	1.2	1.2	5.5
	All Business Types	0.7	1.2	1.2	1.2	5.8
SCU–A–Small–C	Small Business	0.7	1.0	1.4	1.4	10.6
	All Business Types	0.8	1.1	1.5	1.5	11.4

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 2013$ *				
		TSL 1	TSL 2	TSL 3	TSL 4	TSL 5
IMH–W–Small–B	Small Business	155	155	189	189	(561)
	All Business Types	175	175	214	214	(534)
IMH–W–Med–B	Small Business	275	275	275	123	(109)
	All Business Types	308	308	308	165	(63)
IMH–W–Large–B	Small Business	NA	NA	NA	NA	(221)
	All Business Types	NA	NA	NA	NA	(172)
IMH–W–Large–B1	Small Business	NA	NA	NA	NA	(244)
	All Business Types	NA	NA	NA	NA	(200)
IMH–W–Large–B2	Small Business	NA	NA	NA	NA	(148)
	All Business Types	NA	NA	NA	NA	(80)
IMH–A–Small–B	Small Business	118	54	61	61	(423)
	All Business Types	136	72	77	77	(393)
IMH–A–Large–B	Small Business	337	443	321	211	(10)
	All Business Types	382	501	361	265	55
IMH–A–Large–B1	Small Business	398	523	368	237	(25)
	All Business Types	439	580	407	294	45
IMH–A–Large–B2	Small Business	9	9	70	70	70
	All Business Types	76	76	110	110	110
RCU–Large–B	Small Business	679	679	679	347	71
	All Business Types	748	748	748	418	144

TABLE V.29—COMPARISON OF LCC SAVINGS FOR THE LODGING SECTOR SMALL BUSINESS SUBGROUP WITH THE NATIONAL AVERAGE VALUES—Continued

Equipment class	Category	Mean LCC savings 2013$ *				
		TSL 1	TSL 2	TSL 3	TSL 4	TSL 5
RCU–Large–B1	Small Business	676	676	676	322	90
	All Business Types	743	743	743	391	161
RCU–Large–B2	Small Business	718	718	718	718	(205)
	All Business Types	820	820	820	820	(109)
SCU–W–Large–B	Small Business	404	553	494	129	129
	All Business Types	444	613	550	192	192
SCU–A–Small–B	Small Business	98	142	248	196	(182)
	All Business Types	110	161	281	230	(145)
SCU–A–Large–B	Small Business	146	361	392	18	18
	All Business Types	163	400	439	71	71
IMH–A–Small–C	Small Business	222	263	282	282	(189)
	All Business Types	245	292	313	313	(165)
IMH–A–Large–C	Small Business	493	493	571	571	(33)
	All Business Types	539	539	626	626	28
RCU–Small–C	Small Business	456	406	456	456	(133)
	All Business Types	498	448	505	505	(73)
SCU–A–Small–C	Small Business	204	253	261	261	(288)
	All Business Types	224	278	290	290	(268)

* 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	TSL1 (%)	TSL2 (%)	TSL3 (%)	TSL4 (%)	TSL5 (%)
IMH–W–Small–B	–11	–11	–12	–12	–5
IMH–W–Med–B	–11	–11	–11	–26	–72
IMH–W–Large–B	NA	NA	NA	NA	–29
IMH–W–Large–B1	NA	NA	NA	NA	–22
IMH–W–Large–B2	NA	NA	NA	NA	–84
IMH–A–Small–B	–13	–25	–21	–21	–7
IMH–A–Large–B	–12	–12	–11	–20	–118
IMH–A–Large–B1	–9	–10	–10	–19	–155
IMH–A–Large–B2	–88	–88	–37	–37	–37
RCU–Large–B	–9	–9	–9	–17	–50
RCU–Large–B1	–9	–9	–9	–18	–44
RCU–Large–B2	–12	–12	–12	–12	–88
SCU–W–Large–B	–9	–10	–10	–33	–33
SCU–A–Small–B	–11	–11	–12	–15	–26
SCU–A–Large–B	–10	–10	–11	–75	–75
IMH–A–Small–C	–9	–10	–10	–10	–15
IMH–A–Large–C	–9	–9	–9	–9	–215
RCU–Small–C	–8	–9	–10	–10	–83
SCU–A–Small–C	–9	–9	–10	–10	–7

* 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	2.5	2.5	2.8	2.8	13.5
	All Business Types	2.5	2.5	2.7	2.7	13.4
IMH–W–Med–B	Small Business	2.1	2.1	2.1	5.1	7.7
	All Business Types	2.1	2.1	2.1	5.0	7.6
IMH–W–Large–B	Small Business	NA	NA	NA	NA	10.7
	All Business Types	NA	NA	NA	NA	10.6
IMH–W–Large–B1	Small Business	NA	NA	NA	NA	11.2
	All Business Types	NA	NA	NA	NA	11.1
IMH–W–Large–B2	Small Business	NA	NA	NA	NA	9.0
	All Business Types	NA	NA	NA	NA	8.9
IMH–A–Small–B	Small Business	3.4	4.8	4.7	4.7	12.3

TABLE V.31—COMPARISON OF MEDIAN PAYBACK PERIODS FOR THE LODGING SECTOR SMALL BUSINESS SUBGROUP WITH THE NATIONAL MEDIAN VALUES—Continued

Equipment class	Category	Median payback period years				
		TSL 1	TSL 2	TSL 3	TSL 4	TSL 5
	All Business Types	3.4	4.8	4.7	4.7	11.9
IMH–A–Large–B	Small Business	2.2	2.4	2.3	3.9	5.7
	All Business Types	2.2	2.4	2.3	3.9	5.6
IMH–A–Large–B1	Small Business	1.2	1.5	1.5	3.4	5.4
	All Business Types	1.2	1.5	1.5	3.4	5.4
IMH–A–Large–B2	Small Business	7.5	7.5	6.9	6.9	6.9
	All Business Types	7.4	7.4	6.9	6.9	6.9
RCU–Large–B	Small Business	1.1	1.1	1.1	3.4	5.1
	All Business Types	1.1	1.1	1.1	3.3	5.0
RCU–Large–B1	Small Business	0.9	0.9	0.9	3.5	5.0
	All Business Types	0.9	0.9	0.9	3.4	4.9
RCU–Large–B2	Small Business	3.0	3.0	3.0	3.0	7.1
	All Business Types	3.0	3.0	3.0	3.0	7.0
SCU–W–Large–B	Small Business	1.1	1.6	1.8	5.2	5.2
	All Business Types	1.1	1.6	1.8	5.1	5.1
SCU–A–Small–B	Small Business	2.2	2.4	2.6	3.5	8.9
	All Business Types	2.2	2.4	2.6	3.5	8.9
SCU–A–Large–B	Small Business	1.8	1.6	2.1	6.6	6.6
	All Business Types	1.8	1.6	2.1	6.5	6.5
IMH–A–Small–C	Small Business	1.5	1.6	1.7	1.7	9.0
	All Business Types	1.5	1.6	1.7	1.7	8.8
IMH–A–Large–C	Small Business	0.7	0.7	0.7	0.7	6.0
	All Business Types	0.7	0.7	0.7	0.7	5.9
RCU–Small–C	Small Business	0.7	1.2	1.2	1.2	5.9
	All Business Types	0.7	1.2	1.2	1.2	5.8
SCU–A–Small–C	Small Business	0.8	1.1	1.5	1.5	11.7
	All Business Types	0.8	1.1	1.5	1.5	11.4

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 final rule TSD explains the analysis in further detail.

a. Industry Cash Flow Analysis Results

The following tables depict the financial impacts of the new and amended energy conservation standards on manufacturers of automatic commercial ice makers. The financial impacts are represented by changes in the industry net present value (INPV.) In addition, the tables depict the conversion costs that DOE estimates manufacturers would incur for all equipment classes at each TSL. The impact of the energy efficiency standards on industry cash flow were analyzed under two markup scenarios that correspond to the range of anticipated market responses to amended energy conservation standards.

The first markup scenario assessed the lower bound of potential impacts (higher profitability). 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.

The second markup scenario assessed the upper bound of potential impacts (lower profitability). 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 would lower 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. Table V.32 and Table V.33 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	*2013$ millions*	121.6	115.0	112.3	109.5	109.3	109.8
Change in INPV	*2013$ millions*		(6.6)	(9.3)	(12.1)	(12.3)	(11.8)
	%		(5.4)	(7.7)	(10.0)	(10.1)	(9.7)
Product Conversion Costs	*2013$ millions*		12.3	18.1	23.8	28.1	40.3
Capital Conversion Costs	*2013$ millions*		0.2	0.6	1.3	2.0	3.9
Total Conversion Costs	*2013$ millions*		12.6	18.7	25.1	30.0	44.1

* 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	*2013$ millions*	121.6	114.1	110.4	106.5	103.0	91.6
Change in INPV	*2013$ millions*		(7.5)	(11.2)	(15.1)	(18.6)	(30.0)
	%		(6.2)	(9.2)	(12.5)	(15.3)	(24.6)
Product Conversion Costs	*2013$ millions*		12.3	18.1	23.8	28.1	40.3
Capital Conversion Costs	*2013$ millions*		0.2	0.6	1.3	2.0	3.9
Total Conversion Costs	*2013$ millions*		12.6	18.7	25.1	30.0	44.1

* 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 following results.

At TSL 1, DOE estimates impacts on INPV for manufacturers of automatic commercial ice makers to range from −$7.5 million to −$6.6 million, or a change in INPV of −6.2 percent to −5.4 percent. At this TSL, industry free cash flow is estimated to decrease to $6.7 million, or a drop of 35.7 percent, compared to the base-case value of $10.4 million in the year before the compliance date (2017).

DOE estimates that approximately 27 percent of all batch commercial ice makers and 29 percent of all continuous commercial ice makers on the market will require redesign to meet standards at TSL 1. At this TSL DOE expects capital and product conversion costs of $0.2 million and $12.3 million, respectively. Combined, the total conversion cost is $12.5 million.

At TSL 2, DOE estimates impacts on INPV for manufacturers of automatic commercial ice makers to range from −$11.2 million to −$9.3 million, or a change in INPV of −9.2 percent to −7.7 percent. At this TSL, industry free cash flow is estimated to decrease to $4.8 million, or a drop of 53.5 percent, compared to the base-case value of $10.4 million in the year before the compliance date (2017).

DOE estimates that approximately 39 percent of all batch commercial ice makers and 41 percent of all continuous commercial ice makers on the market will require redesign to meet standards at TSL 2. At this TSL, DOE expects industry capital and product conversion costs of $0.6 million and of $18.1 million, respectively. Combined, the total conversion cost is $18.7 million, 48 percent higher than those incurred by industry at TSL 1.

At TSL 3, DOE estimates impacts on INPV for manufacturers of automatic commercial ice makers to range from −$15.1 million to −$12.1 million, or a change in INPV of −12.5 percent to −10.0 percent. At this TSL, industry free cash flow is estimated to decrease to $2.9 million, or a drop of 72.4 percent, compared to the base-case value of $10.4 million in the year before the compliance date (2017).

DOE estimates that approximately 51 percent of all batch commercial ice makers and 55 percent of all continuous commercial ice makers on the market will require redesign to meet standards at TSL 3. At this TSL, DOE expects industry capital and product conversion costs of $23.8 million and of $1.3 million, respectively. Combined, the total conversion cost is $25.1 million, 34 percent higher than those incurred by industry at TSL 2.

At TSL 4, DOE estimates impacts on INPV for manufacturers of automatic commercial ice makers to range from −$18.6 million to −$12.3 million, or a change in INPV of −15.3 percent to −10.1 percent. At this TSL, industry free cash flow is estimated to decrease to $0.9 million, or a drop of 91.1 percent, compared to the base-case value of $10.4 million in the year before the compliance date (2017).

DOE estimates that approximately 66 percent of all batch commercial ice makers and 55 percent of all continuous commercial ice makers on the market will require redesign to meet standards at TSL 4. Additionally, for four equipment classes, there is only one manufacturer with products that currently meet the standard. At this TSL, DOE expects industry capital and product conversion costs of $2.0 million and of $28.1 million, respectively. Combined, the total conversion cost is $30.0 million, 20 percent higher than those incurred by industry at TSL 3.

At TSL 5, DOE estimates impacts on INPV for manufacturers of automatic commercial ice makers to range from −$30.0 million to −$11.8 million, or a change in INPV of −24.6 percent to −9.7 percent. At this TSL, industry free cash flow is estimated to decrease to −$5.3 million, or a drop of 151.1 percent, compared to the base-case value of $10.4 million in the year before the compliance date (2017).

DOE estimates that approximately 84 percent of all batch commercial ice makers and 78 percent of all continuous commercial ice makers on the market will require redesign to meet standards at TSL 5. Additionally, for five equipment classes, there is only one manufacturer with products that currently meet the standard. At this TSL, DOE expects industry capital and product conversion costs of $3.9 million and of $40.3 million, respectively. Combined, the total conversion cost is $44.1 million, 47 percent higher than those incurred by industry at TSL 4.

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 2015 through 2047. DOE used statistical data from the most recent U.S Census Bureau's 2011 Annual Survey of Manufactures (ASM), the results of the engineering analysis, and interviews with manufacturers to determine the inputs necessary to calculate industry-wide labor expenditures and domestic employment levels. Labor expenditures related to 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. The total labor expenditures in the GRIM were then converted to domestic production employment levels by dividing production labor expenditures by the annual payment per production worker (production worker hours multiplied by the labor rate found in the U.S. Census Bureau's ASM).

The estimates of production workers in this section cover workers, including line-supervisors, 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 changes that could result following the compliance date of new and amended energy conservation standards. The upper end of the employment results in Table V.34 estimates the maximum increase in the number of production workers after implementation of new or amended energy conservation standards and it assumes that manufacturers continue to produce the same scope of covered products in the U.S. The lower end of employment results in Table V.34 represent the maximum decrease to the total number of U.S. production workers in the industry due to manufacturers moving production outside of the U.S. While the results present a range of employment impacts following the compliance date of the new and amended energy conservation standards, the following discussion 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 final rule TSD.

DOE estimates that in the absence of amended energy conservation standards, there would be 389 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	TSL 1	TSL 2	TSL 3	TSL 4	TSL 5
Total Number of Domestic Production Workers in 2018 (without changes in production locations)	389	391	402	414	418	444
Potential Changes in Domestic Production Workers in 2018 *		(389) to 2	(389) to 13	(389) to 25	(389) to 29	(389) to 55

* DOE presents a range of potential employment impacts. Values in parentheses are negative numbers.

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 amount of production hours 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, DOE 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, new or 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 that were evaluated are already available on the market as product options. Thus, DOE believes that, short of widespread retooling, manufacturers will 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, 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 fewer than 750 employees for NAICS 333415, ''Air-Conditioning and Warm Air Heating Equipment and Commercial and Industrial Refrigeration Equipment Manufacturing,'' which includes ice-making machinery manufacturing. DOE identified seven manufacturers in the automatic commercial ice makers industry that meet this definition.

For a discussion of the impacts on the small manufacturer subgroup, see the regulatory flexibility analysis in section VI.B of this preamble and chapter 12 of the final rule 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.

For the cumulative regulatory burden analysis, DOE looks at other regulations that could affect ACIM manufacturers that will take effect approximately 3 years before or after the 2018 compliance date of amended energy conservation standards for these products. In written comments, manufacturers cited Federal regulations on equipment other than automatic commercial ice makers that contribute to their cumulative regulatory burden. The compliance years and expected industry conversion costs of relevant amended energy conservation standards are indicated in Table V.35.

TABLE V.35—COMPLIANCE DATES AND EXPECTED CONVERSION EXPENSES OF FEDERAL ENERGY CONSERVATION STANDARDS AFFECTING AUTOMATIC COMMERCIAL ICE MAKER MANUFACTURERS

Federal energy conservation standards	Approximate compliance date	Estimated total industry conversion expense
Commercial refrigeration equipment, 79 FR 17725 (March 28, 2014)	2017	$184.0M, (2012$)
Walk-in Coolers and Freezers, 79 FR 32049 (June 3, 2014)	2017	$33.6M, (2012$)
Miscellaneous Refrigeration Equipment *	TBD	TBD

* The final rule for this energy conservation standard has not been published. The compliance date and analysis of conversion costs have not been finalized at this time.

DOE discusses these and other requirements and includes the full details of the cumulative regulatory burden analysis in chapter 12 of the final rule 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 through 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 through 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.3.

Table V.36 presents the source NES for all equipment classes at each TSL and the sum total of NES for each TSL.

Table V.37 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.36—CUMULATIVE NATIONAL ENERGY SAVINGS AT SOURCE FOR EQUIPMENT PURCHASED IN 2018–2047

[Quads]

Equipment class	Standard level ***				
	TSL 1	TSL 2	TSL 3	TSL 4	TSL 5
IMH–W–Small–B	0.002	0.002	0.004	0.004	0.009
IMH–W–Med–B	0.005	0.005	0.005	0.008	0.010
IMH–W–Large–B †	0.000	0.000	0.000	0.000	0.002
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	0.001
IMH–A–Small–B	0.011	0.023	0.037	0.037	0.071
IMH–A–Large–B †	0.019	0.034	0.039	0.058	0.075

TABLE V.36—CUMULATIVE NATIONAL ENERGY SAVINGS AT SOURCE FOR EQUIPMENT PURCHASED IN 2018–2047—Continued

[Quads]

Equipment class	Standard level * **				
	TSL 1	TSL 2	TSL 3	TSL 4	TSL 5
IMH–A–Large–B1	0.016	0.031	0.035	0.055	0.071
IMH–A–Large–B2	0.002	0.002	0.003	0.003	0.003
RCU–Large–B †	0.015	0.015	0.015	0.029	0.037
RCU–Large–B1	0.014	0.014	0.014	0.027	0.035
RCU–Large–B2	0.001	0.001	0.001	0.001	0.002
SCU–W–Large–B	0.000	0.001	0.001	0.001	0.001
SCU–A–Small–B	0.007	0.018	0.024	0.032	0.036
SCU–A–Large–B	0.006	0.014	0.019	0.023	0.023
IMH–A–Small–C	0.002	0.004	0.006	0.006	0.009
IMH–A–Large–C	0.002	0.002	0.003	0.003	0.006
RCU–Small–C	0.001	0.002	0.003	0.003	0.005
SCU–A–Small–C	0.006	0.010	0.015	0.015	0.023
Total	0.077	0.130	0.171	0.219	0.307

* 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 two typical units denoted by B1 and B2.

TABLE V.37—CUMULATIVE SOURCE 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 (quads)	TSL Savings as percent of baseline usage				
		TSL 1 (%)	TSL 2 (%)	TSL 3 (%)	TSL 4 (%)	TSL 5 (%)
IMH–W–Small–B	0.064	4	4	6	6	15
IMH–W–Med–B	0.089	5	5	5	9	12
IMH–W–Large–B *	0.028	0	0	0	0	6
IMH–W–Large–B1	0.018	0	0	0	0	7
IMH–W–Large–B2	0.010	0	0	0	0	6
IMH–A–Small–B	0.467	2	5	8	8	15
IMH–A–Large–B *	0.644	3	5	6	9	12
IMH–A–Large–B1	0.495	3	6	7	11	14
IMH–A–Large–B2	0.149	2	2	2	2	2
RCU–Large–B *	0.368	4	4	4	8	10
RCU–Large–B1	0.343	4	4	4	8	10
RCU–Large–B2	0.026	4	4	4	4	7
SCU–W–Large–B	0.004	7	14	18	23	23
SCU–A–Small–B	0.150	5	12	16	21	24
SCU–A–Large–B	0.102	6	14	19	23	23
IMH–A–Small–C	0.071	3	5	8	8	12
IMH–A–Large–C	0.044	4	4	7	7	14
RCU–Small–C	0.031	3	6	10	10	16
SCU–A–Small–C	0.145	4	7	10	10	16
Total	2.206	3	6	8	10	14

* 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.38 presents energy savings at each TSL for each equipment class with the FFC adjustment. The NES increases from 0.081 quads at TSL 1 to 0.321 quads at TSL 5.

TABLE V.38—CUMULATIVE NATIONAL ENERGY SAVINGS INCLUDING FULL-FUEL-CYCLE FOR EQUIPMENT PURCHASED IN 2018–2047

[Quads]

Equipment class	Standard level * **				
	TSL 1	TSL 2	TSL 3	TSL 4	TSL 5
IMH–W–Small–B	0.002	0.002	0.004	0.004	0.010
IMH–W–Med–B	0.005	0.005	0.005	0.008	0.011
IMH–W–Large–B †	0.000	0.000	0.000	0.000	0.002

TABLE V.38—CUMULATIVE NATIONAL ENERGY SAVINGS INCLUDING FULL-FUEL-CYCLE FOR EQUIPMENT PURCHASED IN 2018–2047—Continued

[Quads]

Equipment class	Standard level * **				
	TSL 1	TSL 2	TSL 3	TSL 4	TSL 5
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	0.001
IMH–A–Small–B	0.011	0.024	0.039	0.039	0.075
IMH–A–Large–B †	0.020	0.035	0.040	0.061	0.078
IMH–A–Large–B1	0.017	0.033	0.037	0.057	0.075
IMH–A–Large–B2	0.003	0.003	0.004	0.004	0.004
RCU–Large–B †	0.016	0.016	0.016	0.030	0.038
RCU–Large–B1	0.015	0.015	0.015	0.029	0.037
RCU–Large–B2	0.001	0.001	0.001	0.001	0.002
SCU–W–Large–B	0.000	0.001	0.001	0.001	0.001
SCU–A–Small–B	0.008	0.019	0.026	0.033	0.037
SCU–A–Large–B	0.006	0.015	0.020	0.024	0.024
IMH–A–Small–C	0.002	0.004	0.006	0.006	0.009
IMH–A–Large–C	0.002	0.002	0.003	0.003	0.007
RCU–Small–C	0.001	0.002	0.003	0.003	0.005
SCU–A–Small–C	0.007	0.011	0.016	0.016	0.024
Total	0.081	0.136	0.179	0.229	0.321

* 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.[73] The review timeframe established in EPCA generally is not synchronized 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.39 . The impacts are counted over the lifetime of equipment purchased in 2018 through 2026.

TABLE V.39—NATIONAL FULL-FUEL-CYCLE ENERGY SAVINGS FOR 9-YEAR ANALYSIS PERIOD FOR EQUIPMENT PURCHASED IN 2018–2026

[Quads]

Equipment class	Standard level * **				
	TSL 1	TSL 2	TSL 3	TSL 4	TSL 5
IMH–W–Small–B	0.001	0.001	0.001	0.001	0.003
IMH–W–Med–B	0.001	0.001	0.001	0.002	0.003
IMH–W–Large–B †	0.000	0.000	0.000	0.000	0.001
IMH–W–Large–B1	0.000	0.000	0.000	0.000	0.000
IMH–W–Large–B2	0.000	0.000	0.000	0.000	0.000
IMH–A–Small–B	0.003	0.007	0.012	0.012	0.022
IMH–A–Large–B †	0.006	0.011	0.012	0.018	0.023
IMH–A–Large–B1	0.005	0.010	0.011	0.017	0.022
IMH–A–Large–B2	0.001	0.001	0.001	0.001	0.001
RCU–Large–B †	0.005	0.005	0.005	0.009	0.012
RCU–Large–B1	0.005	0.005	0.005	0.009	0.011
RCU–Large–B2	0.000	0.000	0.000	0.000	0.001
SCU–W–Large–B	0.000	0.000	0.000	0.000	0.000
SCU–A–Small–B	0.002	0.006	0.008	0.010	0.011

[73] 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.39—NATIONAL FULL-FUEL-CYCLE ENERGY SAVINGS FOR 9-YEAR ANALYSIS PERIOD FOR EQUIPMENT PURCHASED IN 2018–2026—Continued

[Quads]

Equipment class	Standard level * **				
	TSL 1	TSL 2	TSL 3	TSL 4	TSL 5
SCU–A–Large–B	0.002	0.004	0.006	0.007	0.007
IMH–A–Small–C	0.001	0.001	0.002	0.002	0.003
IMH–A–Large–C	0.001	0.001	0.001	0.001	0.002
RCU–Small–C	0.000	0.001	0.001	0.001	0.002
SCU–A–Small–C	0.002	0.003	0.005	0.005	0.007
Total	0.024	0.041	0.054	0.069	0.097

* 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.40 and Table V.41 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, respectively. In each case, the impacts cover the expected lifetime of equipment purchased from 2018 through 2047. Detailed NPV results are presented in chapter 10 of the final rule TSD.

The NPV results at a 7-percent discount rate for TSL 5 were negative for 9 classes, and also for one of the typical size units of a large batch equipment class for which the class total was positive. In all cases the TSL 5 NPV was significantly lower than the TSL 3 results. This is consistent with the 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 $0.430 billion (2013$) at a 7-percent discount rate. TSL 4 showed the second highest total NPV, with a value of $0.337 billion (2013$) 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.40—NET PRESENT VALUE AT A 7-PERCENT DISCOUNT RATE FOR EQUIPMENT PURCHASED IN 2018–2047

[Billion 2013$]

Equipment class	Standard level *				
	TSL 1	TSL 2	TSL 3	TSL 4	TSL 5
IMH–W–Small–B	0.006	0.006	0.011	0.011	(0.049)
IMH–W–Med–B	0.010	0.010	0.010	0.006	(0.008)
IMH–W–Large–B **	0.000	0.000	0.000	0.000	(0.002)
IMH–W–Large–B1	0.000	0.000	0.000	0.000	(0.002)
IMH–W–Large–B2	0.000	0.000	0.000	0.000	(0.000)
IMH–A–Small–B	0.017	0.017	0.036	0.036	(0.238)
IMH–A–Large–B **	0.043	0.109	0.120	0.109	0.021
IMH–A–Large–B1	0.043	0.109	0.119	0.107	0.020
IMH–A–Large–B2	(0.000)	(0.000)	0.001	0.001	0.001
RCU–Large–B **	0.042	0.042	0.042	0.035	0.007
RCU–Large–B1	0.040	0.040	0.040	0.033	0.008
RCU–Large–B2	0.002	0.002	0.002	0.002	(0.001)
SCU–W–Large–B	0.002	0.002	0.003	0.001	0.001
SCU–A–Small–B	0.016	0.037	0.076	0.068	(0.060)
SCU–A–Large–B	0.014	0.059	0.064	0.004	0.004
IMH–A–Small–C	0.006	0.009	0.014	0.014	(0.014)
IMH–A–Large–C	0.005	0.005	0.009	0.009	(0.001)
RCU–Small–C	0.002	0.004	0.008	0.008	(0.003)

TABLE V.40—NET PRESENT VALUE AT A 7-PERCENT DISCOUNT RATE FOR EQUIPMENT PURCHASED IN 2018–2047—Continued

[Billion 2013$]

Equipment class	Standard level*				
	TSL 1	TSL 2	TSL 3	TSL 4	TSL 5
SCU–A–Small–C	0.018	0.027	0.036	0.036	(0.062)
Total	0.183	0.328	0.430	0.337	(0.406)

* A value equal to 0.000 means the NPV rounds to less than $0.001 (2013$). 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.41—NET PRESENT VALUE AT A 3-PERCENT DISCOUNT RATE FOR EQUIPMENT PURCHASED IN 2018–2047

[Billion 2013$]

Equipment class	Standard level*				
	TSL 1	TSL 2	TSL 3	TSL 4	TSL 5
IMH–W–Small–B	0.014	0.014	0.025	0.025	(0.074)
IMH–W–Med–B	0.022	0.022	0.022	0.016	(0.008)
IMH–W–Large–B**	0.000	0.000	0.000	0.000	(0.003)
IMH–W–Large–B1	0.000	0.000	0.000	0.000	(0.003)
IMH–W–Large–B2	0.000	0.000	0.000	0.000	(0.000)
IMH–A–Small–B	0.039	0.046	0.092	0.092	(0.360)
IMH–A–Large–B**	0.091	0.234	0.259	0.271	0.122
IMH–A–Large–B1	0.090	0.233	0.254	0.266	0.117
IMH–A–Large–B2	0.001	0.001	0.005	0.005	0.005
RCU–Large–B**	0.088	0.088	0.088	0.084	0.039
RCU–Large–B1	0.084	0.084	0.084	0.080	0.039
RCU–Large–B2	0.004	0.004	0.004	0.004	(0.001)
SCU–W–Large–B	0.003	0.005	0.005	0.002	0.002
SCU–A–Small–B	0.035	0.079	0.169	0.159	(0.075)
SCU–A–Large–B	0.030	0.127	0.138	0.031	0.031
IMH–A–Small–C	0.012	0.019	0.030	0.030	(0.022)
IMH–A–Large–C	0.011	0.011	0.019	0.019	0.001
RCU–Small–C	0.005	0.009	0.017	0.017	(0.002)
SCU–A–Small–C	0.038	0.057	0.076	0.076	(0.103)
Total	0.389	0.712	0.942	0.822	(0.453)

* A value equal to 0.000 means the NPV rounds to less than $0.001 (2013$). 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.42 and Table V.43. 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.42—NET PRESENT VALUE AT A 7-PERCENT DISCOUNT RATE FOR 9-YEAR ANALYSIS PERIOD FOR EQUIPMENT PURCHASED IN 2018–2026

[Billion 2013$]

Equipment class	Standard level*				
	TSL 1	TSL 2	TSL 3	TSL 4	TSL 5
IMH–W–Small–B	0.003	0.003	0.005	0.005	(0.030)
IMH–W–Med–B	0.005	0.005	0.005	0.003	(0.004)
IMH–W–Large–B	0.000	0.000	0.000	0.000	(0.001)
IMH–W–Large–B–1	0.000	0.000	0.000	0.000	(0.001)
IMH–W–Large–B–2	0.000	0.000	0.000	0.000	(0.000)
IMH–A–Small–B	0.009	0.009	0.018	0.018	(0.137)
IMH–A–Large–B	0.021	0.051	0.057	0.036	(0.005)
IMH–A–Large–B–1	0.021	0.052	0.057	0.036	(0.006)
IMH–A–Large–B–2	(0.000)	(0.000)	0.001	0.001	0.001
RCU–Large–B	0.021	0.021	0.021	0.018	0.004
RCU–Large–B–1	0.020	0.020	0.020	0.017	0.005
RCU–Large–B–2	0.001	0.001	0.001	0.001	(0.001)
SCU–W–Large–B	0.001	0.001	0.001	0.000	0.000
SCU–A–Small–B	0.008	0.018	0.036	0.032	(0.030)

TABLE V.42—NET PRESENT VALUE AT A 7-PERCENT DISCOUNT RATE FOR 9-YEAR ANALYSIS PERIOD FOR EQUIPMENT PURCHASED IN 2018–2026—Continued

[Billion 2013$]

Equipment class	Standard level *				
	TSL 1	TSL 2	TSL 3	TSL 4	TSL 5
SCU–A–Large–B	0.007	0.028	0.030	0.001	0.001
IMH–A–Small–C	0.003	0.004	0.007	0.007	(0.007)
IMH–A–Large–C	0.003	0.003	0.005	0.005	(0.000)
RCU–Small–C	0.001	0.002	0.004	0.004	(0.001)
SCU–A–Small–C	0.009	0.013	0.018	0.018	(0.030)
Total	0.090	0.158	0.207	0.147	(0.241)

* A value equal to 0.000 means the NPV rounds to less than $0.001 (2013$). Values in parentheses are negative numbers.

TABLE V.43—NET PRESENT VALUE AT A 3-PERCENT DISCOUNT RATE FOR 9-YEAR ANALYSIS PERIOD FOR EQUIPMENT PURCHASED IN 2018–2026

[Billion 2013$]

Equipment class	Standard level *				
	TSL 1	TSL 2	TSL 3	TSL 4	TSL 5
IMH–W–Small–B	0.005	0.005	0.009	0.009	(0.038)
IMH–W–Med–B	0.008	0.008	0.008	0.006	(0.002)
IMH–W–Large–B	0.000	0.000	0.000	0.000	(0.001)
IMH–W–Large–B–1	0.000	0.000	0.000	0.000	(0.001)
IMH–W–Large–B–2	0.000	0.000	0.000	0.000	(0.000)
IMH–A–Small–B	0.014	0.017	0.035	0.035	(0.168)
IMH–A–Large–B	0.033	0.081	0.090	0.067	0.016
IMH–A–Large–B–1	0.033	0.081	0.089	0.065	0.014
IMH–A–Large–B–2	0.001	0.001	0.002	0.002	0.002
RCU–Large–B	0.032	0.032	0.032	0.031	0.015
RCU–Large–B–1	0.030	0.030	0.030	0.030	0.016
RCU–Large–B–2	0.002	0.002	0.002	0.002	(0.000)
SCU–W–Large–B	0.001	0.002	0.002	0.001	0.001
SCU–A–Small–B	0.013	0.029	0.057	0.054	(0.029)
SCU–A–Large–B	0.011	0.043	0.047	0.010	0.010
IMH–A–Small–C	0.004	0.007	0.011	0.011	(0.008)
IMH–A–Large–C	0.004	0.004	0.007	0.007	0.001
RCU–Small–C	0.002	0.003	0.006	0.006	(0.001)
SCU–A–Small–C	0.014	0.021	0.028	0.028	(0.037)
Total	0.142	0.253	0.332	0.264	(0.241)

* A value equal to 0.000 means the NPV rounds to less than $0.001 (2013$). Values in parentheses are negative numbers.

c. Water Savings

One energy-saving design option for batch type ice makers had the additional benefit of reducing potable water usage for some types of batch type ice makers. The water savings are identified on Table V.44. DOE is not, as part of this rulemaking, establishing a potable water standard. The water savings identified through the analyses are products of the analysis of energy-saving design options.

TABLE V.44—WATER SAVINGS

Equipment class	Water savings by standard level * ** million gallons				
	TSL 1	TSL 2	TSL 3	TSL 4	TSL 5
IMH–W–Small–B	761	761	1,733	1,733	1,733
IMH–W–Med–B	0	0	0	0	0
IMH–W–Large–B	0	0	0	0	0
IMH–W–Large–B1	0	0	0	0	0
IMH–W–Large–B2	0	0	0	0	0
IMH–A–Small–B	0	0	0	0	–5,424
IMH–A–Large–B	0	12,501	12,501	11,733	11,733
IMH–A–Large–B1	0	12,501	12,501	11,733	11,733
IMH–A–Large–B2	0	0	0	0	0
RCU–Large–B	0	0	0	0	0
RCU–Large–B1	0	0	0	0	0
RCU–Large–B2	0	0	0	0	0

TABLE V.44—WATER SAVINGS—Continued

Equipment class	Water savings by standard level * ** million gallons				
	TSL 1	TSL 2	TSL 3	TSL 4	TSL 5
SCU–W–Large–B	336	336	336	336	336
SCU–A–Small–B	0	0	13,580	13,580	13,580
SCU–A–Large–B	0	9,388	9,388	9,388	9,388
IMH–A–Small–C	0	0	0	0	0
IMH–A–Large–C	0	0	0	0	0
RCU–Small–C	0	0	0	0	0
SCU–A–Small–C	0	0	0	0	0
Total	1,097	22,987	37,539	36,771	31,347

* A zero indicates no water usage reductions were identified.
** 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.

d. Indirect Employment Impacts

In addition to the direct impacts on manufacturing employment discussed in section IV.N, DOE develops general estimates of the indirect employment impacts of the new and amended standards on the economy. DOE expects amended energy conservation standards for automatic commercial ice makers to reduce energy bills for commercial customers and expects 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 new and 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.J of this rulemaking; see chapter 16 of the final rule TSD for more details).

Customers who purchase more-efficient equipment pay lower amounts towards utility bills, which results in job losses in the electric utilities sector. In this input/output model, the dollars saved on utility bills from more-efficient automatic commercial ice makers are spent in economic sectors that create more jobs than are lost in electric and water utilities sectors. Thus, the new and amended energy conservation standards for automatic commercial ice makers are likely to slightly increase the net demand for labor in the economy. 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.45, DOE estimates that net indirect employment impacts from new and amended automatic commercial ice makers standard are small relative to the national economy.

TABLE V.45—NET SHORT-TERM CHANGE IN EMPLOYMENT

[Number of employees]

Trial standard level	2018	2022
1	18 to 21	104 to 107.
2	31 to 38	196 to 204.
3	41 to 52	263 to 276.
4	41 to 63	315 to 340.
5	4 to 82	376 to 464.

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 6313(d)(4)) As presented in the screening analysis (chapter 4 of the final rule TSD), DOE eliminates from consideration any design options that reduce the utility of the equipment. For this rulemaking, DOE did not consider TSLs for automatic commercial ice makers that 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 rule 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.

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. The Department acknowledges that to be competitive in the marketplace manufacturers must constantly re-examine their supply chains and manufacturing infrastructure. DOE does not believe however, that at the levels specified in this final rule, amended standards would result in domestic firms relocating significant portions of their domestic production capacity to other countries. The majority of automatic commercial ice makers are manufactured in the U.S. and the amended standards are at levels which are already met by a large portion of the product models being manufactured. The amended standards can largely be met using existing capital assets 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 this final rule is likely to improve the security of the Nation's energy system by reducing overall demand for energy. Reduced electricity demand resulting from energy conservation may also improve the reliability of the electricity system. As a measure of this reduced demand, chapter 15 in the final rule TSD presents the estimated reduction in national generating capacity for the TSLs that DOE considered in this rulemaking.

Energy savings from new and 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.46 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 final rule TSD.

TABLE V.46—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*)	4.68	7.87	10.38	13.25	18.62
NO_X (*thousand tons*)	3.71	6.23	8.22	10.50	14.75
Hg (*tons*)	0.01	0.02	0.03	0.04	0.05
N_2O (*thousand tons*)	0.06	0.11	0.14	0.18	0.25
CH_4 (*thousand tons*)	0.44	0.73	0.97	1.24	1.74
SO_2 (*thousand tons*)	4.13	6.95	9.17	11.70	16.45
Upstream Emissions					
CO_2 (*million metric tons*)	0.25	0.42	0.56	0.72	1.00
NO_X (*thousand tons*)	3.59	6.03	7.96	10.17	14.29
Hg (*tons*)	0.00	0.00	0.00	0.00	0.00
N_2O (*thousand tons*)	0.00	0.00	0.00	0.01	0.01
CH_4 (*thousand tons*)	20.91	35.15	46.40	59.23	83.24
SO_2 (*thousand tons*)	0.04	0.08	0.10	0.13	0.18
Total Emissions					
CO_2 (*million metric tons*)	4.93	8.29	10.94	13.97	19.63
NO_X (*thousand tons*)	7.30	12.26	16.19	20.67	29.04
Hg (*tons*)	0.01	0.02	0.03	0.04	0.05
N_2O (*thousand tons*)	0.06	0.11	0.14	0.18	0.26
CH_4 (*thousand tons*)	21.35	35.89	47.37	60.47	84.97
SO_2 (*thousand tons*)	4.18	7.02	9.27	11.83	16.62

As part of the analysis for this final rule, DOE estimated monetary benefits likely to result from the reduced emissions of CO_2 and NO_X that were 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 2013$, are $12/ton, $40.5/ton, $62.4/ton, and $119.0/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.47 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 final rule TSD.

TABLE V.47—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 2013$			
Power Sector and Site Emissions				
1	34.5	154.3	243.8	476.2
2	57.9	259.4	409.9	800.5
3	76.4	342.3	541.0	1,056.6
4	97.6	437.0	690.6	1,348.9
5	137.1	614.1	970.5	1,895.5
Upstream Emissions				
1	1.8	8.2	13.0	25.4
2	3.0	13.8	21.9	42.7
3	4.0	18.2	28.8	56.3
4	5.1	23.3	36.8	71.9
5	7.2	32.7	51.8	101.0
Total Emissions				
1	36.3	162.5	256.8	501.6
2	61.0	273.2	431.7	843.1
3	80.5	360.6	569.8	1,112.9
4	102.7	460.3	727.5	1,420.8
5	144.3	646.8	1,022.3	1,996.5

* For each of the four cases, the corresponding SCC value for emissions in 2015 is $12, $40.5, $62.4, and $119.0 per metric ton (2013$).

DOE is well aware that scientific and economic knowledge about the contribution of CO_2 and other GHG emissions to changes in the future global climate and the potential resulting damages to the world economy continues to evolve rapidly. Thus, any value placed in this rulemaking 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 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 final rule 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 the new and amended standards for the automatic commercial ice makers. The dollar-per-ton values that DOE used are discussed in section IV.L. Table V.48 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.48—PRESENT VALUE OF NO_X EMISSIONS REDUCTION FOR POTENTIAL STANDARDS FOR AUTOMATIC COMMERCIAL ICE MAKERS

TSL	3% Discount rate	7% Discount rate
	million 2013$	
Power Sector and Site Emissions *		
1	5.6	2.9
2	9.4	4.9
3	12.4	6.5
4	15.8	8.2
5	22.2	11.6
Upstream Emissions		
1	5.2	2.5
2	8.7	4.3
3	11.4	5.6
4	14.6	7.2
5	20.5	10.1
Total Emissions		
1	10.7	5.4
2	18.0	9.2
3	23.8	12.1
4	30.4	15.4
5	42.7	21.7

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 rulemaking. Table V.49 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.49—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 $12/metric ton CO_2* and medium value for NO_X*	SCC Value of $40.5/metric ton CO_2* and medium value for NO_X*	SCC Value of $62.4/metric ton CO_2* and medium value for NO_X*	SCC Value of $119.0/metric ton CO_2* and medium value for NO_X*
	billion 2013$			
1	*0.436*	*0.563*	*0.657*	*0.902*
2	*0.791*	*1.004*	*1.162*	*1.574*
3	*1.046*	*1.326*	*1.536*	*2.079*
4	*0.955*	*1.313*	*1.580*	*2.273*
5	*(0.266)*	*0.237*	*0.612*	*1.587*
TSL	Consumer NPV at 7% Discount Rate added with:			
	SCC Value of $12/metric ton CO_2* and medium value for NO_X*	SCC Value of $40.5/metric ton CO_2* and medium value for NO_X*	SCC Value of $62.4/metric ton CO_2* and medium value for NO_X*	SCC Value of $119.0/metric ton CO_2* and medium value for NO_X*
	billion 2013$			
1	*0.225*	*0.351*	*0.445*	*0.690*
2	*0.398*	*0.611*	*0.769*	*1.181*
3	*0.523*	*0.803*	*1.012*	*1.555*
4	*0.455*	*0.813*	*1.080*	*1.773*
5	*(0.240)*	*0.263*	*0.638*	*1.613*

*These label values represent the global SCC in 2015, in 2013$. The present values have been calculated with scenario-consistent discount rates. For NO_X emissions, each case uses the medium value, which corresponds to $2,684 per ton.

Although adding the value of customer savings to the values of emission reductions provides a valuable perspective, the following should be considered. First, the national customer savings are domestic U.S. customer monetary savings that occur as a result of 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. Second, the assessments of customer operating cost savings and emission-related benefits are performed with quite different time frames for analysis. For automatic commercial ice makers, the present value of national customer savings is measured for the lifetime of units shipped from 2018 through 2047. The SCC values, on the other hand, reflect the present value of future climate-related impacts resulting from the emission of one metric ton of CO_2 in each year. Because of the long residence time of CO_2 in the atmosphere, these impacts continue well beyond 2100.

7. Other Factors

EPCA allows the Secretary, in determining whether a standard is economically justified, to consider any other factors that the Secretary deems to be relevant. (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 new or amended national energy conservation standard level. The LCC subgroup impacts are discussed in section V.B.1.b and in final rule TSD chapter 11. DOE also considered the reduction in generation capacity that could result from the imposition of any new or amended national energy conservation standard level. Electric utility impacts are presented in final rule TSD chapter 15.

C. Conclusions/Proposed Standard

Any new or amended energy conservation standard for any type (or class) of covered product must 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, considering 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 6313(d)(4))

DOE considered the impacts of potential standards at each TSL, beginning with the maximum technologically feasible level, to determine whether that level met the evaluation criteria. If the max-tech level was not justified, DOE then considered the next most-efficient level and undertook the same evaluation until it reached the highest efficiency level that is both technologically feasible and economically justified and saves a significant amount of energy.

To aid the reader in understanding the benefits and/or burdens of each TSL, tables are presented to summarize the quantitative analytical results for each TSL, based on the assumptions and methodology discussed herein. The efficiency levels contained in each TSL are described in section V.A. In addition to the quantitative results presented in the tables below, DOE also considers other burdens and benefits that affect economic justification including the effect of technological feasibility, manufacturer costs, and impacts on competition on the economic results presented. Table V.50, Table V.51, Table V.52 and Table V.53 present a summary of the results of DOE's quantitative analysis for each TSL. Results in Table

V.50 through Table V.53 are impacts from equipment purchased in the period from 2018 through 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.1.b presents the estimated impacts of each TSL for these subgroups.

TABLE V.50—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	0.081	0.136	0.179	0.229	0.321.
Cumulative National Water Savings 2018 through 2047 *billion gallons*					
Undiscounted values	1.0	23.0	37.5	36.8	31.3.
Cumulative NPV of Customer Benefits 2018 through 2047 *billion 2013$*					
3% discount rate	0.389	0.712	0.942	0.822	(0.453).
7% discount rate	0.183	0.328	0.430	0.337	(0.406).
Industry Impacts					
Change in Industry NPV (2013$ million).	(7.5) to (6.6)	(11.2) to (9.3)	(15.1) to (12.1)	(18.6) to (12.3)	(30.0) to (11.8).
Change in Industry NPV (%)	(6.2) to (5.4)	(9.2) to (7.7)	(12.5) to (10.0)	(15.3) to (10.1)	(24.6) to (9.7).
Cumulative Emissions Reductions 2018 through 2047 **					
CO_2 (MMt)	4.93	8.29	10.94	13.97	19.63.
NO_X (kt)	7.30	12.26	16.19	20.67	29.04.
Hg (t)	0.01	0.02	0.03	0.04	0.05.
N_2O (*kt*)	0.06	0.11	0.14	0.18	0.26.
N_2O (kt CO_2eq)	17.14	28.81	38.03	48.55	68.23.
CH_4 (*kt*)	21.35	35.89	47.37	60.47	84.97.
CH_4 (*kt* CO_2eq)	597.78	1004.79	1326.27	1693.16	2379.30.
SO_2 (*kt*)	4.18	7.02	9.27	11.83	16.62.
Monetary Value of Cumulative Emissions Reductions 2018 through 2047 †					
CO_2 (2013$ billion)	0.036 to 0.502	0.061 to 0.843	0.080 to 1.113	0.103 to 1.421	0.144 to 1.997.
NO_X—3% discount rate (2013$ million).	10.7	18.0	23.8	30.4	42.7.
NO_X—7% discount rate (2013$ million).	5.4	9.2	12.1	15.4	21.7.
Employment Impacts					
Net Change in Indirect Domestic Jobs by 2022.	104 to 107	196 to 204	263 to 276	315 to 340	376 to 464.

* 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 $2,684/ton.

TABLE V.51—SUMMARY OF RESULTS FOR AUTOMATIC COMMERCIAL ICE MAKERS TSLS: MEAN LCC SAVINGS

[2013$]

Equipment class	Standard level				
	TSL 1	TSL 2	TSL 3	TSL 4	TSL 5
IMH–W–Small–B	$175	$175	$214	$214	($534)
IMH–W–Med–B	$308	$308	$308	$165	($63)
IMH–W–Large–B *	NA	NA	NA	NA	($172)
IMH–W–Large–B1	NA	NA	NA	NA	($200)
IMH–W–Large–B2	NA	NA	NA	NA	($80)
IMH–A–Small–B	$136	$72	$77	$77	($393)
IMH–A–Large–B *	$382	$501	$361	$265	$55
IMH–A–Large–B1	$439	$580	$407	$294	$45
IMH–A–Large–B2	$76	$76	$110	$110	$110

TABLE V.51—SUMMARY OF RESULTS FOR AUTOMATIC COMMERCIAL ICE MAKERS TSLS: MEAN LCC SAVINGS—Continued

[2013$]

Equipment class	Standard level				
	TSL 1	TSL 2	TSL 3	TSL 4	TSL 5
RCU–Large–B *	$748	$748	$748	$418	$144
RCU–Large–B1	$743	$743	$743	$391	$161
RCU–Large–B2	$820	$820	$820	$820	($109)
SCU–W–Large–B	$444	$613	$550	$192	$192
SCU–A–Small–B	$110	$161	$281	$230	($145)
SCU–A–Large–B	$163	$400	$439	$71	$71
IMH–A–Small–C	$245	$292	$313	$313	($165)
IMH–A–Large–C	$539	$539	$626	$626	$28
RCU–Small–C	$498	$448	$505	$505	($73)
SCU–A–Small–C	$224	$278	$290	$290	($268)

* 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.52—SUMMARY OF RESULTS FOR AUTOMATIC COMMERCIAL ICE MAKERS TSLS: MEDIAN PAYBACK PERIOD

Equipment class	Standard level years				
	TSL 1	TSL 2	TSL 3	TSL 4	TSL 5
IMH–W–Small–B	2.5	2.5	2.7	2.7	13.4
IMH–W–Med–B	2.1	2.1	2.1	5.0	7.6
IMH–W–Large–B*	NA	NA	NA	NA	10.6
IMH–W–Large–B1	NA	NA	NA	NA	11.1
IMH–W–Large–B2	NA	NA	NA	NA	8.9
IMH–A–Small–B	3.4	4.8	4.7	4.7	11.9
IMH–A–Large–B*	2.2	2.4	2.3	3.9	5.6
IMH–A–Large–B1	1.2	1.5	1.5	3.4	5.4
IMH–A–Large–B2	7.4	7.4	6.9	6.9	6.9
RCU–Large–B*	1.1	1.1	1.1	3.3	5.0
RCU–Large–B1	0.9	0.9	0.9	3.4	4.9
RCU–Large–B2	3.0	3.0	3.0	3.0	7.0
SCU–W–Large–B	1.1	1.6	1.8	5.1	5.1
SCU–A–Small–B	2.2	2.4	2.6	3.5	8.9
SCU–A–Large–B	1.8	1.6	2.1	6.5	6.5
IMH–A–Small–C	1.5	1.6	1.7	1.7	8.8
IMH–A–Large–C	0.7	0.7	0.7	0.7	5.9
RCU–Small–C	0.7	1.2	1.2	1.2	5.8
SCU–A–Small–C	0.8	1.1	1.5	1.5	11.4

* 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.53—SUMMARY OF RESULTS FOR AUTOMATIC COMMERCIAL ICE MAKER TSLS: DISTRIBUTION OF CUSTOMER LCC IMPACTS

Category	Standard Level percentage of customers (%)				
	TSL 1	TSL 2	TSL 3	TSL 4	TSL 5
IMH–W–Small–B					
Net Cost (%)	0	0	1	1	96
No Impact (%)	63	63	47	47	0
Net Benefit (%)	37	37	52	52	4
IMH–W–Med–B					
Net Cost (%)	0	0	0	28	65
No Impact (%)	44	44	44	24	9
Net Benefit (%)	56	56	56	47	26
IMH–W–Large–B *					
Net Cost (%)	NA	NA	NA	NA	67
No Impact (%)	NA	NA	NA	NA	13
Net Benefit (%)	NA	NA	NA	NA	20
IMH–W–Large–B1					
Net Cost (%)	NA	NA	NA	NA	70
No Impact (%)	NA	NA	NA	NA	13
Net Benefit (%)	NA	NA	NA	NA	17

TABLE V.53—SUMMARY OF RESULTS FOR AUTOMATIC COMMERCIAL ICE MAKER TSLS: DISTRIBUTION OF CUSTOMER LCC IMPACTS—Continued

Category	Standard Level percentage of customers (%)				
	TSL 1	TSL 2	TSL 3	TSL 4	TSL 5
IMH–W–Large–B2					
Net Cost (%)	NA	NA	NA	NA	59
No Impact (%)	NA	NA	NA	NA	13
Net Benefit (%)	NA	NA	NA	NA	29
IMH–A–Small–B					
Net Cost (%)	1	21	21	21	95
No Impact (%)	76	47	0	0	0
Net Benefit (%)	22	32	79	79	5
IMH–A–Large–B *					
Net Cost (%)	1	1	2	31	53
No Impact (%)	69	45	12	12	10
Net Benefit (%)	30	53	86	57	37
IMH–A–Large–B1					
Net Cost (%)	0	0	0	35	61
No Impact (%)	66	38	3	3	0
Net Benefit (%)	34	62	97	63	39
IMH–A–Large–B2					
Net Cost (%)	9	9	10	10	10
No Impact (%)	83	83	61	61	61
Net Benefit (%)	8	8	29	29	29
RCU–Large–B *					
Net Cost (%)	0	0	0	23	55
No Impact (%)	56	56	56	22	2
Net Benefit (%)	44	44	44	55	42
RCU–Large–B1					
Net Cost (%)	0	0	0	25	55
No Impact (%)	56	56	56	20	1
Net Benefit (%)	44	44	44	55	44
RCU–Large–B2					
Net Cost (%)	1	1	1	1	57
No Impact (%)	56	56	56	56	20
Net Benefit (%)	43	43	43	43	23
SCU–W–Large–B					
Net Cost (%)	0	0	0	44	44
No Impact (%)	28	28	5	0	0
Net Benefit (%)	72	72	94	56	56
SCU–A–Small–B					
Net Cost (%)	0	1	1	16	77
No Impact (%)	48	20	12	0	0
Net Benefit (%)	52	79	87	84	23
SCU–A–Large–B					
Net Cost (%)	0	0	0	54	54
No Impact (%)	37	1	1	0	0
Net Benefit (%)	63	99	99	46	46
IMH–A–Small–C					
Net Cost (%)	0	0	0	0	68
No Impact (%)	69	58	39	39	14
Net Benefit (%)	31	42	61	61	18
IMH–A–Large–C					
Net Cost (%)	0	0	0	0	54
No Impact (%)	57	57	35	35	9
Net Benefit (%)	43	43	65	65	37
RCU–Small–C					
Net Cost (%)	0	0	0	0	64
No Impact (%)	72	44	11	11	6
Net Benefit (%)	28	55	89	89	31
SCU–A–Small–C					
Net Cost (%)	0	0	1	1	86
No Impact (%)	56	47	32	32	0
Net Benefit (%)	44	53	67	67	14
Average of Equipment Types **					
Net Cost (%)	1	7	6	20	75
No Impact (%)	62	40	16	12	3
Net Benefit (%)	37	53	77	68	22

* 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.

** Average of equipment types created by weighting the class results by 2018 shipment estimates.

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. 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. 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).

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 is committed to developing a framework that can support empirical quantitative tools for improved assessment of the consumer welfare impacts of appliance standards. 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.[74] DOE welcomes comments on how to more fully assess the potential impact of energy conservation standards on consumer choice and methods to quantify this impact in its regulatory analysis.

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 0.321 quads of energy. Because one energy-saving design option reduces potable water usage, potential savings are estimated to be 31 billion gallons, although such savings should not be construed to be the result of a potable water standard. DOE projects a negative NPV for customers valued at $0.406 billion at a 7-percent discount rate. Estimated emissions reductions are 19.6 MMt of CO_2, up to 29.0 kt of NO_X and 0.05 tons of Hg. The CO_2 emissions have a value of up to $2.0 billion and the NO_X emissions have a value of $21.7 million at a 7-percent discount rate.

For TSL 5, the mean LCC savings for five equipment classes are positive, implying a decrease in LCC, with the decrease ranging from $28 for the IMH–A–Large–C equipment class to $192 for the SCU–W–Large–B equipment class.[75] The results shown on Table V.53 indicates a large fraction of customers would experience net LCC increases (*i.e.,* LCC costs rather than savings) from adoption of TSL 5, with 44 to 96 percent of customers experiencing net LCC increases. As shown on Table V.52, customers would experience payback periods of 5 years or longer in all equipment classes, and in many cases customers would experience payback periods exceeding the estimated 8.5 year equipment lifetime.

At TSL 5, the projected change in INPV ranges from a decrease of $30.0 million to a decrease of $11.8 million, depending on the chosen manufacturer markup scenario. The upper bound is considered optimistic by industry because it assumes manufacturers could pass on all compliance costs as price increases to their customers. DOE recognizes the risk of negative impacts if manufacturers' expectations concerning reduced profit margins are realized. If the lower bound of the range of impacts is reached, TSL 5 could result in a net loss of up to 24.6 percent in INPV for the ACIM industry.

DOE estimates that approximately 84 percent of all batch commercial ice makers and 78 percent of all continuous commercial ice makers on the market will require redesign to meet standards at TSL 5. DOE expects industry conversion costs of $44.1 million. Also of concern, for five equipment classes, there is only 1 manufacturer with products that could currently meet this standard.

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 are outweighed by a decrease of $0.406 billion in customer NPV and a decrease of up to 24.6 percent in INPV. Additionally, the majority of individual customers purchasing automatic commercial ice makers built to TSL 5 standards experience negative life-cycle cost savings, with over 90 percent of customers of 2 equipment classes experiencing negative life-cycle cost savings. 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 0.229 quads of energy—an amount DOE deems significant. Because one energy-saving design option reduces potable water usage, potential water savings are estimated to be 37 billion gallons, although such savings should not be construed to be the result of a potable water standard. At TSL 4, DOE projects an increase in customer NPV of $0.337 billion (2013$) at a 7-percent discount rate; estimated emissions reductions of 14.0 MMt of CO_2, 20.7 kt of $NO_{x,}$ and 0.04 tons of Hg. The monetary value for CO_2 was estimated to be up to $1.4 billion. The monetary value for NO_X was estimated to be $15.4 million at a 7-percent discount rate.

At TSL 4, the mean LCC savings are positive for all equipment classes. As shown on Table V.51, mean LCC savings vary from $71 for SCU–A–Large–B to $626 for IMH–A–Large–C, which implies that, on average, customers will experience an LCC benefit. As shown on Table V.53, for 7 of the 13 classes, some fraction of the customers will experience net costs, while for 5 classes, 1 percent or less will experience net costs. Customers in 3 classes would experience net LCC costs of 30 percent or more, with the percentage ranging up to 54 percent for one equipment class. Median payback periods range from 0.7 years up to 6.5 years.

At TSL 4, the projected change in INPV ranges from a decrease of $18.6 million to a decrease of $12.3 million. If the lower bound of the range of

[74] 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*

[75] For this section of the final rule, the discussion is limited to results for full equipment classes. Thus, for the large equipment classes for which DOE analyzed 2 typical unit sizes, this discussion focuses on the weighted average or totals of the two typical units.

impacts is reached, TSL 4 could result in a net loss of up to 15.3 percent in INPV for manufacturers.

DOE estimates that approximately 66 percent of all batch commercial ice makers and 55 percent of all continuous commercial ice makers on the market will require redesign to meet standards at TSL 4. At this TSL DOE expects industry conversion costs to total $30.0 million. Additionally, for four equipment classes, there is only 1 manufacturer with products that currently meet the standard.

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 $0.337 billion in customer NPV are outweighed by a decrease of up to 15.3 percent in INPV and issues regarding availability of product from multiple manufacturers in some product classes. 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 rule.

At TSL 3, the next highest efficiency level, estimated energy savings from 2018 through 2047 are 0.179 quads of primary energy—an amount DOE considers significant. Because one energy-saving design option reduces potable water usage, potential water savings are estimated to be 37 billion gallons, although such savings should not be construed to be the result of a potable water standard. 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 $0.430 billion at a 7-percent discount rate, and an increase of $0.942 billion at a 3-percent discount rate. Estimated emissions reductions are 10.9 MMt of CO_2, up to 16.2 kt of NO_X and 0.03 tons of Hg at TSL 3. The monetary value of the CO_2 emissions reductions was estimated to be up to $1.1 billion at TSL 3. The monetary value of the NO_X emission reductions was estimated to be $12.1 million at a 7-percent discount rate.

At TSL 3, nearly all customers for all equipment classes are shown to experience positive LCC savings. As shown on Table V.53 Table V.53, the percent of customers experiencing a net cost is 2 percent or less in 12 of 13 classes, with IMH–A–Small–B being the exception with 21 percent of customers experiencing a net cost. The payback period for IMH–A–Small–B is 4.7 years, while for all other equipment classes the median payback periods are 3 years or less. LCC savings range from $77 for IMH–A–Small–B to $748 for RCU–Large–B.

At TSL 3, the projected change in INPV ranges from a decrease of $15.1 million to a decrease of $12.1 million. If the lower bound of the range of impacts is reached, TSL 3 could result in a net loss of up to 12.5 percent in INPV for manufacturers.

DOE estimates that approximately 51 percent of all batch commercial ice makers and 55 percent of all continuous commercial ice makers on the market will require redesign to meet standards at TSL 3. At TSL 3, DOE expects industry conversion costs to total $25.1 million. There are multiple manufacturers with product that could meet this standard at all analyzed equipment classes.

At TSL 3, the monetized CO_2 emissions reduction values range from $0.080 to $1.113 billion. The mid-range value used by DOE to calculate total net benefits is the monetized CO_2 emissions reduction at $40.5 per ton in 2013$, which for TSL 3, is $0.361 billion. The monetized NO_X emissions reductions calculated at an intermediate value of $2,684 per ton in 2013$ are $12.1 million at a 7-percent discount rate and $23.8 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 $1.326 billion and 0.803 billion, respectively, at TSL 3.

Approximately 94 percent of customers are expected to experience net benefits (or no impact) from equipment built to TSL 3 levels. The payback periods for TSL 3 are expected to be 3 years or less for all but the IMH–A–Small–B.

After carefully considering the analysis results and weighing the benefits and burdens of TSL 3, DOE concludes that setting the standards for automatic commercial ice makers at TSL 3 will offer the maximum improvement in energy efficiency that is technologically feasible and economically justified and will result in significant energy savings. Therefore, DOE today is adopting standards at TSL 3 for automatic commercial ice makers. 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.

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 these standards address are as follows:

(1) Insufficient information and the high costs of gathering and analyzing relevant information leads some customers to miss opportunities to make cost-effective investments in energy efficiency.

(2) In some cases the benefits of more efficient equipment are not realized due to misaligned incentives between purchasers and users. An example of such a case is when the equipment purchase decision is made by a building contractor or building owner who does not pay the energy costs.

(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 public health, environmental protection and national security that are not reflected in energy prices, such as reduced emissions of air pollutants and greenhouse gases that impact human health and global warming.

In addition, DOE has determined that today's regulatory action is a ''significant regulatory action'' under Executive Order 12866. DOE presented to the Office of Information and Regulatory Affairs (OIRA) in the OMB for review the draft rule and other documents prepared for this rulemaking, including a regulatory impact analysis (RIA), and has included these documents in the rulemaking record. The assessments prepared pursuant to Executive Order 12866 can be found in the technical support document for this rulemaking.

DOE has also reviewed this regulation pursuant to Executive Order 13563, issued on January 18, 2011. (76 FR 3281, Jan. 21, 2011) EO 13563 is supplemental to and explicitly reaffirms the principles, structures, and definitions governing regulatory review established in Executive Order 12866. To the extent permitted by law, agencies are required by Executive Order 13563 to: (1) Propose or adopt a regulation only upon a reasoned determination that its benefits justify its costs (recognizing that some benefits and costs are difficult to quantify); (2) tailor regulations to impose the least burden on society, consistent with obtaining regulatory objectives, taking into account, among other things, and to the extent practicable, the costs of cumulative regulations; (3) select, in choosing among alternative regulatory approaches, those approaches that maximize net benefits (including potential economic, environmental, public health and safety, and other advantages; distributive impacts; and equity); (4) to the extent feasible, specify performance objectives, rather than specifying the behavior or manner of compliance that regulated entities must adopt; and (5) identify and assess available alternatives to direct regulation, including providing economic incentives to encourage the desired behavior, such as user fees or marketable permits, or providing information upon which choices can be made by the public.

DOE emphasizes as well that Executive Order 13563 requires agencies to use the best available techniques to quantify anticipated present and future benefits and costs as accurately as possible. In its guidance, the Office of Information and Regulatory Affairs has emphasized that such techniques may include identifying changing future compliance costs that might result from technological innovation or anticipated behavioral changes. For the reasons stated in the preamble, DOE believes that this final rule 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 final regulatory flexibility analysis (FRFA) for any rule that by law must be proposed for public comment, unless the agency certifies that the rule, if promulgated, will not have a significant economic impact on a substantial number of small entities. As required by Executive Order 13272, ''Proper Consideration of Small Entities in Agency Rulemaking,'' 67 FR 53461 (August 16, 2002), DOE published procedures and policies on February 19, 2003, to ensure that the potential impacts of its rules on small entities are properly considered during the rulemaking process. 68 FR 7990. DOE has made its procedures and policies available on the Office of the General Counsel's Web site (*http://energy.gov/gc/office-general-counsel*).

For manufacturers of automatic commercial ice makers, the Small Business Administration (SBA) has set a size threshold, which defines those entities classified as ''small businesses'' for the purposes of the statute. DOE used the SBA's small business size standards to determine whether any small entities would be subject to the requirements of the rule. 65 FR 30836, 30848 (May 15, 2000), as amended by 65 FR 53533, 53544 (September 5, 2000) and codified at 13 CFR part 121. The size standards are listed by North American Industry Classification System (NAICS) code and industry description and are available at *http://www.sba.gov/sites/default/files/files/Size_Standards_Table.pdf.* Commercial refrigeration equipment manufacturing is classified under NAICS 333415, ''Air-Conditioning and Warm Air Heating Equipment and Commercial and Industrial Refrigeration Equipment Manufacturing,'' 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 for this category. Based on this threshold, DOE present the following FRFA analysis:

1. Description and Estimated Number of Small Entities Regulated

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,[76] the SBA Database[77]), individual company Web sites, and market research tools (*e.g.,* Dunn and Bradstreet reports[78] and Hoovers reports[79]) to create a list of companies that manufacture or sell products covered by this rulemaking. DOE also asked stakeholders and industry representatives if they were aware of any other small manufacturers during manufacturer interviews and at DOE public meetings. DOE reviewed publicly available data and contacted select companies on its list, as necessary, to determine whether they met the SBA's definition of a small business manufacturer of covered automatic commercial ice makers. DOE screened out companies that do not offer products covered by this rulemaking, do not meet the definition of a ''small business,'' or are foreign owned.

DOE identified 16 manufacturers of automatic commercial ice makers. Seven of those are small businesses manufacturers 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.

In establishing today's standard levels, DOE has carefully considered the impacts on small manufacturers when establishing the standards for this industry. DOE's review of the industry suggests that the five of the seven small manufacturers identified specialize in industrial higher capacity ''tube'', ''flake'' or ''cracked'' ice machines. Industry literature indicates that these types of ice makers are typically designed to produce 2,000–40,000 lb/day of ice, with some designs going as low as 1,000 lb/day. Only at the lowest end of the tube, flake, and cracked ice platforms, typically 2,000 and 4,000 lb/day, do these manufacturers have products within the scope of this rulemaking. Based on product listings from manufacturer Web sites, DOE estimates that approximately 15% of the models produced by these five manufacturers are covered product under today's rule.

Of the remaining two small manufacturers, one exclusively produces continuous ice makers, and one exclusively produces gourmet, large cube, ice makers. Based on publically available information, DOE believes that approximately two-thirds of all the models made by the manufacturer of continuous machines already meet the standard, positioning it well compared to an industry-at-large compliance rate of approximately 50 percent.

DOE estimates that 10 percent of the models made by the manufacturer of gourmet, large cube machines already meet the standard. The low percentage indicates that this manufacturer may be disproportionately affected by the selected standard level, but as discussed in section IV.B.1.f, DOE does not have nor did it receive in response to requests for comments sufficient specific information to evaluate whether larger

[76] ''AHRI Certification Directory.'' AHRI Certification Directory. AHRI. (Available at: *https://www.ahridirectory.org/ahridirectory/pages/home.aspx*) (Last accessed October 10, 2011). See *www.ahridirectory.org/ahriDirectory/pages/home.aspx.*

[77] ''Dynamic Small Business Search.'' SBA. (Available at: See *http://dsbs.sba.gov/dsbs/search/dsp_dsbs.cfm*) (Last accessed October 12, 2011).

[78] ''D&B|Business Information|Get Credit Reports|888 480–6007.''. Dun & Bradstreet (Available at: *www.dnb.com*) (Last accessed October 10, 2011). See *www.dnb.com/.*

[79] ''Hoovers|Company Information|Industry Information|Lists.'' D&B (2013) (Available at: See *http://www.hoovers.com/*) (Last accessed December 12, 2012).

ice has specific consumer utility, nor to allow separate evaluation for such equipment of costs and benefits associated with achieving the efficiency levels considered in the rulemaking. In the absence of information, DOE cannot conclude that this type of ice has unique consumer utility justifying consideration of separate equipment classes. DOE notes that manufacturers of this equipment have the option seeking exception relief pursuant to 41 U.S.C. 7194 from DOE's Office of Hearings and Appeals.

Based on a 2008 study by Koeller & Company,[80] DOE understands that the ACIM market is dominated by four manufacturers who produce approximately 90 percent of the automatic commercial ice makers for sale in the United States. The four major manufacturers with the largest market share are Manitowoc, Scotsman, Hoshizaki, and Ice-O-Matic. The remaining 12 large and small manufacturers account for ten percent of domestic sales.

DOE considered comments that all manufacturers and stakeholders made regarding the engineering analysis and made changes to the analysis, which are described in some detail in section III.IV.D. These changes reduced the highest efficiency levels determined to be possible using the design options considered in the analyses and increased the estimated costs associated with attaining most efficiency levels. Consequently, the most cost-effective efficiency levels for the final rule analysis were lower than for the NOPR. This applied to specific equipment classes associated with the products sold by some of these small businesses, for example continuous ice makers, IMH batch ice makers, and RCU batch ice makers. The energy standards were consequently set at efficiency levels that will be less burdensome to attain for the affected small businesses.

2. Description and Estimate of Compliance Requirements

For the purposes of analysis, DOE assumes that the seven small domestic manufacturers of automatic commercial ice makers identified 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 industrial 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, as described further below, but are still considered small businesses based on the SBA limits for number of employees.

At the new and amended levels, small business manufacturers of automatic commercial ice makers are expected to face negative impacts on INPV. For the portions of their business covered by the standard, the impacts are approximately four times as severe as those felt by the industry at large: a loss of 49.8 percent of INPV for small businesses alone as compared to a loss of 12.5 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. Additionally, smaller manufacturers typically do not have the same technical resources and testing capacity as larger competitors.

The product conversion investments required to comply are estimated to be over 10 times larger than the typical R&D expenditures for small businesses, whereas the industry as a whole is estimated to incur 4 times larger than typical R&D expenditures. 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 invest in redesigning such a small portion of their product offering to meet standards.

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 associated with the production of covered product; noting that for five of the seven small businesses in this analysis, only 15% of their product portfolio, which was based on review capacity ranges of the product offerings listed on these manufacturers' Web sites, is covered product under today's rule DOE then compared these impacts to those modeled for the industry at large, and found that small manufactures could lose up to 49.8 percent of the INPV associated with the production of covered product; as compared to a reduction in small business INPV of 78.8 percent at the NOPR stage. Table VI.1 and Table VI.2 summarize the impacts on small business INPV at each TSL, and Table VI.3 and Table VI.4 summarize the changes in results at TSL 3, between the NOPR and Final Rule analysis.

[80] Koeller, John, P.E., and Herman Hoffman, P.E. A Report on Potential Best Management Practices. Rep. The California Urban Water Conservation Council, n.d. Web. 19 May 2014.

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 (%)	(6.2)	(9.2)	(12.5)	(15.3)	(24.6)
Small Businesses—Impact on INPV (%)	(18.3)	(34.2)	(48.8)	(51.5)	(57.2)

* Small business manufacturer INPV represents only the INPV associated with the production and sale of covered product. Many small business manufacturers produce products not covered by this rule.
** Values in parentheses are negative numbers.

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 (%)	(5.4)	(7.7)	(10.0)	(10.1)	(9.7)
Small Businesses—Impact on INPV (%)	(19.1)	(35.1)	(49.8)	(52.6)	(68.4)

* Small business manufacturer INPV represents only the INPV associated with the production and sale of covered product. Many small business manufacturers produce products not covered by this rule.
** Values in parentheses are negative numbers.

TABLE VI.3—COMPARISON OF SMALL BUSINESS MANUFACTURERS OF AUTOMATIC COMMERCIAL ICE MAKER INPV * TO THAT OF THE INDUSTRY AT LARGE UNDER THE PRESERVATION OF GROSS MARGIN MARKUP SCENARIO **; NOPR VS. FINAL RULE

	NOPR TSL 3	Final rule TSL 3
Industry at Large—Impact on INPV (%)	(20.5)	(12.5)
Small Businesses—Impact on INPV (%)	(76.6)	(48.8)

* Small business manufacturer INPV represents only the INPV associated with the production and sale of covered product. Many small business manufacturers produce products not covered by this rule.
** Values in parentheses are negative numbers.

TABLE VI.4—COMPARISON OF SMALL BUSINESS MANUFACTURERS OF AUTOMATIC COMMERCIAL ICE MAKER INPV * TO THAT OF THE INDUSTRY AT LARGE UNDER THE PRESERVATION OF EBIT MARKUP SCENARIO **; NOPR VS FINAL RULE

	NOPR TSL 3	Final rule TSL 3
Industry at Large—Impact on INPV (%)	(23.5)	(10.0)
Small Businesses—Impact on INPV (%)	(78.6)	(49.8)

* Small business manufacturer INPV represents only the INPV associated with the production and sale of covered product. Many small business manufacturers produce products not covered by this rule.
** 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 adopted today.

4. Significant Alternatives to the Rule

The discussion above analyzes impacts on small businesses that would result from DOE's new and amended standards. In addition to the other TSLs being considered, the rulemaking TSD includes a regulatory impact analysis (RIA). For automatic commercial ice making equipment, the RIA discusses the following policy alternatives: (1) No change in standard; (2) consumer rebates; (3) consumer tax credits; and (4) manufacturer tax credits; (5) voluntary energy efficiency targets; (6) bulk government purchases; and (7) extending the compliance date for small entities. While these alternatives may mitigate to some varying extent the economic impacts on small entities compared to the standards, DOE did not consider these alternatives further because they are either not feasible to implement without authority and funding from Congress, or are expected to result in energy savings that are much smaller (ranging from 39 percent to less than 53 percent) than those that will be achieved by the new and amended standard levels. In reviewing alternatives DOE analyzed a case in which the voluntary programs targeted efficiencies corresponding to final rule TSL 3. DOE also examined standards at lower efficiency levels, TSL 2 and TSL 1. TSL 2 achieves 25 percent lower savings than TSL 3 and TSL 1 achieves less than half the savings of TSL 3. (See Table V.50 for the estimated impacts of standards at lower TSLs.) Voluntary programs at these levels achieve only a fraction of the savings achieved by standards and would provide even lower savings benefits. As shown in Table VI.1 through Table VI.4, the changes to the efficiency levels comprising TSL 3 between the NOPR and final rule resulted in a substantial reduction in the impacts faced by small businesses. To achieve further substantial reductions in small business impacts would force the standard down to TSL 1 levels, at the expense of substantial energy savings and NPV benefits, which would be inconsistent with DOE's statutory mandate to maximize the improvement in energy efficiency that the Secretary determines is technologically feasible and economically justified. DOE believes that establishing standards at TSL 3 provides the optimum balance between energy savings benefits and impacts on small businesses. Accordingly, DOE is declining to adopt any of these alternatives and is adopting the standards set forth in this rulemaking. (See chapter 17 of the TSD for further detail on the policy alternatives DOE considered.)

Additional compliance flexibilities may be available through other means. For example, individual manufacturers may petition for a waiver of the applicable test procedure. Further, EPCA provides that a manufacturer whose annual gross revenue from all of its operations does not exceed $8,000,000 may apply for an exemption from all or part of an energy conservation standard for a period not longer than 24 months after the effective date of a final rule establishing the standard. Additionally, Section 504 of the Department of Energy Organization Act, 42 U.S.C. 7194, provides authority for the Secretary to adjust a rule issued under EPCA in order to prevent ''special hardship, inequity, or unfair distribution of burdens'' that may be imposed on that manufacturer as a result of such rule. Manufacturers should refer to 10 CFR part 430, subpart E, and part 1003 for additional details.

5. Response to Small Business Comments and Comments of the Office of Advocacy

The Chief Counsel of the SBA Office of Advocacy submitted comments regarding the impact of the proposed standards on small businesses and recommended that DOE use its discretion to adopt an alternative to the proposed standard that is achievable for small manufacturers. This letter is posted to the docket at *http://www.regulations.gov/#!docketDetail;D=EERE-2010-BT-STD-0037.*

DOE has taken several steps to minimize the impact of the new and amended standards on small businesses. The comments received in response to the proposed standards led DOE to hold an additional public meeting and allow stakeholders more time to submit additional information to DOE's consultant pursuant to non-disclosure agreements regarding efficiency gains and costs of potential design options. DOE reviewed additional market data, including published ratings of available ice makers, to recalibrate its engineering analysis, and as a result, revised the proposed TSL levels. DOE issued a NODA to announce the availability of the revised analysis and sought comment from stakeholders. In this final rule, DOE is adopting the TSL 3 presented in the NODA. As discussed previously, the changes to the efficiency levels comprising TSL 3 between the NOPR and final rule resulted in a standard that is less burdensome for small businesses.

In addition, in reviewing all available data sources received in response to the proposed standards, DOE found that the IMH–W continuous class ice makers consume more condenser water than DOE assumed at the NOPR stage. In setting the standard for the continuous class condenser water use, DOE intended that the baseline reflect the existing market for continuous type units. Based on this new data, the standard for condenser water use is set at 10 percent below the baseline condenser water use level for IMH–W batch ice makers, rather than 20 percent, as was proposed in the NOPR. As a result, all IMH–W continuous class models produced by small business manufacturers are compliant with the condenser water use standard for this class.

DOE notes that while any one regulation may not impose a significant burden on small business manufacturers, the combined effects of recent or impending regulations may have consequences for some small business manufacturers. In researching the product offerings of small business manufacturers covered by this rulemaking, DOE did not identify any that also manufacture products impacted by the recently issued energy conservation standards for commercial refrigeration equipment or walk-in coolers and freezers. DOE will continue to work with industry to ensure that cumulative impacts from its regulations are not unduly burdensome.

The SBA Office of Advocacy also recommended that DOE adopt a lower TSL for small businesses because the level proposed in the NOPR would have a disproportionately negative impact on small business manufacturers. As discussed previously, the changes to the analysis between the NOPR and final rule resulted in different TSLs. As such, the efficiency levels comprising TSL 3 as set forth in this final rule result in a substantial reduction in the impacts faced by small business manufacturers, as compared to those proposed in the NOPR. DOE also examined standards at lower efficiency levels, TSL 2 and TSL 1. TSL 2 achieves 25 percent lower savings than TSL 3 and TSL 1 achieves less than half the savings of TSL 3. (See Table V.50 for the estimated impacts of standards at lower TSLs.) The impacts on small manufacturers were also considered in comparison to the impacts on larger manufacturers to ensure that small business would remain competitive in the market. Because they compete mostly in market niches not covered by these standards, these rules apply to about 15 percent of these companies product in comparison to 100 percent for large business. In addition, for one of the remaining two manufacturers, DOE estimates that approximately two-thirds of its models already meet the energy efficiency standard and 100 percent of its models meet the condenser water standard. In comparison, a typical large manufacturer will need to redesign half of their products to meet the new and amended standards. Pursuant to DOE's statutory mandate, any new or amended standard must maximize the improvement in energy efficiency that the Secretary determines is both technologically feasible and economically justified. DOE determined that TSL 3 will achieve significant energy savings and is economically justified, and therefore is adopting TSL 3 in this final rule. DOE believes that establishing standards at TSL 3 provides the optimum balance between energy savings benefits and impacts on small businesses.

Finally, the SBA Office of Advocacy recommended that DOE consider extending the compliance date for small entities. DOE notes that 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)) As described previously, the standard levels set forth in this final rule are less stringent relative to those proposed in the NOPR, and fewer ice maker models will require redesign to meet the new standard. Therefore, DOE has determined that the 3-year period is adequate and is not extending the compliance date for small business manufacturers.

C. Review Under the Paperwork Reduction Act

Manufacturers of automatic commercial ice makers must certify to DOE that their products comply with any applicable energy conservation standards. In certifying compliance, manufacturers must test their products according to the DOE test procedures for 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 equipment, including commercial refrigeration equipment. (76 FR 12422 (March 7, 2011). The collection-of-information requirement for the certification and recordkeeping is subject to review and approval by OMB under the Paperwork Reduction Act (PRA). This requirement has been approved by OMB under OMB control number 1910–1400. Public reporting burden for the certification is estimated to average 20 hours per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information.

Notwithstanding any other provision of the law, no person is required to respond to, nor shall any person be subject to a penalty for failure to comply with, a collection of information subject to the requirements of the PRA, unless that collection of information displays a currently valid OMB Control Number.

D. Review Under the National Environmental Policy Act of 1969

Pursuant to the National Environmental Policy Act (NEPA) of 1969, DOE has determined that this final 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, App. B, B5.1(b); 1021.410(b) and Appendix B, B(1)–(5). This final 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 rule. DOE's CX determination for this final rule is available at *http://energy.gov/nepa/categorical-exclusion-determinations-b51.*

E. Review Under Executive Order 13132

Executive Order 13132, ''Federalism.'' 64 FR 43255 (Aug. 10, 1999) imposes certain requirements on Federal agencies formulating and implementing policies or regulations that preempt State law or that have Federalism implications. The Executive Order requires agencies to examine the constitutional and statutory authority supporting any action that would limit the policymaking discretion of the States and to carefully assess the necessity for such actions. The Executive Order also requires agencies to have an accountable process to ensure meaningful and timely input by State and local officials in the development of regulatory policies that have Federalism implications. On March 14, 2000, DOE published a statement of policy describing the intergovernmental consultation process it will follow in the development of such regulations. 65 FR 13735. EPCA governs and prescribes Federal preemption of State regulations as to energy conservation for the products that are the subject of this final 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 (February 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 final 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 an amended 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 ''significant intergovernmental mandate,'' and requires an agency plan for giving notice and opportunity for timely input to potentially affected small governments before establishing any requirements that might significantly or uniquely affect small governments. On March 18, 1997, DOE published a statement of policy on its process for intergovernmental consultation under UMRA. 62 FR 12820. DOE's policy statement is also available at *http://energy.gov/gc/office-general-counsel.*

DOE has concluded that this final rule would likely require expenditures of $100 million or more on the private sector. Such expenditures may include: (1) Investment in research and development and in capital expenditures by automatic commercial ice maker manufacturers in the years between the final rule and the compliance date for the new standards, and (2) incremental additional expenditures by consumers to purchase higher-efficiency automatic commercial ice maker, 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 final rule. 2 U.S.C. 1532(c). The content requirements of section 202(b) of UMRA relevant to a private sector mandate substantially overlap the economic analysis requirements that apply under section 325(o) of EPCA and Executive Order 12866. The **SUPPLEMENTARY INFORMATION** section of the notice of final rulemaking and the ''Regulatory Impact Analysis'' section of the TSD for this final rule respond to those requirements.

Under section 205 of UMRA, the Department is obligated to identify and consider a reasonable number of regulatory alternatives before promulgating a rule for which a written statement under section 202 is required. 2 U.S.C. 1535(a). DOE is required to select from those alternatives the most cost-effective and least burdensome alternative that achieves the objectives of the 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), 6313(d), this final rule would establish energy conservation standards for automatic commercial ice maker 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'' chapter 17 of the TSD for today's final 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 (March 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 (February 22, 2002), and DOE's guidelines were published at 67 FR 62446 (October 7, 2002). DOE has reviewed this final rule 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 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 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 concluded that this regulatory action, which sets forth energy conservation standards for automatic commercial ice makers, is not a significant energy action because the new and amended 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 final 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 (January 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.

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.*

M. Congressional Notification

As required by 5 U.S.C. 801, DOE will report to Congress on the promulgation of this rule prior to its effective date. The report will state that it has been determined that the rule is a ''major rule'' as defined by 5 U.S.C. 804(2).

VII. Approval of the Office of the Secretary

The Secretary of Energy has approved publication of today's final rule.

List of Subjects in 10 CFR Part 431

Administrative practice and procedure, Confidential business information, Energy conservation, Reporting and recordkeeping requirements.

Issued in Washington, DC, on December 31, 2014.

Kathleen B. Hogan,

Deputy Assistant Secretary for Energy Efficiency, Energy Efficiency and Renewable Energy.

For the reasons set forth in the preamble, DOE amends 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 of this chapter.

(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 January 28, 2018, shall meet the following standard levels:

Equipment type	Type of cooling	Harvest rate lb ice/24 hours	Maximum energy use kWh/100 lb ice	Maximum condenser water use [1] gal/100 lb ice
Ice-Making Head	Water	<500	7.8–0.0055H [2]	200–0.022H.
Ice-Making Head	Water	≥500 and <1,436	5.58–0.0011H	200–0.022H.
Ice-Making Head	Water	≥1,436	4.0	200–0.022H.
Ice-Making Head	Air	<450	10.26–0.0086H	Not Applicable.
Ice-Making Head	Air	≥450	6.89–0.0011H	Not Applicable.
Remote Condensing (but not remote compressor)	Air	<1,000	8.85–0.0038H	Not Applicable.
Remote Condensing (but not remote compressor)	Air	≥1,000	5.1	Not Applicable.
Remote Condensing and Remote Compressor	Air	<934	8.85–0.0038H	Not Applicable.
Remote Condensing (but not remote compressor)	Air	≥934	5.3	Not Applicable.
Self-Contained	Water	<200	11.40–0.019H	191–0.0315H.
Self-Contained	Water	≥200	7.6	191–0.0315H.
Self-Contained	Air	<175	18.0–0.0469H	Not Applicable.
Self-Contained	Air	≥175	9.8	Not Applicable.

[1] Water use is for the condenser only and does not include potable water used to make ice.
[2] H = harvest rate in pounds per 24 hours, indicating the water or energy use for a given 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 January 28, 2018, shall meet the following standard levels:

Equipment type	Type of cooling	Harvest rate lb ice/24 hours	Maximum energy use kilowatt-hours (kWh)/100 lb ice [1]	Maximum condenser water use gal/100 lb ice [2]
Ice-Making Head	Water	< 300	6.88–0.0055H	200–0.022H.
Ice-Making Head	Water	≥300 and <850	5.80–0.00191H	200–0.022H.
Ice-Making Head	Water	≥850 and <1,500	4.42–0.00028H	200–0.022H.
Ice-Making Head	Water	≥1,500 and <2,500	4.0	200–0.022H.
Ice-Making Head	Water	≥2,500 and <4,000	4.0	145.
Ice-Making Head	Air	< 300	10–0.01233H	NA.
Ice-Making Head	Air	≥ 300 and < 800	7.05–0.0025H	NA.
Ice-Making Head	Air	≥ 800 and < 1,500	5.55–0.00063H	NA.
Ice-Making Head	Air	≥ 1500 and < 4,000	4.61	NA.
Remote Condensing (but not remote compressor)	Air	< 988	7.97–0.00342H	NA.
Remote Condensing (but not remote compressor)	Air	≥ 988 and < 4,000	4.59	NA.
Remote Condensing and Remote Compressor	Air	< 930	7.97–0.00342H	NA.
Remote Condensing and Remote Compressor	Air	≥ 930 and < 4,000	4.79	NA.
Self-Contained	Water	< 200	9.5–0.019H	191–0.0315H.
Self-Contained	Water	≥ 200 and < 2,500	5.7	191–0.0315H.
Self-Contained	Water	≥ 2,500 and < 4,000	5.7	112.
Self-Contained	Air	< 110	14.79–0.0469H	NA.
Self-Contained	Air	≥ 110 and < 200	12.42–0.02533H	NA.
Self-Contained	Air	≥ 200 and < 4,000	7.35	NA.

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

(d) Each continuous type automatic commercial ice maker with capacities between 50 and 4,000 pounds per 24-hour period manufactured on or after January 28, 2018, shall meet the following standard levels:

Equipment type	Type of cooling	Harvest rate lb ice/24 hours	Maximum energy use kWh/100 lb ice [1]	Maximum condenser water use gal/100 lb ice [2]
Ice-Making Head	Water	<801	6.48–0.00267H	180–0.0198H.
Ice-Making Head	Water	≥801 and <2,500	4.34	180–0.0198H.
Ice-Making Head	Water	≥2,500 and <4,000	4.34	130.5.
Ice-Making Head	Air	<310	9.19–0.00629H	NA.
Ice-Making Head	Air	≥310 and <820	8.23–0.0032H	NA.
Ice-Making Head	Air	≥820 and <4,000	5.61	NA.
Remote Condensing (but not remote compressor)	Air	<800	9.7–0.0058H	NA.
Remote Condensing (but not remote compressor)	Air	≥800 and <4,000	5.06	NA.
Remote Condensing and Remote Compressor	Air	<800	9.9–0.0058H	NA.
		≥800 and <4,000	5.26	NA.
Self-Contained	Water	<900	7.6–0.00302H	153–0.0252H.
Self-Contained	Water	≥900 and <2,500	4.88	153–0.0252H.
Self-Contained	Water	≥2,500 and <4,000	4.88	90.
Self-Contained	Air	<200	14.22–0.03H	NA.
Self-Contained	Air	≥200 and <700	9.47–0.00624H	NA.
Self-Contained	Air	≥700 and <4,000	5.1	NA.

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

Appendix

[The following letter from the Department of Justice will not appear in the Code of Federal Regulations.]

U.S. Department of Justice, Antitrust Division, William J. Baer, Acting Assistant Attorney General, RFK Main Justice Building, 950 Pennsylvania Ave., NW., Washington, DC 20530–0001, (202)514–2401/(202)616–2645 (Fax)

December 24, 2014

Eric J. Fygi, Deputy General Counsel, Department of Energy, Washington, DC 20585

Re: Energy Conservation Standards for Automatic Commercial Ice Makers,

Dear Deputy General Counsel Fygi:

I am responding to your December 3, 2014 letter seeking the views of the Attorney General about the potential impact on competition of proposed energy conservation standards for automatic commercial ice makers. Your request was submitted under Section 325(o)(2)(B)(i)(V) of the Energy Policy and Conservation Act, as amended (ECPA), 42 U.S.C. 6295(o)(2)(B)(i)(V), which requires the Attorney General to make a determination of the impact of any lessening of competition that is likely to result from the imposition of proposed energy conservation standards. The Attorney General's responsibility for responding to requests from other departments about the effect of a program on competition has been delegated to the Assistant Attorney General for the Antitrust Division in 28 CFR §0.40(g).

In conducting its analysis the Antitrust Division examines whether a proposed standard may lessen competition, for example, by substantially limiting consumer choice, by placing certain manufacturers at an unjustified competitive disadvantage, or by inducing avoidable inefficiencies in production or distribution of particular products. A lessening of competition could result in higher prices to manufacturers and consumers.

We have reviewed the proposed standards contained in the Notice of Proposed Rulemaking (79 FR 14848, March 17, 2014) (NOPR). In light of the short time frame for our review of the proposed standards, we also consulted with DOE staff on the issues raised by the proposed NOPR.

Based on this review and consultation with DOE staff, our conclusion is that the proposed energy conservation standards for automatic commercial ice makers are unlikely to have a significant adverse impact on competition.

Sincerely,

William J. Baer

Enclosure

[FR Doc. 2015–00326 Filed 1–27–15; 8:45 am]

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