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6450-01-P

DEPARTMENT OF ENERGY

10 CFR Parts 429 and 431

[Docket Number EERE–2013–BT–STD–0022]

RIN 1904-AD00

Energy Conservation Program: Energy Conservation Standards for Refrigerated Bottled or Canned Beverage Vending Machines

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 refrigerated bottled or canned beverage vending machines (beverage vending machines or BVM). EPCA also requires the U.S. Department of Energy (DOE) to periodically 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 amending the energy conservation standards for Class A and Class B beverage vending machines. DOE is also amending the definition for Class A equipment to more unambiguously differentiate Class A and Class B beverage vending machines. In addition, DOE is amending the

definition of combination vending machine, is defining two new classes of combination vending machines, Combination A and Combination B, and is promulgating standards for those new classes. Finally, DOE is adopting new provisions that DOE will use to verify the appropriate equipment class and refrigerated volume during enforcement testing.

DATES: The effective date of this rule is **[INSERT DATE 60 DAYS AFTER DATE OF PUBLICATION IN THE FEDERAL REGISTER]**. Compliance with the new and amended standards established for beverage vending machines in this final rule is required on and after **[INSERT DATE 3 YEARS AFTER DATE OF PUBLICATION IN THE FEDERAL REGISTER].** The incorporation by reference of certain material listed in this rule is approved by the Director of the Federal Register as of **[INSERT DATE 60 DAYS AFTER DATE OF PUBLICATION IN THE FEDERAL REGISTER]**.

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 www.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: www.regulations.gov/#!docketDetail;D=EERE-2013-BT-STD-0022. The www.regulations.gov web page will contain 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:

This final rule incorporates by reference into part 431 the following industry standard:

- ASTM E 1084 - 86 (Reapproved 2009), "Standard Test Method for Solar Transmittance (Terrestrial) of Sheet Materials Using Sunlight," approved April 1, 2009.

Copies of ASTM standards may be obtained from ASTM International, 100 Barr Harbor Drive, PO Box C700, West Conshohocken, PA, 19428-2959, (877) 909-2786, or go to www.astm.org/.

See section I.A for a further discussion of this standard.

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I. Synopsis of the Final Rule

Title III, Part A[1] of the Energy Policy and Conservation Act of 1975 (EPCA or the Act), Pub. L. 94-163 (42 U.S.C. 6291–6309, as codified), established the Energy Conservation Program for Consumer Products Other Than Automobiles.[2] These products include refrigerated bottled or canned beverage vending machines (beverage vending machines or BVM), the subject of this document. (42 U.S.C. 6295(v))[3]

Pursuant to EPCA, any new or amended energy conservation standard must be designed to achieve the maximum improvement in energy efficiency that DOE determines is 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)) EPCA also provides that not later than 6 years after issuance of any final rule establishing or amending a standard, DOE must publish either a notice of determination that standards for the equipment do not need to be amended, or a notice of proposed rulemaking including new proposed energy conservation standards. (42 U.S.C. 6295(m)(1))

[1] For editorial reasons, upon codification in the U.S. Code, Part B was redesignated Part A.
[2] All references to EPCA in this document refer to the statute as amended through the Energy Efficiency Improvement Act of 2015, Pub. L. 114-11 (Apr. 30, 2015).
[3] Because Congress included beverage vending machines in Part A of Title III of EPCA, the consumer product provisions of Part A (not the industrial equipment provisions of Part A-1) apply to beverage vending machines. DOE placed the regulatory requirements specific to beverage vending machines in Title 10 of the Code of Federal Regulations (CFR), part 431, "Energy Efficiency Program for Certain Commercial and Industrial Equipment" as a matter of administrative convenience based on their type and will refer to beverage vending machines as "equipment" throughout this document because of their placement in 10 CFR part 431. Despite the placement of beverage vending machines in 10 CFR part 431, the relevant provisions of Title A of EPCA and 10 CFR part 430, which are applicable to all product types specified in Title A of EPCA, are applicable to beverage vending machines. See 74 FR 44914, 44917 (Aug. 31, 2009).

In accordance with these and other statutory provisions discussed in this document, DOE is adopting new and amended energy conservation standards for beverage vending machines. The new and amended standards, which are described in terms of the maximum daily energy consumption (MDEC) as a function of refrigerated volume, are shown in Table I.1. Specifically, DOE is amending the energy conservation standards established by the 2009 BVM final rule for Class A and Class B beverage vending machines. In addition, DOE is establishing two new equipment classes at 10 CFR 431.292, Combination A and Combination B, as well as new energy conservation standards for those equipment classes. The new and amended standards adopted in this final rule will apply to all equipment listed in Table I.1 and manufactured in, or imported into, the United States starting on **[INSERT DATE 3 YEARS AFTERDATE OF PUBLICATION IN THE FEDERAL REGISTER]**.

Table I.1. Energy Conservation Standards for Beverage Vending Machines (Compliance Starting [INSERT DATE 3 YEARS AFTER DATE OF PUBLICATION IN THE FEDERAL REGISTER])

Equipment Class*	**New and Amended Energy Conservation Standards** Maximum Daily Energy Consumption (MDEC) kWh/day†**
Class A	0.052 × V + 2.43‡
Class B	0.052 × V + 2.20‡
Combination A	0.086 × V + 2.66‡
Combination B	0.111 × V + 2.04‡

* See section IV.A.1 of this final rule for a discussion of equipment classes.
** "V" is the representative value of refrigerated volume (ft^3) of the BVM model, as measured in accordance with the method for determining refrigerated volume adopted in the recently amended DOE BVM test procedure and appropriate sampling plan requirements at 10 CFR 429.52(a)(3). 80 FR 45758 (July 31, 2015). See section III.B and V.A of this final rule for more details.
† kilowatt hours per day
‡ Trial Standard Level (TSL) 3

A. Benefits and Costs to Customers

Table I.2 and Table I.3 present DOE's evaluation of the economic impacts of the new and amended energy conservation standards on customers, or purchasers, of beverage vending machines, as measured by the average life-cycle cost (LCC) savings and the simple payback period (PBP).[4] This analysis is based upon beverage vending machines that use either CO_2 (R-744) or propane (R-290). These refrigerants were selected for analysis based on the recent actions of the U.S. Environmental Protection Agency's (EPA) Significant New Alternatives Policy (SNAP) program,[5] including the listing of propane as acceptable in BVM applications under Rule 19 (80 FR 19454, 19491 (April 10, 2015)) and the change of status of R-134a to unacceptable in BVM applications beginning January 1, 2019 under Rule 20 (80 FR 42870, 42917–42920 (July 20, 2015)). The selection of these refrigerants was also guided by visible trends within the BVM marketplace and feedback from interested parties during public meetings, in written comments, and during manufacturer interviews.

Where applicable, the average LCC savings are positive for all equipment classes and refrigerants, and the PBP is less than the average lifetime of the equipment, which is estimated to be 13.5 years.

[4] The average LCC savings are measured relative to the efficiency distribution in the no-new-standards case, which depicts the market in the compliance year (see section IV.F.6 of this final rule). The simple PBP, which is designed to compare specific efficiency levels, is measured relative to the baseline model (see section IV.C.1 of this final rule). DOE acknowledges that not all BVM customers are also the entity that is responsible for the energy costs of operating the beverage vending machine in the field. However, there are many different contracting mechanisms for leasing and operating beverage vending machines, which are influenced by many factors, including the capital cost of the machine and the annual operating costs. As such, DOE believes that a simple "customer" LCC-model accurately demonstrates the cost-effectiveness of the potential energy efficiency improvements resulting from any new or amended standards, regardless of by whom the costs and benefits are borne.

[5] The EPA's SNAP program, which is the U.S. government regulatory program responsible for maintaining the list of alternatives to ozone-depleting substances allowed for use within specific applications in the United States, has taken two rulemaking actions that concern refrigerants for the U.S. refrigerated vending machine market. See section IV.C.2 of this final rule for more details.

Table I.2 Impacts of New and Amended Energy Conservation Standards on Customers of Beverage Vending Machines – CO_2 Refrigerant

Equipment Class	Life-Cycle Cost Savings 2014$	Payback Period years
Class A	65	2.0
Class B	42	1.1
Combination A	990	0.8
Combination B	597	0.5

Table I.3 Impacts of New and Amended Energy Conservation Standards on Customers of Beverage Vending Machines – Propane Refrigerant

Equipment Class	Life-Cycle Cost Savings 2014$	Payback Period years
Class A	0*	1.1
Class B	361	0.5
Combination A	772	0.7
Combination B	610	0.3

* In this case, $0 savings is a result of all customers in the no-new-standards efficiency distribution already achieving the efficiency standard.

DOE's analysis of the impacts of the new and amended standards on customers is described in section V of this document.

B. Impact on Manufacturers

The industry net present value (INPV) is the sum of the discounted cash flows to the industry from the base year through the end of the analysis period (2015 to 2048). Using a real discount rate of 8.5 percent, DOE estimates that the (INPV) for manufacturers of beverage vending machines in the case without amended standards is $94.8 million in 2014$. Under the adopted standards, DOE expects that manufacturers may lose up to 0.8 percent of this INPV, which is approximately $0.7 million.[6] Additionally, based on DOE's interviews with the manufacturers of beverage vending

[6] All monetary values in section I.B of this final rule are expressed in 2014 dollars; discounted values are discounted to 2014 unless explicitly stated otherwise.

machines, DOE does not expect significant impacts on manufacturing capacity or loss of employment for the industry as a whole to result from the standards for beverage vending machines.

DOE's analysis of the impacts of the adopted standards on manufacturers is described in section IV.J of this document.

C. National Benefits and Costs[7]

DOE's analyses indicate that the adopted energy conservation standards for beverage vending machines would save a significant amount of energy. Relative to the case without amended standards, the lifetime energy savings for Class A, Class B, Combination A, and Combination B beverage vending machines purchased in the 30-year period that begins in the anticipated year of compliance with the new and amended standards (2019–2048) amount to 0.122 quadrillion Btu (quads).[8] This represents a savings of 16 percent relative to the energy use of this equipment in the case without amended standards (referred to as the "no-new-standards case").[9]

[7] All monetary values in this section are expressed in 2014 dollars and, where appropriate, are discounted to 2015 unless explicitly stated otherwise. Energy savings in this section refer to the full-fuel-cycle (FFC) savings (see section IV.H for discussion).

[8] A quad is equal to 10^{15} British thermal units (Btu). The quantity refers to FFC energy savings. FFC energy savings includes the energy consumed in extracting, processing, and transporting primary fuels (i.e., coal, natural gas, petroleum fuels), and, thus, presents a more complete picture of the impacts of energy efficiency standards. For more information on the FFC metric, see section IV.H.1.

[9] The no-new-standards case represents a mix of efficiencies above the minimum efficiency level (EL 0). Please see section IV.F.6 for a more detail description of associated assumptions.

The cumulative net present value (NPV) of total customer costs and savings of the standards for beverage vending machines range from \$0.21 billion (at a 7-percent discount rate) to \$0.51 billion (at a 3-percent discount rate).[10] This NPV expresses the estimated total value of future operating-cost savings minus the estimated increased equipment costs for beverage vending machines purchased in 2019–2048.

In addition, the standards for beverage vending machines are projected to yield significant environmental benefits. DOE estimates that the standards would result in cumulative greenhouse gas emission reductions (over the same period as for energy savings) of 7 million metric tons (Mt)[11] of carbon dioxide (CO_2), 4 thousand tons of sulfur dioxide (SO_2), 13 thousand tons of nitrogen oxides (NO_X), 32 thousand tons of methane (CH_4), 0.09 thousand tons of nitrous oxide (N_2O), and 0.02 tons of mercury (Hg).[12] The cumulative reduction in CO_2 emissions through 2030 amounts to 1.16 Mt, which is equivalent to the emissions resulting from the annual electricity use of more than 160,000 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

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[10] 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.H of this final rule.

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

[12] DOE calculated emissions reductions relative to the no-new-standards case, which reflects key assumptions in the Annual Energy Outlook 2015 (AEO2015) Reference case, which generally represents current legislation and environmental regulations for which implementing regulations were available as of October 31, 2014.

Federal interagency process.[13] The derivation of the SCC values is discussed in section IV.L of this final rule. Using discount rates appropriate for each set of SCC values, DOE estimates that the net present monetary value of the CO_2 emissions reduction (not including CO_2 equivalent emissions of other gases with global warming potential) is between $49 million and $701 million, with a value of $230 million using the central SCC case represented by $40.0 per metric ton in 2015. DOE also estimates that the net present monetary value of the NO_X emissions reduction to be $16 million at a 7-percent discount rate, and $42.0 million at a 3-percent discount rate.[14]

Table I.4 summarizes the national economic benefits and costs expected to result from the adopted standards for beverage vending machines.

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

[14] DOE estimated the monetized value of NO_X emissions reductions using benefit per ton estimates from the Regulatory Impact Analysis for the Proposed Carbon Pollution Guidelines for Existing Power Plants and Emission Standards for Modified and Reconstructed Power Plants, published in June 2014 by EPA's Office of Air Quality Planning and Standards. (Available at http://www3.epa.gov/ttnecas1/regdata/RIAs/111dproposalRIAfinal0602.pdf.) See section IV.L.2 for further discussion. For the monetized NOx benefits associated with PM2.5 in DOE's primary estimate, the benefit-per-ton values are based on an estimate of premature mortality derived from the ACS study (Krewski et al. Extended Follow-Up and Spatial Analysis of the American Cancer Society Study Linking Particulate Air Pollution and Mortality. 2009), which is the lower of the two EPA central tendencies. DOE is using the lower value as its primary estimate to be conservative when making the policy decision concerning whether a particular standard level is economically justified. DOE also estimated monetized NO_X benefits used EPA's higher benefit-per-ton estimates, and the overall benefits are over two times larger (see Table V.41). See chapter 14 of the TSD for further description of EPA's low and high values and the study mentioned above. DOE is currently investigating valuation of avoided Hg and SO_2 emissions.

Table I.4 Summary of National Economic Benefits and Costs of New and Amended Energy Conservation Standards for Beverage Vending Machines*

Category	Present Value <u>million 2014$</u>	Discount Rate <u>%</u>
Benefits		
Customer Operating Cost Savings	225	7%
	542	3%
CO_2 Reduction Monetized Value ($12.2/metric ton case)**	49	5%
CO_2 Reduction Monetized Value ($40.0/metric ton case)**	230	3%
CO_2 Reduction Monetized Value ($62.3/metric ton case)**	366	2.5%
CO_2 Reduction Monetized Value ($117/metric ton case)**	701	3%
NO_X Reduction Monetized Value†	16	7%
	42	3%
Total Benefits††	471	7%
	814	3%
Costs		
Customer Incremental Installed Costs	18	7%
	34	3%
Net Benefits		
Including CO_2 and NO_X† Reduction Monetized Value ††	453	7%
	780	3%

* This table presents the costs and benefits associated with beverage vending machines shipped in 2019–2048. These results include benefits to customers that accrue after the last year of analyzed shipments (2048) from the equipment purchased during the 30-year analysis period. The costs account for the incremental variable and fixed costs incurred by manufacturers due to the standard, some of which may be incurred in preparation for the rule.
** The CO_2 values represent global monetized values of the SCC, in 2014$, in 2015 under several scenarios of the updated SCC values. The first three cases use the averages of SCC distributions calculated using 5-percent, 3-percent, and 2.5-percent discount rates, respectively. The fourth case represents the 95th percentile of the SCC distribution calculated using a 3-percent discount rate. The SCC time series used by DOE incorporates an escalation factor. The value for NO_X is the average of high and low values found in the literature.
† The $/ton values for NO_X are described in section IV.L
†† Total benefits for both the 3-percent and 7-percent cases are derived using the series corresponding to average SCC with a 3-percent discount rate ($40.0/metric ton case).

The benefits and costs of the adopted standards for beverage vending machines sold in 2019–2048 can also be expressed in terms of annualized values. The monetary values for the total annualized net benefits are the sum of (1) the national economic value of the benefits in reduced operating costs, minus (2) the increases in equipment purchase prices and installation costs, plus (3) the value of the benefits of CO_2 and NO_X emission reductions, all annualized.[15]

[15] To convert the time-series of costs and benefits into annualized values, DOE calculated a present value in 2015, the year used for discounting the NPV of total consumer costs and savings. For the benefits, DOE calculated a present value associated with each year's shipments in the year in which the shipments occur

Although the value of operating cost savings and CO_2 emission reductions are both important, two issues are relevant. First, the national operating cost 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 for the lifetime of beverage vending machines shipped in 2019–2048. Because CO_2 emissions have a very long residence time in the atmosphere,[16] the SCC values in future years reflect future CO_2-emissions impacts that continue beyond 2100.

Estimates of annualized benefits and costs of the adopted standards are shown in Table I.5. The results under the primary estimate are as follows. Using a 7-percent discount rate for benefits and costs other than CO_2 reduction (for which DOE used a 3-percent discount rate along with the SCC series that has a value of $40.0 per metric ton in 2015),[17] the estimated cost of the standards in this rule is $1.8 million per year in increased equipment costs, while the estimated annual benefits are $22.2 million in reduced equipment operating costs, $12.8 million in CO_2 reductions, and $1.6 million in

(e.g., 2020 or 2030), and then discounted the present value from each year to 2015. The calculation uses discount rates of 3 and 7 percent for all costs and benefits except for the value of CO_2 reductions, for which DOE used case-specific discount rates, as shown in Table I.4. Using the present value, DOE then calculated the fixed annual payment over a 30-year period, starting in the compliance year that yields the same present value.

[16] The atmospheric lifetime of CO_2 is estimated of the order of 30–95 years. Jacobson, MZ. Correction to 'Control of fossil-fuel particulate black carbon and organic matter, possibly the most effective method of slowing global warming,' J. Geophys. Res. 2005. 110. pp. D14105.

[17] DOE used a 3-percent discount rate because the SCC values for the series used in the calculation were derived using a 3-percent discount rate (see section IV.L).

reduced NO_X emissions. In this case, the net benefit amounts to $35 million per year. Using a 3-percent discount rate for all benefits and costs and the SCC series that has a value of $40.0 per metric ton in 2015, the estimated cost of the standards is $1.9 million per year in increased equipment costs, while the estimated annual benefits are $30.2 million per year in reduced operating costs, $12.8 million in CO_2 reductions, and $2.3 million in reduced NO_X emissions. In this case, the net benefit amounts to $43 million per year.

DOE also calculated the low net benefits and high net benefits estimates by calculating the operating cost savings and shipments at the AEO2015 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. In addition, the low and high benefits estimates reflect low and high shipments scenarios (see section IV.G.3 of this final rule). 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 New and Amended Standards for Beverage Vending Machines*

	Discount Rate	Primary Estimate*	Low Net Benefits Estimate*	High Net Benefits Estimate*
		million 2014$/year		
Benefits				
Customer Operating Cost Savings	7%	22	16	27
	3%	30	21	36
CO_2 Reduction Monetized Value ($12.2/metric ton case)**	5%	4	3	4
CO_2 Reduction Monetized Value ($40.0/metric ton case)**	3%	13	9	14
CO_2 Reduction Monetized Value ($62.3/metric ton case)**	2.5%	19	14	21
CO_2 Reduction Monetized Value ($117/metric ton case)**	3%	39	29	44
NO_X Reduction Monetized Value†	7%	2	1 to 3	4
	3%	2	2 to 4	6
Total Benefits††	7% range	28 to 63	20 to 46	36 to 75
	7%	37	26	46
	3% range	36 to 69	25 to 51	46 to 86
	3%	45	32	56
Costs				
Incremental Equipment Costs	7%	1.79	1.38	2.10
	3%	1.89	1.42	2.13
Net Benefits				
Total††	7% range	26 to 61	18 to 44	34 to 73
	7%	35	25	44
	3% range	34 to 70	24 to 50	44 to 84
	3%	43	31	54

* This table presents the annualized costs and benefits associated with beverage vending machines shipped in 2019–2048. These results include benefits to customers that accrue after the last year of analyzed shipments (2048) from the equipment purchased in during the 30-year analysis period. The results account for the incremental variable and fixed costs incurred by manufacturers due to the standard, some of which may be incurred in preparation for the rule. The primary, low benefits, and high benefits estimates utilize projections of energy prices from the AEO2015 Reference case, Low Economic Growth case, and High Economic Growth case, respectively as well as the default shipments scenario along with the low and high shipments scenarios. In addition, incremental equipment costs reflect a medium decline rate for projected equipment price trends in the primary estimate, a low decline rate for projected equipment price trends in the low benefits estimate, and a high decline rate for projected equipment price trends in the high benefits estimate. The methods used to derive projected price trends are explained in appendix 8C of the technical support document (TSD).

** The CO_2 values represent global monetized SCC values, in 2014$, in 2015 under several scenarios. The first three cases use the averages of SCC distributions calculated using 5-percent, 3-percent, and 2.5-percent discount rates, respectively. The fourth case represents the 95^{th} percentile of the SCC distribution calculated using a 3-percent discount rate. The SCC time series incorporates an escalation factor.
† The $/ton values used for NO_X are described in section IV.L.2. The Primary and Low Benefits Estimates used the values at the low end of the ranges estimated by EPA, while the High Benefits Estimate uses the values at the high end of the ranges.
†† Total benefits for both the 3-percent and 7-percent cases are derived using the series corresponding to the average SCC with a 3-percent discount rate ($40.0/metric ton case). In the rows labeled "7% plus CO_2 range" and "3% plus CO_2 range," the operating cost and NO_X benefits are calculated using the labeled discount rate, and those values are added to the full range of CO_2 values.

DOE's analysis of the national impacts of the adopted standards is described in section V.B.3 of this final rule.

D. Conclusion

Based on the analyses culminating in this final rule, DOE found the benefits to the nation of the standards (energy savings, customer LCC savings, positive NPV of customer benefit, and emission reductions) outweigh the burdens (loss of INPV and LCC increases for some users of these equipment). DOE has concluded that the standards in this final rule represent the maximum improvement in energy efficiency that is technologically feasible and economically justified, and would result in significant conservation of energy.

DOE further notes that equipment achieving these standard levels is already commercially available for Class A and Class B beverage vending machines. While DOE does not have certification data for combination equipment to determine the existence or extent of equipment meeting the adopted standard levels, DOE believes that the standard levels adopted for combination equipment are reasonable as they are based on technology options that are widely available in the BVM market today (see section

III.D). DOE acknowledges that equipment using the SNAP-approved refrigerants (i.e., CO_2 and propane) meeting the current or adopted standard levels is not available for all equipment classes, due to the limited use of CO_2 as a refrigerant to date and the fact that propane has only recently been approved for use in BVM applications. 80 FR 19454, 19491 (April 10, 2015).

However, DOE notes that Class B beverage vending machines using CO_2 are currently available. In addition, Class A and Class B equipment that meets the new and amended standard levels is currently available, although such equipment may not use refrigerants that will be acceptable under EPA SNAP at the time of compliance with these new and amended standards. While DOE acknowledges that industry experience with SNAP-compliant refrigerants is limited, DOE believes that the existing industry experience in improving the efficiency of R-134a-based equipment is applicable and transferable to equipment using CO_2 or propane as a refrigerant. DOE has addressed the technical feasibility and economic implications of meeting the new and amended standard levels utilizing CO_2 and propane refrigerants in the analyses presented in this final rule, and based on these analyses, DOE has concluded that the benefits of the new and amended standards to the nation (energy savings, positive NPV of customer benefits, customer LCC savings, and emission reductions) outweigh the burdens (loss of INPV for manufacturers).

DOE also considered more-stringent energy efficiency levels as potential standards. However, DOE concluded that the potential burdens of the more-stringent energy efficiency levels would outweigh the projected benefits. Based on consideration of the public comments DOE received in response to the 2015 BVM energy conservation standards notice of proposed rulemaking (2015 BVM ECS NOPR) and related information collected and analyzed during the course of this rulemaking effort, DOE is adopting MDEC levels, in terms of kWh/day, that are less-stringent than the new and amended standards proposed in the NOPR and represent the standard levels resulting in the maximum economic benefits for the nation.

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 and new standards for beverage vending machines.

A. Authority

Title III, Part B of the Energy Policy and Conservation Act of 1975 (EPCA or the Act), Pub. L. 94-163 (codified as 42 U.S.C. 6291-6309) established the Energy Conservation Program for Consumer Products Other Than Automobiles, a program covering most major household appliances (collectively referred to as "covered products"), which includes the beverage vending machines that are the subject of this rulemaking. (42 U.S.C. 6291(40)) As part of this program, EPCA directed DOE to prescribe energy conservation standards for beverage vending machines. (42 U.S.C. 6295(v)) In addition, under 42 U.S.C. 6295(m), DOE must periodically review its established energy conservation standards for the covered equipment. This final rule fulfils these statutory requirements.

Pursuant to EPCA, DOE's energy conservation program for covered equipment consists essentially of four parts: (1) testing; (2) labeling; (3) the establishment of Federal energy conservation standards; and (4) certification and enforcement procedures. The Secretary or the Federal Trade Commission, as appropriate, may prescribe labeling requirements for beverage vending machines. (42 U.S.C. 6294(a)(5)(A)) 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 covered equipment. (42 U.S.C. 6293) Manufacturers of covered equipment must use the prescribed DOE test procedure as the basis for certifying to DOE that their equipment complies with the applicable energy conservation standards adopted under EPCA and when making representations to the public regarding the energy use or efficiency of that equipment. (42 U.S.C. 6293(c) and 6295(s)) Similarly, DOE must use these test procedures to determine whether the equipment complies with standards adopted pursuant to EPCA. (42 U.S.C. 6295(s))

DOE updated its test procedure for beverage vending machines in a final rule published July 31, 2015 (2015 BVM test procedure final rule). 80 FR 45758. In the 2015 BVM test procedure final rule, DOE adopted several amendments and clarifications to the DOE test procedure in appendix A and appendix B of subpart Q of 10 CFR part 431. As specified in the 2015 BVM test procedure final rule, manufacturers of beverage vending machines are required to use appendix B to demonstrate compliance with any new and amended energy conservation standards adopted as a result of this rulemaking.

DOE must follow specific statutory criteria for prescribing new or amended standards for covered equipment, including beverage vending machines. Any new or amended standard for a covered piece of 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 (3)(B)) Furthermore, DOE may not adopt any standard that would not result in the significant conservation of energy. (42 U.S.C. 6295(o)(3)) Moreover, DOE may not prescribe a standard: (1) for certain equipment, including beverage vending machines, if no test procedure has been established for the equipment, or (2) if DOE determines by rule that the standard is not technologically feasible or economically justified. (42 U.S.C. 6295(o)(3)(A)–(B))

In deciding whether a 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)) DOE must make this determination after receiving comments on the proposed standard, and by considering, to the greatest extent practicable, the following seven statutory 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 standard;

3) The total projected amount of energy (or as applicable, water) savings likely to result directly from the standard;
4) Any lessening of the utility or the performance of the covered equipment likely to result from the standard;
5) The impact of any lessening of competition, as determined in writing by the Attorney General, that is likely to result from the standard;
6) The need for national energy and water conservation; and
7) Other factors the Secretary of Energy (Secretary) considers relevant.

(42 U.S.C. 6295(o)(2)(B)(i)(I)–(VII))

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 piece of equipment complying with an energy conservation standard level will be less than three times the value of the energy (and, as applicable, water) 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))

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 a covered equipment type. (42 U.S.C. 6295(o)(1)) 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 in any covered equipment 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))

Additionally, EPCA specifies requirements when promulgating an energy conservation standard for covered equipment that has two or more subcategories. DOE must specify a different standard level for a type or class of equipment that has the same function or intended use if DOE determines that equipment 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 which other equipment within such type (or class) do not have and such feature justifies a higher or lower standard. (42 U.S.C. 6295(q)(1)) In determining whether a performance-related feature justifies a different standard for certain equipment, DOE must consider such factors as the utility to the consumer of such a 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)) In this final rule, DOE is prescribing energy conservation standards for different classes of beverage vending machines and DOE's basis for establishing such separate classes is discussed in this final rule.

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

Finally, pursuant to EPCA any final rule for new or amended energy conservation standards promulgated after July 1, 2010, must address standby mode and off mode energy use. (42 U.S.C. 6295(gg)(3)) Specifically, when DOE adopts a standard for any covered equipment after that date, it must, if justified by the criteria for adoption of standards under EPCA (42 U.S.C. 6295(o)), incorporate standby mode and off mode energy use into the standard, or, if that is not feasible, adopt a separate standard for such energy use for that equipment. (42 U.S.C. 6295(gg)(3)(A)–(B))

DOE reviewed the operating modes available for beverage vending machines and determined that this equipment does not have operating modes that meet the definition of standby mode or off mode, as established at 42 U.S.C. 6295(gg)(3). Specifically, beverage vending machines are typically always providing at least one main function—refrigeration. (42 U.S.C. 6295(gg)(1)(A)) DOE recognizes that in a unique equipment design, the low power mode includes disabling the refrigeration system, while for other equipment the low power mode controls only elevate the thermostat set point. Because low power modes still include some amount of refrigeration for the vast majority of equipment, DOE believes that such a mode does not constitute a "standby mode," as defined by EPCA, for beverage vending machines. Therefore, DOE believes that beverage vending machines do not operate under standby and off mode conditions as defined in EPCA, and that the energy use of a beverage vending machine is captured in any standard established for active mode energy use. As such, the new and amended energy conservation standards adopted in this final rule do not specifically address standby mode or off mode energy consumption for the equipment.

B. Background

1. Current Standards

In a final rule published on August 31, 2009 (henceforth referred to as the 2009 BVM final rule), DOE prescribed the current energy conservation standards for beverage vending machines. 74 FR 44914 (Aug. 31, 2009). The 2009 BVM final rule established energy conservation standards for Class A and Class B beverage vending machines, with a compliance date of August 31, 2012, as shown in Table II.1. DOE also established a class of combination machines, but did not set standards for combination machines, instead reserving a place for possible development of future standards for that equipment.

Table II.1 Energy Conservation Standards for Beverage Vending Machines, Prescribed by the 2009 BVM Final Rule—Compliance Date August 31, 2012

Class	Definition	Maximum Daily Energy Consumption
A	Class A means a refrigerated bottled or canned beverage vending machine that is fully cooled, and is not a combination vending machine.	0.055 × V + 2.56
B	Class B means any refrigerated bottled or canned beverage vending machine not considered to be Class A, and is not a combination vending machine.	0.073 × V + 3.16
Combination	Combination means a refrigerated bottled or canned beverage vending machine that also has non-refrigerated volumes for the purpose of vending other, non-“sealed beverage” merchandise.	[reserved]

The 2009 BVM final rule document is currently available at www.regulations.gov/#!documentDetail;D=EERE-2006-STD-0125-0005.

2. History of Standards Rulemaking for Beverage Vending Machines

EPCA directed the Secretary to issue, by rule, no later than August 8, 2009, energy conservation standards for beverage vending machines. (42 U.S.C. 6295 (v)) On August 31, 2009, DOE issued a final rule establishing performance standards for beverage vending machines to complete the first required rulemaking cycle. 74 FR 44914.

DOE conducted this energy conservation standards rulemaking pursuant to 42 U.S.C. 6295(m), which requires that within 6 years of issuing any final rule establishing or amending a standard, DOE shall publish either a notice of determination that amended standards are not needed or a NOPR proposing amended standards.

In initiating this rulemaking, DOE prepared a framework document, "Energy Conservation Standards Rulemaking Framework Document for Refrigerated Beverage Vending Machines" (framework document), which describes the procedural and analytical approaches DOE anticipates using to evaluate energy conservation standards for beverage vending machines. DOE published a notice that announced both the availability of the framework document and a public meeting to discuss the proposed analytical framework for the rulemaking. That notice also invited written comments from the public. 78 FR 33262 (June 4, 2013). That document is available at www.regulations.gov/#!docketDetail;D=EERE-2013-BT-STD-0022.

DOE held the framework public meeting on June 20, 2013, at which it (1) presented the contents of the framework document; (2) described the various analyses DOE 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) equipment classes, (2) analytical approaches and methods used in the rulemaking; (3) impact of standards and burden on manufacturers; (5) technology options; (6) distribution channels and shipments; (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 beverage vending machines relevant to this rulemaking.

DOE then gathered additional information and performed preliminary analyses to help review standards for this equipment. DOE published a notice to announce the availability of the preliminary analysis TSD and a public meeting to discuss the preliminary analysis results. 79 FR 46379 (Aug. 8, 2014). In the preliminary analysis, DOE discussed and requested comment on the tools and methods DOE used in performing its preliminary analysis, as well as analyses results. DOE also sought comments concerning other relevant issues that could affect potential amended standards for beverage vending machines. Id.

The preliminary analysis provided an overview of DOE's technical and economic analyses supporting new and amended standards for beverage vending machines, discussed the comments DOE received in response to the framework document, and addressed issues raised by those comments. The preliminary analysis TSD also described the analytical framework that DOE used (and continues to use) in considering new and amended standards for beverage vending machines, 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, data sources, methodologies, and results. These analyses included (1) the market and technology assessment, (2) the screening analysis, (3) the engineering analysis, (4) the energy use analysis, (5) the markups analysis, (6) the LCC analysis, (7) the PBP analysis, (8) the shipments analysis, (9) the national impact analysis (NIA), and (10) a preliminary manufacturer impact analysis (MIA).

The preliminary TSD that presents the methodology and results of each of these analyses is available at www.regulations.gov/#!docketDetail;D=EERE-2013-BT-STD-0022. In this final rule, DOE is presenting additional and revised analysis in all of these areas.

The public meeting to review the preliminary analysis took place on September 16, 2014 (preliminary analysis public meeting). At the preliminary analysis public meeting, DOE presented the methodologies and results of the analyses prescribed in the preliminary analysis TSD. Comments received in response to the preliminary analysis helped DOE identify and resolve issues related to the preliminary analyses and helped refine the analyses for beverage vending machines.

DOE presented its updated analyses and proposed new and amended standard levels in the 2015 BVM ECS NOPR, which DOE published on August 19, 2015. 80 FR 50462 (Aug. 19, 2015). On September 29, 2015, DOE held a public meeting to discuss the 2015 BVM ECS NOPR and request comments on DOE's proposal (BVM ECS NOPR public meeting). DOE received multiple comments from interested parties and considered these comments in the preparation of the final rule. In response to DOE's 2015 BVM ECS NOPR, several interested parties requested additional time to prepare their written comments. (AMS, No. 45 at p. 1; NAMA, No. 44 at p. 1; Royal Vendors, No. 46 at p. 1; and Coca-Cola, No. 49 at p. 1).[18] To accommodate this request, DOE issued a notice to reopen the 2015 BVM ECS NOPR comment period on October 23, 2015 until November 23, 2015. 80 FR 64370 (Oct. 23, 2015). Relevant comments received during both comment periods and the BVM ECS NOPR public meeting, as well as DOE's responses, are provided throughout this document.

[18] DOE will identify comments received in response to the 2015 BVM ECS NOPR and placed in Docket No. EERE-2013-BT-STD-0022 by the commenter, the number of document as listed in the docket maintained at www.regulations.gov, and the page number of that document where the comment appears (for example: Coca-Cola, No. 52 at p. 2). If a comment was made verbally during the BVM ECS NOPR public meeting, DOE will also specifically identify those as being located in the NOPR public meeting transcript (for example: Coca-Cola, Public Meeting Transcript, No. 48 at p. 184).

III. General Discussion

DOE is amending standards for Class A and Class B beverage vending machines. DOE is also amending the definition for Class A equipment to more unambiguously differentiate Class A and Class B beverage vending machines. In addition, DOE is amending the definition of combination vending machine, creating two classes of combination vending machine equipment, and promulgating standards for those classes. In the subsequent sections, DOE discusses the scope of coverage, test procedure, compliance dates, technical feasibility, energy savings, and economic justification of the new and amended standards.

A. Equipment Classes and Scope of Coverage

EPCA defines a beverage vending machine as "a commercial refrigerator[19] that cools bottled or canned beverages and dispenses the bottled or canned beverages on payment." (42 U.S.C. 6291(40))

When evaluating and establishing energy conservation standards, DOE divides covered equipment into equipment classes by the type of energy used or by capacity or

[19] EPCA defines commercial refrigerator, freezer, and refrigerator-freezer' as "refrigeration equipment that—
(i) is not a consumer product (as defined in section 6291 of this title);
(ii) is not designed and marketed exclusively for medical, scientific, or research purposes;
(iii) operates at a chilled, frozen, combination chilled and frozen, or variable temperature;
(iv) displays or stores merchandise and other perishable materials horizontally, semivertically, or vertically;
(v) has transparent or solid doors, sliding or hinged doors, a combination of hinged, sliding, transparent, or solid doors, or no doors;
(vi) is designed for pull-down temperature applications or holding temperature applications; and
(vii) is connected to a self-contained condensing unit or to a remote condensing unit." 42 U.S.C. 6311(9)(A).

other performance-related features that justifies a different standard. In making a determination whether a performance-related feature justify differing standards, DOE must consider such factors as the utility to the customer of the feature and other factors DOE determines are appropriate. (42 U.S.C. 6295(q))

In the 2009 BVM final rule, DOE determined that unique energy conservation standards were warranted for Class A and Class B beverage vending machines and added the following definitions to 10 CFR 431.292 to differentiate such equipment:

Class A means a beverage vending machine that is fully cooled, and is not a combination vending machine.

Class B means any beverage vending machine not considered to be Class A, and is not a combination vending machine.

74 FR 44914, 44967 (Aug. 31, 2009).

DOE differentiated Class A and Class B beverage vending machines based on whether the refrigerated volume (V) of equipment was fully cooled, as DOE determined that this was the most significant criteria affecting energy consumption. Id. at 44924.

The 2009 BVM final rule also established a definition for combination vending machine at 10 CFR 431.292.

Combination vending machine means a beverage vending machine that also has non-refrigerated volumes for the purpose of vending other, non-"sealed beverage" merchandise.

74 FR 44914, 44967 (Aug. 31, 2009).

DOE considered the definition of beverage vending machine broad enough to include any vending machine that cools at least one bottled or canned beverage and dispenses it upon payment. DOE elected to establish combination machines as a separate equipment class because such machines may be challenged by component availability and such machines have a distinct utility that limits their energy efficiency improvement potential compared to Class A and B beverage vending machines. However, DOE did not establish standards for combination machines in the 2009 BVM final rule. Id. at 44920.

While DOE's existing definitions of Class A and Class B equipment distinguish equipment based on whether or not the refrigerated volume is "fully cooled," DOE regulations have never defined the term "fully cooled." In the framework document, DOE suggested a definition for "fully cooled" and further refined that definition in the BVM test procedure NOPR DOE published on Aug. 11, 2014 (2014 BVM test procedure NOPR). 79 FR 46908, 46934. In response to comments received on both the framework document and 2014 BVM test procedure NOPR, DOE proposed to modify the definition of Class A to more unambiguously differentiate Class A and Class B equipment. In this final rule, DOE is using the presence of a transparent front on Class A beverage vending machines as a key distinguishing characteristic between Class A and Class B equipment and is adopting this distinction as part of the Class A equipment class definition.

In this final rule, DOE is also amending the definition of combination vending machine to better align with industry definitions and provide more clarity regarding the physical characteristics of the “refrigerated” and “non-refrigerated” volumes, or compartments. In addition, DOE is creating two classes of combination vending machines, Combination A and Combination B, to differentiate combination vending machines based on criteria similar to those used to distinguish Class A and Class B beverage vending machines (i.e., the presence of a transparent front). See section IV.A.1 of this final rule for more discussion on the equipment classes addressed in this final rule.

B. Test Procedure

The estimates of energy use and energy saving potential presented in the final rule analysis are based on the performance of beverage vending machines when tested in accordance with appendix B of the recently amended DOE BVM test procedure located at 10 CFR 431.294. (See sections IV.B, IV.C, and IV.E of this final rule for more discussion.) On July 31, 2015, DOE published the 2015 BVM test procedure final rule, which amended DOE’s test procedure for beverage vending machines. 80 FR 45758. In the 2015 BVM test procedure final rule, DOE adopted several minor amendments to clarify DOE’s test procedure for beverage vending machines and also adopted several amendments related to the impact of low power modes on the measured daily energy consumption of BVM models. Id. DOE also reorganized the DOE test procedure into two new appendices, appendix A and appendix B to subpart Q to part 431 of Title 10 of the Code of Federal Regulations, and adopted a minor change to the certification and reporting requirements for beverage vending machines at 10 CFR 429.52(b)(2) and 10 CFR 431.296.

The DOE BVM test procedure, as amended, incorporates by reference American National Standards Institute (ANSI)/American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) Standard 32.1–2010 to describe the measurement equipment, test conditions, and test protocol applicable to testing beverage vending machines. DOE's test procedure also specifies that the measurement of "refrigerated volume" of beverage vending machines must be in accordance with the methodology specified in Appendix C of ANSI/ASHRAE Standard 32.1-2010.

In the 2015 BVM test procedure final rule, DOE also adopted several new clarifying amendments including:

1) eliminating testing at the 90 °F ambient test condition,
2) clarifying the test procedure for combination vending machines,
3) clarifying the requirements for loading BVM models under the DOE test procedure,
4) clarifying the specifications of the standard product,
5) clarifying the next-to-vend beverage temperature test condition,
6) specifying placement of thermocouples during the DOE test procedure,

7) establishing testing provisions at the lowest application product temperature, and

8) clarifying the treatment of certain accessories when conducting the DOE test procedure.

These test procedure amendments are all reflected in DOE's new appendix A, which became effective August 31, 2015 and must be used, beginning January 27, 2016, by manufacturers for representations and to demonstrate compliance with the BVM energy conservation standards adopted in the 2009 BVM final rule, for which compliance was required as of August 31, 2012. 80 FR 45758 (July 31, 2015). DOE also adopted amended language at 10 CFR 429.52(b) and 10 CFR 431.296 clarifying the certification and reporting requirements for beverage vending machines, which also became effective August 31, 2015. Id. at 45787.

Appendix B includes all provisions in appendix A, as well as, provisions for testing low power modes. The test procedure found in appendix B is to be used in conjunction with the new and amended standards established as a result of this final rule. As such, manufacturers are not required to use appendix B until the compliance date of the new and amended standards established in this final rule. Id.

During the BVM ECS NOPR public meeting and subsequent comment period, several interested parties commented about DOE's updated BVM test procedure and how equipment are currently tested in the industry. ASAP commented in the BVM ECS

NOPR public meeting that there may be potential ambiguity in the BVM test procedure DOE adopted in 2006 (71 FR 71340 (Dec. 8, 2006)) with regard to lighting low power modes in that some machines may have shown artificially lower energy consumption under this test procedure due to lighting controls automatically turning off the lights when no one is in the test room. (ASAP, Public Meeting Transcript, No. 48 at p. 67) Royal Vendors and SandenVendo America (SVA) commented that the current standard is achievable without the use of low power modes and that they test all of their equipment without low power modes enabled, and do not include payment systems in their reported energy consumption. (Royal Vendors, No. 54 at p. 4; SVA, No. 53 at p. 2) The National Automatic Merchandising Association (NAMA) also commented that at least one manufacturer has achieved the current standard level without the use of energy management systems, and that reported energy consumption currently does not include payment systems. NAMA additionally urged DOE to allow energy management systems to be enabled during testing. (NAMA, No. 50 at p. 5) In its written comments, NAMA requested that DOE review the European Vending Association's Energy Management Protocol Program and stated that it may provide additional guidance related to the testing of beverage vending machines in Europe that may be applicable to the United States (NAMA, No. 50 at p. 14)

Automated Merchandising Systems (AMS) commented that the revised test procedure would adversely affect the daily energy consumption (DEC) even though performance has not changed. (AMS, No. 57 at p. 2) Specifically, SVA commented that including payment systems in reported energy consumption effectively lowers the allowable DEC by 0.2 kWh/day, which would account for over 9 percent of allowable energy consumption for Class A and 6 percent for Class B. (SVA, No. 53 at p. 4) SVA stated in written comments that the inclusion of payment systems in the reported energy consumption under the new test procedure would make it difficult to meet the current standard. (SVA, No. 53 at p. 2) Similarly, Coca-Cola and Royal Vendors stated that allowances for low power states are offset by the inclusion of payment systems in the reported energy consumption under the new test procedure. (Coca-Cola, No. 52 at p. 3; Royal Vendors, No. 54 at p. 1)

DOE recognizes that the previous DOE BVM test procedure adopted in DOE's 2006 test procedure final rule (71 FR 71340 (Dec. 8, 2006)) may have allowed for misinterpretation of some aspects of DOE's test procedure methodology. However, the clarifications and amendments recently adopted in appendix A of the DOE BVM test procedure seeks to unambiguously clarify how BVM equipment should be configured and tested in accordance with the DOE BVM test procedure. 80 FR 45758, 45760 (July 31, 2015). Specifically, related to lighting controls, appendix A requires that all lights be in the "on" state for the full duration of the test. However, appendix B, which is required for demonstrating compliance with the energy conservation standards adopted in this final rule, allows lighting and other accessories that are controlled by an accessory low power mode to be turned off (by the accessory low power mode) for a period of 6 hours. DOE believes this accurately represents the impact of accessory low power modes on BVM DEC. Regarding the energy consumption and configuration of payment mechanisms when testing beverage vending machines, DOE clarified in the 2015 BVM test procedure final rule that energy consumed by BVM payment systems should be included in the measured energy consumption of this equipment under both appendix A and appendix B.

In the analysis supporting this final rule, DOE has analyzed equipment under appendix B, which accounts for the use of accessory and refrigeration low power modes. DOE's analysis also assumes the energy consumption of payment mechanisms are accounted for in the DEC of BVM equipment. DOE recognizes that some test procedure amendments included in appendix B, such as those addressing accessory and lighting low power modes, may change the measured energy consumption of covered equipment. As such, as stated in the 2015 BVM test procedure final rule, use of appendix B is only permitted to demonstrate compliance with the new and amended standards adopted in this final rule. 80 FR 45758, 45760–45761. DOE notes that, on the effective date of this BVM ECS final rule, manufacturers may elect to begin using the appendix B test procedure prior to the compliance date, provided they use the results of such testing to demonstrate compliance with the new and amended standards adopted in this final rule. Manufacturers may not use the results of testing under appendix B to demonstrate compliance with the energy conservation standards adopted in the 2009 BVM final rule.[20]

In response to NAMA's comment requesting that DOE allow for the use of energy management systems during testing, DOE notes that the revised DOE BVM test

[20] See DOE's test procedure guidance on this topic at https://www1.eere.energy.gov/buildings/appliance_standards/pdfs/tp_earlyuse_faq_2014-8-25.pdf

procedure now allows for the use of lighting and refrigeration low power states. In response to NAMA's suggestion that DOE consult the European Vending Association's Energy Management Protocol Program, DOE appreciates the suggestion from NAMA, but notes that DOE has already clarified the appropriate configuration and use of energy management systems when testing in accordance with the DOE BVM test procedure in the recently published 2015 BVM test procedure final rule. 80 FR 45758. DOE also notes that EPCA requires that the DOE BVM test procedure for beverage vending machines shall be based on ASHRAE Standard 32.1–2004, entitled "Methods of Testing for Rating Vending Machines for Bottled, Canned or Other Sealed Beverages." 42 U.S.C. 6395(15)

C. Compliance Dates

Pursuant to 42 U.S.C. 6295(v)(3), the new and amended standards in this final rule will apply to equipment manufactured beginning on [**INSERT DATE 3 YEARS AFTER DATE OF PUBLICATION IN THE FEDERAL REGISTER**], 3 years after the publication date of this final rule in the Federal Register. In its analysis, DOE used a 30-year analysis period of 2019–2048.

In written comments submitted in response to the 2015 BVM ECS NOPR, Coca-Cola, NAMA, Royal Vendors, and the American Beverage Association (ABA) requested that the compliance date for DOE's proposed standards be delayed until 2022, 3 years after the compliance date for the new EPA SNAP Rules 19 and 20, which list as acceptable the use of CO_2, propane, and isobutane refrigerants (80 FR 19454, 19491

(April 10, 2015)) and phase out the use of R-134a refrigerant for BVM applications (80 FR 42870, 42917–42920 (July 20, 2015)), respectively. (Coca-Cola, No. 52 at p. 1; NAMA, No. 50 at p. 2; Royal Vendors, No. 54 at p. 2; ABA No. 63 at p. 3) During the written comment period following the publication of the 2015 BVM ECS NOPR, DOE also received 1,140 identical form letters (hereafter referred to as the Form Letters) from interested parties (the Form Letter Writers) regarding several aspects of DOE's proposal. In the Form Letter, commenters echoed the request for an extension of the compliance date to 2022. (The Form Letter Writers, No. 64 and 65 at p. 1)

In response to the request for an alternative compliance date for the new and amended BVM standards established as a result of this rulemaking, DOE notes that it does not have the discretion to deviate from the compliance period for beverage vending machines established under EPCA. Pursuant to 42 U.S.C. 6295(v), any energy conservation standard prescribed for beverage vending machines "shall apply to [equipment] manufactured 3 years after the date of publication of a final rule establishing the energy conservation standard." As such, DOE is not authorized to accommodate the request of commenters and maintains that compliance of the new and amended standards adopted in this final rule is required beginning 3 years after the publication date of this final rule in the Federal Register, or on [**INSERT DATE 3 YEARS AFTER DATE OF PUBLICATION IN THE FEDERAL REGISTER**].

D. Technological Feasibility

1. General

In each energy conservation standards rulemaking, DOE conducts a screening analysis based on information gathered on all current technology options and prototype designs that could improve the efficiency of the equipment that are the subject of the rulemaking. As the first step in such an analysis, DOE develops a list of technology options for consideration in consultation with manufacturers, design engineers, and other interested parties. DOE then determines which of those means for improving efficiency are technologically feasible. DOE considers technologies incorporated in commercially available equipment or in working prototypes to be technologically feasible. 10 CFR part 430, subpart C, appendix A, section 4(a)(4)(i).

After DOE has determined that particular technology options are technologically feasible, it further evaluates each technology option in light of the following additional screening criteria: (1) practicability to manufacture, install, and 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). Additionally, it is DOE policy not to include in its analysis any proprietary technology that is a unique pathway to achieving a certain efficiency level. Section IV.B of this document discusses the results of the screening analysis for beverage vending machines, particularly the designs DOE considered, those it screened out, and those that are the basis for the standard levels considered in this rulemaking. For further details on the screening analysis for this rulemaking, see chapter 4 of the final rule TSD.

In response to the proposed standard levels in the 2015 BVM ECS NOPR, DOE received several comments regarding the technological feasibility of those proposed standard levels. In written comments, the Appliance Standards Awareness Project (ASAP), Alliance to Save Energy (ASE), Natural Resources Defense Council (NRDC), Northwest Energy Efficiency Alliance (NEEA), and the Northwest Power and Conservation Council (NPCC) (herein referred to as the Energy Efficiency Advocates Joint Commenters, or EEA Joint Commenters) submitted a joint comment ((herein referred to as the EEA Joint Comment) expressing support for DOE's proposed standards (EEA Joint Commenters, No. 56 at p. 1) Conversely, in the BVM ECS NOPR public meeting and in written comments, NAMA, SVA, Coca-Cola, Royal Vendors, AMS, Seaga Manufacturing (Seaga), and the U.S. Small Business Administration's Office of Advocacy (SBA Advocacy) all stated that DOE's proposed standards were too aggressive, especially in light of EPA SNAP regulations concurrent with DOE's rulemaking. (NAMA, No. 50 at p. 1; SVA, No. 53 at p. 10; Coca-Cola, No 52 at p. 1; Royal Vendors, AMS, and Seaga, Public Meeting Transcript, No. 48 at pp. 175, 177; SBA Advocacy, No. 61 at p. 3) ABA requested that DOE coordinate with EPA to ensure the proposed standards are technologically and economically feasible relative to ENERGY STAR equipment specifications. (ABA, No. 63 at p. 3) The European Vending Association stated that adopting a standard more stringent than ENERGY STAR was not justifiable in Europe and it would not be feasible for DOE to adopt more stringent standards (EVA, No. 60 at p. 1) NAMA, SVA, and SBA Advocacy stated that the proposed standards are not technologically feasible or economically justified and will cause substantial negative impacts on the industry if enacted. (NAMA, No. 50 at p. 1; SVA, No. 53 at p. 10; SBA Advocacy, No. 61 at p. 3) AMS, SVA, and Royal Vendors stated in the BVM ECS NOPR public meeting and in written comments that compliance with DOE's proposed standards is unattainable, and Royal Vendors added that compliance would require cutting 1 kWh/day from its Class A machines and 1.5 kWh/day from its Class B machines. (AMS, SVA, and Royal Vendors, Public Meeting Transcript, No. 48 at p. 175; Royal Vendors, No. 54 at p. 1)

In the BVM ECS NOPR public meeting, Coca-Cola inquired about the manufacturer of the CO_2 unit that DOE examined and found to meet the 2009 standard, and expressed doubt that an existing CO_2 machine would be able to meet the proposed standard. (Coca-Cola, Public Meeting Transcript, No. 48 at pp. 96–101) Similarly, SVA and SBA Advocacy expressed agreement that the current standards could be met using any refrigerant but disagreement that the efficiency levels in the NOPR TSD could be met. (SVA, No. 53 at p. 3; SBA Advocacy, No. 61 at p. 3) SVA additionally expressed disagreement with DOE's assumption that all baseline Class A and Class B propane equipment and Class A CO_2 equipment would be able to meet EL1 because it believes many of DOE's proposed design options have already been implemented to meet the 2009 standard. (SVA, No. 53 at p. 7) AMS commented that it would not be able to meet even the 2009 standard for class A with CO_2 refrigerant, and further stated that it might be possible to meet trial standard level (TSL) 1 for Class A with substantial design changes. AMS additionally commented that it may be possible for it to meet TSL 2 for Combination A equipment using CO_2 and TSL 3 with propane with substantial design changes. (AMS, No. 57 at p. 4) In written comments, the Form Letter Writers stated DOE has not provided proof that CO_2 machines meeting the proposed standards are already available. (The Form Letter Writers, No. 64 and 65 at p. 1) Further, in the Form Letters, commenters stated the combination vending machines have not been tested to the proposed standard. (The Form Letter Writers, No. 64 and 65 at p. 1)

In the BVM ECS NOPR public meeting, SVA stated that the proposed standards do not leave room for any new or innovative features which consume energy. (SVA, Public Meeting Transcript, No. 48 at p. 174) In its written comment, Coca-Cola stated that the proposed standards would make it difficult for suppliers to offer equipment with display panels for equipment interaction, video content, or advertising, and would therefore reduce utility of the equipment. (Coca-Cola, No. 52 at p. 4)

DOE appreciates the support for DOE's proposed standard levels from the EEA Joint Commenters. Regarding the concerns raised by Coca-Cola, NAMA, Royal Vendors, AMS, Seaga, and SBA Advocacy DOE has revised its engineering and economic analyses based on the specific feedback of interested parties. DOE believes that its analyses accurately reflect the capabilities of existing current equipment designs and component design options. Specifically, DOE compared its engineering outputs to empirical DEC data gathered from the units that DOE selected for testing and teardowns, as well as to certified DEC data included in the Compliance Certification Management System (CCMS) and ENERGY STAR® directories in order to confirm the validity and accuracy of its engineering analysis inputs and results. Chapter 3 of the final rule TSD contains plots of the relevant ENERGY STAR and CCMS certification data, while Chapter 5 of the final rule TSD discusses DOE's methodology in selecting units for testing and teardown.

DOE also revised certain assumptions regarding the cost of more-efficient components and the cost to maintain, repair, and/or replace those more-efficient components to better reflect the BVM market today and throughout the analysis period. Component costs, as well as maintenance, repair, and replacement costs are discussed in chapters 5 and 8 of the final rule TSD, respectively. Based on these revised analyses, DOE is adopting in this final rule new and amended standards for beverage vending machines that are less stringent than the MDEC levels proposed in the 2015 BVM ECS NOPR. As discussed further in section V, the MDEC levels adopted in this final rule represent the standard levels for each equipment class with the maximum net benefits for the nation. DOE's engineering and economic analyses presented in this final rule represent the best available data on BVM performance and costs and include substantial input from interested parties received throughout the course of the rulemaking. As such, DOE believes the MDEC standard levels adopted in this final rule are technologically feasible and economically justified. DOE also analyzed these adopted standard levels against the reported and tested DEC values of currently available equipment and notes that there are several models of Class A and Class B equipment that would meet the amended MDEC levels under either appendix A or appendix B (that is, with or without low power modes employed). While DOE acknowledges that not all of these models use refrigerants that will be required in 2019 when compliance with the amended standards is required, DOE notes that at least one BVM model using CO_2 as a refrigerant are listed in the ENERGY STAR database that comply with the amended MDEC standard for Class B equipment adopted in this final rule.

In response to ABA and EVA's comments suggesting that DOE coordinate with ENERGY STAR and highlighting the technological feasibility of the ENERGY STAR standard levels, DOE notes that DOE coordinates closely with EPA's ENERGY STAR program. Regarding the technological feasibility of the new and amended standards adopted in this final rule as compared to ENERGY STAR levels, DOE is obligated to adopt the standard levels that represent the maximum improvement in energy efficiency that is technologically feasible and economically justified, subject to specific criteria established by EPCA. (42 U.S.C. 6295(o)(2) and (3)(B)) DOE specifically analyzed the technological feasibility and economic benefits of the current ENERGY STAR levels for Class A and Class B equipment (and comparable levels for Combination equipment) as TSL 1. DOE's analysis considers only those technology options considered to be technologically feasible, as discussed in section III.D.2 and IV.B. Therefore, by definition, all ELs and TSLs analyzed by DOE represent technologically feasible energy consumption levels for beverage vending machines. Based on DOE's analysis, as discussed further in section V.B, DOE found TSL 3 to result in the maximum economic benefits for the nation. Therefore, while the current ENERGY STAR are also technologically feasible, TSL 3 represents the maximum improvement in energy efficiency that is technologically feasible and economically justified, based on DOE's analysis.

In response to the Form Letter Writers statement that DOE has not provided proof that CO_2 machines meeting the proposed standards are already available, DOE recognizes that there was a statement in the 2015 BVM ECS NOPR that may have been misinterpreted by some to indicate that Class B equipment using CO_2 as a refrigerant was available that met the standard level proposed in the NOPR. Specifically, in both the 2015 BVM ECS NOPR public meeting and in written comments, Coca-Cola stated that it does not believe that there is a beverage vending machine with a CO_2 refrigeration system that is capable of meeting the proposed standards, even with credits for low power modes. (Coca-Cola, No. 52 at p. 2; Coca-Cola, Public Meeting Transcript, No. 48 at p. 184) In this final rule, DOE clarifies that the sentence in the 2015 BVM ECS NOPR was intended to read "Class B equipment that utilizes CO_2 as a refrigerant and Class B equipment that meets the proposed standard level is currently available." 80 FR 50462, 50467 (August 19, 2015). However, regarding the standard adopted in this final rule, DOE reiterates that at least one BVM model using CO_2 refrigerant is listed in the ENERGY STAR data base that meets the amended Class B standard level, and it is possible that additional units would meet the amended standard level when tested until the new appendix B test procedure adopted in the 2015 BVM test procedure final rule. 80 FR 45758 (July 31, 2015). BVM models of Class A and combination equipment using CO_2 refrigerant have not yet been developed, so a similar comparison is not possible.

In response to commenters concerns regarding combination equipment, DOE notes that combination equipment manufacturers are currently not required to report their DEC or comply with any energy conservation standards and, as such, DOE does not have the data that would be needed to perform a similar comparative analysis of the analytically-determined performance levels from the engineering analysis versus certification or testing data. However, DOE notes that the design options that DOE modeled in the engineering analysis as included at the adopted standard levels for Combination A and Combination B equipment are commonly available technologies that are also included in the packages of design options analyzed at the amended standard levels for Class A and B. That is, DOE believes that all Combination A and Combination B equipment should be able to meet the new energy conservation standard levels using the same technology options and equipment designs that would be employed by Class A and Class B equipment in meeting the amended standard levels adopted for the equipment. This determination was made based on an assessment of the commonalities in design present between the analogous classes, for example the presence of a transparent front and lighting in Class A and Combination A machines, and the use of a fully insulated cabinet and zone cooling in Class B and Combination B machines. A full discussion of DOE's analysis of the performance potential of combination vending machines is contained in Chapter 5 of the TSD.

In response to SVA and Coca-Cola's concerns regarding the ability of BVM models that feature digital display screens or other innovative, interactive designs, DOE notes that compliance with the new and amended standards is assessed based on the tested DEC, as measured in accordance with appendix B of the recently updated DOE BVM test procedure (80 FR 45758 (July 31, 2015)), and appropriate sampling plans (10 CFR 429.52(a)). In both appendix A and appendix B of the recently amended DOE BVM test procedure, DOE adopted specific provisions clarifying the configuration of BVM models featuring external customer display signs, lights, or digital screens, among other accessories and components. 80 FR 45758, 45778–45780 (July 31, 2015). Specifically, the DOE BVM test procedure specifies that external customer display signs, lights, or digital screens should be de-energized or, if they cannot be de-energized without impacting the primary functionality of the equipment, placed in the external accessory standby mode (if available) or the lowest energy consuming state (if no external accessory standby mode is available) that maintains such functionality. 10 CFR 431.292. As the incremental energy consumption of display signs and digital screens referred to by Coca-Cola and SVA potentially are not included in the measured DEC for such BVM models, DOE does not believe that innovation of manufacturers to include such features and accessories will be affected by the newly adopted test procedure or the standard levels adopted in this final rule. If any BVM manufacturers produce a BVM model with any features or accessories that cannot be accommodated by the DOE BVM test procedure or believe that application of the DOE BVM test procedure would produce results that are not adequately representative of the energy consumption of the equipment, the manufacturer of that equipment may submit a petition for a test procedure waiver in accordance with the provisions in 10 CFR 431.401.[21]

[21] DOE issued a final rule amending its regulations governing petitions for waiver and interim waiver from DOE test procedures for consumer products and commercial and industrial equipment. 79 FR 26591 (May 9, 2014). This final rule became effective on June 9, 2014.

2. Maximum Technologically Feasible Levels

When DOE proposes to adopt an amended standard for a type or class of covered equipment, it must determine the maximum improvement in energy efficiency or maximum reduction in energy use that is technologically feasible for such equipment. (42 U.S.C. 6295(p)(1)) Accordingly, in the engineering analysis, DOE determined the maximum technologically feasible ("max-tech") improvements in energy efficiency for beverage vending machines, using the design parameters for the most efficient equipment available on the market or in working prototypes. The max-tech levels that DOE determined for this rulemaking are described in section III.D.2 of this final rule and in chapter 5 of the final rule TSD.

E. Energy Savings

1. Determination of Savings

For each TSL, DOE projected energy savings from application of the TSL to beverage vending machines purchased in the 30-year period that begins in the year of compliance with any new and amended standards (2019–2048).[22] The savings are measured over the entire lifetime of equipment purchased in the 30-year analysis period. DOE quantified the energy savings attributable to each TSL as the difference in energy consumption between each standards case and the no-new-standards case. The no-new-standards case represents a projection of energy consumption that reflects how the market

[22] Each TSL is composed of specific efficiency levels for each equipment class. The TSL considered for this final rule are described in section V.A. DOE also presents a sensitivity analysis that considers impacts for equipment shipped in a 9-year period.

for the equipment would likely evolve in the absence of new and amended energy conservation standards.

DOE used its NIA spreadsheet models to estimate energy savings from new and amended standards for beverage vending machines. The NIA spreadsheet model (described in section IV.H of this document) calculates savings in site energy, which is the energy directly consumed by equipment at the locations where they are used. Based on the site energy, DOE calculates national energy savings (NES) in terms of primary energy savings at the site or at power plants, and also in terms of full-fuel-cycle (FFC) energy savings. The FFC metric includes the energy consumed in extracting, processing, and transporting primary fuels (i.e., coal, natural gas, petroleum fuels), and thus presents a more complete picture of the impacts of energy conservation standards.[23] DOE's approach is based on the calculation of an FFC multiplier for each of the energy types used by covered equipment. For more information on FFC energy savings, see section IV.H.2 of this document.

2. Significance of Savings

To adopt standards for any covered equipment, DOE must determine that such action would result in "significant" energy savings. (42 U.S.C. 6295(o)(3)(B)) Although the term "significant" is not defined in the Act, the U.S. Court of Appeals, for the District of Columbia Circuit in Natural Resources Defense Council v. Herrington, 768 F.2d 1355, 1373 (D.C. Cir. 1985), indicated that Congress intended "significant" energy savings in

[23] The FFC metric is discussed in DOE's statement of policy and notice of policy amendment. 76 FR 51282 (Aug. 18, 2011), as amended at 77 FR 49701 (Aug. 17, 2012).

the context of EPCA to be savings that were not "genuinely trivial." The energy savings for all the TSLs considered in this rulemaking, including the adopted standards, are nontrivial; therefore, DOE considers them "significant" within the meaning of section 325 of EPCA.

F. Economic Justification

1. Specific Criteria

As noted above, 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)) The following sections discuss how DOE has addressed each of those seven factors in this rulemaking.

a. Economic Impact on Manufacturers and Customers

In determining the impacts of a potential amended standard on manufacturers, DOE conducts an MIA, as discussed in section IV.J of this document. DOE first uses an annual cash-flow approach to determine the quantitative impacts. This step includes both a short-term assessment—based on the cost and capital requirements during the period between when a regulation is issued and when entities must comply with the regulation—and a long-term assessment over a 30-year period. The industry-wide impacts analyzed include: (1) the INPV, which values the industry on the basis of expected future cash flows; (2) cash flows by year; (3) changes in revenue and income; and (4) other measures of impact, as appropriate. Second, DOE analyzes and reports the impacts on different types of manufacturers, including impacts on small manufacturers. Third, DOE considers the impact of standards on domestic manufacturer employment and manufacturing capacity, as well as the potential for standards to result in plant closures and loss of capital investment. Finally, DOE takes into account cumulative impacts of various DOE regulations and other regulatory requirements on manufacturers.

For individual customers, measures of economic impact include the changes in LCC and PBP associated with new or amended standards. These measures are discussed further in the following section. For customers in the aggregate, DOE also calculates the national NPV of the economic impacts applicable to a particular rulemaking. DOE also evaluates the LCC impacts of potential standards on identifiable subgroups of customers that may be affected disproportionately by a national standard.

b. Savings in Operating Costs Compared to Increase in Price (LCC and PBP)

EPCA requires DOE to consider 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 of, or in the initial charges for, or maintenance expenses of, the covered equipment that are likely to result from a standard. (42 U.S.C. 6295(o)(2)(B)(i)(II)) DOE conducts this comparison in its LCC and PBP analysis.

The LCC is the sum of the purchase price of a piece of equipment and the operating cost (including energy, maintenance, and repair expenditures) discounted over the lifetime of the equipment. The LCC analysis requires a variety of inputs, such as equipment prices, equipment energy consumption, energy prices, maintenance and repair costs, equipment lifetime, and discount rates appropriate for customers. To account for uncertainty and variability in specific inputs, such as equipment lifetime and discount rate, DOE uses a distribution of values, with probabilities attached to each value.

The PBP is the estimated amount of time (in years) it takes customers to recover the increased purchase cost (including installation) of a more-efficient piece of equipment through lower operating costs. DOE calculates the PBP by dividing the change in purchase cost due to a more-stringent standard by the change in annual operating cost for the year that standards are assumed to take effect.

For its LCC and PBP analysis, DOE assumed that customers will purchase the covered equipment in the first year of compliance with amended standards. The LCC savings for the considered efficiency levels are calculated relative to the case that reflects projected market trends in the absence of amended standards. DOE identifies the percentage of customers estimated to experience an LCC increase, as well as calculates the average LCC savings associated with a particular standard level. DOE's LCC and PBP analyses are discussed in further detail in section IV.F of this document.

c. Energy Savings

Although significant conservation of energy is a separate statutory requirement for adopting an energy conservation standard, EPCA requires DOE, in determining the economic justification of a standard, to consider the total projected energy savings that are expected to result directly from the standard. (42 U.S.C. 6295(o)(2)(B)(i)(III)) As discussed in section IV.H of this document, DOE uses the NIA spreadsheet models to project NES.

d. Lessening of Utility or Performance of Equipment

In establishing equipment classes, and in evaluating design options and the impact of potential standard levels, DOE evaluates potential standards that would not lessen the utility or performance of the considered equipment. (42 U.S.C. 6295(o)(2)(B)(i)(IV)) DOE determined based on the data available that the standards adopted in this final rule will not reduce the utility or performance of the equipment under consideration in this rulemaking.

e. Impact of Any Lessening of Competition

EPCA directs DOE to consider the impact of any lessening of competition, as determined in writing by the Attorney General that is likely to result from a standard. (42 U.S.C. 6295(o)(2)(B)(i)(V)) It also directs the Attorney General to determine the impact, if any, of any lessening of competition likely to result from a standard and to transmit such determination to the Secretary within 60 days of the publication of a proposed rule, together with an analysis of the nature and extent of the impact. (42 U.S.C. 6295(o)(2)(B)(ii)) DOE 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. DOE received no adverse comments from DOJ regarding the proposed rule.

f. Need for National Energy Conservation

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

The adopted 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 potential standards may affect these emissions, as discussed in section IV.K of this final rule; the emissions impacts are reported in section V.B.6 of this document. DOE also estimates the economic value of emissions reductions resulting from the considered TSLs, as discussed in section IV.L of this document.

g. Other Factors

EPCA allows the Secretary of Energy, 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)) To the extent interested parties submit any relevant information regarding economic justification that does not fit into the other categories described above, DOE could consider such information under "other factors."

2. Rebuttable Presumption

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

IV. Methodology and Discussion of Related Comments

This section addresses the analyses DOE has performed for this rulemaking with regard to beverage vending machines. Each component of DOE's analysis is discussed in the following subsections, and DOE summarizes and responds to associated comments received in response to the NOPR.

DOE used several analytical tools to estimate the impact of the standards considered in this document. The first tool is a spreadsheet that calculates the LCC savings and PBP of potential amended or new energy conservation standards. The NIA uses a second spreadsheet set that provides shipments forecasts and calculates NES and NPV of total customer costs and savings expected to result from potential energy conservation standards. DOE uses the third spreadsheet tool, the Government Regulatory Impact Model (GRIM), to assess manufacturer impacts of potential standards. These three spreadsheet tools are available on the DOE website for this rulemaking: https://www1.eere.energy.gov/buildings/appliance_standards/rulemaking.aspx/ruleid/73. Additionally, DOE used output from the latest version of EIA's AEO, a widely known energy forecast for the United States, for the emissions and utility impact analyses.

A. Market and Technology Assessment

DOE develops information in the market and technology assessment that provides an overall picture of the market for the equipment concerned, including the purpose of the equipment, the industry structure, manufacturers, market characteristics, and technologies used in the equipment. This activity includes both quantitative and qualitative assessments, based primarily on publicly available information.

DOE reviewed relevant literature and interviewed manufacturers to develop an overall picture of the BVM market in the United States. Industry publications, trade journals, government agencies, and trade organizations provided the bulk of the information, including (1) manufacturers and their market shares, (2) shipments by equipment type, (3) detailed equipment information, (4) industry trends, and (5) existing regulatory and non-regulatory equipment efficiency improvement initiatives. The key findings of DOE's market assessment are summarized below. See chapter 3 of the final rule TSD for further discussion of the market and technology assessment.

1. Equipment Classes

In this final rule, DOE is amending the energy conservation standards established by the 2009 BVM final rule for Class A and Class B beverage vending machines. DOE believes that Class A and Class B equipment classes continue to provide distinct utility to customers and have different energy profiles and applicable design options, as described below. As such, DOE has determined that it is appropriate to separately analyze and regulate Class A and Class B equipment. As noted previously, DOE is amending the definition for Class A equipment to more clearly and unambiguously describe the equipment characteristics that distinguishing Class A from Class B equipment. Specifically, DOE distinguishes Class A equipment from Class B equipment based on the presence of a transparent front. DOE is also amending the definition of combination vending machine to better align with industry definitions and provide more clarity regarding the physical characteristics of the "refrigerated" and "non-refrigerated" volumes, or compartments.[24] In addition, DOE is defining two new equipment classes, Combination A and Combination B, as well as establishing new energy conservation standards for those equipment classes. In the 2009 BVM final rule, DOE also established a definition for combination vending machines but elected not to set standards for them at that time. 74 FR 44914, 44920 (Aug. 31, 2009). In considering standards for combination vending machines as part of this rulemaking, DOE determined that the presence of a transparent front is an important differentiating feature for combination equipment, similar to Class A and Class B beverage vending machines.

Table IV.1 summarizes the new and amended definitions for the four equipment classes analyzed in this final rule. The definitions, as well as the general characteristics and differentiating features, of the four equipment classes adopted in this final rule are described in the following subsections of this document. In addition, the following subsections address any comments received from interested parties on DOE's proposed definitions presented in the 2015 BVM ECS NOPR and DOE's response to those comments.

[24] The definition of combination vending machine established by DOE in the 2009 BVM final rule referenced the presence of "non-refrigerated volumes" to differentiate combination vending machines from other styles of beverage vending machines. In the amended definition for combination vending machine, DOE is referring instead to "compartments," which DOE believes captures the same intent as the term "volumes" in the previous definition, but better indicates that the "volumes" are to be physically separate.

Table IV.1 Equipment Classes for Beverage Vending Machines

Class	Definition
A	A refrigerated bottled or canned beverage vending machine that is not a combination vending machine and in which 25 percent or more of the surface area on the front side of the beverage vending machine is transparent[25]
B	Any refrigerated bottled or canned beverage vending machine that is not considered to be Class A and is not a combination vending machine
Combination A	A combination vending machine where 25 percent or more of the surface area on the front side of the beverage vending machine is transparent
Combination B	A combination vending machine that is not considered to be Combination A

a. Class A and Class B Beverage Vending Machines

Class A and Class B equipment are currently differentiated based on the cooling mechanism employed by the equipment. The distinguishing criterion between these two equipment classes is whether the equipment is fully cooled. 10 CFR 431.292.

When the definitions of Class A and Class B were established as part of the 2009 final rule, DOE did not define the term "fully cooled." In the framework document, DOE suggested defining "fully cooled" to mean a beverage vending machine within which each item in the beverage vending machine is brought to and stored at temperatures that fall within ±2 °F of the average beverage temperature, which is the average of the temperatures of all the items in the next-to-vend position for each selection. 78 FR 33262 (June 4, 2013).

[25] DOE notes that in the 2015 BVM ECS NOPR, DOE proposed to the definition of Class A to include the term "combination beverage vending machine." In this final rule, DOE is adopting a definition of Class A that, instead, references the term "combination vending machine," as that is the defined term for combination equipment at 10 CFR 431.292. DOE notes that this minor editorial change does not affect the meaning or scope of the definition, just ensure consistency between all of the definition pertinent to the regulation of this equipment.

Throughout the course of this rulemaking and the parallel DOE BVM test procedure rulemaking, DOE has discussed and received comments on the most appropriate, clear, and unambiguous definitions for Class A and Class B beverage vending machines. Specifically, in the 2014 DOE BVM test procedure NOPR, DOE proposed to define "fully cooled" as "a condition in which the refrigeration system of a beverage vending machine cools product throughout the entire refrigerated volume of a machine instead of being directed at a fraction (or zone) of the refrigerated volume as measured by the average temperature of the standard test packages in the furthest from the next-to-vend positions being no more than 10 °F above the integrated average temperature of the standard test packages." 79 FR 46908, 46934 (Aug. 11, 2014). To accompany DOE's proposed definition of "fully cooled," the 2014 BVM test procedure NOPR also proposed to adopt an optional test method that could be used to quantitatively differentiate between Class A and Class B equipment. 79 FR at 46917.

In response to the definition of "fully cooled" proposed in the 2014 BVM test procedure NOPR, several interested parties recommended that DOE consider an alternative differentiation between equipment types to better capture differences in energy consumption. In a joint comment submitted on behalf of the California investor-owned utilities (Pacific Gas and Electric Company (PG&E), Southern California Gas Company (SCGC), San Diego Gas and Electric (SDG&E), Southern California Edison (SCE), and Arizona Public Service (APS); hereafter referred to as CA IOUs) commenters suggested that the presence of a transparent or opaque front and/or the arrangement of products within the machine could be potential differentiating criteria that are more appropriate and consistent with the differentiation between equipment configurations applied in industry. (Docket No. EERE-2013-BT-TP-0045, CA IOUs, No. 0005 at p. 1) SVA also supported this position. (Docket No. EERE-2013-BT-TP-0045, SVA, Public Meeting Transcript, No. 0004 at p. 52) Many interested parties also commented on the difficulty of establishing a quantitative temperature threshold to differentiate fully cooled equipment from non-fully cooled equipment that would be applicable across all BVM models. (Docket No. EERE-2013-BT-TP-0045, AMS, Public Meeting Transcript, No. 0004 at p. 54; Docket No. EERE-2013-BT-TP-0045, Coca-Cola, No. 0010 at p. 4; Docket No. EERE-2013-BT-TP-0045, Coca-Cola, No. 0010 at p. 4; Docket No. EERE-2013-BT-TP-0045, SVA, No. 0008 at p. 2; Docket No. EERE-2013-BT-TP-0045, NEEA, No. 0009 at p. 1)

In light of the extent and scope of the comments received in response to the amendments proposed in the 2014 BVM test procedure NOPR regarding the proposed definition of fully cooled, alternative criteria for differentiating Class A and Class B equipment, and the optional fully cooled verification test protocol, DOE wished to further consider potential classification options and criteria suggested by interested parties, as well as provide interested parties an additional opportunity to provide feedback on any proposals to amend the equipment class definitions. As such, DOE responded to the comments presented by interested parties in response to the 2014 BVM test procedure NOPR and proposed an alternative approach to differentiate Class A and Class B equipment in the 2015 BVM ECS NOPR. Specifically, in the 2015 BVM ECS NOPR, DOE proposed to amend the definition of Class A beverage vending machines to read as follows:

Class A means a refrigerated bottled or canned beverage vending machine that is not a combination vending machine and in which 25 percent or more of the surface area on the front side of the beverage vending machine is transparent.

DOE did not propose in the 2015 BVM ECS NOPR to substantively modify the definition of Class B, since Class B is defined as the mutually exclusive converse of Class A. However, DOE made a minor editorial change to include the term "that" to improve readability of the definition. 80 FR 50462, 50474–50475 (Aug. 19, 2015).

DOE also noted in the 2015 BVM ECS NOPR that beverage vending machines with horizontal product rows are typically fully cooled and have a transparent front, while beverage vending machines with vertical product stacks are typically zone cooled and are fully opaque. DOE added that it is not aware of any instances of BVM models that are not fully cooled but which have a transparent front and/or horizontal product configuration or BVM models that are fully cooled but which have and opaque front and/or vertical stacks. Thus, DOE believed that, based on current equipment designs, using criteria of (a) whether the equipment is fully cooled, (b) whether the equipment has a transparent front, or (c) whether the product arrangement is horizontal or vertical, would result in virtually identical equipment categorization. Finally, DOE also noted that, since DOE's engineering analysis considers typical, representative equipment designs for each equipment class (see section IV.C), the cooling method, the presence of a transparent or opaque front,[26] and product arrangement are linked in DOE's engineering analysis, as shown in Table IV.2. Id.

Table IV.2 Equipment Classes Design Parameters for Beverage Vending Machines Modeled in the Engineering Analysis

Class	Cooling Method	Transparent or Opaque Front	Vendible Product Orientation
A	Fully cooled	Transparent front	Horizontal product rows
B	Zone cooled	Opaque front	Vertical product stacks
Combination A	Fully cooled	Transparent front	Horizontal product rows
Combination B	Zone cooled	Opaque front	Vertical product stacks

In response to DOE's 2015 BVM ECS NOPR, NAMA and Royal Vendors, in their written comments, stated that the presence of a transparent front does not always correlate with fully-cooled equipment, and that at least one manufacturer has developed fully-cooled vending machines with solid fronts. (NAMA, No. 50 at p. 3; Royal Vendors, No. 54 at p. 3) SVA expressed disagreement with DOE's proposed definition of Class A equipment because it stated that not all fully-cooled beverage vending machines have a transparent panel and that this may discourage the production of Class B equipment due to the more stringent proposed standards for Class B. (SVA, No. 53 at p. 1) AMS stated that the presence of a transparent front does not necessarily reflect the design intent or energy consumption characteristics of the machine (AMS, No. 57 at p. 2)

NAMA also expressed concern that the transparency requirement excludes the use of digital video display screens in Class A equipment (NAMA, No. 50 at p. 3) SVA

[26] In this notice, DOE uses the terms "solid front," "opaque front," and "non-transparent" front interchangeably to refer to equipment that does not meet DOE's definition of Class A or Combination A. That is, equipment where greater than 75 percent of the material used to construct the front of the beverage vending machine does not meet the definition of "transparent" adopted in this final rule.

agreed with NAMA and expressed its belief that vending machines with digital video display screens should be considered as Class A instead of Class B equipment (SVA, Public Meeting Transcript, No. 48 at p. 19) Conversely, the CA IOUs expressed their belief that equipment with transparent and opaque video screen fronts should be regulated as separate equipment classes, with non-transparent screens classified as Class B and transparent screens classified as Class A. (CA IOUs, No. 58 at p. 1)

In determining the best way to clarify the differentiation of Class A and Class B equipment, DOE considered all comments submitted by interested parties, as well as the manner in which equipment is currently categorized by DOE and industry. It is DOE's continued understanding that the cooling method is significantly correlated with the product configuration and presence of a transparent front. Therefore, differentiating Class A and Class B equipment based on either the product's configuration or the transparency of the front side of the BVM, rather than the cooling method, would preserve the same utility in each class of equipment.   The presence of a transparent front provides a specific utility that allows a customer to view and select from all of the various next-to-vend product selections, which are all maintained at the appropriate vending temperature. In this manner, the presence of a transparent front is inherently related to the cooling method of a beverage vending machine (i.e., whether or not the equipment is "fully cooled"). DOE acknowledges that there may be some fully cooled beverage vending machines that have an opaque front and, as such, will be subject to the energy conservation standard for Class B. For example, in the 2015 BVM ECS NOPR, DOE pointed to test data that demonstrated some equipment with opaque fronts and small refrigerated volumes experience temperature differentials of less than 2 °F between the next-to-vend and furthest from next-to-vend beverage locations and are, therefore, effectively "fully cooled." 80 FR 50462, 50478 (Aug. 19, 2015). However, DOE believes that the Class B standards are more appropriate for such equipment because the insulating quality of the transparent versus non-transparent front has a larger impact on energy consumption than the cooling method.

DOE believes that the presence of a transparent front provides the customer with the specific utility of being able to see all the available the product selections and choose from the larger number of merchandise options that are provided by Class A equipment. In addition, DOE notes that the presence of a transparent material on the front side of a beverage vending machine has a larger impact on the energy consumption of a given beverage vending machine than the cooling method or equipment product arrangement. Thus, while DOE continues to believe that the presence of a transparent front, a "fully cooled" refrigerated volume, and horizontal product placement are all representative characteristics of most Class A equipment, DOE believes that defining equipment classes based on the feature that is most related to the unique utility and which has the largest impact on the energy use of the equipment is the most appropriate criterion to use to ensure that the utility provided by Class A equipment is maintained in the marketplace.

While DOE acknowledges that there may be some opaque front equipment that is fully cooled, DOE believes that it is more appropriate for such equipment to be treated as Class B. Because an opaque, insulated panel has significantly different heat transfer characteristics than a transparent glass front, a BVM model that is insulated on all six sides should use less energy than a similar BVM model with a transparent front. That is, DOE believes energy consumption and the presence of a transparent front are correlated.

DOE performed a sensitivity analysis using the engineering analysis spreadsheet to compare the impact of a transparent front versus solid front on DEC with the impact of a fully cooled refrigerated volume versus a zone cooled refrigerated volume on DEC. Specifically, DOE compared the analytically derived performance of two specific sets of representative units differing only in one design characteristic—either a transparent front or a fully cooled interior. That is, DOE modeled the following three BVM unit configurations:

1) a BVM unit with a fully cooled refrigerated volume and a transparent front
2) a BVM unit with a fully cooled refrigerated volume and a solid front
3) a BVM unit with a zone cooled refrigerated volume and a transparent front.

DOE compared the modeled DEC of number 1) and number 2) to determine the impact of a transparent front and compared number 1) and number 3) to determine the impact of the cooling method. The results of this analysis indicated that the difference in energy consumption between a BVM model that has a transparent front as compared to a model that does not is greater than the difference in energy consumption between a BVM model that is fully cooled as compared to one that is not. Based on this analysis, DOE has determined that the presence of a transparent front is closely correlated to the utility associated with Class A equipment and directly corresponds to the energy consumption of the equipment. Because the cooling method and the presence of a glass or solid front are correlated in practice for the vast majority of equipment, DOE believes that clarifying DOE's equipment class definitions using the presence of a transparent front (an unambiguous equipment characteristic based on customer utility) will not result in significant changes to the classification of BVM models that are currently available on the market.

Similarly, regarding the treatment of digital screens, DOE agrees with CA IOUs that the transparency of BVM models equipped with digital screens should be ascertained as it is for BVM models with conventional glass or panel materials. That is, transparency should be determined for all the materials between the refrigerated volume and the ambient environment and only if the aggregate performance of all those materials yields a light transmittance of greater than or equal to 45 percent would that area be treated as transparent.

DOE believes that this is the most appropriate and reasonable treatment of equipment with digital screens because the energy consumption of BVM models with opaque digital screens is more similar to the energy consumption of BVM models with opaque, insulated fronts than to BVM models with transparent fronts. That is, as noted by SVA in the BVM ECS NOPR public meeting, the panel behind any external customer display signs or digital screens is typically insulated. (SVA, Public Meeting Transcript, No. 48 at p. 24–25) DOE notes that external customer digital screens and customer display signs are not required to be energized during the testing of beverage vending machines, in accordance with the newly adopted BVM test procedure. 80 FR 45758, 45778–45780 (July 31, 2015). Accordingly, the energy consumption and heat transfer characteristics of a BVM model with an external, opaque digital screen is much more similar to the energy consumption and heat transfer characteristics of a BVM model with an opaque, insulated front than a BVM model with a transparent front.

Regarding equipment with transparent digital screens, DOE acknowledges the statement by CA IOUs that equipment with transparent display screens where all materials between the refrigerated space and external ambient environment meet the definition of transparent will be treated as part of the transparent surface area under DOE's definition. As such, equipment with large transparent display screens (such as, potentially, holograms projected onto glass) that still enabled the BVM user to see the refrigerated merchandise inside the BVM refrigerated compartment and constitute at least 25 percent of the front side of the beverage vending machine would be categorized as a Class A beverage vending machine. However, DOE notes that it is not aware of any such technology on the market today.

Consequently, in this final rule, DOE maintains that only BVM models where at least 25 percent of the surface area on the front side of the beverage vending machine is transparent, and that is not a combination vending machine, will be considered to be Class A. Conversely, if greater than 75 percent of the surface area on the front side of the beverage vending machine is not transparent, and the beverage vending machine is not a combination vending machine, then the beverage vending machine will be considered to be Class B. DOE notes that the amended Class A definition only considers transparent area on the front side of beverage vending machine and transparency must be determined for the entire panel, as described in section IV.A.1.c.

As interested parties did not suggest any alternative definitions or differentiating characteristics, DOE believes that modifying the definitions of Class A and Class B to rely on the presence of a transparent front allows for the most clear and unambiguous differentiation of equipment classes. Further, DOE believes referencing the presence of a transparent front to identify Class A equipment generally aligns with DOE's and industry's interpretation of Class A machines to date. DOE notes that the amended Class A and Class B definitions are effective on the effective date of this final rule.

b. Combination Vending Machines

In the 2009 BVM final rule, DOE established a definition for combination vending machines (74 FR 44914, 44920 (Aug. 31, 2009)). That definition describes a combination vending machine as a refrigerated bottled or canned beverage machine that also has non-refrigerated volumes for the purpose of vending other, non-"sealed beverage" merchandise. 10 CFR 431.292. However, the 2009 BVM final rule did not consider or differentiate equipment within the combination vending machine equipment category or address any specific criteria that could be used to differentiate "refrigerated" and "non-refrigerated."

In its recent test procedure rulemaking, culminating in the 2015 BVM test procedure final rule, DOE considered the applicability of the combination vending machine definition to equipment designs it has encountered on the market, and considered stakeholder comments on the definition of “combination vending machine.” 80 FR 45758, 45765–45767 (July 31, 2015). In the 2015 BVM test procedure final rule, DOE clarified the test procedure for combination vending machines and noted that such equipment must include compartments that are physically separated, while acknowledging that some combination equipment designs may employ a common product delivery chute between the refrigerated and non-refrigerated compartments for the purposes of delivering vendible merchandise to the customer. DOE also gave notice that it would seek to further clarify the definition of “combination vending machine” in this BVM energy conservation standard final rule. Id. at 45765-45767.

As such, in consideration of the input from various commenters throughout both the test procedure and energy conservation standards rulemaking processes, as well as of the range of equipment designs that DOE has observed for sale on the market, DOE proposed in the 2015 BVM ECS NOPR an amended definition of “combination vending machine.” Specifically, DOE proposed to amend the definition of “combination vending machine” to more clearly and unambiguously establish the distinction between “refrigerated” and “non-refrigerated” compartments contained in a combination vending machine based on whether a compartment is designed to be refrigerated, as demonstrated by the presence of temperature controls. 80 FR 50462, 50478–50480 (Aug. 19, 2015).

DOE also proposed that, similar to Class A and Class B equipment classes, the transparency of the front side of the vending machine can differentiate certain styles of combination vending machines that provide a unique utility in the marketplace because their specific design attributes allow the equipment to be stocked with a wider variety of product selections that can be viewed directly through the equipment's transparent front. As such, in the 2015 BVM ECS NOPR, DOE proposed to define two new equipment classes at 10 CFR 431.292, Combination A and Combination B, and defined those equipment classes as follows:

Combination A means a combination vending machine where 25 percent or more of the surface area on the front side of the beverage vending machine is transparent.

Combination B means a combination vending machine that is not considered to be Combination A.

Id.

In response to DOE's proposed new and amended definitions for Combination A, Combination B, and combination vending machine, several interested parties raised questions about DOE's proposed definitions. In particular, AMS stated that machines intended to dispense both refrigerated and unrefrigerated products have an insulated tray between the refrigerated and unrefrigerated compartments and are defined as combination vending machines by their company. (AMS, Public Meeting Transcript, No. 48 at p. 18) AMS also stated that its combination vending machines only have temperature controls for the compartment intended to be refrigerated and therefore do not meet DOE's proposed definition for combination vending machines. (AMS, No. 57 at p. 2) Steven Chesney of Seaga inquired if a non-cooled refrigerated compartment attached to a separate cabinet with a refrigerated compartment would be considered as a combination vending machine. (Steven Chesney, Public Meeting Transcript, No. 48 at p. 26) EVA commented that DOE should use "simple and understandable" definitions and consider defining them similar to the European definitions. (EVA, No. 60 at p. 2)

In response to AMS's comments regarding their combination vending machine designs, featuring an insulated shelf separating refrigerated and non-refrigerated compartments and temperature controls in the compartment intended to be refrigerated, DOE notes that this is in fact consistent with its proposed definition for combination vending machines, provided the insulated shelf is a "solid partition" and does not allow for air transfer between the compartments outside of the product delivery chute. To clarify, DOE notes that the combination vending machine definition only requires temperature controls in the compartment that is designed to be refrigerated.

In response to Mr. Chesney's inquiry regarding whether two separate cabinets attached to each other would constitute a combination vending machine, DOE clarifies that, consistent with all equipment, compliance for each model is based on how that model is distributed in commerce. That is, if the vending machine: (1) is distributed in commerce as a single piece of equipment and (2) includes at least one compartment that was designed to be refrigerated (demonstrated by the presence of temperature controls) and at least one compartment that is not designed to be refrigerated (and, therefore, does not include temperature controls) separated by a solid partition, such equipment meets the definition of combination vending machine and would be classified as either Combination A or Combination B for the purposes of compliance with DOE's energy conservation standards. Such equipment may share the same product deliver chute or include separate product delivery chutes.

In response to EVA's suggestion that DOE use simple and understandable definitions, similar to those in the European vending market, DOE researched the definitions used in Europe to describe beverage vending machines and was not able to find consistent definitions or terminology that are publically available and such definitions were note provided in EVA's comments. However, DOE continues to believe that the definitions adopted in this final rule represent the clearest and most unambiguous approach to differentiating equipment classes for the U.S. market.

In response to DOE's 2015 BVM ECS NOPR, NAMA stated that DOE's proposed definition of combination vending machines is inconsistent with industry practice and the EPA's ENERGY STAR definition and requested that DOE change this definition to be consistent with industry practice. NAMA specifically stated that very few vending machines have a [fully-extending] solid partition, and that instead many of them allow air to comingle between the unrefrigerated and refrigerated compartments. NAMA additionally stated that the unrefrigerated space pulls down to nearly the same temperature as the refrigerated volume over time in machines it considers to be combination vending machines. (NAMA, No. 50 at p. 1) In the Form Letters, commenters stated the definition of combination vending machines were not consistent with terms used in industry. (The Form Letter Writers, No. 64 and 65 at p. 1)

In response to comments from NAMA and the Form Letter Writers that DOE's definition of combination vending machine should be consistent with the ENERGY STAR or other industry definitions for such equipment, DOE notes that the ENERGY STAR definition of combination vending machines is identical to the current DOE definition for combination vending machine. DOE is not aware of any other specific industry definitions that are relevant for this equipment, and notes that the "industry" terms mentioned by The Form Letter Writers were not provided in comments. As noted previously, DOE believes the existing definition could be made more clear and unambiguous to improve the consistency of equipment definition for regulatory purposes. In addition, in response to NAMA's observation that typical combination vending machines do not have a fully extending solid partition, DOE notes that the definition of combination specifies that such equipment have two compartments, separated by a solid partition, but that such equipment may also include a common product delivery chute. DOE agrees with NAMA that, for many designs of combination equipment on the market today, the common product delivery chute may prevent the solid partition separating the refrigerated and non-refrigerated compartments from fully extending from front to back and side to side. That is, the solid partition need not thermally isolate the refrigerated compartment(s) from the non-refrigerated compartment(s) provided any air exchange between compartments occurs only unintentionally through the common product delivery chute. If a vending machine model were to feature openings in the solid partition designed to allow for air transfer between the compartments, other than the product delivery chute, such equipment would not be considered a combination vending machine as it would not include any “non-refrigerated” compartments. That is, DOE interprets the designed presence of openings in the solid partition as a means of “intentional refrigeration” of that compartment. Therefore, equipment that is designed for air transfer between compartments is treated as Class A or Class B, depending on whether or not the equipment featured a transparent front (see sections IV.A.1.a and IV.A.1.c)

Based on the comments submitted by interested parties, DOE is adopting, in this final rule, the amended definition for combination vending machine and new definitions for Combination A and Combination B, as proposed in the 2015 BVM ECS NOPR. As noted in the 2015 BVM test procedure final rule, DOE believes that both appendix A and appendix B of the amended DOE BVM test procedure are applicable to combination vending machines. 80 FR 45758 (July 31, 2015). Specifically, appendix A of the DOE BVM test procedure is applicable to combination vending machines for the purposes of making any representations regarding the energy consumption of such equipment beginning January 27, 2016. Id. However, beginning on the compliance date of this final rule, manufacturers of combination vending machines will be required to use appendix B of the DOE BVM test procedure for the purposes of demonstrating compliance with any such energy conservation standards and when making representations regarding the energy consumption of covered equipment.

c. Definition of Transparent and Optional Test Method for Determining Equipment Classification

In the 2015 BVM ECS NOPR, DOE proposed a quantitative criterion to clearly determine whether a BVM model "has a transparent front" based on the percentage of transparent surface area on the front side of the beverage vending machine. Specifically, DOE proposed the procedure by which DOE would (1) determine the surface area of beverage vending machines and (2) determine whether such surface area is transparent. However, DOE noted that these procedures would not be required for rating and certification of specific BVM models. Under the proposal, manufacturers would be able to certify equipment as Class A, Class B, Combination A, or Combination B based on knowledge of the specific equipment dimensions and characteristics. However, DOE would use these procedures in enforcement testing to verify the appropriate equipment classification for all cases. As such, DOE also noted that where the appropriate equipment classification is not abundantly clear, manufacturers may elect to perform the test to ensure they are categorizing their equipment properly. To clarify that such procedures are only optional for manufacturers, DOE proposed to add such procedures to the product-specific enforcement provisions at 10 CFR 429.134. 80 FR 50462, 50476–50480 (Aug. 19, 2015).

Specifically, to determine the surface area, DOE proposed to specify that the total surface area of the front side of the beverage vending machine, from edge to edge, be determined as the total length multiplied by the total height of a beverage vending machine. DOE also proposed to specify that the transparent surface area would consist of all areas composed of transparent material on the front side of a beverage vending machine, and that the non-transparent surface area would consist of all areas composed of material that is not transparent on the front side of a beverage vending machine, where the sum of the transparent and non-transparent surface areas should equal the total surface area of the front side of a beverage vending machine, as shown in Figure IV.1. 80 FR 50462, 50476 (Aug. 19, 2015).

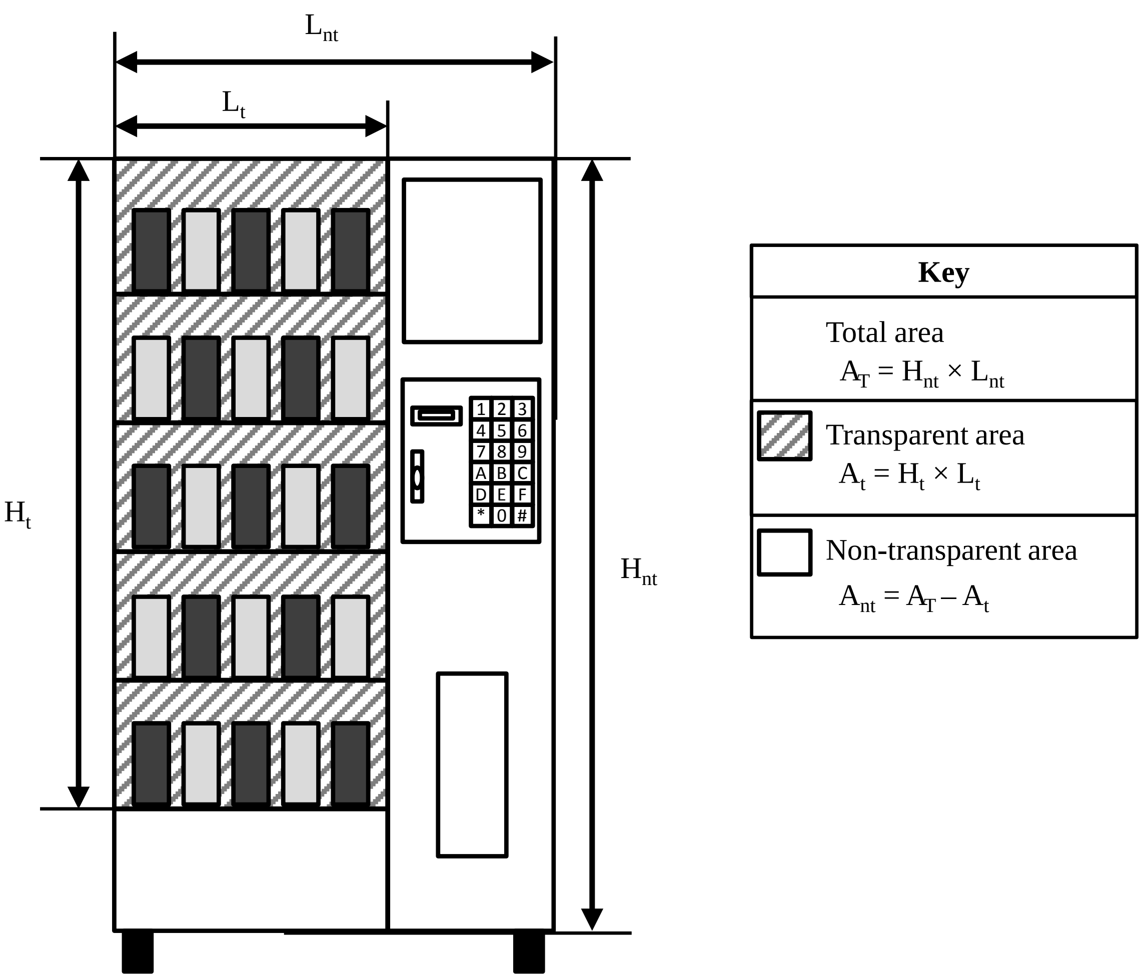

Figure IV.1 Determination of Transparent and Non-Transparent Area for Beverage Vending Machines

In the 2014 BVM ECS NOPR, DOE also noted that the same optional test protocol to determine the transparency of materials and the relative surface areas of transparent and non-transparent surfaces would be applicable to combination vending machines except that, the external surface areas surrounding the non-refrigerated compartment(s) would not be considered. That is, all the surfaces that surround and enclose the compartment designed to be refrigerated (as demonstrated by the presence of temperature controls), as well as any surfaces that do not enclose any product-containing compartments (e.g., surfaces surrounding any mechanical equipment or containing the product selection and delivery apparatus) would be considered in the calculation of transparent and non-transparent surface area for a beverage vending machine, as shown in Figure IV.2. 80 FR at 50479 (Aug. 19, 2015).

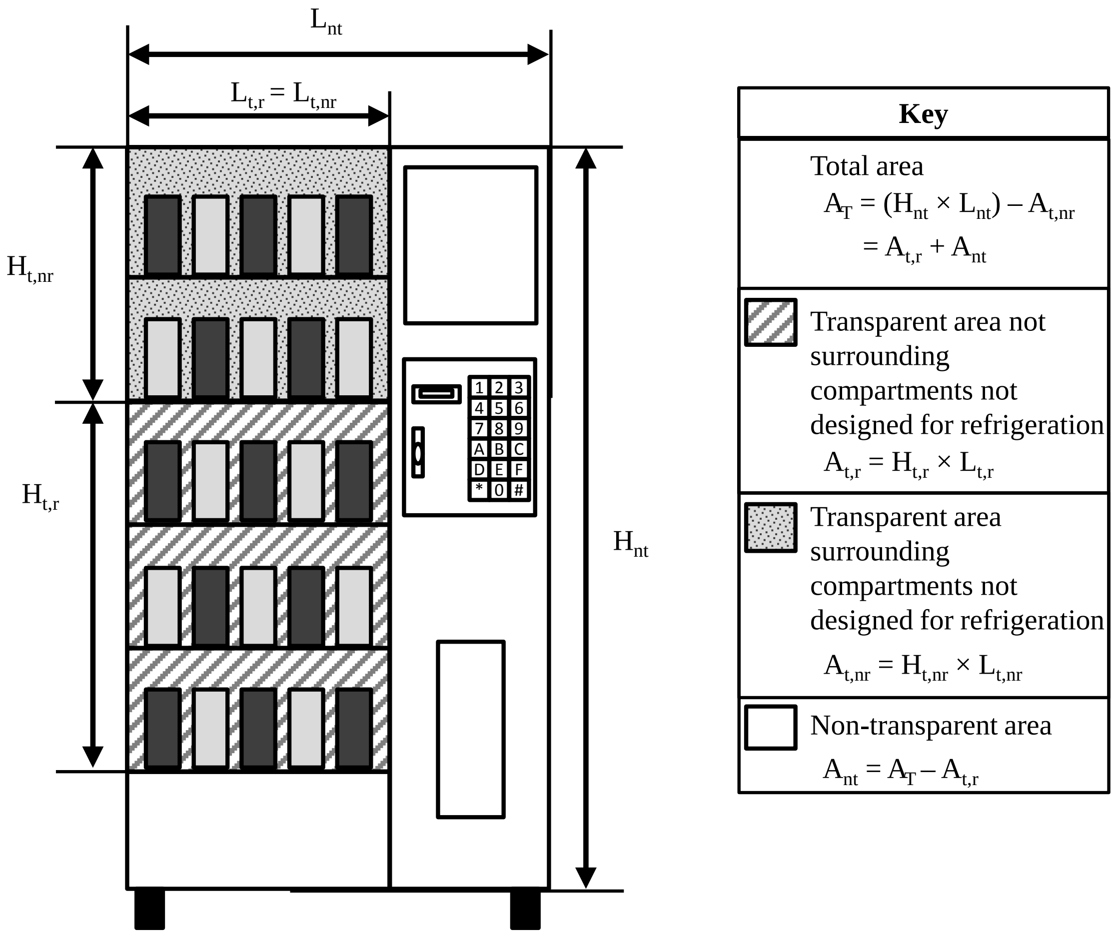

Figure IV.2 Determination of Transparent and Non-Transparent Area for a Combination Vending Machine with Products Arranged Horizontally

For both Class A and Combination A beverage vending machines, in the 2015 BVM ECS NOPR, DOE also proposed a specific definition and criteria to determine whether a material is transparent. Specifically, DOE proposed to adopt the definition of transparent that is applicable to commercial refrigeration equipment,[27] as adopted in the 2014 commercial refrigeration equipment test procedure final rule. 10 CFR 431.62; 79 FR 22277, 22286–22287, and 22308 (April 21, 2014). Under this definition, the term

[27] As a beverage vending machine is defined as a type of commercial refrigerator, DOE believes that it is consistent and appropriate to use the same definition of transparent for both commercial refrigeration equipment and beverage vending machines.

“transparent” would apply to any material with greater than or equal to 45 percent light transmittance, as determined in accordance with the ASTM Standard E 1084-86 (Reapproved 2009), “Standard Test Method for Solar Transmittance (Terrestrial) of Sheet Materials Using Sunlight,” at normal incidence and in the intended direction of viewing. With regard to beverage vending machines, DOE also clarified that, when determining material properties, that the transparency of the BVM cabinet materials should be determined with consideration of all the materials used to construct the wall segment(s), since the utility of the transparent material is only applicable if the viewer can clearly see the refrigerated products contained within the refrigerated volume of the beverage vending machine. 80 FR 50462, 50477 (Aug. 19, 2015).

In response to DOE’s proposed definition of transparent and optional test method for determining the relative transparent surface area, DOE received several comments and suggestions from interested parties. The CA IOUs recommended that DOE more clearly define the equipment classes being regulated using the term, “transparent.” The CA IOUs also recommended that DOE amend its definition of Class A equipment to take into account possible fluctuations in transparency of the front. (CA IOUs, No. 58 at p. 1) Similarly, in written comments, NAMA and Royal Vendors stated that the 45 percent light transmittance criterion for the determination of transparency of the glass front of a vending machine is acceptable at this time, but may not be so in the future if better low-emissivity coatings are developed. (NAMA, No. 50 at p. 3; Royal Vendors, No. 54 at p. 3) In written comments, Royal Vendors stated also that the definition of Class A would apply to a unit in which at least 25 percent of the front surface area is transparent, but that the definition of transparency would not always be met by equipment Royal Vendors considers to be "Class A." (Royal Vendors, No. 54 at p. 3)

In response to the comments submitted by the CA IOUs regarding the treatment of certain equipment with respect to the term "transparent," DOE clarifies that the definition of transparent adopted in this final rule is applicable to all classes of beverage vending machines. In particular, the definition of transparent is pertinent to differentiating Class A equipment from Class B equipment and Combination A equipment from Combination B equipment. Similarly, DOE also uses the term to determine equipment classification for commercial refrigeration equipment, the definition of transparent adopted in this final rule is pertinent only to beverage vending machines.

In response to the comments by CA IOUs, NAMA, and Royal Vendors regarding the suitability of the 45 percent threshold for light transmittance, DOE notes that it has considered the current and potential future characteristics of advanced, high-performing glass and acrylic products featuring low-emissivity coatings, low solar heat gain, or other features that may impact the overall light transmittance of the material. In the commercial refrigeration equipment test procedure NOPR, DOE had originally proposed that a transparent material was any material with greater than or equal to 65 percent light transmittance, consistent with the definition of total display area in the Air-Conditioning, Heating, and Refrigeration Institute (AHRI) Standard 1200 (I-P)-2010 (AHRI 1200-2010), "Performance Rating of Commercial Refrigerated Display Merchandisers and Storage Cabinets." 78 FR 64295, 64301–64302 (Oct. 28, 2013). However, after conducting market research regarding the visible transmittance of typical materials used in commercial refrigeration equipment manufacturing, as well as new high-performing glass products that could be used in such an application, DOE adopted a threshold of 45 percent in the 2014 CRE test procedure final rule. 79 FR 22277, 22287 (April 21, 2014). In support of this BVM ECS final rule, DOE conducted additional research into the glass and acrylic products typically used by manufacturers to produce Class A and Combination A beverage vending machines, as well as any new, high-performing glass products that may have been introduced since DOE's review for the 2014 CRE test procedure final rule. Based on its review, DOE believes that the threshold of 45 percent light transmittance to determine transparency is equally applicable to materials that are typically used to manufacture both commercial refrigeration equipment and beverage vending machines. DOE will continue to monitor the BVM and CRE market for any new materials integrated into equipment designs that meet DOE's intent of allow customers to view the merchandise contained within the refrigerated space but do not meet DOE's definition of transparent and, if necessary, revise the definition of transparent accordingly.

Therefore, in this final rule, DOE is adopting a definition of transparent applicable to materials with greater than or equal to 45 percent light transmittance based testing in accordance with ASTM Standard E 1084-86 (Reapproved 2009). DOE reiterates that this test method is optional and is not required for equipment certification or testing by manufacturers. Specifically, manufacturers may continue to specify the appropriate equipment class without determining the light transmittance of materials based on testing in accordance with ASTM Standard E 1084-86 (Reapproved 2009) However, if the transparency of a material is in question, the determination of the light transmittance of a transparent material must be determined in accordance with ASTM Standard E 1084-86 (Reapproved 2009) and DOE will use this test method to determine equipment classification in enforcement testing.

2. Machines Vending Perishable Goods

In response to DOE's 2015 BVM ECS NOPR, NAMA and Royal Vendors stated that vending machines that vend perishable goods should be regulated under a separate equipment class because they must maintain temperatures that do not allow for a refrigeration low power mode credit. (NAMA, No. 50 at p. 5; Royal Vendors, No. 54 at p. 4) Conversely, SVA expressed agreement with DOE's position that vending machines that vend perishable goods do not require a separate equipment classification. (SVA, No. 53 at p. 2)

DOE notes that there are beverage vending machines that are capable of vending certain perishable products that may require more strict temperature control than beverage vending machines that only vend non-perishable products, such as bottled or canned soda, juice, or water. DOE notes such perishable products may or may not be sealed beverages but that, if a vending machine is refrigerated and is capable of, or can be configured to, vend sealed beverages for at least one of the product selections, then the vending machine meets DOE's definition of beverage vending machine and must comply with DOE's regulations for this equipment.

Based on input from interested parties provided throughout this rulemaking, DOE believes that machines capable of vending perishable goods are generally not materially different from other beverage vending machines, and that the necessary levels of temperature maintenance needed to preserve perishables are achieved through the application of control settings rather than through design changes. In addition, such equipment can be tested using DOE's existing method of testing and does not have significantly different energy consumption profiles from other beverage vending machines when tested using DOE's methodology. Therefore, DOE does not believe separate equipment classes and standard levels are warranted for beverage vending machines that are capable of vending perishable goods, and DOE is not implementing a separate class for such equipment in this final rule. As such, equipment that vends perishable products along with at least one sealed beverage must be tested in accordance with the DOE test procedure and must meet applicable energy conservation standards. Vending machines that are not capable of vending sealed beverages or are not refrigerated do not meet DOE's definition of beverage vending machine and, as such, are not subject to standards, test procedures, and certification and reporting requirements for beverage vending machines.

DOE agrees with SVA that beverage vending machines that may be configured to, or capable of, vending perishable goods do not require a separate equipment class or separate energy conservation standards. Specifically, as noted in comments provided by interested parties in response to the framework document, including Witterns, Crane, AMS, and NAMA (see preliminary TSD chapter 2) DOE understands that the same BVM models may be configured to vend perishable or non-perishable goods. DOE also believes, based on market research and input from interested parties, that, if the BVM model is configured to vend perishable goods, the refrigeration low power mode that may be installed on the machine as distributed in commerce is simply disabled or overridden for that particular installation. DOE additionally understands that installations where beverage vending machines are configured to vend perishable goods represent a minority of installations, a position supported in public comments provided by Royal Vendors and NAMA (see preliminary TSD chapter 2).

3. Market Characterization

As part of the market and technology assessment, DOE identified and characterized relevant trade associations, manufacturers and their market shares, and current regulatory programs and non-regulatory initiatives related to BVM energy use. Details related to this characterization are in chapter 3 of the final rule TSD.

In response to the 2015 BVM ECS NOPR, DOE received several comments related to the role that the ENERGY STAR program plays in the U.S. BVM market. In the BVM ECS NOPR public meeting and in written comments, EEA Joint Commenters expressed the belief that minimum efficiency standards and the ENERGY STAR program are complementary and that, by nature of being mandatory, DOE's energy conservation standards program is able to save more energy than ENERGY STAR alone. (EEA Joint Commenters, No. 56 at p. 4; EEA Joint Commenters, Public Meeting

Transcript, No. 48 at p. 118) The Form Letter Writers stated standards would eliminate the current ENERGY STAR specification as the most efficient which would remove the credibility of the ENERGY STAR Industry. (The Form Letter Writers, No. 64 and 65 at p. 1) SVA expressed its belief at the BVM ECS NOPR public meeting that voluntary standards such as ENERGY STAR are more effective in driving the market towards more efficient equipment than DOE's mandatory standards. (SVA, Public Meeting Transcript, No. 48 at p. 117) In written comments, Royal Vendors, NAMA, and Coca-Cola stated that ENERGY STAR certification is required by a majority of equipment purchasers, and that DOE's proposed standards would trigger a revision to ENERGY STAR to further reduce allowable energy consumption below the DOE standard. These stakeholders added that a revision to the ENERGY STAR standard in response to DOE's BVM ECS rulemaking would make it more difficult to meet their customers' expectations for the ENERGY STAR label. Coca Cola added that manufacturers may devote more resources to developing technologies that can immediately meet newly-revised ENERGY STAR standards, instead of investing in the development of technologies that may result in more significant energy savings in the long term. (Royal Vendors, No. 54 at p. 7; NAMA, No. 50 at p. 14; Coca-Cola, No. 52 at p. 3).

DOE thanks the EEA Joint Commenters and SVA for their comments regarding the efficacy of ENERGY STAR in driving the market towards increased efficiency and agrees with the EEA Joint Commenters' assessment of ENERGY STAR and DOE's energy conservation standards as being complementary and more effective than voluntary standards alone. In response to comments regarding potential revision to ENERGY

STAR standards as a result of today's rulemaking, DOE notes that ENERGY STAR is a voluntary program that exists to help customers identify energy-efficient equipment on the market and save on energy costs. Specifically, the ENERGY STAR program includes only those equipment that exceeds mandated minimum standards that DOE is required by statute to set and enforce. Due to its nature as a voluntary program, DOE does not consider the impact of its energy conservation standards on potential updates to ENERGY STAR standards in its analysis. DOE coordinates with EPA on ENERGY STAR in order to reevaluate the ENERGY STAR specifications when DOE promulgates new or amended standards.

DOE also received several comments in response to the 2015 BVM ECS NOPR's request for updated estimates for the market share of combination vending machines. AMS commented that it only manufactures Class A machines and that its production volume is split roughly evenly between Class A and Combination A machines. (AMS, No. 57 at p. 2) In its written submission, NAMA stated that it did not have data to estimate the market share of combination vending machines specifically, but it estimated that beverage vending machines are approximately 60 percent of the total market for vending machines.

DOE thanks these stakeholders for their submission of specific data and has incorporated it into the analysis.

4. Technology Options

As part of the technology assessment, DOE developed a list of technologies to consider for improving the efficiency of beverage vending machines. DOE considers as design options all technologies that meet the screening criteria (see section I.B) and that produce quantifiable results under the DOE test procedure.

DOE typically uses information about existing and past technology options and prototype designs to help determine which technologies manufacturers can use to attain higher energy performance levels. In consultation with interested parties, DOE develops a list of technologies for consideration in its screening and engineering analyses. Initially these technologies encompass all those that DOE believes are technologically feasible. Since many options for improving equipment efficiency are available in existing equipment, equipment literature and direct examination of BVM units currently on the market provided much of the information underlying this analysis. While DOE notes that the majority of currently available equipment uses R-134a for its refrigerant, and R-134a will no longer be available for BVM applications at the time compliance will be required with any amended standards established as part of this final rule (80 FR 42870, 42917–42920 (July 20, 2015)), DOE believes that the majority of technology options considered in DOE's analysis and presented in the following list are applicable to all beverage vending machines, regardless of the refrigerant utilized. Specifically, DOE considered the following technologies in this final rule analyses:

- higher efficiency lighting
- higher efficiency evaporator fan motors

- higher efficiency evaporator fan blades
- improved evaporator design
- evaporator fan motor controllers
- low-pressure-differential evaporators
- insulation improvements (including foam insulation thickness increase and use of improved materials such as vacuum insulated panels)
- improved glass pack (for Class A and Combination A equipment)
- higher efficiency defrost mechanism
- higher efficiency compressors
- variable speed compressors
- increased condenser performance
- higher efficiency condenser fan motors
- higher efficiency condenser fan blades
- microchannel heat exchangers
- higher efficiency expansion valves
- improved anti-sweat heaters
- lighting controls (including timers and/or sensors)
- refrigeration low power modes.

Chapter 3 of the final rule TSD includes the detailed description of all technology options DOE identified for consideration in this rulemaking.

B. Screening Analysis

The purpose of the screening analysis is to evaluate the technologies identified in the technology assessment to determine which technologies to consider further and which technologies to screen out. DOE consulted with industry, technical experts, and other interested parties in developing a list of energy-saving technologies for the technology assessment, detailed in chapter 3 of the final rule TSD. DOE then applied the screening criteria to determine which technologies were unsuitable for further consideration in this rulemaking. Chapter 4 of the final rule TSD contains details about DOE's screening criteria.

DOE uses the following four screening criteria to determine which technology options are suitable for further consideration in an energy conservation standards rulemaking:

1) Technological feasibility. DOE considers only those technologies incorporated in commercial equipment or in working prototypes to be technologically feasible.

2) Practicability to manufacture, install, and service. If it is determined that mass production and reliable installation and servicing of a technology in commercial equipment could not be achieved on the scale necessary to serve the relevant market at the time of the projected compliance date of the standard, then that technology will not be considered further.

3) Impacts on equipment utility or product availability. If it is determined that a technology would have significant adverse impact on the utility of the product to significant subgroups of customers or would result in the unavailability of any covered equipment type with performance characteristics (including reliability), features, sizes, capacities, and volumes that are substantially the same as equipment generally available in the United States at the time, it will not be considered further.

4) Adverse impacts on health or safety. If it is determined that a technology would have significant adverse impacts on health or safety, it will not be considered further.

10 CFR part 430, subpart C, appendix A, 4(a)(4) and 5(b).

In sum, if DOE determines that a technology, or a combination of technologies, fails to meet one or more of the above four criteria, it will be excluded from further consideration in the engineering analysis. The reasons for eliminating any technology are discussed below.

The subsequent sections address DOE's evaluation of each technology option against the screening analysis criteria and DOE's determination of technology options excluded ("screened out") based on the screening criteria.

1. Screened-Out Technologies

These four screening criteria do not include the propriety status of design options. As noted previously, DOE will only consider efficiency levels achieved through the use of proprietary designs in the engineering analysis if they are not part of a unique path to achieve that efficiency level. DOE does not believe that any of the technologies identified in the technology assessment are proprietary, and thus, did not eliminate any technologies for that reason.

2. Remaining Technologies

Through a review of each technology, DOE concludes that all of the other identified technologies listed in this section IV.B.2 met all four screening criteria to be examined further as design options in DOE's final rule analysis. In summary, DOE did not screen out the following technology options:

- higher efficiency lighting
- higher efficiency evaporator fan motors
- higher efficiency evaporator fan blades
- evaporator fan motor controllers
- improved evaporator design
- low-pressure differential evaporators
- improvements to anti-sweat heaters
- improved or thicker insulation
- higher efficiency defrost mechanisms
- higher efficiency compressors

- variable speed compressors
- microchannel heat exchangers
- improved condenser design
- higher efficiency condenser fan motors
- higher efficiency condenser fan blades
- improved glass pack design (for Class A and Combination A machines)
- lighting controls
- refrigeration low power modes

DOE determined that these technology options are technologically feasible because they are being used or have previously been used in commercially available equipment or working prototypes. DOE also finds that all of the remaining technology options meet the other screening criteria (i.e., practicable to manufacture, install, and service and do not result in adverse impacts on customer utility, equipment availability, health, or safety). For additional details, see chapter 4 of the final rule TSD.

C. Engineering Analysis

The engineering analysis establishes the relationship between an increase in energy efficiency of the equipment and the corresponding increase in manufacturer selling price (MSP) associated with that efficiency level. This relationship serves as the basis for cost-benefit calculations for individual customers, manufacturers, and the nation. DOE typically structures its engineering analysis using one of three approaches: (1) the design-option approach, (2) the efficiency-level approach, or (3) the cost-assessment (reverse engineering) approach. The next paragraphs provide overviews of these three approaches.

A design-option approach identifies individual technology options (from the market and technology assessment) that can be used alone or in combination with other technology options to increase the energy efficiency of a given BVM unit. Under this approach, cost estimates of the baseline equipment and more-efficient equipment that incorporates design options are based on manufacturer or component supplier data or engineering computer simulation models. Individual design options, or combinations of design options, are added to the baseline model in descending order of cost-effectiveness.

An efficiency-level approach establishes the relationship between manufacturer cost and increased efficiency at predetermined efficiency levels above the baseline. Under this approach, DOE typically assesses increases in manufacturer cost for incremental increases in efficiency, without identifying the technology or design options that would be used to achieve such increases.

A reverse-engineering, or cost-assessment, approach involves disassembling representative units of beverage vending machines, and estimating the manufacturing costs based on a "bottom-up" manufacturing cost assessment; such assessments use detailed data to estimate the costs for parts and materials, labor, shipping/packaging, and investment for models that operate at particular efficiency levels.

As discussed in the 2015 BVM ECS NOPR, DOE employed the design-option approach to develop the relationship between energy use of a beverage vending machine and MSP. The decision to use this approach was made due to several factors, including the lack of numerous discrete levels of equipment efficiency currently available on the market and the prevalence of energy-saving technologies applicable to this equipment. More specifically, DOE identified design options for analysis and used a combination of industry research and teardown-based cost modeling to determine manufacturing costs, then employed numerical modeling to determine the energy consumption of each combination of design options employed in increasing equipment efficiency. The resulting range of equipment efficiency levels and associated manufacturer production costs (MPCs) were converted to MSPs using information regarding typical manufacturer markups and outbound freight costs. Typical manufacturer markups are presented in chapter 5 of the final rule TSD.

DOE revised the engineering analysis presented in the 2015 BVM ECS NOPR based on the feedback from stakeholders, additional industry research, and responses to recent regulatory changes implemented by EPA's SNAP program. In particular, DOE revised its assumptions for the thermal modeling of combination vending machines to account for some cooling in the compartment that is not designed to be refrigerated, incorporated higher production costs associated with specific requirements for beverage vending machines using flammable refrigerants (propane), and revised which design options were included in Class A and Class B baseline configurations. In addition, DOE adjusted the efficiency of CO_2 compressors relative to R-134a compressors, increased the amount of LED lighting accounted for in place of T8 lighting, decreased the impact attributed to enhanced coils, incorporated a single-pane glass pack for Combination A vending machines at baseline, removed the most-efficient compressor design option from the 2015 BVM ECS NOPR, and updated its cost estimates for several design options.

1. Baseline Equipment and Representative Sizes

For each of the two classes of equipment with current standards (Class A and Class B), DOE developed baseline configurations containing design options consistent with units designed to perform at a level that approximates the existing 2009 BVM standard. DOE based its representative size assumptions for Class A and Class B equipment on the representative sizes assumed in the 2009 BVM rulemaking and input from manufacturers during the framework, preliminary analysis, and NOPR phases of this rulemaking, as well as data gathered from supplemental sources. DOE believes that these representative sizes continue to reflect the design and features of current baseline equipment for Class A and Class B equipment.

For Combination A and Combination B equipment, DOE set its baseline efficiency level differently than for Class A and Class B equipment, since there are no current regulatory standards for this equipment. Specifically, DOE modeled the baseline level of efficiency for the Combination A and Combination B equipment as representing the least-efficient technology generally found in the BVM market currently for each design option analyzed. That is, the baseline efficiency level for Combination A and

Combination B equipment represented the least-efficient combination of technologies available.

Representative sizes for Combination A and Combination B were established in the preliminary analysis based on equipment available in the current market, and have been maintained for this final rule. Specific details of the representative sizes chosen for analysis and design options representing each of the baseline equipment definitions for Class A, Class B, Combination A, and Combination B beverage vending machines are described in more detail in appendix 5A of the final rule TSD.

Based on input from manufacturers at the BVM ECS NOPR public meeting as well as feedback received in the preliminary analysis phase of the rulemaking, DOE adjusted the assumptions it used in its analysis of baseline level for Class A and Class B beverage vending machines, for which there are current standards. In this final rule, DOE began its engineering analysis by analyzing equipment designs that had levels of energy consumption much higher than allowed by the standard level set in the 2009 final rule. DOE's analysis then implemented all applicable design options (including some which likely were implemented in order to meet the 2009 final rule standard levels) in order of ascending payback period. Such an approach results in equipment designs that better reflect the current BVM market. To determine the MPC for a beverage vending machine that is minimally-compliant with the current BVM standards each size, refrigerant, and equipment class combination DOE analyzed, DOE linearly interpolated between the energy consumption levels just above (more consumptive) and just below (less consumptive) than the standard. Additional design options were then added as part of the design option engineering analysis. This methodology represents the approach that a new entrant to the market, or an existing manufacturer conducting a redesign, would take to meet the new standard analyzed in this rule, and allows cost and price associated with meeting the current standard with appendix B of the amended test procedure. See Table Table IV.4 for an example of this methodology.

Most of the design options analyzed in this final rule were observed by DOE in some portion of the equipment currently on the market. The presence of these design options in equipment that exceeds the current standard level serves as validation of the energy performance improvements over the baseline level that are possible with these design options. However, DOE also realizes that no two manufacturers may necessarily use the same design option pathways to improve energy performance. As such, DOE notes that its engineering analyses represent just one potential pathway to achieve the efficiency levels modeled in downstream analyses, the one that its analysis shows to be the most cost-efficient.

After the NOPR stage, stakeholders provided comments regarding DOE's analysis of baseline equipment. In written comments, AMS commented that the baseline level calculated for Combination A beverage vending machines is far more efficient than the performance of actual machines in use today. Specifically, AMS stated that machines it manufactures, which would meet DOE's proposed definition of a Combination A vending machine, were tested, they would consume 8.09 kWh/day as opposed to the 6.18

kW/day baseline that DOE presented in the NOPR TSD. (AMS, No. 57, at p. 10) AMS specifically stated that converting a Class A machine to a Combination A machine only reduces energy by 25 percent even though the refrigerated volume was reduced by 60 percent and urged DOE to reconsider its assumptions for baseline combination vending machines. (AMS, No. 57 at p. 11)

DOE appreciates the submission of specific data by stakeholders and used this data to better inform its rulemaking activities. In response to comments and data submitted after the 2015 BVM ECS NOPR, DOE has refined its engineering model for Combination A vending machines to better account for air comingling between the compartment(s) that are designed to be refrigerated and the compartment(s) that are not designed to be refrigerated, which effectively increases the heat load associated with the non-refrigerated volumes and, correspondingly, energy consumption. DOE notes that the results of this updated analysis now more closely align with AMS's reported test results.

2. Refrigerants

At the time of the final rule analysis, hydrofluorocarbon (HFC) refrigerants, and specifically R-134a, were used in most beverage vending machines on the market in the United States. In addition, based on equipment certification reports received by DOE, public statements from major end users of beverage vending machines such as Coca-Cola,[28] and information DOE obtained through confidential manufacturer interviews (see

[28] One example of such a public statement is available at www.coca-colacompany.com/innovation/coca-cola-installs-1-millionth-hfc-free-cooler-globally-preventing-525mm-metrics-tons-of-co2.

section IV.J), DOE has come to understand that CO_2 refrigerant is used in a small but growing portion of the BVM market.

As discussed earlier, the refrigerants that are available for use in the U.S. BVM market are changing as a result of two recent rulemaking actions by EPA SNAP. First, EPA published proposed Rule 19 (Docket No. EPA-HQ-OAR-2014-0198) on July 9, 2014, that proposed, among other things, to list several hydrocarbons—isobutane and propane — and the hydrocarbon blend R-441A as acceptable alternatives under SNAP in BVM applications, subject to certain use conditions. 79 FR 38811. A final rule adopting these proposals became effective on May 11, 2015, and was published in the Federal Register on April 10, 2015. 80 FR 19454, 19491. EPA's second rulemaking under SNAP, Proposed Rule 20 (Docket No. EPA-HQ-OAR-2013-0748), was published on August 6, 2014 and proposed to change the status of certain refrigerants to unacceptable for certain applications, including R-134a for BVM application. 79 FR 46126. A final rule corresponding to proposed Rule 20 was published in the Federal Register on July 20, 2015. 80 FR 42870, 42917–42920 (July 20, 2015). This rule changes the status of R-134a for new beverage vending machines to unacceptable beginning on January 1, 2019. Therefore, equipment complying with the amended BVM standards DOE is adopting in this final rule will do so using the refrigerants allowable under the newly amended SNAP listings.

Due in large part to the EPA SNAP rulemaking, DOE received a number of stakeholder comments related to refrigerants in this rulemaking. In particular, commenters addressed which refrigerants were likely to be used in the future, DOE's approach to analyzing the different refrigerants, and the relative energy efficiency of the different refrigerants.

a. Refrigerants Used in the Analysis

DOE notes that while CO_2 has been approved for use in the United States in refrigerated beverage vending applications by EPA SNAP for several years, other refrigerants such as hydrocarbons, including propane, were only recently listed as acceptable alternatives for use in refrigerated beverage vending applications in the United States with EPA's recent publication of final Rule 19. Although DOE is not aware of any BVM models that are currently commercially available using propane as a refrigerant, DOE accounted for the use of propane as an alternative refrigerant, in addition to CO_2, as a potential refrigerant for BVM application. This was based on use of propane as a refrigerant in other similar, self-contained commercial refrigeration applications.

DOE did not receive any comments disagreeing with the use of these two refrigerants in the analysis. In response to DOE's 2015 BVM ECS NOPR request for comment, SVA stated that it has no plans to use isobutane as a refrigerant. (SVA, No. 53 at p. 5) SVA stated that it is in the early stages of research and development (R&D) for propane refrigerants and is concerned about EPA and UL requirements that restrict BVM placement, as well as significant equipment and facilities costs associated with flammable refrigerants. AMS commented that beverage vending machines with propane refrigeration systems require spark-proof motors to maintain safe operation in the event of a refrigerant leak. AMS stated that these motors are roughly three times the cost of non-spark proof motors and that this and other changes would add several hundred dollars to the cost of each machine (SVA, No. 53 at p. 5; AMS, No. 57 at p. 8)

DOE thanks SVA and AMS for their comments. DOE has reviewed the relevant section of the UL 541 standard regarding flammable refrigerants in BVM applications and agrees with AMS that additional related costs should be accounted for in order to appropriately reflect the cost of procuring motors in compliance with the UL requirements. Accordingly, DOE has revised its cost model to account for the increased cost of the motors required by this standard.

b. DOE Approach

In the engineering analysis for this final rule, DOE first conducted an analysis for each equipment class based on equipment using R-134a refrigerant, the refrigerant found in the majority of equipment available today and therefore providing the most specific and comprehensive data available. DOE then conducted analysis on each equipment class using CO_2 and propane refrigerants, by adjusting the R-134a analysis to account for the performance differences attributable to the new refrigerants. This methodology allowed DOE to leverage the large existing base of experience, data, and models for sale utilizing R-134a while ensuring that its engineering model and downstream analyses properly addressed the refrigerant landscape applicable at the time when compliance with new and amended standards will be required.

In conducting its CO_2 analysis, DOE adjusted its engineering analysis to account for an increase in energy use for a beverage vending machine that uses CO_2 versus a similarly equipped unit using R-134a. Specifically, in its final rule analysis, DOE used a 10-percent compressor power increase, based on a separate analytical comparison of HFC and CO_2 compressors and feedback from manufacturers, to account for the inherent relative inefficiency of CO_2. This figure was reviewed with manufacturers during interviews and through requests for public comment on the preliminary analysis. DOE also analyzed components for CO_2 refrigeration systems such as compressors and refrigeration coils as having higher costs than those for HFC refrigeration systems. Additionally, as CO_2 models were currently available on the market for purchase at the time of this analysis, DOE was able to procure, test, and tear down CO_2 equipment to use in corroborating its analysis.

For propane equipment, DOE used a similar methodology to that applied for CO_2. The engineering analysis used adjusted values for compressor performance, incorporating a 15-percent reduction in energy consumption as compared to an R-134a compressor, as well as adjustments to the cost of the compressor, heat exchangers, and other system components. These factors were developed through a separate, focused analysis targeting the inherent differences in performance potential between HFC and hydrocarbon refrigerants. Additionally, as mentioned above, DOE reviewed the requirements in UL 541 Supplement SA, and accordingly included an additional MPC factor representative of changes that may be needed to vend motors and other electronic components in order to comply with the UL requirements for all units modeled with propane refrigerant. For a detailed explanation of the methodology used in adjusting the analysis conducted on equipment using R-134a refrigerant for analyzing CO_2 and propane beverage vending machines in this final rule, please see chapter 5 of the final rule TSD.

In the BVM ECS NOPR public meeting and in written comments, EEA Joint Commenters and the CA IOUs requested that DOE treat more efficient refrigerants as a design option in its engineering analysis rather than conducting the analysis such that the proposed standards could be met by either CO_2 or propane. The EEA Joint Commenters expressed the belief that DOE's refrigerant-neutral approach overestimates cost and underestimates potential energy savings as a result of any update to the standard. (EEA Joint Commenters, No. 56 at p. 2; CA IOUs, No. 58 at p. 2; EAA Joint Commenters, Public Meeting Transcript, No. 48 at pp. 8, 43)

DOE thanks the CA IOUs and EEA Joint Commenters for their comments. However, as noted by DOE in the BVM ECS NOPR public meeting, DOE's analysis for beverage vending machines has taken a refrigerant-neutral approach to maintain diversity and customer choice with regard to refrigerant in the BVM market. For example, Coca-Cola acknowledged in the BVM ECS NOPR public meeting that its choice for the North American business unit was CO_2 as a refrigerant. (Coca-Cola, Public Meeting Transcript, No. 48 at p. 48-50). Coca-Cola's statement is consistent with DOE's understanding that BVM customers may select different refrigerants for a variety of reasons and DOE does not wish the standards adopted as a result of this final rule to limit the availability or viability of certain SNAP-approved refrigerants in the BVM market.

Therefore, in this final rule analysis, DOE has maintained a refrigerant-neutral analysis approach that ensures equitability across refrigerant platforms and continued availability of CO_2 as a refrigerant option for beverage vending machines. That is, DOE has maintained an analysis approach that independently analyzes CO_2- and propane-refrigerant equipment so that the economic results can be analyzed individually. Such an approach results in selection of new and amended standard levels that result in the highest NPV for both refrigerants and that does not disadvantage another refrigerant.

c. Relative Energy Efficiency of Refrigerants

NAMA and Royal Vendors commented in their written submissions that CO_2 systems consume approximately 15 percent more energy than their R-134a counterparts and cautioned that data may not be available due to the lack of current use. (NAMA, No. 50 at p. 5; Royal Vendors, No. 54 at p. 4) SBA Advocacy agreed that CO_2 is about 15 percent less efficient than R-134a and, therefore, claimed that it is not a technologically feasible alternative. (SBA Advocacy, No. 61 at p. 3) EVA also commented that CO_2 is 15 percent less efficient than an R-134a unit and the cost in Europe for "a cooling unit operating on CO_2 is double that of an R-134a unit as a result of a lack of availability of CO_2 compressors." (EVA, No. 60 at p. 2) SVA commented that its experience with CO_2 refrigeration systems indicates comparable efficiency performance to R-134a systems if optimized solely for steady-state conditions but stated that these systems must be designed for pull-down requirements associated with equipment reload at higher ambient temperature and/or humidity conditions, and that this causes CO_2 systems tend to be about 5 percent less energy efficient than R-134a. (SVA, No. 53 at p. 3) Additionally, AMS commented that it had no direct knowledge with CO_2 but that its limited testing with propane showed equal or only slightly better efficiency than R-134a. (AMS, No. 57 at p. 4)

DOE thanks these stakeholders for their comments. It is DOE's understanding that the difference in performance between equipment using the different refrigerants is primarily a result of the different compressor efficiencies. DOE has incorporated these differences into its analysis and notes that its analytical results are in line with comments provided and specifically that the efficiency penalty associated with CO_2 refrigeration systems in the analysis is bounded by the estimates provided. Additional information about these results is in the compressors section of IV.C.4 and in chapter 5 of the final rule TSD.

3. Screened-in Technologies not Implemented as Design Options

DOE removed several screened-in technologies from consideration in the engineering analysis due to lack of data, lack of availability, competing effects, or lack of measurable energy savings when tested to the DOE test procedure. The technologies included higher efficiency fan blades for evaporator and condenser fans, low-pressure differential evaporators, improvements to anti-sweat heaters, higher efficiency defrost mechanisms, variable speed compressors, and microchannel heat exchangers. More information about these technologies and the reasons they were removed from consideration can be found in chapter 5 of the final rule TSD.

DOE received several comments regarding one of the technologies it removed from consideration in the engineering analysis, variable speed compressors. In response to DOE's request for comment on the use of variable speed compressors in beverage vending machines, AMS commented that although it had used variable speed compressors for energy savings in the past, this technology was no longer available for BVM applications due to the small market. (AMS, No. 57 at p. 3) SVA commented that it is not aware of any variable speed CO_2 compressors. (SVA, No. 53 at p. 5) In the BVM ECS NOPR public meeting and written comments, CA IOUs and the EEA Joint Commenters stated their belief that the three operating modes of beverage vending machines (pull-down, steady-state, and low power mode) make them good candidates for variable speed compressors to reduce energy consumption and inquired as to why DOE chose to exclude them as design options. (CA IOUs and EEA Joint Commenters, Public Meeting Transcript, No. 48 at p. 35) In its written comments, the CA IOUs requested that DOE consider variable speed compressors as a design option. (CA IOUs, No. 58 at p. 2)

DOE thanks these stakeholders for their comments and notes that manufacturers are not precluded from exploring variable speed compressors as a means to meet the updated energy conservation standards for beverage vending machines. However, manufacturer comments are consistent with DOE's conclusion in the 2015 BVM ECS NOPR that there are currently no variable speed compressors with operating capacity ranges applicable to beverage vending machines available on the market that use refrigerants other than R-134a, which will not be available for use in vending machine applications by the compliance date of this rulemaking due to EPA's SNAP regulations. Because DOE is required to set energy conservation standards that are both technologically feasible and economically justified, DOE did not include variable speed compressors as a design option in its analysis.

4. Design Options Analyzed and Maximum Technologically Feasible Efficiency Level

In response to the 2015 BVM ECS NOPR, DOE received comments with specific feedback regarding several of the design options analyzed, including glass packs, improved insulation and vacuum insulated panels, higher efficiency lighting, lighting low power modes, fan motors, evaporator fan controls, coils, and higher efficiency compressors.

a. Glass Packs

In written comments, Coca-Cola expressed its belief that enhanced glass packs, specifically those using three panes of glass, are not economically justified for the energy savings delivered. Coca-Cola further stated that some of its current Class A equipment with CO_2 refrigeration systems use double pane, argon-filled, low E glass and cannot accommodate triple pane glass pack without a major redesign. (Coca-Cola, No. 52 at p. 3) Similarly, Royal Vendors commented that its Class A machines currently use double-pane, argon-filled, low-emissivity glass and cannot accommodate triple-pane glass packs without major redesigns, large development costs, and substantial machine cost increases. (Royal Vendors, No. 54 at p. 2) SVA also commented that enhanced glass packs are not economically justified. (SVA, No. 53 at p. 4)

DOE thanks Coca-Cola, Royal Vendors, and SVA for their comments and has increased the cost associated with the enhanced glass pack design option from that used during the NOPR, in order to better represent the economic ramifications of implementing that design option. DOE notes that the engineering analysis in this final rule considers the enhanced glass pack design option, which is a triple-paned glass pack, as technologically feasible, but that the economic analysis does not deem it to be part of the least-cost approach to meeting the new standard levels at any analysis point. Additionally, DOE accounted for the cost of equipment redesign and production equipment cost increases in its manufacturer impact and customer subgroup analyses (See sections IV.J and IV.I, respectively).

b. Evaporator Fan Motor Controls

Royal Vendors stated in written comments that its machines already use evaporator fan controls to meet the current standards. (Royal Vendors, No. 54 at p. 2)

DOE thanks Royal Vendors for their comment and agrees that most equipment on the market today makes use of evaporator fan motor controls. Accordingly, in DOE's engineering analysis in this final rule, the evaporator fan motor controls design option is implemented in the baseline level for all Class A and most Class B analysis points. See section IV.C.1 for information on how DOE established baseline levels for Class A and Class B equipment in this analysis.

c. Coils

In their written comments, SVA questioned DOE's assumption of 14 percent energy savings due to enhanced evaporator coils, and stated their general belief that predicted efficiency improvements based on software modeling are typically optimistic compared to test results. SVA also stated that for its Class A equipment, it already uses enhanced evaporator coils to meet the current standard, and that enhanced condenser coils reduce equipment utility. (SVA, No. 53 at pp. 3–4)

DOE thanks SVA for their comments and has revised the cost and energy improvement associated with enhanced coils in this final rule. DOE additionally notes that in all of the final rule analysis points, the resulting reduction in DEC attributable to changes in the evaporator coil is shown to be well less than 10 percent. In addition, DOE notes that such "enhanced" evaporator and condenser coil options are already commonly implemented and commercially-available design options.

d. Compressors

DOE received several comments regarding different compressors. Specifically, DOE received comments regarding the higher efficiency compressor design option and regarding CO_2 compressors. In the BVM ECS NOPR public meeting, SVA expressed doubt that a beverage vending machine with the compressor that DOE considered as baseline in its engineering model would be able to meet the 2009 standard, and stated that DOE should instead consider the Embraco FFU130HAX compressor as the baseline efficiency level. SVA additionally stated that CO_2 compressors capable of reducing energy consumption to the degree indicated in DOE's 2015 BVM ECS NOPR analysis do not exist on the market. (SVA, Public Meeting Transcript, No. 48 at pp. 63–72) In written comments, Royal Vendors stated that it is not aware of any compressors with higher efficiency than the Embraco FFU130HAX for R-134a or the Sanden SRABB for CO_2 and that therefore DOE should not consider a more efficient compressor as a design option to reduce energy consumption. (Royal Vendors, No. 54 at p. 1) In its written comments, Coca-Cola similarly stated that the assumed ability to move to higher efficiency compressors does not exist. (Coca-Cola, No. 52 at p. 3)

While, through testing and teardowns, DOE has observed equipment on the current market that meets the current energy conservation standards that uses compressors other than the Embraco FFU130HAX, DOE agrees with stakeholder comments in that it is not currently aware of a compressor available for use in beverage vending machines in the United States that is more efficient than the Embraco FFU130HAX. Accordingly, DOE has removed from the analysis the design option that represented a higher efficiency compressor. Additionally, the engineering analysis now includes the "Improved single speed reciprocating compressor" design option (which corresponds to the FFU130HAX, adjusted according to the refrigerant-specific analysis) in all Class A baseline equipment configurations.

Regarding CO_2 compressors, in written comments, AMS commented that CO_2 refrigerant has a significant efficiency penalty, and that it is aware of only one supplier that makes CO_2 compressors in the capacity range required for BVM applications.

(AMS, No. 57 at p. 8) Coca-Cola also stated in its written comments that it is aware of only one CO_2 compressor supplier in the U.S. for beverage vending machines. (Coca-Cola, No. 52 at p. 2) Additionally, in the BVM ECS NOPR public meeting, Coca-Cola stated that it was aware of six CO_2 compressors, all early in the technology curve, and suggested that DOE take into account potential rapid improvements in efficiency for CO_2 compressors as a result of maturing engineering and supply chains into account in its analysis. (Public Meeting Transcript, No. 48 at p. 51)

DOE thanks Coca-Cola and AMS for their comments. DOE is aware that there is currently a limited selection of CO_2 compressors available to BVM manufacturers in the United States. Based on the feedback received, CO_2 compressors were analyzed in the final rule engineering analysis as using 10 percent more energy than an R-134a compressor of similar design, as opposed to the 6 percent value used in the 2015 BVM ECS NOPR engineering.

e. Insulation and Vacuum Insulated Panels

Royal Vendors commented that the only design options considered by DOE in this rulemaking that it has not already implemented to meet existing energy conservation standards are increased insulation thickness and vacuum insulated panels, and stated that increased insulation thickness would require large investments in redesign and new foaming fixtures. Royal Vendors additionally stated that it does not know the viability of vacuum insulated panels. (Royal Vendors, No. 54 at p. 2) Coca-Cola commented that vacuum insulated panels are highly costly to implement and that its supply base has not worked to develop this option. (Coca-Cola, No. 52 at p. 3) EEA Joint Commenters stated that DOE's analysis may overestimate the cost and underestimate the performance of vacuum insulated panels due to possibly outdated information. (EEA Joint Commenters, No. 56 at p. 3) SVA commented that they are already using increased insulation thickness on their Class B equipment to meet the existing standard. (SVA, No. 53 at p. 4).

DOE has accounted for redesign and increased materials costs in its manufacturer impact and engineering analyses, respectively. (See sections IV.J and chapter 12 of the TSD for information on the manufacturer impact analysis.) In response to Royals' comment concerning the viability of vacuum insulated panels in BVM applications, DOE notes that proof of concept for enhanced insulation to increase energy efficiency has been shown in related industries such as commercial refrigerator manufacturing and serves as a basis on which to assess technological feasibility. Regarding Coca-Cola's comment, DOE has quantified the costs to implement vacuum insulated panels, which it agrees to be sizably higher at this time than those of traditional foam insulation, and has incorporated those costs into its engineering analysis. In response to the comment by EEA Joint Commenters regarding the cost and performance of vacuum insulated panels, DOE notes that it has continued research into this technology in concurrent rulemakings and that its assessment for beverage vending machines is based on the most up to date information that it has obtained through manufacturer interviews and other sources.

f. Lighting and Lighting Low Power Modes

Regarding lighting, CA IOUs in the BVM ECS NOPR public meeting and EEA Joint Commenters in their written comment expressed the belief that DOE should have accounted for a greater variation in LED lighting system efficiency rather than considering it as a single efficiency tier. (CA IOUs and the EEA Joint Commenters, Public Meeting Transcript, No. 48 at p. 59; CA IOUs, No. 58 at p. 4) In written comments, Royal Vendors stated that it is already using LED lighting in its Class A machines to meet the current standard. (Royal Vendors, No. 54 at p. 1)

DOE thanks the CA IOUs, EEA Joint Commenters, and Royal Vendors for their comments. DOE acknowledges that there are a range of LED efficiencies available on the market and notes that several design options in the analysis could be implemented to different extents, including, for example, lighting systems, thicker insulation, and various types of controls (e.g., accessory and refrigeration low power modes). In its engineering model, DOE used representative values for the energy consumption of each design option, including lighting systems, for each equipment class. DOE notes that manufacturers are free to choose whichever design path they wish in order to meet current and future energy conservation standards. DOE analyzes and orders design options based on its determination of the relative cost-effectiveness of each design option. DOE notes that its engineering analysis agrees with Royal Vendors and accounts for the use of LED lighting in order to meet the baseline level at many Class A analysis points.

Regarding lighting low power modes, in the BVM ECS NOPR public meeting, SVA expressed the belief that test results currently included in certification directories and showing high levels of efficiency may have been developed using lighting low power modes. (SVA, Public Meeting Transcript, No. 48 at p. 66) Also in the public meeting, SVA expressed doubt that the 6-hour allowance for lighting low power states under the updated test procedure could account for as steep a drop in energy consumption as DOE's analysis shows. (SVA, Public Meeting Transcript, No. 48 at p. 66) In its written comments, SVA estimated that 20 percent energy savings over a baseline model was possible if LED lighting systems are used in conjunction with lighting controls, and 10 percent energy savings were possible if lighting controls are used with T-8 lighting systems. (SVA, No. 53 at p. 4) SVA also stated that it only uses one LED bulb in its Class A equipment while DOE assumes two LED bulbs in its engineering model. (SVA, No. 53 at p. 4)

DOE thanks SVA for its comments, and especially appreciates the submission of specific data on potential energy savings as a result of increased efficiency lighting. With regard to SVA's comment on the number of LED bulbs, DOE notes that its engineering model is based on equipment configurations equipment found in teardowns, and that it believes to be generally representative of the beverage vending machine market due to the presence of similar configurations across multiple manufacturers. DOE acknowledges that individual models may not have the same components. Additionally, DOE revisited the specifications of models available on the markets and, after additional review of available data, in its final rule analysis, DOE increased the linear footage of

LED fixtures used within the case to replace T8 lighting in Class B and Combination B analyses to 8 total feet of LED fixtures, and maintained the values for Class A and Combination A at 6 total feet of LED fixtures.

g. Fan Motors

In the BVM ECS NOPR public meeting, SVA commented that 9 watt fan motors are unrealistic for BVM applications and provided more detail in its written comments, stating that it uses 4 watt fan motors for its evaporator and condenser fans. In written comments, SVA also stated that its Class B equipment already implements PSC condenser fan motors and that ECM condenser fan motors are not economically justified. (SVA, Public Meeting Transcript, No. 488 at p. 174; SVA, No. 53 at p. 4) In written comments, Royal Vendors stated that it is already using ECM evaporator fan motors and PSC condenser fan motors to meet the current standards and added that converting from PSC to ECM condenser fan motors would not yield significant energy savings for the added cost. (Royal Vendors, No. 54 at p. 1)

In response to SVA's comment regarding fan power draw, DOE notes that it used fan motor wattage values that were shown to be typical of the BVM market as evidenced by their inclusion in numerous models examined during DOE's teardown analysis. DOE thanks Royal Vendors for its comment regarding the use of fan motor design options and notes that it has reviewed the energy consumption model in its engineering analysis and that Royal's and SVA's comments generally align with DOE's engineering analysis with

ECM evaporator fan motors often being among the more cost-effective design options and ECM condenser fan motors being among the least cost-effective.

h. Performance of Design Option Packages

DOE also received several more general comments regarding the design options being used by manufacturers and the maximum technologically feasible level. In the BVM ECS NOPR public meeting and in written submission, SVA commented that it was already implementing many of DOE's proposed design options to meet existing ENERGY STAR levels and that it would not be able to come close to meeting DOE's proposed standard levels. SVA stated that many of the design options DOE analyzed are not technologically feasible or economically justified and that the remaining design options for Class A equipment are automatic lighting controls and refrigeration low power modes, which it believes would yield approximately 5 percent energy savings. SVA listed the remaining design options for Class B equipment as including automatic lighting controls, enhanced evaporator coils, LED lighting, and refrigeration low power states. (SVA, No. 53 at pp. 3–4; Public Meeting Transcript, No. 48 at 173)

AMS commented in its written submission that it has already incorporated several design options to meet the 2009 energy conservation standards and that reducing daily energy consumption by an additional 25 percent is not feasible with present technologies and would require drastic changes to overall cabinet sizes and door design. (AMS, No. 57 at p. 9) Similarly, Royal Vendors commented that it has already employed most of the design options considered by DOE in its analysis to meet the 2009 standards and therefore does not believe it can meet the proposed standard using any refrigerant. (Royal Vendors, No. 54 at p. 4) NAMA commented that most manufacturers have already employed most of the design options considered by DOE and specifically stated that some manufacturers already use ECM evaporator fan motors, split capacitor condenser fan motors, LED lighting, and evaporator fan controls to meet the current standard. (NAMA, No. 50 at p. 5) Coca-Cola commented that many vending machines with CO_2 refrigeration systems that it purchases are already using LED lighting, ECM evaporator fan motors, and PSC condenser fan motors to meet ENERGY STAR. Coca-Cola additionally stated that while LEDs can save energy, ECM condenser fan motors have minimal impact on energy consumption. (Coca-Cola, No. 52 at p. 3)

SVA commented that many of the design options considered by DOE are not technologically feasible, are not economically justified, or otherwise have a negative impact on equipment utility, citing the rebuttable presumption that the cost to the customer will be less than three times the value of the energy savings during the first year for energy conservation standards to be economically justified (Title 42 U.S.C. 6295(o)) and stated that this should preclude DOE from considering design options that do not yield an energy cost savings of at least one third of their incremental cost. (SVA, No. 53 at p. 3) Additionally, in the BVM ECS NOPR public meeting, SVA expressed the belief that DOE should have more fully disclosed the data used in its analysis and that DOE's assumptions are generally off base with regard to manufacturer capability. (SVA, Public Meeting Transcript, No. 48 at p. 181)

In response to stakeholder comments, DOE has revised its engineering model to better represent which design options are already being used to meet the existing standard and therefore not be considered as potential sources of further incremental energy savings. In response to SVA's comment regarding the economic justification of design options, DOE notes that it includes in the engineering analysis all technologies that have survived the screening analysis. At the engineering analysis phase, DOE only screens out those technologies that are not technologically feasible; are not practical to manufacture, install, and service; do not impact equipment utility or equipment availability; and do not adversely affect health and safety (see section IV.B). DOE considers the economic implications of any screened-in design options in its downstream analyses and sets new and amended standard levels based on any improvements in efficiency that are economically justified based on the new costs and benefits accrued by the nation, as well as the specific impacts on manufacturers (see section IV.J) and certain customer subgroups (see section IV.I). In the LCC and PBP analyses, DOE considers the time, in years, it takes for the cumulative energy savings from more efficient equipment to recover any incremental increase in equipment cost necessary to achieve those efficiency improvements. DOE notes that the PBP analysis is assessed based on the total incremental equipment cost necessary to achieve a given efficiency level and the commensurate energy savings, rather than determining the PBP of individual design options. 42 U.S.C. 6295(o)(2)(B)(iii) DOE further discusses the methodology for the PBP analysis in section IV.F and presents the results of such analyses in section V.B.1.a.

The design options included in this final rule analysis are shown in Table IV.4.

Table IV.3 Design Options Modeled in the Engineering Analysis

Design Option	Notes
Higher efficiency lighting	e.g., LEDs
Higher efficiency evaporator fan motors	e.g., Electronically commutated motors
Evaporator fan controls	–
Improved evaporator design	–
Insulation increases or improvements	e.g., Thicker insulation, vacuum insulated panels
Improved glass pack	Class A and Combination A only
Higher efficiency condenser fan motors	e.g., Electronically commutated motors
Improved condenser design	–
Higher efficiency compressors	–
Lighting low power modes	e.g., Lighting timers
Refrigeration low power modes	e.g., Timer-based cabinet temperature rise

An example of the results of the engineering analysis for a Class A BVM model with CO_2 refrigerant and a medium refrigerated volume is provided in Table IV.4 of this notice.

Table IV.4 Example of Design Option Analysis – Class A Medium CO_2 Refrigerant

DEC kWh/day	MPC $	MSP $	Design Option Added
8.598	$1,736.52	$2,340.77	High Energy Use; with SPM fan motors, no energy controls, T8 lighting, double-pane glass pack, 1″ insulation, etc.
7.552	$1,740.50	$2,345.63	Evaporator Fan Controls
5.555	$1,755.03	$2,363.36	Improved Single Speed Reciprocating Compressor
5.126	$1,759.01	$2,368.22	Automatic Lighting Controls
4.604	$1,764.90	$2,375.40	Permanent Split Capacitor Evaporator Fan Motor
4.348	$1,770.79	$2,382.59	Permanent Split Capacitor Condenser Fan Motor
3.867	$1,786.90	$2,402.24	LED Lighting
3.792	$1,789.48	$2,405.38	Baseline – Interpolated – Exactly Meets Current Standards; Includes all Design Options Above le
3.751	$1,790.88	$2,407.10	Refrigeration Low Power State
3.487	$1,806.03	$2,425.57	Enhanced Evaporator Coil
3.372	$1,830.10	$2,454.94	Electronically-Commutated Evaporator Fan Motor
3.267	$1,857.71	$2,488.62	1.125″ Thick Insulation
2.966	$1,984.86	$2,643.75	Enhanced Glass Pack

5. Manufacturer Production Costs

In its engineering analysis, DOE estimates costs for manufacturers to produce equipment at the baseline energy use level and at increasingly higher levels of energy efficiency. In this final rule, DOE based the manufacturer production cost model upon data from physical disassembly of units available on the market, corroborated with information from manufacturer literature, discussions with industry experts, input from manufacturer interviews (see section IV.J of this final rule), and other sources. The baseline units modeled in the engineering analysis only incorporated refrigerants allowable under SNAP regulations at the time of the effective date of any new or amended standards, namely propane and CO_2. As such, the manufacturer production costs at the baseline and increasing levels of efficiency all reflect the costs incurred in producing equipment using acceptable refrigerants under the final SNAP regulations issued in 2015. The incremental cost associated with producing a given BVM unit using propane or CO_2 refrigerant, as compared to a similar BVM unit using R-134a refrigerant is accounted for through the use of these refrigerant-specific cost curves. Chapter 5 of the final rule TSD provides a detailed description of the manufacturing cost analysis.

DOE received comments regarding the selection of units for teardown and regarding the MPCs that resulted from the analysis. Specifically, in written comments, NAMA expressed concern that no combination vending machines were directly torn down and tested and requested that DOE perform such testing before regulations are imposed on this equipment class. (NAMA, No. 50 at p. 4) And, in its written comments, SVA expressed agreement with DOE's assumed markups for Class A and Class B equipment but added that it believes MPCs are underestimated. (SVA, No. 53 at p. 2)

In response to NAMA, DOE agrees that additional teardowns might have provided further information regarding combination vending machines. However, difficulty in procuring combination vending equipment ultimately made such teardowns impracticable. Instead, DOE used data gathered through teardowns of Class A and Class B machines and extended those data to the analysis of combination machines, drawing on the inherent physical and design similarities between the analogous equipment classes. In response to SVA, DOE notes that its MPC estimates are built up as the sum of individual component and system cost estimates, which have been subjected to numerous rounds of stakeholder review in previous stages of this rulemaking. DOE has incorporated into its cost modeling analysis all specific, actionable cost information received at each stage of the rulemaking. DOE additionally notes that as mentioned elsewhere in this final rule, it has updated its cost model for propane units to account for motors and other components that comply with applicable UL standards, and that this has had the net result of increasing MPC values for those units.

D. Markups Analysis

DOE uses manufacturer-to-customer markups to convert the MSP estimates from the engineering analysis into customer purchase prices, which are subsequently used in the LCC and PBP analysis to evaluate how the increased cost of higher efficiency equipment compares to the annual and lifetime energy and operating cost savings resulting from such efficiency improvements. Accordingly, DOE estimated markups for baseline and all higher efficiency levels that are applied to the MSPs from the engineering analysis to obtain final customer purchase prices. The markups analysis developed appropriate markups (e.g., manufacturer markups, retailer markups, distributor markups, contractor markups) in the distribution chain and sales taxes to convert the MPC estimates derived in the engineering analysis to customer prices, which were then used in the LCC and PBP analysis and in the manufacturer impact analysis. At each step in the distribution channel, companies mark up the price of the equipment to cover business costs and profit margin.

In order to develop markups, DOE identified distribution channels (i.e., how the equipment is distributed from the manufacturer to the customer). Once proper distribution channels for each of the equipment classes were established, DOE relied on economic data from the U.S. Census Bureau and input from the industry to determine to what extent equipment prices increase as they pass from the manufacturer to the customer (see chapter 6 of the final rule TSD).

DOE identified three distribution channels, as described below:

1) Equipment Manufacturer →Vending Machine Operator (e.g., bottler, beverage distributor, large food operator)
2) Equipment Manufacturer →Distributor →Vending Machine Operator
3) Equipment Manufacturer →Distributor →Site Owner

Chapter 6 of the final rule TSD provides details on DOE's development of markups for beverage vending machines.

E. Energy Use Analysis

The purpose of the energy use analysis is to establish an estimate of annual energy consumption (AEC) of beverage vending machines now and over the 30-year analysis period and to assess the energy-savings potential of different equipment efficiencies. DOE uses the resulting estimated AEC in the LCC and PBP analysis (section IV.F of this final rule) to establish the customer operating cost savings of efficiency improvements considered. DOE also uses the estimate of energy use at the baseline and at higher levels of efficiency to estimate NES in the NIA (section IV.H of this final rule).

The energy use analysis assessed the estimated AEC of a beverage vending machine as installed in the field. DOE recognizes that a variety of factors may affect the actual energy use of a beverage vending machine in the field, including ambient conditions, use and stocking profiles, and other factors. In the 2015 BVM ECS NOPR, to model the AEC of each BVM unit, DOE separately estimated the energy use of equipment installed indoors and outdoors, to account for the impact of ambient temperature and relative humidity on field-installed BVM energy use. 80 FR 5050462, 50486 (Aug. 19, 2015).

To determine the AEC of BVM units installed indoors, DOE estimated that the DEC modeled in the engineering analysis and measured according to the DOE test procedure is representative of the average energy consumption for that equipment every day of the year. DOE believes this is a reasonable assumption, as beverage vending machines installed indoors are typically subject to relatively constant temperature and relative humidity conditions consistent with the nominal DOE test conditions (75 ºF and 45 percent relative humidity). DOE estimated that Class A and Combination A beverage vending machines and a majority of Class B and Combination B beverage vending machines will all be installed inside. Id.

However, DOE understands that some Class B and Combination B beverage vending machines are installed outdoors and will be subject to potentially more variable ambient temperature and relative humidity conditions than BVM units installed indoors. Therefore, in the 2015 BVM ECS NOPR, DOE modeled the AEC of BVM units installed outdoors based on a linear relationship that was developed between the DEC determined in accordance with the DOE test procedure, as modeled in the engineering analysis, and the AEC for Class B and Combination B beverage vending machines installed outdoors. DOE developed this linear regression based on analysis performed in support of the 2009 BVM rulemaking, where DOE modified its energy consumption model developed in the engineering analysis to reflect the equipment's thermal and compressor performance characteristics and to simulate the realistic performance of the machine exposed to varying temperature and relative humidity conditions (chapter 7 of the 2009 BVM final rule TSD). (Docket No. EERE-2006-STD-0125, No. 79) DOE then estimated the AEC of a given Class B or Combination B beverage vending machine installed outside by multiplying the DEC value by the linear equation determined from based on the 2009 BVM rulemaking analysis. Id.

Regarding DOE's analysis of Class B and Combination B beverage vending machines installed outdoors, DOE's NOPR analysis did not consider the incremental energy use of any electric resistance heating elements energized to prevent freezing in cold temperatures, as DOE lacked sufficient data to do so and such energy use is not directly affected by improved efficiency levels considered by DOE because the technology options DOE considered in the engineering analysis do not include any design changes that would impact the energy use of resistance heaters. As such, DOE noted that accounting for the energy use of cold weather heaters would not significantly impact the energy use analysis, LCC analysis, or NIA results. Id.

In the 2015 BVM ECS NOPR, DOE estimated, based on publicly available data from college campuses,[29] that 16 percent of Class B machines were installed outdoors. DOE believes that these data from college campuses are reasonably representative of BVM locations nationally due to the wide variety of building types and outdoor spaces on large college campuses, which can be correlated with the likely BVM locations expected. Id.

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[29] Beverage vending machine Outdoor Location and Elevated (90 °F) Outdoor Temperature Analysis. Lawrence Berkeley National Laboratory. June 2014. Available at http://eetd.lbl.gov/sites/all/files/lbnl-6744e.pdf.

In addition, the engineering analysis considered three specific sizes (small, medium, and large) for Class A and Class B equipment, and two specific sizes (medium and large) for Combination A and Combination B equipment. However, DOE based its energy use analysis on a "representative size" beverage vending machine for each equipment class, determined based on a weighted average of the equipment sizes modeled in the engineering analysis. Id. at 50487.

In response to DOE's energy use analysis presented in the NOPR, Seaga stated the belief that DOE should not consider the number of Class A machines installed outside to be negligible, but did not provide any additional data (Seaga, Public Meeting Transcript, No. 48 at p. 84). NAMA also noted the lack of college campuses from the Northeast and Deep South in the dataset that DOE used and recommended that DOE expand its data collection to include these two regions of the country. (NAMA, No. 50 at p. 7) Royal Vendors agreed with DOE that use of cold weather heaters should not be considered in the NIA. (Royal Vendors, No. 54 at p. 5) Similarly, AMS expressed agreement with DOE's analysis with regard to its methodology in calculating annual energy consumption. (AMS, No. 57 at p. 5)

DOE appreciates AMS and Royal Vendor's support of DOE's energy use assessment methodology and treatment of cold weather heaters, respectively. In response to Seaga and NAMA's concerns regarding the number and type of beverage vending machines located outdoors, DOE believes that the data from six colleges and universities around the country are sufficiently representative of the general BVM population because college campuses typically have a mix of building types that mirror some of the major markets for beverage vending machines, including retail, commercial lodging, offices, public assembly, and outdoor spaces (see chapter 7 in the final rule TSD for a full discussion of the building types represented in the sample from college campuses). DOE appreciates the comments from Seaga and NAMA but, without data to improve DOE's estimates of outdoor BVM installations, DOE was not able to identify any data or information supporting such claims. DOE acknowledges that these trends could underestimate the outdoor instances of outdoor Class A machines and specific regional installation trends. However, DOE continues to believe that, on average, the majority of outdoor BVM installations across the country are Class B or Combination B units and that the number of Class A outdoor installations is small. In addition, DOE acknowledges that the six-school sample may underrepresent certain climatic regions in the United States. However, DOE does not have reason to believe that the installation trends for BVM in those regions would be significantly different from those in the regions represented in the data. Therefore, in this final rule, DOE maintained the assumption that 16 percent of Class B beverage vending machines are installed outside.

In the 2015 BVM ECS NOPR, DOE also requested comments on any other variables that it should account for in its estimate of national energy use. In response, DOE received several comments regarding the effect of dirty coils in field installations. Mr. Richard Kenelly of CoilPod LLC commented that dirty coils lead to reduced performance and higher energy use (CoilPod LLC, No. 42 at p. 1) and added that energy consumption may be reduced 45 to 50 percent after coils are cleaned (CoilPod LLC, Public Meeting Transcript, No. 48 at p. 53). SVA added that increased condenser efficiency is often achieved by increasing fin density that can lead to accelerated coil fouling, which decreases energy consumption under actual use conditions. (SVA, Public Meeting Transcript, No. 54 at p. 54). USelectIt (USI) agreed with SVA's statement that increased fin density is used to increase condenser coil efficiency and that because customers don't generally clean their coils, they have implemented technology that runs the condenser fan motors backwards in an attempt to automatically clean the coils. USI also agreed with SVA that under real-world conditions, efficiency would decrease substantially due to coil degradation and that including higher efficiency condenser coils may work against DOE's intended goal of energy savings, as the higher fin density of these coils makes them more difficult to clean (USI, Public Meeting Transcript, No. 54 at p. 5). In written comments, Coca-Cola, Royal Vendors, and SVA expressed concern that increasing coil fin density will hinder performance in the field due to increased fouling and shorter equipment life. Royal Vendors provided the specific example of higher compressor strain due to higher static pressure and increased coil restriction in the case of increased fin density (Coca-Cola, No. 52 at p. 3; Royal Vendors, No. 54 at pp. 2, 6; SVA, No. 53 at p. 6)

DOE understands the importance of proper maintenance, including cleaning of the condenser coil, on the energy use and lifetime of beverage vending machines. DOE has accounted for regular maintenance of BVM equipment in the LCC model, which accounts for an annual preventative maintenance cost that includes coil cleaning, cleaning the exterior of the machine and machine components, and inspection of the refrigeration system (see section IV.F and chapter 8 of the TSD). DOE notes that BVM manufacturers and distributors encourage regular coil cleaning in their operation manuals.[30] In addition, some manufacturers and distributors require adherence to the operations manual in order to maintain the warranty on the equipment,[31] which DOE believes may compel such regular preventative maintenance. While DOE acknowledges that some BVM operators may not adhere to the recommended maintenance schedule, manufacturers do not have control over the actions of BVM operators.

Furthermore, DOE does not have authority to address such application-based usage as part of these equipment standards, which are applied at the point of manufacture when the coil is clean. Therefore, DOE is electing not to consider the impact of failure to clean condenser coils or otherwise properly maintain BVM equipment in the field in the energy use analysis. DOE notes that BVM operators may install and operate their equipment in any number of inadvisable ways that may have an impact on energy use of the equipment. However, in this analysis, DOE is accounting for the anticipated energy use of beverage vending machines in the field as intended by manufacturers and distributors. DOE believes that BVM manufacturers, who are subject to these standards, should not be held responsible for any failure by BVM operators to properly operate BVM equipment in the field. DOE also notes that, were DOE to account for the impact of coil fouling in the energy use analysis, it would likely affect all equipment classes and

[30] See e.g., Dixie Narco. Glassfront BevMax 3 Vender Technical Manual. Crane. http://69.129.141.51:8080/RD/techbulletins.nsf/e667893fe32caf4785256bcd0066752b/67ec964a7ec11a7f85257346004b668b/$FILE/Bev%20Max%203%20CC%20Man%20260.01.pdf or Sma's Club http://scene7.samsclub.com/is/content/samsclub/633055_P1pdf.
[31] See e.g., Drop's Vending www.dropsvending.com/Merchant2/merchant.mvc?Screen=TERMPOL or Royal http://royalvendors.com/wp-content/uploads/2014/05/Domestic-Vender-Warranty.pdf

ELs equivalently and, thus, would not affect the LCC analysis or NIA results because only costs that vary with efficiency levels (ELs) (incremental costs) lead to changes in these results.

In addition, CA IOUs requested that DOE provide state level energy savings projections for its proposed standard (CA IOUs, No. 58 at p. 6) In response to this request, DOE notes that it is obligated by EPCA to consider the national benefits and costs, including the total national energy savings, of any new or amended standards to determine whether such standards are technologically feasible and economically justified. EPCA does not require DOE to consider such state-specific information in considering and promulgating Federal standards. (42 U.S.C. 6295 (o)(2)) Furthermore, DOE does not believe that such detailed analysis would significantly improve the analysis or affect the outcome of such analysis. Therefore, DOE did not perform a state-level analysis and has based the standards analysis conducted in this final rule on the national aggregate impacts on customer, manufacturers, and the nation in performing the analyses required by 42 U.S.C. 6295(o)(2).

Chapter 7 of the final rule TSD provides additional details on DOE's energy use analysis for beverage vending machines.

F. Life-Cycle Cost and Payback Period Analysis

New or amended energy conservation standards usually decrease equipment operating expenses and increase the initial purchase price. DOE analyzes the net effect of new or amended standards on customers by evaluating the net LCC. To evaluate the net LCC, DOE uses the cost-efficiency relationship derived in the engineering analysis and the energy costs derived from the energy use analysis. Inputs to the LCC calculation include the installed cost of equipment to the customer, operating expenses (energy expenses, and maintenance and repair costs), the lifetime of the unit, and a discount rate.

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

DOE uses Monte Carlo simulation and probability distributions to incorporate uncertainty and variability in the LCC and PBP analysis. DOE used Microsoft Excel combined with Crystal Ball™ (a commercially available program) to develop an LCC and PBP spreadsheet model that incorporates both Monte Carlo simulation and probability distributions. The LCC subgroup analysis includes an assessment of impacts on customer subgroups.

DOE determined several input values for the LCC and PBP analysis including (1) customer purchase prices; (2) electricity prices; (3) maintenance, service, and installation costs; (4) equipment lifetimes; (5) discount rates; (6) equipment efficiency in the no-new-standards case; and (7) split incentives. The approach and data DOE used to derive these input values are described below.

1. Customer Purchase Prices

DOE multiplied the MSPs estimated in the engineering analysis by the supply-chain markups to calculate customer purchase prices for the LCC and PBP analysis. DOE determined, on average, 15 percent of this equipment passes through a distributor or wholesaler, and 85 percent of the equipment is sold by a manufacturer directly to the end user. In the LCC and PBP analysis, approximately 15 percent of the Monte Carlo iterations include a distributor or wholesaler markup, while 85 percent of the iterations use a markup factor of 1.0, indicative of no additional markup on top of the MSPs (besides sales tax).

DOE developed a projection of price trends for beverage vending machines in the 2015 BVM ECS NOPR, based on historical price trends that projected the MSP to decline by almost 2 percent from the 2014 MSP estimates through the 2019 assumed compliance date of new or amended standards.

DOE re-examined the data available and updated the price trend analysis for this final rule analysis. DOE continued to use the automatic merchandising machines PPI and included historical shipments data from the U.S. Census Bureau's current industrial reports to examine the decline in inflation-adjusted PPI as a function of cumulative BVM shipments. Using these data for the BVM price trends analysis and DOE's projections for future shipments yields a price decline of roughly 10 percent over the period of 2014 through 2048. For the LCC model, between 2014 and 2019, the price decline is almost 2 percent. DOE used this revised price trend in the final rule analysis, which reflects analytical techniques more consistent with the methodology DOE has preferentially used for other appliances. See appendix 8C of the TSD for further details on the price learning analysis.

2. Energy Prices

DOE derived electricity prices from state-level EIA energy price data for the commercial and industrial sectors (manufacturing facilities). DOE used projections of these energy prices for commercial and industrial customers to estimate future energy prices in the LCC and PBP analysis. EIA's Annual Energy Outlook 2015 (AEO2015) was used as the source of projections for future energy prices.

DOE developed estimates of commercial and industrial electricity prices for each state and the District of Columbia. DOE derived these average energy prices from data that are published annually based on EIA Form 826. DOE then used EIA's AEO2015 price projections to estimate state-level commercial and industrial electricity prices in future years. DOE assumed that 60 percent of installations were in commercial locations and 40 percent were in industrial locations.

In response to the 2015 BVM ECS NOPR, Coca-Cola asked if electricity prices from EIA used in the analysis are based on a national average or if any kind of weighting or regionality was taken into account. Coca-Cola also inquired whether DOE considered marginal costs of electricity (Coca-Cola, Public Meeting Transcript, No. 48 at p. 110). DOE notes that the LCC and PBP analysis uses state-level electricity prices in its Monte Carlo approach, and as such inherently includes regional variability in prices. DOE has considered using marginal costs of electricity but opted to use average electricity prices by state in this final rule analysis because compiling and utilizing marginal rates for the commercial sector across the nation is extremely complex, and data is difficult to obtain.

3. Maintenance, Repair, and Installation Costs

DOE considered any expected changes to maintenance, repair, and installation costs for the beverage vending machines covered in this rulemaking. Typically, small incremental changes in equipment efficiency incur little or no changes in repair and maintenance costs over baseline equipment. The repair cost is the cost to the customer for replacing or repairing components in the BVM equipment that have failed. The maintenance cost is the cost to the customer of maintaining equipment operation. There is a greater probability that equipment with efficiencies that are significantly higher than the baseline will incur increased repair and maintenance costs, as such equipment is more likely to incorporate technologies that are not widely available or are potentially less reliable than conventional, baseline technologies.

DOE based repair costs for baseline equipment on data in a Foster-Miller Inc.[32] report with adjustments to account for LED lighting. Maintenance costs include both

[32] Foster-Miller, Inc. Vending Machine Service Call Reduction Using the VendingMiser. February 18, 2002. Report BAY-01197. Waltham, MA.

preventative maintenance and annualized cost of refurbishment. DOE estimated that beverage vending machines undergo refurbishment every 4.5 years based on two ENERGY STAR reports indicating that beverage vending machines are refurbished every 4 to 5 years. DOE used RSMeans[33] data for preventative maintenance costs and used data from the 2009 BVM final rule[34] for the annualized cost of refurbishment.

In the 2009 BVM rulemaking, DOE assumed that more-efficient beverage vending machines would not incur increased installation costs. Further, DOE did not find evidence of a change in repair or maintenance costs by efficiency level with the exception of repair cost decreases for efficiency levels that used LED lighting.

In the 2015 BVM ECS NOPR, DOE requested comment on the maintenance and repair costs modeled in the LCC analysis, especially additional data regarding differences in maintenance or repair costs that vary as a function of refrigerant, equipment class, or efficiency level. DOE received two comments. Royal Vendors commented that maintenance and repair costs will be higher for units using new refrigerants than they currently are for R-134a units, and that more efficient components are more expensive, thus higher efficiency levels should have higher maintenance costs. However, Royal Vendors did not supply supporting data. (Royal Vendors, No. 54 at p. 6) AMS

[33] RSMeans Facilities Maintenance & Repair 2010, 17th Annual Edition. 2009. Kingston, MA.

[34] U.S. Department of Energy–Office of Energy Efficiency and Renewable Energy. Chapter 8 Life-Cycle Cost And Payback Period Analyses, Beverage Vending Machines Final Rule Technical Support Document. 2009. Washington, DC. Available online at www.regulations.gov under Docket No. EERE-2006-STD-0125.

commented that they had observed no measurable differences in cost or frequency of service calls for higher efficiency Class A machines. (AMS, No. 57 at pp. 5–6)

In response to these comments, in this final rule analysis DOE included higher maintenance costs for more efficient machines which implemented such design options as enhanced condenser coils, improved compressors, and high performance fans. Please see chapter 8 of the final rule TSD for more information regarding maintenance and repair costs.

4. Equipment Lifetime

DOE used information from various literature sources and input from manufacturers and other interested parties to establish average equipment lifetimes for use in the LCC and subsequent analyses. The 2009 final rule assumed that average BVM lifetime is 10 years. 74 FR 44914, 44927 (Aug. 31, 2009). For this final rule, a longer average lifetime of 13.5 years is assumed based on refurbishments occurring twice during the life of the equipment at an interval of 4.5 years. As discussed in section IV.F.3, this estimate is based on a 2010 ENERGY STAR webinar,[35] which reported average lifetimes of 12 to 15 years, and data on the distribution of equipment ages in the stock of beverage vending machines in the Pacific Northwest from the Northwest Power and Conservation

[35] EPA. Always Count Your Change, How ENERGY STAR Refrigerated Vending Machines Save Your Facility Money and Energy. 2010. www.energystar.gov/ia/products/vending_machines/Vending_Machine_Webinar_Transcript.pdf.

Council 2007 Regional Technical Forum[36] (RTF), which observed the age of the units in service to be approximately 8 years on average.

Refurbishment costs are included in the maintenance costs presented in section IV.F.3 of this final rule, and a discussion of how maintenance and repair costs are derived is in chapter 8 of the final rule TSD. DOE believes a lifetime of 13.5 years across efficiency levels is a representative lifetime assumption for beverage vending machines. DOE used this assumption in its analysis for this final rule.

At the NOPR stage, DOE requested comment on the assumed lifetime of beverage vending machines and if the lifetime of beverage vending machines is likely to be longer or shorter in the future. In addition, DOE requested comment on its assumption that a beverage vending machine will typically undergo two refurbishments during the course of its life and if refurbishments are likely to increase or decrease in the future. DOE also requested comment on the applicability of this assumption to all equipment classes.

DOE received several additional comments on equipment lifetime in response to the NOPR analysis. AMS generally agreed with DOE's methodology and results for equipment lifetime (AMS, No.57 at p. 6), but AMS also noted that new component types with unproven reliability records may either shorten or lengthen BVM lifetimes. (AMS,

[36] Haeri, H., D. Bruchs, D. Korn, S. Shaw, J. Schott. Characterization and Energy Efficiency Opportunities in Vending Machines for the Northwestern US Market. Prepared for Northwest Power and Conservation Council Regional Technical Forum by Quantec, LLC and The Cadmus Group, Inc. Portland, OR. July 24, 2007.

No. 57 at p. 6) Royal Vendors commented that the evaporator fan and condenser fan will have shorter life with increased fan density, thereby decreasing performance and shortening compressor lifetime. (Royal Vendors, No. 54 at p. 6) NAMA commented that the lifetime of machine could be longer in the future because BVM owners will retrofit instead of buy new machines. (NAMA, No. 50 at p. 8)

DOE appreciates these comments, and maintained its average lifetime assumption of approximately 13.5 years for this final rule. However, DOE did compensate for the effects of enhanced evaporator and condenser fans in the repair and maintenance costs component of the LCC and PBP analysis. In this analysis, while the shorter life of these fans does not shorten the overall life of the BVM equipment, the costs to maintain more efficient equipment is greater.

DOE notes that assumptions regarding equipment lifetime and refurbishment cycles also affect DOE's shipments model, which is discussed in section IV.G of this final rule.

5. Discount Rates

DOE developed discount rates by estimating the average cost of capital to companies that purchase beverage vending machines covered under this rulemaking. DOE commonly uses the cost of capital to estimate the present value of cash flows to be derived from a typical company project or investment. Most companies use both debt and equity capital to fund investments, so the cost of capital is the weighted-average cost to the firm of equity and debt financing.

6. Equipment Efficiency in the No-New-Standards Case

To accurately analyze the incremental costs and benefits of the adopted standard levels, DOE's analyses consider the projected distribution of equipment efficiencies in the no-new-standards case (the case without new energy efficiency standards). That is, DOE calculates the percentage of customers who will be affected by a standard at a particular efficiency level (in the LCC and PBP analysis, discussed in this section IV.F), as well as the national benefits (in the NIA, discussed in section IV.H) and impacts on manufacturers (in the MIA, discussed in section IV.J) recognizing that a range of efficiencies currently exist in the marketplace for beverage vending machines and will continue to exist in the no-new-standards case.

To estimate the efficiency distributions for each equipment class, DOE relied on all publicly available energy use data. Specifically, the market efficiency distribution was determined separately for each equipment class and for each refrigerant. For equipment for which certification information was available in the DOE certification[37] and ENERGY STAR databases,[38] these data were used to determine the efficiency distribution of models within the equipment class, which only included Class B CO_2 equipment. 80 FR 50462, 50492 (Aug. 19, 2015).

[37] www.regulations.doe.gov/ccms
[38] www.energystar.gov/productfinder/product/certified-vending-machines/results

For Class A and Class B equipment that is not represented in DOE's combined BVM models database (Class A CO_2 equipment and Class A and Class B propane equipment), DOE assumed all equipment would be ENERGY STAR-compliant or use design options consistent with ENERGY STAR equipment in the no-new-standards case. That is, DOE assumed that if a manufacturer did not reengineer the model to meet the ENERGY STAR level independently, DOE assumed that it is likely that a manufacturer would use the same case and basic accessory set (i.e., non-refrigeration system components) available on other similar ENERGY STAR-listed models using R-134a, changing only the compressor and other sealed-system components, as opposed to building or purchasing separate, less efficient, components for any new propane models. This analysis approach resulted in selection of the first efficiency level above the baseline, or EL 1, for Class A and Class B propane equipment and for Class A CO_2 beverage vending machines. Id.

For Combination A and Combination B beverage vending machines, DOE notes that very little data exists regarding the efficiency distribution of such equipment. However, because most manufacturers of Combination A and Combination B equipment also produce Class A and/or Class B equipment, DOE employed a methodology to estimate the efficiency distribution of existing Combination A and Combination B equipment based on the known efficiency of Class A and Class B equipment. Therefore, based on the same analytical methodology used for Class A and Class B propane equipment and Class A CO_2 equipment, DOE estimated the efficiency distribution of Combination A and Combination B equipment based on the set of design options reflected in the efficiency distribution for Class A and Class B equipment that is currently available on the market. However, DOE notes that there are some BVM manufacturers that produce only Class A and/or Class B equipment and these manufacturers typically produce the most efficient units. Therefore, DOE assumed that the design option set corresponding to the ENERGY STAR levels for Class A and Class B equipment, which is the most common design, represented the maximum efficiency for combination equipment and higher efficiency Class A and Class B models did not have commensurate combination equipment platforms. Therefore, equivalent market share for combination equipment and the remaining shipments were equally distributed between the "ENERGY STAR equivalent" efficiency level and the baseline efficiency level, or EL 0. Id.

To project this efficiency distribution over the analysis time frame in the no-new-standards case, DOE assumed that the efficiency distribution that currently exists in the market will be maintained over the analysis period (2019–2048). Id.

In response to the 2015 BVM ECS NOPR analysis, DOE received comments from interested parties regarding DOE's efficiency distribution assumptions. In particular, AMS commented that it sells Combination A machines with and without features found in their ENERGY STAR Class A machines and that less than 10 percent of its customers purchase more efficient models because the company does not see the energy savings benefits themselves. (AMS, No. 57 at p. 7) NAMA also expressed concern that DOE's definition for combination vending machines may make the assumption that Combination A and Combination B machines have similar efficiency distributions to their Class A and Class B counterparts false. (NAMA, No. 50 at p. 9)

Regarding the efficiency distribution of combination machines, as stated above, DOE assumed that combination vending machines enter the market at efficiency levels similar to, but slightly less than, the comparable Class A and Class B efficiency distributions. Consistent with AMS and NAMA's comments, DOE acknowledges that Combination A and Combination B equipment classes may be less efficient than Class A and B equipment because these classes have not previously been subject to standards. Therefore, DOE defined the baseline efficiency distribution for Combination A and Combination B equipment as significantly less efficient than Class A and Class B equipment. That is, Combination A and Combination B equipment is assumed to fall between the baseline efficiency unit (the least efficient combination unit that could be produced) and the EL with comparable design options to the ENERGY STAR EL for Class A and Class B equipment. DOE notes that this is significantly less efficient than the baseline efficiency distribution for Class A and Class B equipment, as this equipment is not assumed to have shipments below ENERGY STAR and in some cases has shipments of BVM models with efficiency levels far exceeding the ENERGY STAR requirement.

DOE also notes that the values in the ENEGY STAR and CCMS databases represent values gathered under the existing DOE test procedure, or appendix A. Because this final rule analysis is conducted based on testing in accordance with appendix B, DOE elected to translate the existing equipment efficiency data to be representative of testing under appendix B. To do this, DOE calculated the average energy savings, in kWh/day, for accessory low power mode and refrigeration low power mode for those equipment classes represented in the ENERGY STAR and CCMS databases,[39] as these are the test procedure provisions in appendix B that affect the measured DEC of covered equipment. The energy savings from accessory and refrigeration low power mode will vary based on the specific technologies and components implemented in each different BVM model. However, DOE believes that the design options and technologies modeled in the engineering analysis are representative of typical equipment available in the market; therefore, the average energy savings for the accessory and refrigeration low power mode generated based on the engineering analysis are similarly representative of the average change in daily energy consumption that BVM models with low power modes would observe when testing in accordance with appendix B. That is, DOE's analysis calculates the average change in measured DEC when testing under appendix B, with low power modes enabled, compared to appendix A, for the typical BVM model.

To adjust the CCMS and ENERGY STAR certified ratings, DOE assumed that all ENERGY STAR-certified equipment would have both accessory low power mode and lighting low power mode. DOE notes that ENERGY STAR prescribes that either accessory or refrigeration low power mode (or both) be present in order for a model to

[39] While DOE performed this analysis for both Class A and Class B equipment represented in the CCMS and ENERGY STAR database, only Class B CO_2 units are relevant for DOE's analysis, as all Class A units in the ENERGY STAR and CCMS databases use R-134a refrigerant.

qualify for ENERGY STAR certification. Therefore, all ENERGY STAR models are offset by the average energy savings resulting from the use of low power modes when testing under appendix B (0.21 kWh/day for Class B equipment). DOE assumed that the models that were certified in CCMS but were not ENERGY STAR-qualified did not have low power modes and, thus, their energy consumption was not adjusted.

Some commenters observed that some certified ratings in the CCMS or ENERGY STAR databases may be based on testing of equipment without accounting for the energy consumption of money processing equipment and/or without lighting fully energized for the duration of the test, as is currently required under appendix A (see section III.B). DOE notes that the recently published 2015 BVM test procedure final rule adopted a new appendix A that clarifies the treatment of certain accessories, including lighting, under the DOE test procedure. Specifically, appendix A provides that, while energy management systems that cannot be adjusted by the machine operator may be employed, all lighting is to be illuminated to the maximum extent throughout the test and the energy consumption of payment mechanisms is to be accounted for the DEC for each BVM model. 80 FR 45758 (July 31, 2015). DOE also notes that appendix A of the amended BVM test procedure must currently be used to certify equipment with existing energy conservation standards. While DOE acknowledges that some manufacturers may have previously misinterpreted the DOE test procedure and certified equipment without lighting fully illuminated and/or without money processing equipment in place, DOE notes that the analysis supporting the standard levels adopted in this final rule was done based on a modeled engineering analysis, which was validated based on testing DOE conducted in accordance with the amended BVM test procedure adopted in the 2015 BVM test procedure final rule. Based on the engineering analysis and testing results, DOE maintains that equipment can meet the current and amended standard levels when testing in accordance with the 2015 BVM test procedure final rule test procedure amendments. In addition, DOE notes that the CCMS and ENERGY STAR databases are only used to inform the distribution of equipment efficiencies currently available in the market. As DOE does not have information on whether and which specific models may have been testing without lighting fully illuminated and/or without money processing devices in place, DOE declines to modify the DEC values found in the CCMS and ENERGY STAR databases to account for these potential misinterpretations. However, DOE did conduct a sensitivity analysis to determine the impact of any artificially reduced DEC values in the CCMS and ENERGY STAR databases and found that it did not have a significant impact on the feasibility or cost-effectiveness of the analyzed TSLs.

For equipment that are not represented in DOE's combined BVM models database, the efficiency distributions assumed in the final rule are estimated based on the ENERGY STAR and CCMS database, knowledge of the market, test data, and comments received from manufacturers. Specifically, for Class A CO_2 equipment and Class A and Class B propane equipment, these models were all assumed to be designed based on a similar ENERGY STAR-compliant R-134a design platform for the given or similar equipment class. This analysis approach resulted in selection of the baseline efficiency level for Class A CO_2 equipment, EL1 for Class A propane equipment, and primarily

EL2 for Class B propane equipment.[40] Chapter 8 of this final rule TSD provides more detail about DOE's approach to developing no-new-standards case efficiency distributions.

7. Split Incentives

DOE understands that in most cases the purchasers of beverage vending machines (a bottler or a vending services company) do not pay the energy costs for operation and thus will not directly reap any energy cost savings from more-efficient equipment. However, DOE believes that BVM owners will seek to pass on higher equipment costs to the users who pay the energy costs, if possible. DOE understands that the BVM owner typically has a financial arrangement with the company or institution on whose premises the beverage vending machine is located, in which the latter may pay a fee or receive a share of the revenue from the beverage vending machine. Thus, DOE expects that BVM owners could modify the arrangement to effectively pass on higher equipment costs. Therefore, DOE's LCC and PBP analysis uses the perspective that the company or institution on whose premises the beverage vending machine is located pays the higher equipment cost and receives the energy cost savings.

In response to the 2015 BVM ECS NOPR, NAMA and AMS commented that operators of vending machines typically do not pay the energy costs associated with the

[40] DOE assumed that 85 percent of the market would enter at the ENERGY STAR level (EL2), with the remaining 15 percent distributed between the lower ELs (EL1 and EL0), to reflect the fact that some manufacturers may elect to trade off the increased efficiency of propane equipment with other more efficient design options to reduce cost. This assumption for Class B equipment also reflects the larger spread in efficiency currently observed in the market, as compared to Class A equipment.

machine, which are instead borne by the business or institution where the machine is installed. (NAMA, Public Meeting Transcript, No. 48 at p. 108; AMS, No. 57 at p. 6) DOE is aware of this "split incentive" issue and its impact on the perceived cost-effectiveness of savings in the marketplace. However, as noted above, in this analysis DOE has assumed BVM owners will seek to modify existing financial arrangements and contracts to pass on higher equipment costs to the users who pay the energy costs. Therefore, DOE's LCC and PBP analysis uses the perspective that the company or institution on whose premises the beverage vending machine is located will be impacted by the higher equipment cost and receives the energy cost savings. In the MIA, DOE also accounts for the ability of manufacturers to pass on higher equipment costs to customers (see section IV.J).

G. Shipments Analysis

DOE uses forecasts of annual equipment shipments to calculate the national impacts of standards (NES and NPV) and to calculate the future cash flows of manufacturers.[41] For beverage vending machines, DOE developed shipments forecasts based on an analysis of key market drivers and industry trends for this equipment. In DOE's shipments model, shipments of equipment are driven by stock replacements assuming that the overall population of beverage vending machines will slightly decrease over the next several decades.

[41] DOE uses all available data on manufacturer model availability, shipments, or national sales to develop estimates of the number of BVM units of each equipment class sold in each year of the analysis period. In general one would expect a close correspondence between shipments and sales and a reasonable correlation between model availability and sales.

In the 2015 BVM ECS NOPR analysis, DOE estimated historical shipments between the years of 1998 and 2006 based on the 2009 BVM final rule shipments model, increased by 18 percent to reflect the fact that the 2009 BVM final rule shipments model addresses only Class A and Class B equipment, not Combination A or Combination B equipment. 74 FR 44914, 44928 (Aug. 31, 2009) DOE estimates that combination machines represent 18 percent of total BVM shipments, as discussed further in section IV.G.1. DOE also referenced the ENERGY STAR shipment data to estimate shipments of new beverage vending machines between the years of 2005 and 2012 to corroborate DOE's historical shipments estimates during this period. These historical shipment estimates were used to build up a stock of BVM equipment with a representative distribution of ages, and DOE estimated a stock of 3.1 million BVM units in the United States in 2006. 80 FR 50462, 50493 (Aug. 19, 2015).

Between 2006 and 2014, DOE estimated that annual shipments declined linearly from 118,000 in 2006 to 45,000 in 2014, consistent with comments from manufacturers received in during manufacturer interviews conducted during the NOPR phase of this rulemaking (see section IV.J of this final rule). Based on these shipments, the estimated stock in 2014 is approximately 2.2 million units, compared to a stock of approximately 3 million in 2006. In the 2015 BVM ECS NOPR, DOE noted that if shipments were maintained at 2014 levels of around 45,000 units per year over the 30-year analysis period, this would result in an 80-percent reduction in overall stock of beverage vending machines in the United States and would reflect many current BVM owners removing BVM units from the marketplace permanently. Lacking any data indicating or supporting a significant reduction in availability or deployment of beverage vending machines, DOE assumed that shipments would recover over time to maintain reasonably constant stocks of beverage vending machines into the future. Id.

In both the BVM ECS NOPR analysis and this final rule analysis, DOE modeled future shipments of new beverage vending machines from 2014 through 2048 based on data from Vending Times Census of the Industry 2014[42] that reported BVM stock trends in the commercial and industrial building sectors, as well as specific commercial and industrial building sectors where beverage vending machines are commonly deployed. For each commercial and industrial building sector, DOE modeled an average annual percentage reduction in stock, as shown in Table IV.5, based on an assumed percentage reduction in BVM units for different commercial building uses. The number of buildings for each sector was also evaluated based on data available from the 2012 Commercial Building Energy Consumption Survey (CBECS),[43] and an average increase in number of buildings was calculated by comparing 2012 CBECS data to historical 2003 CBECS data. The estimated stock in 2048 based on this method was 1.8 million, a 20-percent decrease from the 2.2 million estimated in 2014. To estimate the shipments of new beverage vending machines based on these stock projections, DOE assumed the minimum growth rate necessary to result in a stock of 1.8 million in 2048, which resulted in a growth rate of 3.7 percent annually throughout the analysis period. Id at 50494.

[42] Vending Times Census of the Industry 2014. Available at www.vendingtimes.com.
[43] www.eia.gov/consumption/commercial/reports/2012/preliminary/index.cfm

Table IV.5 Average Annual Percent Reduction in BVM Stock and Growth in Number of Buildings for Each Industrial Sector and the Industry Overall

Commercial and Industrial Building Sector*	Average Annual % Reduction in BVM Stock	Annual Growth in # of Buildings (Est. from CBECS Data)*
Plants, Factories	0.29%	3.01%
Schools & Colleges and Universities	0.74%	0.09%
Public Locations	0.38%	-0.80%
Government and Military	0.29%	2.03%
Offices, Office Complexes	0.74%	2.54%
Hospitals, Nursing Homes	1.47%	2.41%
Other Locations	0.45%	1.27%
Total	**0.55%**	**1.78%**

* Note that the commercial and industrial building sectors assumed in this analysis correspond to those referenced in the 2013 Vending Times Census of the Industry. DOE mapped the CBECS building types to these commercial and industrial building sectors and provides a description of that mapping in chapter 9 of the final rule TSD.

At the 2015 BVM ECS NOPR stage, DOE requested comment on the several assumptions regarding historical shipments between 1998 and 2014 and also requested data from manufacturers on historical shipments, by equipment class, size, and efficiency level, for as many years as possible, ideally beginning in 1998 until the present.

In response, AMS offered that it manufactures only Class A and Combination A machines and that its shipment volumes are split roughly 50-50 between the two (AMS, No. 57 at p. 3). AMS also commented that DOE's shipments assumption contradict a 2014 ENERGY STAR publication which reports 54,000 shipments for that year. AMS noted that this does not include combination machines, and claimed that even the estimated 54,000 value is likely underestimated. (AMS, No. 57 at p. 7) SVA commented that historical shipments between 1998 and 2014 had a downward trend. (SVA, No. 53 at p. 8) Regarding existing BVM stock assumptions, NAMA provided an average estimate of 2.5 machines installed per "customer location." (NAMA, No. 50 at p. 11)

In response to these comments submitted by interested parties, DOE revised the historical shipments model to reference the most current ENERGY STAR market penetration reports, including the 2014 report cited by AMS. As AMS noted that the previous estimate of 45,000 is likely too low, DOE has updated the shipments in 2014 to be consistent with the shipments of ENERGY STAR-qualified units reported by ENERGY STAR (54,000 units), but scaled this number to reflect the shipments of combination equipment and non-ENERGY STAR-qualified Class A and Class B equipment. Specifically, DOE increased the 54,000 estimate by 18 percent to account for shipments of combination equipment and by 11 percent to represent the shipments of non-ENERGY-STAR-qualified units,[44] resulting 71,443 units shipped in 2014. DOE agrees with SVA's comment regarding the consistent downward trend of shipments between 1198 and 2014 and notes that DOE's shipments model reflects this industry trend. DOE believes the referenced ENERGY STAR reports represent the best available data to estimate historical BVM shipments.

At the NOPR stage DOE also requested comment on its assumptions regarding future shipments. Specifically, DOE requested comment on the stock of BVM units likely to be available in the United States and in particular commercial and industrial building sectors over time. DOE also requested comment on its assumptions regarding the likely reduction in stock in different commercial and industrial building sectors in which beverage vending machines are typically installed and on any other factors that might influence an overall reduction in BVM stock.

[44] DOE estimates that in 2014 89 percent of Class A and B equipment were ENERGY STAR-qualified based on the relative number of models available in the CCMS and ENERGY STAR databases in 2014.

In response to these requests, DOE received several comments regarded future shipments. In the BVM ECS NOPR public meeting and in written comments, NAMA expressed concern regarding DOE's assumed reduction in shipments due to health initiatives and stated that the industry is moving towards healthier options. NAMA additionally stated that the ability to place whatever the operator wants in a given machine would negate the need to remove the machine itself due to a soda ban. NAMA referenced an industry census study by Technomic, Inc. projecting growth in future revenues and asked DOE to re-evaluate assumptions regarding shipments. (NAMA, No. 50 at p. 9; NAMA, Public Meeting Transcript, No. 48 at p. 129) Reinforcing that comment, the EEA Joint Commenters argued that DOE may be underestimating total number of shipments over time because an increase in healthy options that are being offered in vending machines may actually cause shipments to increase over time, but did not provide supporting data. (EEA Joint Commenters, No. 56 at p. 4)

In written comments, NAMA commented that it is not aware of any situations that would result in further reduction to BVM stock other than micromarket expansion. However, NAMA expressed its belief that this trend may not be as significant as once thought, or as DOE suggested in the 2015 BVM ECS NOPR. NAMA cited a 15 percent growth in conversion from beverage vending machines to micromarkets and estimated there to be 10,000 micromarkets currently in existence in the United States. NAMA stated that it was unable to provide data as to how the increased presence of micromarkets would affect future shipments. (NAMA, No. 50 at pp. 10−11)

Conversely, SVA stated that new technologies such as micromarkets are resulting in the replacement of coin operated vending machines with bottle coolers. (SVA, Public Meeting Transcript, No. 48 at p. 133) In written comments, SVA expressed the belief that the current downward trend in beverage vending machine shipments in the United States will continue for the foreseeable future and recommended that DOE work to improve its understanding of equipment life, a significant driver of projected shipment calculations. (SVA, No. 53 at p. 9) SVA stated that tightening equipment budgets and increasing prices would result in increased equipment life, and if equipment life decreases, the stock of beverage vending machines in the United States would continue to decrease. SVA cited a downward trend in shipments between 1998 and 2014, and expressed strong disagreement with DOE's assumption that this trend would reverse. SVA additionally stated that due to the limited time allowed to submit comments, it was not able to provide data on shipments by equipment class. SVA stated its belief that micromarkets will continue to displace beverage vending machines and have an increasingly negative impact on shipments. (SVA, No. 53 at pp. 7−8)

DOE notes that changes in the availability of new refrigerants and limitation of certain other refrigerants for BVM applications may impact the overall BVM market in the United States and, specifically, the future shipments of new beverage vending machines through 2048. At the 2015 BVM ECS NOPR stage, DOE requested comment on the impact of the EPA SNAP rules on future shipments of beverage vending machines, by equipment class, refrigerant, and efficiency level. With respect to the impact of new refrigerants on shipments, Royal Vendors, AMS, and NAMA all commented that added machine costs due to alternative refrigerants as a result of EPA SNAP, combined with the increased efficiency required by DOE's proposed standards, would decrease new machine purchases in favor of refurbishments. (Royal Vendors, No. 54 at p. 8; AMS, No. 57 at p. 3; NAMA, No. 50 at p. 8) Conversely, NEEA expressed the belief that EPA SNAP compliance would lead to an increase in new shipments, as refurbishment may not be practical when switching refrigerants. (NEEA, Public Meeting Transcript, No. 48 at p. 135) Related to refurbishments, SVA stated in the BVM ECS NOPR public meeting that beverage vending machines can be refurbished from R-134a to CO_2 but not to propane due to different safety concerns for flammable refrigerants. (SVA, Public Meeting Transcript, No. 48 at p. 136)

In response to comments received from interested parties, DOE revised certain aspects of the shipments model in its final rule analysis. Primarily, DOE revised the shipments model to more explicitly account for refurbished beverage vending machines and their impact on overall shipments, as DOE understands this is an important factor driving current and future shipments of beverage vending machines. Specifically, DOE revised the BVM shipments model to calculate the stock of beverage vending machines that survive from 1 year to the next according to the following Eq. IV.1:

$$SurvivingStock = \sum_a U(t,a) + U_{new}(t) - U_{retirements}(t) + U_{refurbishments}(t)$$

Eq. IV.1

Where:

U(t,a) = total stock of age a in a given year t, Unew(t) = new shipments of BVM units in year t (units with age a=0),

Uretirements(t) = retirements of BVM units in year t (units with various age a≥13.4),

Urefurbishments(t) = refurbishments of BVM units in year t (units with various age 30≥a≥1),

a = age of stock in years, and

t = year.

DOE's shipments model assumes as increasing trend in refurbishing existing equipment beginning in 2009 and continuing through 2024, after which refurbishments return to pre-2009 levels. DOE notes that the impact of this increased refurbishment rate serves only to delay shipments of new equipment, rather than depress shipments permanently.

In addition, DOE revised its assumptions regarding the consistent growth of shipments beginning in 2014, in light of the impact of the new EPA SNAP regulations on the BVM market. While DOE does not have data to suggest the impact of changes in refrigerant availability on future shipments, DOE acknowledges the comments received from interested parties expressing their concern and belief that added machine costs due to alternative refrigerants as a result of EPA SNAP combined with the increased efficiency required by DOE's proposed standards would decrease new machine purchases in favor of refurbishments after both regulations go into effect. However, between 2014 and 2019, DOE agrees with NEEA that EPA SNAP and the pending compliance date of DOE's amended standards adopted herein may actually act to increase shipments in the near term, as BVM owners opt to replace aging equipment in advance of the required design changes that will occur in 2019. DOE expects that some customers may act in anticipation of the likely increase in equipment prices that may occur as a result of the design changes necessary to comply with EPA SNAP regulations and DOE's new and amended energy conservation standards.

DOE also notes that many beverage vending machines that were refurbished beginning in 2009 to increase their life will be 4.5 years older, the typical average "refurbishment" cycle, and the additional retirement of those older refurbished machines may increase the number of retirements beginning in 2014 and thus, may also increase shipments from 2014 through 2024. However, DOE also acknowledges that BVM owners may also choose to refurbish existing equipment prior to the EPA SNAP compliance date and assumes that a significant amount of refurbishments will occur through 2024. Notably, DOE's shipments model assumes that greater than 50 percent of equipment that would otherwise reach the end of its life and be retired will instead be refurbished, delaying purchases of new equipment, until after 2024. DOE believes this assumption effectively captures the likely behavior of customers who may choose to refurbish existing R-134a equipment in anticipation of new R-134a equipment no longer being available following the compliance date of the EPA SNAP regulations.

In 2019, when EPA's SNAP regulations are anticipated to take effect, DOE estimated that shipments will decline dramatically to 2014 levels, which represents the lowest annual shipments in any year from 1998 through the end of the analysis period. In the succeeding three years, consistent with manufacturer expectations, DOE believes that BVM shipments will stagnate while manufacturers, customers, and the market respond and acclimate to the new EPA SNAP regulations and their effect on equipment availability and price. In 2022, DOE anticipates that shipments will increase, beginning to recover the aging and depleted BVM stock. DOE notes that, based on DOE's assumptions regarding the choice of customers to refurbish or delay purchases of new BVM equipment in response to the increased cost of BVM units that are compliant with EPA SNAP and DOE's new and amended standards, the BVM shipments model estimates that the BVM stock in 2022 will have decreased 46 percent compared to the existing stock in 2014. DOE believes that, by this time, customers and the marketplace will have adapted to the new alternative refrigerants and, thus, will begin to return to typical purchasing and refurbishment cycles. Therefore, to replace retiring units, DOE's final rule shipments model assumes increases in shipments through 2035, with the most significant growth occurring between 2022 and 2028.

Beyond 2035, DOE estimates that growth in shipments will slowly decline as shipments return to a more consistent, static-lifetime "replacement" scenario as older equipment permanently leaves the market. DOE estimates shipments will remain flat from 2045 through the end of the analysis period at around 135,000 units per year, resulting in a final stock of 1.8 million in 2048, as projected by DOE based on the Vending Times data. This represents a 20-percent decrease from 2014 levels, primarily due to replacement by bottle coolers and micromarkets,[45] which is consistent with SVA's comment that micromarkets will continue to displace beverage vending machines and have an increasingly negative impact on shipments.

DOE notes that it does not expect the specific refrigerant used in a given beverage vending machine to impact demand for beverage vending machines and overall equipment stocks over time. As such, DOE maintains that the historical Vending Times data and stock-based analysis approach that DOE employed to develop shipment assumptions for this final rule are appropriate and represent the best available information about future shipments of beverage vending machines.

DOE believes it is reasonable to model increasing shipments between 2022 and 2035 to recover BVM stock in the United States, given the commitment by major bottlers to alternative refrigerants.[46] DOE notes that major bottlers represent approximately 90 percent of the BVM market[47] and, as such, anticipates consistent or increasing demand for alternative refrigerant BVM units over time. DOE notes that increasing shipments to

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[45] The term bottle cooler refers to a specific type of self-contained commercial refrigerator with transparent doors designed for pull-down applications. Such equipment is specifically defined as a "commercial refrigerator designed for pull-down applications" at 10 CFR 431.62. Micromarkets are small, self-service, convenience store-like establishments and typically feature a bottle cooler for selling bottled and canned beverages, among other snacks, which are paid for at a central payment kiosk. See www.vending.org/images/pdfs/micro-market/Tech_W7_bulletin_Micro_Market_v4.0.pdf.

[46] See e.g., R744, "Coca-Cola to approve 9 models of CO2 vending machine – exclusive interview," Available online www.r744.com/news/view/3466; The Coca-Cola Company (2014), "2013/2014 Global Reporting Initiative Report." Available online http://assets.coca-colacompany.com/1a/e5/20840408404b9bc484ebc58d536c/2013-2014-coca-cola-sustainability-report-pdf.pdf; and PepsiCo (2015). "Performance with Purpose." 2015 Atmosphere Conference.

[47] Northwest Power and Conservation Council Regional Technical Forum. 2007. Characterization of Energy Efficiency Opportunities in Vending Machines for the Northwestern US Market. Available at http://rtf.nwcouncil.org//meetings/2007/08/RTF%20Vending%20Characterization%20Study_Revised%20Report_072407.pdf.

maintain reasonable stock[48] and availability of BVM units in the marketplace is also consistent with the opinions of NAMA and the EEA Joint Commenters regarding the availability of healthy options in BVM merchandise and, thus, continued relevance of beverage vending machines in all industry sectors, including schools, office buildings, and other public locations.

In response to the specific comments received from NAMA and the EEA Joint Commenters, DOE has reviewed its assumptions regarding the rationale for certain reductions in different market segments. DOE agrees with commenters that the types of vended products available in beverage vending machines are not limited to soda or other sugary beverages and that sales of water, energy drinks, and sports drinks have been increasing over the past several years.[49] However, DOE also acknowledges that the increasing trend of micromarkets to replace beverage vending machines in some applications and notes that Vending Times reports that installations of such micromarkets nearly doubled between 2012 and 2013 and anticipates similar growth between 2013 and 2014.[50] As such, DOE believes that its projected reductions in certain BVM industry sectors to be reasonable, but more likely driven by replacement by mircomarkets than any health food trends or soda bans. In addition, DOE notes that these industry-segment-specific declines are primarily illustrative and serve only to support the overall 0.55

[48] As noted in the 2015 BVM ECS NOPR, DOE assumed an average 0.55-percent reduction in BVM stock overtime, based on projected data from Vending Times Census of the Industry 2014 and CBECS building growth trends. DOE believes that further reductions in BVM stock would represent a dramatic shift in the availability of BVM units in the United States and, thus, purchasing trends of consumers who currently purchase a variety of snacks and beverages from such vending machines. See chapter 10 of the final rule TSD for more information.
[49] Vending Times Census of the Industry 2013 and 2014. Available at www.vendingtimes.com.
[50] Vending Times Census of the Industry 2014. Available at www.vendingtimes.com.

percent annual reduction in stock modeled for the industry as a whole. DOE believes that this overall trend in BVM stock continues to be valid, as supported by comments from manufacturers anticipating continuing declines in BVM stock and shipments.

For more information on DOE's shipments estimates, the shipments analysis assumptions, and details on the calculation methodology, refer to chapter 9 of the final rule TSD.

1. Market Share by Equipment Class

Given a total volume of shipments, DOE estimates the shipments of each equipment class based on the estimated market share of each equipment class. In the 2015 BVM ECS NOPR, DOE assumed the market share assigned to each of the equipment classes shown in Table IV.6.

Table IV.6 Market Share of Each Equipment Class Assumed in NOPR Analysis.

Equipment Class	NOPR Market Share
Class A	54.3%
Class B	27.7%
Combination A	9.3%
Combination B	8.7%

In the NOPR analysis, DOE assumed that the market share for each equipment class was maintained over the 30-year analysis period and did not change as a function of standard level or as a function of changes in refrigerant availability resulting from the two recent EPA SNAP rulemakings. 80 FR 19454, 19491 (April 10, 2015) and 80 FR 42870, 42917–42920 (July 20, 2015). That is, in 2048, Class A, Class B, Combination A, and Combination B continued to represent 54.3, 27.7, 9.3, and 8.7 percent of the market, respectively. DOE made this assumption because it does not have data or information to suggest that the relative shipments of different equipment classes will change over time and, if so, in what direction and on what basis. 80 FR 50462, 50494−50495 (Aug. 19, 2015).

DOE did not receive any comments in response to the NOPR on these market distributions and, as such, is maintaining the market share distribution modeled in the NOPR in the shipments model for this final rule.

2. Market Share by Refrigerant

Once DOE has defined shipments by equipment class, DOE also defined the shipments within each equipment class by refrigerant. In the 2015 BVM ECS NOPR, DOE based its assumptions regarding the relative shipments of each refrigerant based on recent regulatory actions under EPA's SNAP program, which listed propane and certain other hydrocarbon refrigerants as acceptable for BVM applications (80 FR 19454, 19491 (April 10, 2015)) and changed the status of the industry-standard refrigerant R-134a to unacceptable beginning on January 1, 2019 (80 FR 42870, 42917–42920 (July 20, 2015)). Specifically, in the NOPR, DOE modeled a shipments scenario assuming that all shipments of new BVM equipment will use CO_2 or propane as a refrigerant beginning on January 1, 2019, the effective date of the status change of R-134a as required by Final Rule 20. 80 FR 50462, 50495 (Aug. 19, 2015).

Given the greater market experience with CO_2, DOE assumed that CO_2 will represent 60 percent of the market and propane will represent 40 percent of the market for all equipment classes beginning in 2019 and continuing through the end of the analysis period (2048). Specifically, due to the listing of CO_2 as an acceptable refrigerant for BVM applications several years ago by EPA SNAP, as well as a commitment by Coca-Cola (the largest equipment purchaser) to move away from HFC refrigerants in the near future, the market has already seen evolution towards the widespread use of CO_2. Id.

However, DOE acknowledges that propane-based BVM models have only very recently become authorized under SNAP and that there is much more limited industry experience with this refrigerant. DOE has based this final rule analysis on the use of propane as an alternative refrigerant, in addition to CO_2, and assumed that propane-based BVM models will represent 40 percent of shipments by 2019. As mentioned in the engineering analysis, DOE believes this assumption is reasonable based on use of propane as a refrigerant in other, similar, self-contained commercial refrigeration applications.[51] Id.

In its written comments, SVA stated that the relative market share of each refrigerant by equipment class depended heavily on the ability of manufacturers to develop economically sound equipment that meets UL standards for flammable refrigerants. (SVA, No. 53 at p. 9) In the BVM ECS NOPR public meeting, Coca-Cola

[51] See e.g., Docket No. EPA-HQ-OAR-2014-0198, The Environmental Investigation Agency, No. 0134.

stated that its refrigerant preference for the North American market is CO_2 and noted that Japan (another large vending market) is already using CO_2. Also in the public meeting, SVA expressed commitment to CO_2 but also stated it was beginning to explore propane, and Wittern stated that it was pursuing propane over CO_2 due to the higher operating pressures of CO_2 refrigeration systems, which labor the compressors and decrease efficiency. (Coca-Cola, SVA, and Wittern, Public Meeting Transcript, No. 48 at pp. 48–55)

In response to comments submitted by interested parties, DOE reviewed its assumptions regarding the relative distribution of shipments of CO_2 and propane BVM equipment. DOE believes that its 2015 BVM ECS NOPR assumptions regarding the increased market share of CO_2 equipment relative to propane equipment are consistent with the statements made by commenters regarding the existing use and preference for CO_2 equipment, as well as the additional safety certifications that will be necessary for propane equipment. Specifically, DOE accounted for the fact that beverage vending machines with propane refrigerant must meet all requirements of Supplement SA to the 7th edition of UL Standard 541, ‘‘Refrigerated Vending Machines,’’ dated December 30, 201, which specifically addresses flammable refrigerants in vending machines, as required by EPA SNAP’s Rule 19 final rule. 80 FR 19454, 19460 (April 10, 2015). However, consistent with Wittern’s observation regarding the relative efficiency of propane as a refrigerant compared to CO_2, DOE believes it is reasonable to assume that propane will gain a significant market share by 2019 as some manufacturers elect to take advantage of propane’s increased efficiency as a refrigerant in BVM applications. In summary, DOE appreciates comments from interested parties and believes they are generally consistent with DOE's assumptions in the NOPR. As such, DOE is maintaining the distribution of shipments by refrigerant modeled in the NOPR with no modification.

DOE's shipments analysis and assumptions are discussed in more detail in chapter 9 of the final rule TSD.

3. High and Low Shipments Assumptions

DOE recognizes that there is considerable uncertainty in forecasting future shipments of beverage vending machines. As such, in addition to the primary shipments scenario presented above, DOE estimated low and high shipments scenarios as sensitivities on the primary scenario. For the high and low shipments scenarios, DOE assumed the market share by equipment class and refrigerant as in the default shipments scenario, while the magnitude of total shipments of new beverage vending machines is varied among the scenarios. DOE's low shipments scenario modeled lower shipments from 2014 through 2019 than DOE estimated in the NOPR to reflect comments that the increased cost of equipment (due to both EPA SNAP requirements and DOE's proposed standards) would cause a decrease in new machine purchases in favor of refurbishments. In 2019, when EPA's SNAP regulations will take effect, DOE estimated that shipments would return to 2014 levels, before beginning to recover in 2022 at the reduced growth rate, reflecting the potential increased refurbishment cycles and commensurate increased lifetime for existing BVM equipment. DOE also assumed that BVM shipments recover only to approximately 100,000 shipments per year and result in a stock of 1.3 million at the end of the analysis period, a 40-percent reduction in units installed in the United States. DOE notes that this stock reduction is consistent with the projected stock based on the Vending Times data of a 2 percent annual reduction over the analysis period,[52] without adjusting for the growth in buildings over the analysis period calculated based on CBECS.

Conversely, the high shipments scenario assumes the same overall decline in stock assumed in the primary shipment case; that is, a stock of 1.8 million BVM units in 2048. However, the high shipments scenario assumes that shipments recover more quickly than in the primary shipments case. The high shipments scenario assumes shipments of new beverage vending machines increase in advance of SNAP, consistent with the default shipments scenario, as BVM customers act preemptively to purchase remaining R-134a equipment before it is no longer allowed beginning in 2019. Then, following 2019, the high shipments scenario assumes that shipments stagnate before growing rapidly again beginning in 2022 to recover over the next 5 years. DOE believes this scenario represents the case where shipments of BVM units increase over time based on the increased offerings of healthy options in beverage vending machines and demand from bottlers for such alternative refrigerant BVM units, consistent with comments by NAMA and Coca-Cola, respectively. These two sensitivity scenarios are discussed in more detail in chapter 9 of the final rule TSD.

[52] Vending Times Census of the Industry 2013 and 2014. Available at www.vendingtimes.com.

H. National Impact Analysis

The NIA assesses the NES and the national NPV from a perspective of total customer costs and savings that would be expected to result from new or amended standards at specific efficiency levels (i.e., TSL) for each equipment class of beverage vending machines.[53] ("Customer" in this context refers to customers of the equipment being regulated, in this case the purchaser of the BVM) DOE calculated the NES and NPV based on projections of annual shipments, along with the annual energy consumption and total installed cost data from the energy use and LCC analyses.[54] For the present analysis, DOE projected the energy savings, operating cost savings, equipment costs, and NPV of customer benefits for equipment sold from 2019 through 2048 (the expected year in which the last standards-compliant equipment is shipped during the 30-year analysis).

DOE evaluates the impacts of new and amended standards by comparing a no-new-standards case projections with the standards case projections. The no-new-standards case characterizes energy use and customer costs for each equipment class in the absence of new or amended energy conservation standards. For this projection, DOE considered historical trends in efficiency and various forces that are likely to affect the mix of efficiencies over time. DOE compared the no-new-standards case with projections characterizing the market for each equipment class if DOE adopted new or amended standards at specific energy efficiency levels (i.e., the TSLs or standards cases)

[53] The NIA accounts for impacts in the 50 states and U.S. territories.
54 For the NIA, DOE adjusts the installed cost data from the LCC analysis to exclude sales tax, which is a transfer.

for that class. For the standards cases, DOE considers how a given standard would likely affect the market shares of equipment with efficiencies less than the standard.

DOE used a spreadsheet model to calculate the energy savings and the national customer costs and savings from each TSL. Interested parties can review DOE's analyses by changing various input quantities within the spreadsheet. The NIA spreadsheet model uses average values as inputs (rather than probability distributions of key input parameters as used in the LCC). To assess the effect of input uncertainty on NES and NPV results, DOE developed its spreadsheet model to conduct sensitivity analyses by running scenarios on specific input variables.

For the current analysis, the NIA used projections of energy price trends from the AEO2015 Reference case. In addition, DOE analyzed scenarios that used inputs from the AEO2015 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 appendix 10E 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.

Table IV.7 summarizes the inputs and methods DOE used for the NIA analysis for the final rule. Discussion of these inputs and methods appears following Table IV.7. See chapter 10 of the final rule TSD for further details.

Table IV.7 Summary of Inputs and Methods for the National Impact Analysis

Inputs	Method
Shipments	Annual shipments from shipments model.
Compliance Date of Standard	2019.
Efficiency Trends	No-new-standards case: Standards cases:
Annual Energy Consumption per Unit	Annual weighted-average values are a function of energy use at each TSL.
Total Cost per Unit	Annual weighted-average values are a function of cost at each TSL. Incorporates projection of future equipment prices based on historical data.
Annual Energy Cost per Unit	Annual weighted-average values as a function of the annual energy consumption per unit and energy prices.
Repair and Maintenance Cost per Unit	Repair cost and maintenance costs provided from LCC analysis.
Energy Prices	AEO2015 forecasts (to 2040) and extrapolation through 2078.
Energy Site-to-Primary and FFC Conversion	A time-series conversion factor based on AEO2015.
Discount Rate	3% and 7%.
Present Year	2015.
Price Learning	Projection of future price trends for BVM equipment.
Lifetime	Weibull distribution for equipment lifetime.

1. Equipment Efficiency Trends

A key component of the NIA is the trend in energy efficiency projected for the no-new-standards case and each of the standards cases. Section IV.F.6 of this final rule describes how DOE developed an energy efficiency distribution for the no-new-standards case (which yields a shipment-weighted average efficiency) for each of the considered equipment classes for the first year of the forecast period.

DOE developed a distribution of efficiencies in the no-new-standards case for the compliance year of new standards for each BVM equipment class. Because no information was available to suggest a different trend, DOE assumed that the efficiency distribution in the no-new-standards case will remain the same in future years. In each standards case, a “roll-up” scenario approach was applied to establish the efficiency distribution for the compliance year. Under the “roll-up” scenario, DOE assumed: (1) equipment efficiencies in the no-new-standards case that do not meet the standard level under consideration will “roll-up” to meet the new standard level; and (2) equipment efficiencies above the standard level under consideration will not be affected. The “roll-up” was a more conservative approach over the “market shift” approach. In a market shift approach it is assumed that a given number of customers will prefer to buy equipment above the baseline. Therefore, in a standards case scenario customers will continue to purchase above the new baseline by shifting to an efficiency level that keeps their purchase the same number of efficiency levels above the new baseline until they no longer can do so because the market becomes compressed by the maximum available efficiency level.

DOE also recognizes that recent changes in refrigerant availability resulting from the two recent EPA SNAP rulemakings may have an impact on forecasted efficiency distributions under the no-new-standards case. 80 FR 19454, 19491 (April 10, 2015) and 80 FR 42870, 42917–42920 (July 20, 2015). However, DOE did not account for such potential impacts on efficiency distributions in this final rule analysis, as DOE does not have data or information to suggest how efficiency distributions of different equipment classes or refrigerants will change over time and, if so, in what direction and on what basis as a result of potential changes.

2. National Energy Savings

The inputs for determining the NES are (1) annual energy consumption per unit, (2) shipments, (3) equipment stock, (4) national energy consumption, and (5) site-to-source conversion factors. As discussed in the energy use analysis, DOE calculated the national energy consumption by multiplying the number of units (stock) of each type of equipment (by vintage or age) by the unit energy consumption (also by vintage). Vintage represents the age of the equipment.

DOE calculated annual NES based on the difference in national energy consumption for the no-new-standards case (without new efficiency standards) and for each higher efficiency standard.[55] Cumulative energy savings are the sum of the annual NES over the period in which equipment shipped in 2019–2048 are in operation.

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

[55] The no-new-standards case represents a mix of efficiencies above the minimum efficiency level (EL 0). Please see section IV.F.6 for a more detail description of associated assumptions.

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 AEO2015 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 from the compliance year plus the life of equipment).

a. Full-Fuel-Cycle Analysis

DOE has historically presented NES in terms of primary energy savings. On August 18, 2011, DOE published a final statement of policy in the Federal Register announcing its intention to use FFC measures of energy use and greenhouse gas and other emissions in the NIA and emissions analyses included in future energy conservation standards rulemakings. 76 FR 51281. While DOE stated in that document that it intended to use the Greenhouse Gases, Regulated Emissions, and Energy Use in Transportation (GREET) model to conduct the analysis, it also said it would review alternative methods, including the use of NEMS. After evaluating both models and the approaches discussed in the August 18, 2011 document, DOE published an amended statement of policy, articulating its determination that NEMS is a more appropriate tool for this purpose. 77 FR 49701 (August 17, 2012).

The approach used for this final rule, and the FFC multipliers that were applied, are described in appendix 10D of the TSD. NES results are presented in terms of both primary and FFC savings; the savings by TSL are summarized in terms of FFC savings in section I.C of this final rule.

3. Net Present Value Analysis

The inputs for determining NPV are: (1) total annual equipment cost, (2) total annual savings in operating costs, (3) a discount factor to calculate the present value of costs and savings, (4) present value of costs, and (5) present value of savings. DOE calculated the net savings for each year as the difference between the no-new-standards case and each standards case in terms of total savings in operating costs versus total increases in equipment costs. DOE calculated savings over the lifetime of equipment shipped in the forecast period. DOE calculated NPV as the difference between the present value of operating cost savings and the present value of total equipment costs.

For the NPV analysis, DOE calculates increases in total equipment costs as the difference in total equipment cost between the no-new-standards case and standards case (i.e., once the standards take effect). Because the more-efficient equipment bought in the standards case usually costs more than equipment bought in the no-new-standards case, cost increases appear as negative values in calculating the NPV.

DOE expresses savings in operating costs as decreases associated with the lower energy consumption of equipment bought in the standards case compared to the no-new-standards case. Total savings in operating costs are the product of savings per unit and the number of units of each vintage that survive in a given year.

DOE multiplied monetary values in future years by the discount factor to determine the present value of costs and savings. DOE estimates the NPV of customer benefits using 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. DOE used these discount rates in accordance with guidance provided by the U.S. Office of Management and Budget (OMB) to Federal agencies on the development of regulatory analysis. (OMB Circular A-4 (Sept. 17, 2003), section E, "Identifying and Measuring Benefits and Costs") The 7-percent real value is an estimate of the average before-tax rate of return to private capital in the U.S. economy. The 3-percent real value represents the "societal rate of time preference," which is the rate at which society discounts future consumption flows to their present.

I. Customer Subgroup Analysis

In analyzing the impact of new or amended standards on commercial customers, DOE evaluated the impact on identifiable groups (i.e., subgroups) of customers, such as different types of businesses that may be disproportionately affected by a national standard. The purpose of the subgroup analysis is to determine the extent of this disproportional impact. In comparing potential impacts on the different customer subgroups, DOE may evaluate variations in regional electricity prices, energy use profiles, and purchase prices that might affect the LCC of an energy conservation standard to certain customer subgroups. For this rulemaking, DOE identified manufacturing and/or industrial facilities that purchase their own beverage vending machines as a relevant subgroup. These facilities typically have higher discount rates and lower electricity prices than the general population of BVM customers. These two conditions make it likely that this subgroup will have the lowest LCC savings of any major customer subgroup.

Two stakeholders commented on the 2015 BVM ECS NOPR subgroup analysis. AMS commented that because those who purchase the machines do not usually pay for electricity, PBP numbers for subgroup "do not really exist" (i.e., energy savings are only realized by site owners). (AMS, No. 57 at Page 6) NAMA suggested that subgroups might include vending machine operating companies because "most corporate and manufacturing facilities provide vending machines to their employees through vending machine companies." (NAMA, No. 50 at p. 12)

In response to the comment from AMS, DOE notes that the money saved by more efficient equipment through lower operating costs is accounted for in the split incentives approach. DOE believes that the subgroup to which NAMA refers can be represented by the manufacturing and/or industrial facilities that purchase their own beverage vending machines because each group would likely have lower electricity prices and higher discount rates than the typical customer.

DOE determined the impact on this BVM customer subgroup using the LCC spreadsheet model. DOE conducted the LCC and PBP analysis for customers represented by the subgroup. The results of DOE's LCC subgroup analysis are summarized in section V.B.1.b of this final rule and described in detail in chapter 12 of the final rule TSD.

J. Manufacturer Impact Analysis

1. Overview

DOE performed a MIA to determine the financial impact of amended energy conservation standards on manufacturers of beverage vending machines, and to estimate the potential impact of such standards on employment and manufacturing capacity. The MIA has both quantitative and qualitative aspects. 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 are data on the industry cost structure, equipment costs, shipments, and assumptions about markups and conversion expenditures. The key output is the INPV. Different sets of assumptions (i.e., markup and shipments scenarios) will produce different results. The qualitative part of the MIA addresses factors such as equipment characteristics, impacts on particular subgroups of firms, and important market and equipment trends. 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 conducted structured, detailed interviews with manufacturers and prepared a profile of the BVM industry. During manufacturer interviews, DOE discussed engineering, manufacturing, procurement, and financial topics to identify concerns and to inform and validate assumptions used in the GRIM. See appendix 12A of the TSD for a copy of the interview guide.

DOE used information obtained during these interviews to prepare a profile of the BVM industry. Drawing on financial analysis performed as part of the 2009 energy conservation standard for beverage vending machines, as well as feedback obtained from manufacturers, DOE derived financial inputs for the GRIM (e.g., sales, general, and administration (SG&A) expenses; research and development (R&D) expenses; and tax rates). DOE also used public sources of information, including company SEC 10-K filings,[56] corporate annual reports, the U.S. Census Bureau's Economic Census,[57] and Hoover's reports,[58] to develop the industry profile.

In Phase 2 of the MIA, DOE prepared an industry cash-flow analysis to quantify the potential impacts of an amended energy conservation standard on manufacturers of beverage vending machines. 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

[56] U.S. Securities and Exchange Commission. Annual 10-K Reports. Various Years. http://sec.gov.
[57] 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.
[58] Hoovers Inc. Company Profiles. Various Companies. www.hoovers.com.

possible changes in sales volumes. To quantify these impacts, DOE used the GRIM to perform a cash-flow analysis for the BVM industry using financial values derived during Phase 1.

In Phase 3 of the MIA, DOE evaluated subgroups of manufacturers that may be disproportionately impacted by amended energy conservation standards or that may not be represented accurately by the average cost assumptions used to develop the industry cash-flow analysis. For example, small manufacturers, niche players, or manufacturers exhibiting a cost structure that largely differs from the industry average could be more negatively affected. DOE identified one subgroup for a separate impact analysis, small businesses.

DOE identified eight companies that sell BVM equipment in the United States. For the small businesses subgroup analysis, DOE applied the small business size standards published by the Small Business Administration (SBA) to determine whether a company is considered a small business. 65 FR 30836, 30848 (May 15, 2000), as amended at 65 FR 53533, 53544 (Sept. 5, 2000) and codified at 13 CFR part 121. To be categorized as a small business under North American Industry Classification System (NAICS) code 333318, "Other Commercial and Service Industry Machinery Manufacturing," a BVM manufacturer and its affiliates may employ a maximum of 1,000 employees. The 1,000-employee threshold includes all employees in a business's parent company and any other subsidiaries. Based on this classification, of the eight companies selling beverage vending machines in the United States, DOE identified five manufacturers that qualify as small businesses, one of which is a foreign manufacturer with domestic-sited subsidiary that serves as its marketing arm in the United States. The BVM small manufacturer subgroup is discussed in chapter 12 of the final rule TSD and in section IV.J of this final rule.

Additionally, in Phase 3 of the MIA, DOE evaluated impacts of amended energy conservation standards on manufacturing capacity and direct employment. DOE also evaluated cumulative regulatory burdens affecting the BVM industry.

2. Government Regulatory Impact Model

DOE uses the GRIM to quantify the changes in cash flow due to new standards that result in a higher or lower industry value. The GRIM analysis uses a standard, annual cash-flow analysis that incorporates manufacturer costs, markups, shipments, and industry financial information as inputs. The GRIM models changes in costs, distribution of shipments, investments, and manufacturer margins that could result from an amended energy conservation standard. The GRIM spreadsheet uses the inputs to arrive at a series of annual cash flows, beginning in 2015 (the reference year of the analysis) and continuing to 2048. DOE calculated INPVs by summing the stream of annual discounted cash flows during this period. For BVM manufacturers, DOE used a real discount rate of 8.5 percent, which was derived from industry financials and then modified according to feedback received during manufacturer interviews.

The GRIM calculates cash flows using standard accounting principles and compares changes in INPV between a no-new-standards case and each standards case. The difference in INPV between the no-new-standards case and a standards case represents the financial impact of the amended energy conservation standard on manufacturers. As discussed previously, DOE collected this information on the critical GRIM inputs from a number of sources, including publicly available data and interviews with a number of manufacturers. The GRIM results are shown in section IV.J.2.b of this final rule. Additional details about the GRIM, the discount rate, and other financial parameters can be found in chapter 12 of the final rule TSD.

a. Government Regulatory Impact Model Key Inputs

Manufacturer Production Costs

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

In the MIA, DOE used the MPCs for each considered efficiency level calculated in the engineering analysis, as described in section IV.C of this final rule and further detailed in chapter 5 of the final rule TSD. In addition, DOE used information from its teardown analysis, described in chapter 5 of the TSD, to disaggregate the MPCs into material, labor, and overhead costs. To calculate the MPCs for equipment above the baseline, DOE added the incremental material, labor, and overhead costs from the engineering cost-efficiency curves to the baseline MPCs. These cost breakdowns and equipment markups were validated and revised with manufacturers during manufacturer interviews. DOE notes that, since all BVM equipment will be required to be compliant with EPA's new Rule 20 regulations prohibiting the use of R-134a after January 1, 2019 (80 FR 42870, 42917–42920 (July 20, 2015)), the MPCs modeled in the GRIM represent equipment that is compliant with Rule 20 (i.e., uses only CO_2 and propane refrigerants), as well as any existing energy conservation standards for such equipment.

Shipments Forecasts

The GRIM estimates manufacturer revenues based on total unit shipment forecasts by equipment class and the distribution of these values by efficiency level. Changes in sales volumes and efficiency mix over time can significantly affect manufacturer finances. For this analysis, the GRIM uses the NIA's annual shipment forecasts derived from the shipments analysis. See section IV.H of this final rule and chapter 10 of the final rule TSD for additional details.

Product and Capital Conversion Costs Associated with Energy Conservation Standards for Beverage Vending Machines

An amended energy conservation standard will cause manufacturers to incur one-time conversion costs to bring their production facilities and product designs into compliance. DOE evaluated the level of conversion-related expenditures that will be needed to comply with each considered efficiency level in each equipment class. For the

MIA, DOE classified these conversion costs into two major groups: (1) product conversion costs and (2) capital conversion costs. Product conversion costs are one-time investments in research, development, testing, marketing, and other non-capitalized costs necessary to make product designs comply with the amended energy conservation standard. Capital conversion costs are one-time investments in property, plant, and equipment necessary to adapt or change existing production facilities such that new compliant equipment designs can be fabricated and assembled.

Industry investments related to compliance with EPA Rule 20 are detailed in the next section ("One-Time Investments Associated with EPA SNAP Rule 20") and are separate from the conversion costs manufacturers are estimated to incur to comply with amended energy conservation standards.

To evaluate the level of capital conversion expenditures manufacturers will likely incur to comply with amended energy conservation standards, DOE used manufacturer interview feedback to determine an average per-manufacturer capital conversion cost for each design option and equipment class. DOE scaled the per-manufacturer capital conversion costs to the industry level using a count of manufacturers producing the given equipment type (i.e., Class A, Class B, Combination A, Combination B).

As detailed in section IV.G of this final rule, shipments of BVM units with HFC refrigerants are forecasted to fall to zero by 2019 as a result of the EPA SNAP Rule 20 compliance date of 2019. Therefore, DOE estimates no conversion costs associated with the remaining shipments of BVM units with HFC refrigerants that are forecasted to occur during the conversion period (the 3 years leading up to the amended energy conservation standard year of 2019).

Table IV.8 contains the per-manufacturer capital conversion costs associated with key design options for each equipment class. DOE assumes that all Combination A units share a common cabinet and glass pack design with a Class A unit, and will not carry any additional capital conversion costs.

Table IV.8 Per-Manufacturer Capital Conversion Costs for Key Design Options (million 2014$)

Design Option	Capital Conversion Costs million 2014$			
	Class A	**Class B**	**Combination A**	**Combination B**
Evaporator Fan Controls	N/A*	0.04	0	0.04
1.125 Inch Thick Insulation	0.07	0.09	0	0.09
Enhanced Glass Pack	0.06	N/A*	0	N/A*
Vacuum Insulated Panels	0.14	0.17	0	0.18

* N/A = Not Applicable

DOE used a top-down approach that relied on manufacturer feedback from interviews to assess product conversion costs for the BVM industry. Using the DOE's CCMS[59] and ENERGY STAR[60] databases, along with manufacturer websites, DOE determined the number of platforms that are currently available for each equipment type (i.e., Class A, Class B, Combination A, Combination B). DOE used manufacturer feedback to determine an average per platform product conversion cost by design option

[59] "CCMS." CCMS. January 19, 2015. Accessed January 19, 2015. www.regulations.doe.gov/certification-data/.
[60] ENERGY STAR Certified Vending Machines. June 6, 2013. Accessed January 19, 2015. www.energystar.gov/products/certified-products.

and equipment type. DOE then used the platform counts to scale the average per platform product conversion to the industry level. DOE received insufficient feedback from industry to estimate representative product conversion costs for Combination A and Combination B equipment. As a result, because of the inherent commonalities of design and manufacture between Class A and Combination A equipment and between Class B and Combination B equipment, DOE scaled Class A product conversion costs to estimate Combination A product conversion costs and DOE scaled Class B product conversion costs to scale Combination B product conversion costs. This scaling was based on the ratio of Combination A to Class A platforms in the industry and the ratio of Combination B to Class B platforms, respectively.

Table IV.9 contains the per-platform product conversion costs associated with key design options for each equipment class.

Table IV.9 Per-Platform Product Conversion Costs for Key Design Options (million 2014$)

Design Option	Product Conversion Costs million 2014$			
	Class A	**Class B**	**Combination A**	**Combination B**
Evaporator Fan Controls	N/A*	0.02	0.004	0.02
Enhanced Evaporator Coil	0.02	0.01	N/A*	0.01
Enhanced Glass Pack	0.06	N/A*	0.004	N/A*
1.125 Inch Thick Insulation	0.02	0.02	0.004	0.02
Vacuum Insulated Panels	0.06	0.06	0.004	0.06

* N/A = Not Applicable

DOE assumes that all energy conservation standards-related conversion costs occur between the year of publication of the final rule and the year by which manufacturers must comply with the new standard. The conversion cost figures used in the GRIM can be found in section IV.J.2.a of this final rule. For additional information on the estimated product and capital conversion costs, see chapter 12 of the final rule TSD.

One-Time Investments Associated with EPA SNAP Rule 20

As a result of EPA Rule 20, the industry will be required to make an upfront investment in order to transition from the use of R-134a to CO_2 or propane. Although this industry investment (detailed below) is not a result of the amended DOE energy conservation standards, DOE reflects the impact of this investment in both the no-new-standards and standards cases.

EPA Rule 20 did not provide an estimate of the upfront investments associated with a R-134a refrigerant phase-out for BVM manufacturers. Based on feedback in interviews, DOE estimated an upfront cost to the industry to comply with Rule 20 using refrigerants CO_2 and propane. DOE estimated that each BVM manufacturer will need to invest $750,000 to update their equipment to comply with Rule 20 if they have no compliant equipment today. DOE assumed this one-time investment applied to all eight manufacturers, resulting in an industry cost of $6 million.[61] DOE believes that this estimate falls on the high end of the range of potential costs because there are manufacturers that already have SNAP-compliant equipment on the market today, and those manufacturers will not need to make the same level of investment ahead of the 2019 effective date. For integration into the GRIM, DOE assumed that this one-time cost

[61] In the GRIM, the $6 million one-time SNAP investment would affect the industry in the no-new-standards case as well as at each TSL.

will occur in 2018 because the EPA's Rule 20 requires a phaseout of R-134a by 2019. This cost is independent of conversion costs that industry will need to make as a result of amended energy conservation standards (discussed in the previous section). Unlike product and capital conversion costs necessitated by DOE energy conservation standards, DOE includes this one-time Rule 20 investment in the GRIM in both the no-new-standards case and the standards case. Accordingly, the costs related to complying with EPA Rule 20 have been incorporated into the baseline to which DOE analyzed these adopted standards. As such, all the costs to industry that occur in the standards case relate to the impact of the adopted energy conservations standards.

b. Government Regulatory Impact Model Scenarios

Manufacturer Markup Scenarios

MSPs include direct manufacturing production costs (i.e., labor, materials, and overhead estimated in DOE's MPCs) and all non-production costs (i.e., SG&A, R&D, and interest), along with profit. To calculate the MSPs in the GRIM, DOE applied manufacturer markups to the MPCs estimated in the engineering analysis for each equipment class and efficiency level. Modifying these manufacturer markups in the standards case yields different sets of impacts on manufacturers. For the MIA, DOE modeled two standards case manufacturer 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 per-unit operating profit markup scenario. These scenarios lead to different manufacturer markup values that, when applied to the inputted 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 (for a given equipment class), which assumes that manufacturers will be able to maintain the same amount of profit as a percentage of revenues at all efficiency levels within an equipment class. 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 beverage vending machines as well as comments from manufacturer interviews, DOE assumed the average manufacturer markups to vary by equipment class as shown in Table IV.10.

Table IV.10 Baseline Manufacturer Markups

Equipment Class	Markup
Class A	1.22
Class B	1.17
Combination A	1.36
Combination B	1.36

Because this manufacturer markup scenario assumes that manufacturers will be able to maintain their gross margin percentage markups as production costs increase in response to an amended energy conservation standard, it represents a high bound to industry profitability.

In the preservation of per-unit operating profits scenario, manufacturer markups are calibrated such that the per-unit operating profit in the year after the compliance date of the amended energy conservation standard is the same as in the no-new-standards case for each equipment class. Under this scenario, as the cost of production goes up, manufacturers are generally required to reduce the markups on their minimally compliant equipment to maintain a cost-competitive offering. The implicit assumption behind this scenario is that the industry can only maintain operating profits after compliance with the amended standard is required. Therefore, gross margin (as a percentage) is reduced between the no-new-standards case and the standards case. This manufacturer markup scenario represents a low bound to industry profitability under an amended energy conservation standard.

3. Discussion of Comments

During the 2015 BVM ECS NOPR public meeting and in public comments submitted in response to the 2015 BVM ECS NOPR, manufacturers, trade organizations, and SBA Advocacy provided several comments on the potential impact of amended energy conservation standards on manufacturers. These comments are outlined below. DOE notes that these comments helped to update the analysis reflected in this final rule.

Relating to DOE's 2015 BVM ECS NOPR estimates of industry conversion costs associated with compliance with amended energy conservation standards, Seaga commented that DOE is underestimating industry conversion costs because different bottlers may want different refrigerants. (Seaga, No. 48 at p. 177)

As part of the manufacturer impact analysis, DOE evaluated the level of energy conservation standards-related expenditures that will be needed to comply with each considered efficiency level in each equipment class. DOE notes that these conversion costs are based on manufacturer feedback on costs associated with individual design options, which are common to both CO_2 and propane machines. These individual design option costs were scaled to reflect industry conversion costs per design option and equipment type (ie., Class A, Class B, Combination A, Combination B) using the count of manufacturers currently producing beverage vending machines of each equipment type and the count of current platforms of each equipment type. These industry conversion cost estimates were then allocated by refrigerant using assumptions developed in the Shipments Analysis related to the distribution of refrigerants in the BVM industry by 2019 (see section IV.G.2 for a description of DOE's methodology for forecasting future BVM shipments by refrigerant type). As DOE's shipments forecasts by refrigerant assume a significant market share for both CO_2 and propane equipment, DOE accounts for manufacturers' decisions to produce beverage vending machines using both CO_2 and propane in its estimates of industry conversion costs.

In response to the 2015 BVM ECS NOPR, AMS expressed concern relating to the fact that EPA's enforcement of SNAP includes remanufactured equipment, in addition to new refrigerated beverage vending machines, while DOE energy conservation standards apply only to new machines. AMS believes this inconsistency will contribute to the cumulative regulatory burdens faced by BVM manufacturers. (AMS, No.48 at p. 137) Additionally, NAMA stated that compliance with both EPA SNAP rule 20 and proposed rule would be very costly to the industry. (NAMA, No. 50 at p. 13) The Form Letter Writers stated the standards were not technologically feasible or economically justified because of the burden on small businesses who also have to meet new EPA mandates as well as new DOE testing procedures (The Form Letter Writers, No. 64 and 65 at p. 1)

DOE recognizes that EPA regulations that restrict the use of HFC refrigerants will lead to changes in production costs for BVM manufacturers, necessitate investments, and will, accordingly, contribute to the cumulative regulatory burdens incurred by manufacturers as a result of amended DOE energy conservation standards. DOE notes that although EPA SNAP Rule 20 lists certain refrigerants as unacceptable in refurbished machines as of July 20, 2016, R-134a is not among the unacceptable refrigerants. Therefore, because manufacturers are currently capable of producing beverage vending machines with R-134a, DOE believes that the cumulative regulatory burdens associated with EPA's enforcement of SNAP on refurbished beverage vending machines will be minimal, on both large and small manufacturers. Moreover, DOE's statutory authority to prescribe new and amended energy conservation standards only applies to the point of manufacture, and as such, DOE does not have the authority to extend such standards to refurbished equipment.

DOE accounted for the forthcoming R-134a phase out by estimating refrigerant-specific design pathways, cost efficiency curves and the upfront investments needed to adapt equipment, production lines, and facilities to the use of propane and CO_2. DOE used a value of $750,000 per manufacturer to account for capital expenditures as well as non-equipment costs such R&D, testing, and marketing material changes to bring BVM equipment using propane or CO_2 to market. DOE integrated this cost into both the no-new-standards and standards case estimates of INPV. See section IV.J.2.a for further detail on one-time costs associated with SNAP Rule 20 compliance. Furthermore, DOE includes the EPA's SNAP Rule 20 in its list of cumulative regulatory burdens in section V.B.2.e of this final rule. DOE also independently analyzed the impact of the adopted new and amended standards on small business in the Regulatory Flexibility Analysis, presented in section VI.B.

Also relating to cumulative regulatory burdens, Royal Vendors commented that the vending industry has experienced numerous regulatory and economic challenges in the past 5–10 years and that DOE's proposed standards would cause undue hardship on the vending industry. (Royal Vendors, No. 54 at p. 2)

In response to stakeholder feedback relating to the 2015 BVM ECS NOPR, DOE has updated its engineering analysis and standard efficiency levels for this final rule, resulting in less burdensome standard levels for all product classes of beverage vending machines relative to the 2015 BVM ECS NOPR proposal. DOE investigates cumulative regulatory burden impacts associated with this rulemaking in more detail in section V.B.2.e of this notice, and in chapter 12 of the final TSD.

Regarding the impacts of the standard levels proposed in the 2015 BVM ECS NOPR on small domestic BVM manufacturers, Seaga noted that the proposed standards would make it difficult for small manufacturers to remain in the industry. (Seaga, No. 48 at p. 177) Similarly, AMS commented that the investments in engineering and development to meet DOE's proposed standard may require it to abandon the vending machine market. (AMS, No. 57 at p. 10) Additionally, SBA Advocacy's conversations with small businesses on their projected compliance costs [associated with the standard levels proposed in the 2015 BVM ECS NOPR] yielded estimates exceeding $1,000,000 per small manufacturer. (SBA Advocacy, No. 61 at p. 2) SBA Advocacy stated further that, to ensure that the cost implications of complying with the SNAP rule are considered in DOE's analysis, it recommends that a sensitivity analysis be done. (SBA Advocacy, No. 61 at p. 3)

DOE recognizes that small manufacturers may be disproportionately impacted by energy conservation standards relative to other manufacturers in the industry. Again, DOE notes that, in response to stakeholder feedback relating to the 2015 BVM ECS NOPR, it has updated its engineering analysis and standard efficiency levels for this final rule, resulting in less burdensome standard levels for all equipment classes of beverage vending machines relative to the 2015 BVM ECS NOPR proposal.

DOE believes that the $1,000,000 per small manufacturer compliance cost estimate cited by SBA Advocacy is inclusive of the both ECS-related conversion costs and SNAP-related upfront investments. DOE accounted for the forthcoming R-134a phaseout required by EPA SNAP by estimating refrigerant-specific design pathways, cost efficiency curves and the upfront investments needed to adapt equipment, production lines, and facilities to the use of propane and CO_2 (see section IV.C.2 for information relating to refrigerant-specific design pathways and cost efficiency curves). DOE estimated an upfront cost of $750,000 per manufacturer to comply with Rule 20 using refrigerants propane and CO_2 refrigerants (this cost is independent of product and capital conversion costs associated with DOE standards compliance), and incorporated this cost in the GRIM in both the no-new-standards case and the standards case. This allowed DOE to isolate the incremental impact of amended energy conservation standards on BVM manufacturers, while still accounting for the impact of the 2019 R-134a phaseout on the industry. See section IV.J.2 for further details on DOE's modeling of ECS-related conversion costs and SNAP-related upfront investments. Additionally, DOE's analysis of the impacts of the final rule standard levels on small manufacturers is detailed in sections V.B.2 and VI.B.

Finally, SBA commented that DOE set the baseline for Combination A and Combination B equipment classes as the least efficient combination of technologies analyzed in the engineering analysis. As a result, SBA Advocacy believes DOE could be overstating benefits at higher TSLs because the baseline represents equipment that is less efficient than actual equipment on the market and may not represent a reasonable combination of technologies. (SBA Advocacy, No. 61 at p. 2)

Since there are currently no energy-related regulatory standards for Combination A and Combination B beverage vending machines, the baseline for these equipment classes is defined as the level of efficiency representing the least-efficient technology currently found in the BVM market for each design option analyzed. Starting with the least efficient technology results in an analysis where manufacturers must incorporate more design options and accrue greater conversion costs to reach an amended standard. This approach results in estimates of manufacturer conversion costs related to ECS compliance which fall in the high end of the range of potential costs.

DOE notes that, in written comments in response to the 2015 BVM ECS NOPR, AMS commented that the baseline level calculated for Combination A beverage vending machines is far more efficient than the performance of actual machines in use today (see section IV.C.1 the full discussion of this comment). In the final rule analysis, DOE made additional analytical adjustments to the engineering analysis, and as such, the baseline performance of the combination equipment showed better agreement with the figure suggested by AMS.

K. Emissions Analysis

The emissions analysis consists of two components. The first component estimates the effect of potential energy conservation standards on power sector and site (where applicable) combustion emissions of CO_2, NO_X, SO_2, and Hg. The second component estimates the impacts of potential standards on emissions of two additional greenhouse gases, CH_4 and N_2O, as well as the reductions to emissions of all species due to "upstream" activities in the fuel production chain. These upstream activities comprise extraction, processing, and transporting fuels to the site of combustion. The associated emissions are referred to as upstream emissions.

The analysis of power sector emissions uses marginal emissions factors that were derived from data in AEO2015. The methodology is described in chapters 13 and 15 of the final rule TSD.

Combustion emissions of CH_4 and N_2O are estimated using emissions intensity factors published by the EPA, GHG Emissions Factors Hub.[62] The FFC upstream emissions are estimated based on the methodology described in chapter 15 of the final rule TSD. The upstream emissions include both emissions from fuel combustion during extraction, processing, and transportation of fuel, and "fugitive" emissions (direct leakage to the atmosphere) of CH_4 and CO_2.

The emissions intensity factors are expressed in terms of physical units per MWh or MMBtu of site energy savings. Total emissions reductions are estimated using the energy savings calculated in the national impact analysis.

For CH_4 and N_2O, DOE calculated emissions reduction in tons and in terms of units of carbon dioxide equivalent (CO_2eq). Gases are converted to CO_2eq by multiplying each ton of gas by the gas' global warming potential (GWP) over a 100-year time horizon. Based on the Fifth Assessment Report of the Intergovernmental Panel on Climate Change,[63] DOE used GWP values of 28 for CH_4 and 265 for N_2O.

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[62] Available at www.epa.gov/climateleadership/inventory/ghg-emissions.html.

[63] IPCC, 2013: Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Stocker, T.F., D. Qin, G.-K.

The AEO incorporates the projected impacts of existing air quality regulations on emissions. AEO2015 generally represents current legislation and environmental regulations, including recent government actions, for which implementing regulations were available as of October 31, 2014. DOE's estimation of impacts accounts for the presence of the emissions control programs discussed in the following paragraphs.

SO_2 emissions from affected electric generating units (EGUs) are subject to nationwide and regional emissions cap-and-trade programs. Title IV of the Clean Air Act sets an annual emissions cap on SO_2 for affected EGUs in the 48 contiguous States and the District of Columbia (D.C.). (42 U.S.C. 7651 et seq.) SO_2 emissions from 28 eastern States and D.C. were also limited under the Clean Air Interstate Rule (CAIR). 70 FR 25162 (May 12, 2005). CAIR created an allowance-based trading program that operates along with the Title IV program. In 2008, CAIR was remanded to EPA by the U.S. Court of Appeals for the District of Columbia Circuit, but it remained in effect.[64] 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,[65] and the court ordered EPA to continue administering CAIR. On April 29, 2014, the U.S. Supreme Court reversed the judgment of the D.C. Circuit and

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.

[64] 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).

[65] See EME Homer City Generation, LP v. EPA, 696 F.3d 7, 38 (D.C. Cir. 2012), cert. granted, 81 U.S.L.W. 3567, 81 U.S.L.W. 3696, 81 U.S.L.W. 3702 (U.S. June 24, 2013) (No. 12-1182).

remanded the case for further proceedings consistent with the Supreme Court's opinion.[66] On October 23, 2014, the D.C. Circuit lifted the stay of CSAPR.[67] Pursuant to this action, CSAPR went into effect (and CAIR ceased to be in effect) as of January 1, 2015.

EIA was not able to incorporate CSAPR into AEO2015, so it assumes implementation of CAIR. Although DOE's analysis used emissions factors that assume 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 emissions impacts from energy conservation standards.

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 will occur as a result of standards.

[66] See EPA v. EME Homer City Generation, 134 S.Ct. 1584, 1610 (U.S. 2014). 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.
[67] See Georgia v. EPA, Order (D. C. Cir. filed October 23, 2014) (No. 11-1302).

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 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. AEO2015 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, which are used to reduce acid gas emissions, 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.[68] Therefore, DOE believes that energy conservation standards will generally 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.[69] Energy conservation standards are expected to have little effect on NO_X

[68] DOE notes that the Supreme Court recently remanded EPA's 2012 rule regarding national emission standards for hazardous air pollutants from certain electric utility steam generating units. See Michigan v. EPA (Case No. 14-46, 2015). DOE has determined that the remand of the MATS rule does not change the assumptions regarding the impact of energy efficiency standards on SO_2 emissions. Further, while the remand of the MATS rule may have an impact on the overall amount of mercury emitted by power plants, it does not change the impact of the energy efficiency standards on mercury emissions. DOE will continue to monitor developments related to this case and respond to them as appropriate.

[69] 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.

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 from other facilities. 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 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 AEO2015, which incorporates the MATS.

In response to the 2015 BVM ECS NOPR, CoilPod commented that DOE's estimate of emissions reduction is overstated as it does not take into account coil degradation that occurs in real-world use. They additionally cited a government report finding that bottlers have no incentive to clean the coils on their vending machines because the establishments in which they are installed pay the electricity costs. (CoilPod, Public Meeting Transcript, No. 48 at pp. 53–55)

DOE's calculation of emissions savings is based on the amount of energy saved. Coil degradation has little impact on emissions savings because it is based on incremental savings. Both baseline and more efficient equipment will be impacted by coil fouling, and the energy savings differential between the no-new-standards case and the standards case would largely remain the same.

L. Monetizing Carbon Dioxide and Other Emissions Impacts

As part of the development of this 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 analogous to the calculation of the NPV of customer 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 of CO_2 and NO_X emissions and presents the values considered in this final rule.

For this final rule, DOE relied on a set of values for the social cost of carbon (SCC) that was developed by a Federal interagency process. The basis for these values is summarized in the next section, 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) climate-change-related 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)(6) of Executive Order 12866, "Regulatory Planning and Review," 58 FR 51735 (Oct. 4, 1993), 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 challenges. A report from the National Research Council[70] points out that any assessment will suffer from uncertainty, speculation, and lack of information about: (1) future emissions of GHGs; (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 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 values appropriate for that year. The NPV 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

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

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 Federal 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

After the release of the interim values, the interagency group reconvened on a regular basis to generate improved SCC estimates. Specially, 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 (IPCC). Each model was given equal weight in the SCC values that were developed.

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

In 2010, 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 95^{th} percentile SCC estimate across all three models at a 3-percent discount rate, was included to represent higher-than-expected impacts from climate 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,[71] although preference is given to consideration of the global benefits of reducing CO_2 emissions. Table IV.11 presents the values in the 2010 interagency group report,[72] which is reproduced in appendix 14A of the final rule TSD.

Table IV.11 Annual SCC Values from 2010 Interagency Report, 2010–2050 (2007$ 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 document were generated using the most recent versions of the three integrated assessment models that have been published in the peer-reviewed literature, as described in the 2013 update from the interagency working group (revised July 2015).[73] Table IV.12 shows the updated sets of SCC estimates from the latest interagency update in 5-year increments from 2010 to 2050. The full set of annual

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[71] It is recognized that this calculation for domestic values is approximate, provisional, and highly speculative. There is no a priori reason why domestic benefits should be a constant fraction of net global damages over time.

[72] 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) (Available at: www.whitehouse.gov/sites/default/files/omb/inforeg/for-agencies/Social-Cost-of-Carbon-for-RIA.pdf).

[73] 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 July 2015) Available at www.whitehouse.gov/sites/default/files/omb/inforeg/scc-tsd-final-july-2015.pdf.

SCC estimates between 2010 and 2050 is reported in appendix 14B 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.12 Annual SCC Values from 2013 Interagency Update (Revised July 2015), 2010–2050 (2007$ per metric ton CO_2)

Year	Discount Rate			
	5%	3%	2.5%	3%
	Average	Average	Average	95th percentile
2010	10	31	50	86
2015	11	36	56	105
2020	12	42	62	123
2025	14	46	68	138
2030	16	50	73	152
2035	18	55	78	168
2040	21	60	84	183
2045	23	64	89	197
2050	26	69	95	212

It is important to recognize that a number of key uncertainties remain, and that current SCC estimates should be treated as provisional and revisable because 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 previously 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 analytical 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.[74]

In summary, in considering the potential global benefits resulting from reduced CO_2 emissions, DOE used the values from the 2013 interagency report (revised July 2015), adjusted to 2014$ using the implicit price deflator for gross domestic product (GDP) from the Bureau of Economic Analysis. For each of the four sets of SCC cases specified, the values for emissions in 2015 were $12.2, $40.0, $62.3, and $117 per metric ton avoided (values expressed in 2014$). 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.

A number of stakeholders represented by the U.S. Chamber of Commerce stated that DOE should not use SCC values to establish monetary figures for emissions

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[74] In November 2013, OMB announced a new opportunity for public comment on the interagency technical support document underlying the revised SCC estimates. 78 FR 70586 (Nov. 26, 2013). In July 2015 OMB published a detailed summary and formal response to the many comments that were received. www.whitehouse.gov/blog/2015/07/02/estimating-benefits-carbon-dioxide-emissions-reductions. It also stated its intention to seek independent expert advice on opportunities to improve the estimates, including many of the approaches suggested by commenters.

reductions until the SCC undergoes a more rigorous notice, review, and comment process. (The Associations, No. 62 at p. 4)

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 final rule 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, OMB announced a new opportunity for public comment on the TSD underlying the revised SCC estimates. See 78 FR 70586 (Nov. 26, 2013). OMB issued a revision to the 2013 SCC estimates in July of 2015. 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.

2. Social Cost of Other Air Pollutants

As noted previously, DOE has estimated how the considered energy conservation standards would reduce site NO_X emissions nationwide and decrease power sector NO_X emissions in those 22 States not affected by the CAIR.

DOE estimated the monetized value of NO_X emissions reductions using benefit per ton estimates from the "Regulatory Impact Analysis for the Proposed Carbon Pollution Guidelines for Existing Power Plants and Emission Standards for Modified and Reconstructed Power Plants," published in June 2014 by EPA's Office of Air Quality Planning and Standards.[75] The report includes high and low values for NO_X (as $PM_{2.5}$) for 2020, 2025, and 2030 discounted at 3 percent and 7 percent,[76] which are presented in chapter 14 of the final rule TSD. DOE assigned values for 2021–2024 and 2026–2029 using, respectively, the values for 2020 and 2025. DOE assigned values after 2030 using the value for 2030.

DOE multiplied the emissions reduction (tons) in each year by the associated $/ton values and then discounted each series using discount rates of 3 percent and 7 percent as appropriate.

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

[75] http://www3.epa.gov/ttnecas1/regdata/RIAs/111dproposalRIAfinal0602.pdf. See Tables 4-7, 4-8, and 4-9 in the report.

[76] For the monetized NOx benefits associated with PM2.5, the related benefits (derived from benefit-per-ton values) are primarily based on an estimate of premature mortality derived from the ACS study (Krewski et al., 2009), which is the lower of the two EPA central tendencies. Using the lower value is more conservative when making the policy decision concerning whether a particular standard level is economically justified. If the benefit-per-ton estimates were based on the Six Cities study (Lepuele et al., 2012), the values would be nearly two-and-a-half times larger. (See chapter 14 of the final rule TSD for further description of the studies mentioned above.)

M. Utility Impact Analysis

The utility impact analysis estimates several effects on the electric power industry that would result from the adoption of new or amended energy conservation standards. The utility impact analysis estimates the changes in installed electrical capacity and generation that would result for each TSL. The analysis is based on published output from the NEMS associated with AEO2015. NEMS produces the AEO Reference case, as well as a number of side cases that estimate the economy-wide impacts of changes to energy supply and demand. DOE uses published side cases to estimate the marginal impacts of reduced energy demand on the utility sector. These marginal factors are estimated based on the changes to electricity sector generation, installed capacity, fuel consumption and emissions in the AEO Reference case and various side cases. Details of the methodology are provided in the appendices to chapters 13 and 15 of the final rule TSD.

The output of this analysis is a set of time-dependent coefficients that capture the change in electricity generation, primary fuel consumption, installed capacity and power sector emissions due to a unit reduction in demand for a given end use. These coefficients are multiplied by the stream of electricity savings calculated in the NIA to provide estimates of selected utility impacts of new or amended energy conservation standards.

N. Employment Impact Analysis

DOE considers employment impacts in the domestic economy as one factor in selecting a standard. Employment impacts from new or amended energy conservation standards include both direct and indirect impacts. Direct employment impacts are changes in the number of employees at the plants that produce the covered equipment, along with affiliated distribution and service companies. The MIA addresses those impacts.

Indirect employment impacts are changes in national employment that occur due to the shift in expenditures and capital investment caused by the purchase and operation of more-efficient appliances. Indirect employment impacts from standards consist of the net jobs created or eliminated in the national economy, other than in the manufacturing sector being regulated, caused by: (1) reduced spending by end users on energy; (2) reduced spending on new energy supply by the utility industry; (3) increased customer spending on new equipment to which the new standards apply; 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).[77] BLS regularly publishes its estimates of the number of jobs per million dollars of economic activity in different

[77] Data on industry employment, hours, labor compensation, value of production, and the implicit price deflator for output for these industries are available upon request by calling the Division of Industry Productivity Studies (202-691-5618) or by sending a request by e-mail to dipsweb@bls.gov.

sectors of the economy, as well as the jobs created elsewhere in the economy by this same economic activity. Data from BLS indicate that expenditures in the utility sector generally create fewer jobs (both directly and indirectly) than expenditures in other sectors of the economy.[78] 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 due to shifts in economic activity resulting from energy conservation standards.

DOE estimated indirect national employment impacts for the standard level adopted in this final rule using an input/output model of the U.S. economy called Impact of Sector Energy Technologies version 4.0 (ImSET).[79] 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

[78] See Bureau of Economic Analysis, Regional Multipliers: A User Handbook for the Regional Input-Output Modeling System (RIMS II), U.S. Department of Commerce (1992).
[79] Livingston OV, SR Bender, MJ Scott, and RW Schultz. ImSET 4.0: Impact of Sector Energy Technologies Model Description and User's Guide. 2015. Pacific Northwest National Laboratory, Richland, WA. Report No. PNNL-24563.

structural coefficients that characterize economic flows among 187 sectors most relevant to industrial, commercial, and residential building energy use.

DOE notes that ImSET is not a general equilibrium-forecasting model, and understands the uncertainties involved in projecting employment impacts, especially changes in the later years of the analysis. Because ImSET does not incorporate price changes, the employment effects predicted by ImSET may over-estimate actual job impacts over the long run for this rule. Therefore, DOE generated results for near-term timeframes (2020 and 2025), where these uncertainties are reduced. For more details on the employment impact analysis, see chapter 16 of the final rule TSD.

DOE reiterates that the indirect employment impacts estimated with ImSET for the entire economy differ from the direct employment impacts in the BVM 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.

O. Description of Materials Incorporated by Reference

In this final rule DOE is incorporating by reference ASTM Standard E 1084-86 (Reapproved 2009), "Standard Test Method for Solar Transmittance (Terrestrial) of Sheet Materials Using Sunlight," to determine whether a material is transparent when assessing whether a beverage vending machine has a transparent front and meets the adopted Class A definition. Copies of ASTM standards may be purchased from ASTM International, 100 Barr Harbor Drive, PO Box C700, West Conshohocken, PA, 19428, (877) 909-2786, or at www.astm.org.

V. Analytical Results and Conclusions

The following section addresses the results of DOE's analyses with respect to the considered energy conservation standards for beverage vending machines. It addresses the TSLs examined by DOE, the projected impacts of each of these levels if adopted as energy conservation standards for beverage vending machines, and the standards levels that DOE is adopting in this final rule. Additional details regarding DOE's analyses are contained in the final rule TSD supporting this notice.

A. Trial Standard Levels

DOE analyzed 8 ELs for Class A equipment, 12 ELs for Class B equipment, 15 ELs for Combination A equipment, and 13 ELs for Combination B equipment in the LCC and NIA analyses, where each EL represents a 5-percent improvement in efficiency from baseline efficiency (EL 0) to up to max tech. Of the ELs analyzed for each class DOE selected five TSLs based on the following criteria:

1) TSL 1 is equivalent to the current ENERGY STAR criterion for all equipment that is eligible for ENERGY STAR qualification. This corresponded to EL 2 for Class B equipment and EL 1 for Class A. Combination equipment is currently not eligible for ENERGY STAR qualification and, as such, DOE

selected TSL 1 as equivalent to EL 1, since EL 1 was the first EL analyzed above the baseline (EL 0).

2) TSL 2 was selected to be the EL that is hypothetically representative of the next version of ENERGY STAR. That is, for the given equipment class, DOE selected the EL comprising TSL 2 to be 5 or 10 percent better than TSL 1, depending on the improvement potential in different equipment classes. That is, TSL 2 represents EL 2 for Class A (5-percent improvement over TSL 1), EL 4 for Class B (10-percent improvement over TSL 1), and EL 3 for Combination A and Combination B (10-percent improvement over TSL 1).
3) TSL 3 represents the EL with the maximum NPV at a 7-percent discount rate. This level also corresponds to the maximum LCC savings for most equipment classes. In addition, the EL corresponding to a 3-year payback, zero customers with net cost, and maximum NPV at a 3-percent discount rate were the same or within one EL from the selected EL.
4) TSL 4 was selected to be an interim analysis point corresponding to the EL halfway between TSL 3 and 5 (rounding up when between ELs).
5) TSL 5 corresponds to the max tech EL.

In response to DOE's TSL selection presented in the 2015 BVM ECS NOPR, the CA IOUs commented in their written submission that DOE should consider an intermediate efficiency tier between TSL 4 and TSL 5 for Class A and Combination A and supported TSL 4 for Class B and Combination B equipment. (CA IOUs, No. 58 at p. 5) In response to CA IOUs suggestion, DOE notes that DOE has revised the TSL selection criteria for this final rule. Specifically, because the final rule analysis resulted in the maximum NVP at a 7-percent discount rate occurring at lower ELs for all equipment classes than in the NOPR, DOE revised TSL 3 to represent the TSL with maximum NPV at a 7-percent discount rate instead of TSL 4, as proposed in the 2015 BVM ECS NOPR. Therefore, DOE has defined TSL 4 as an interim analysis point consisting of the EL halfway between TSL 3 and TSL 5 for all equipment classes. While, in the final rule analysis, TSL 3 and TSL 4 consist of lower ELs than DOE's proposed TSL 4 presented in the 2015 BVM ECS NOPR, DOE notes that the TSL 4 analysis point now reflects an interim analysis point between the TSL with maximum NPV at a 7-percent discount rate and max tech, as requested by the commenters. DOE also notes that, based on the revised final rule analyses, ELs beyond TSL 3 for equipment Class A result in increased LCC compared to baseline equipment and a negative NPV.

Table V.1 shows the TSL levels DOE selected for the equipment classes analyzed. Note that DOE performed its analyses for a "representative size" beverage vending machine and defined refrigerant-neutral ELs such that the selected ELs could be met by any refrigerant. Similarly, the defined TSLs share this approach and can be met by either refrigerant.

Table V.1 Trial Standard Levels for a Representative Size BVM Model Expressed in Terms of Daily Energy Consumption (kWh/day)

Equipment Class	Representative Volume ft^3	TSL	Base-line	TSL 1	TSL 2	TSL 3	TSL 4	TSL 5
Class A	30.0	EL	0	1	2	1*	4	8
		DEC	4.21	4.00	3.79	4.00	3.37	2.60
Class B	23.4	EL	0	2	4	6	9	12
		DEC	4.87	4.38	3.90	3.41	2.68	1.94
Combination A	10.3	EL	0	1	3	11	13	15
		DEC	7.89	7.49	6.70	3.55	2.76	2.10
Combination B	4.3	EL	0	1	3	9	11	13
		DEC	4.58	4.35	3.89	2.52	2.06	1.46

* DOE notes that the EL selected for TSL 3 for Class A equipment is EL 1, which is the same EL selected for TSL1 for Class A equipment.

In this final rule, DOE elected to maintain the energy conservation standard structure established in the 2009 BVM final rule, which establishes the MDEC of covered BVM models in terms of a linear equation of the following form:

$$MDEC = A \times V + B$$

Eq. V.1

Where:

A is expressed in terms of kWh/(day·ft^3) of measured refrigerated volume,

V is the representative value of refrigerated volume (ft^3) calculated for the equipment, and

B is an offset factor expressed in kWh/day.

Coefficients A and B are uniquely derived for each equipment class based on a linear equation passing between the daily energy consumption values for equipment of different refrigerated volumes. For the A and B coefficients, DOE used the unique energy consumption values of the small, medium, and large or medium and large size

BVM units for Class A and Class B or Combination A and Combination B beverage vending machines, respectively. Table V.2 depicts the TSL equations for each analyzed TSL and equipment class. The methodology used to establish the TSL equations and more detailed results is described in more detail in appendix 10B of the TSD.

Table V.2 Trial Standard Levels Maximum Daily Energy Consumption (kWh/day) Expressed in Terms of Equations and Coefficients for BVM Equipment

TSL	Class A	Class B	Combination A	Combination B
Baseline	0.055 × V + 2.56	0.074 × V + 3.15	0.192 × V + 5.91	0.202 × V + 3.71
1	0.052 × V + 2.43	0.066 × V + 2.83	0.182 × V + 5.62	0.192 × V + 3.52
2	0.050 × V + 2.30	0.059 × V + 2.52	0.163 × V + 5.03	0.172 × V + 3.15
3	0.052 × V + 2.43	0.052 × V + 2.20	0.086 × V + 2.66	0.111 × V + 2.04
4	0.044 × V + 2.05	0.041 × V + 1.73	0.067 × V + 2.07	0.091 × V + 1.67
5	0.034 × V + 1.58	0.029 × V + 1.25	0.051 × V + 1.58	0.064 × V + 1.18

In Table V.2, "V" is the representative value of refrigerated volume (ft^3) of the BVM model, as measured in accordance with the method for determining refrigerated volume adopted in the recently amended DOE test procedure for beverage vending machines and appropriate sampling plan requirements. 80 FR 45758 (July 31, 2015). In the 2015 BVM ECS NOPR, DOE proposed a calculation method to be adopted at 10 CFR 429.52(a)(3) for determining the representative value of refrigerated volume for each BVM model. 80 FR 50507–50508 (Aug. 19, 2015). In response to DOE's proposal, SVA expressed support for DOE's proposal to clarify the calculation of refrigerated volume. (SVA, No. 53 at p. 10) DOE appreciates SVA's support and, in this final rule, is adopting provisions to specify that the representative value of refrigerated volume must be determined as the mean of the measured refrigerated volume of each tested unit. Manufacturers must use this calculated value for determining the appropriate standard level for that model.

In addition, in the 2015 BVM ECS NOPR, DOE proposed provisions to assess whether the representative value of refrigerated volume, as certified by manufacturers, is valid. 80 FR 50507–50508 (Aug. 19, 2015). DOE did not receive any comments on this proposal and, therefore, is adopting the proposal for determining if the certified value of refrigerated volume is valid as described in the 2015 BVM ECS NOPR with no modifications.

Under the adopted provisions, DOE will compare the manufacturer's certified rating with results from the unit or units in DOE's tested sample. If the results of the tested unit or units in DOE's sample are within 5 percent of the representative value of refrigerated volume certified by manufacturers, the certified refrigerated volume value is considered valid. Based on whether the representative value of refrigerated volume is valid, DOE will do one of the following:

1) If the representative value of refrigerated volume, as certified by manufacturers, is valid, DOE will use the certified value to determine the MDEC for that model; or
2) If the representative value of refrigerated volume is invalid, DOE will use its results from the tested unit or units as the basis for calculating the MDEC for that BVM model.

Additionally, DOE notes that these sampling and enforcement provisions are effective **[INSERT DATE 60 DAYS AFTER DATE OF PUBLICATION IN THE**

FEDERAL REGISTER], as such, applicable to both the existing standards, as well as any new and amended standards adopted as a result of this final rule.

B. Economic Justification and Energy Savings

1. Economic Impacts on Individual Customers

DOE analyzed the economic impacts on BVM customers by looking at the effects that potential new and amended standards at each TSL would have on the LCC and PBP. DOE also examined the impacts of potential standards on customer subgroups. These analyses are discussed in the following subsections.

a. Life-Cycle Cost and Payback Period

Customers affected by new 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 no-new-standards case scenario against the standards case scenarios at each TSL. Inputs used for calculating the LCC include total installed costs (i.e., equipment price plus installation costs), operating expenses (i.e., annual energy savings, energy prices, energy price trends, repair costs, and maintenance costs), equipment lifetime, and discount rates.

The LCC analysis is carried out using Monte Carlo simulations. Consequently, the results of the LCC analysis are distributions covering a range of values, as opposed to a single deterministic value. DOE presents the mean or median values, as appropriate, calculated from the distributions of results. The LCC analysis also provides information on the percentage of customers for whom an increase in the minimum efficiency standard would have a negative impact (net cost).

DOE also performed a PBP analysis as part of the LCC analysis. The PBP is the number of years it takes for a customer to recover the increased costs of higher efficiency equipment as a result of operating cost savings. The PBP is an economic benefit-cost measure that uses benefits and costs without discounting. Chapter 8 of the final rule TSD provides detailed information on the LCC and PBP analysis.

DOE used a "roll-up" scenario in this rulemaking. Under the roll-up scenario, DOE assumed that the market shares of the efficiency levels (in the no-new-standards 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 no-new-standards case scenario who buy the equipment at or above the TSL under consideration would be unaffected if the standard were to be set at that TSL. Customers in the no-new-standards case scenario who buy equipment below the TSL under consideration would be affected if the standard were to be set at that TSL. Among these affected customers, some may benefit from lower LCCs of the equipment and some may incur net cost due to higher

LCCs, depending on the inputs to the LCC analysis, such as electricity prices, discount rates, and installed costs.

DOE's LCC and PBP analysis provided key outputs for each efficiency level above the baseline. The results for all equipment classes are displayed in Table V.3 through Table V.18.

Table V.3 Average LCC and PBP Results for Class A, CO_2*

TSL	EL	% of Baseline Energy Use	Average Costs 2014$				Simple Payback Period** years	Average Lifetime years
			Installed Cost	First Year's Operating Cost	Lifetime Operating Cost	LCC		
-	0	100	2,817	487	4,991	7,807	---	13.5
1,3	1	95	2,832	480	4,910	7,742	2.0	13.5
2	2	90	2,867	505	5,157	8,025	N/A	13.5
-	3	85	2,951	530	5,405	8,356	N/A	13.5
4	4	80	3,071	557	5,674	8,744	N/A	13.5
-	5	75	3,232	549	5,593	8,825	N/A	13.5
-	6	70	3,467	542	5,512	8,979	N/A	13.5
-	7	65	3,701	534	5,431	9,132	N/A	13.5
5	8	62	3,853	529	5,379	9,232	N/A	13.5

* The results for each EL are calculated assuming that all customers use equipment at that efficiency level or higher. The PBP is measured relative to the baseline equipment.

** Values of N/A indicate paybacks that are not possible, given that more efficient equipment is not only more expensive to purchase, but also costs more to operate.

Table V.4 Average LCC Savings Relative to the No-New-Standards Case Efficiency Distribution for Class A, CO_2

TSL	EL	% of Baseline Energy Use	Life-Cycle Cost Savings	
			% of Customers that Experience a Net Cost	Average Life-Cycle Cost Savings* 2014$
-	0	100	---	---
1,3	1	95	0	65
2	2	90	100	(217)
-	3	85	100	(549)
4	4	80	100	(937)
-	5	75	100	(1,018)
-	6	70	100	(1,171)
-	7	65	100	(1,325)
5	8	62	100	(1,424)

* The calculation includes customers with zero LCC savings (no impact). Parentheses indicate negative values.

Table V.5 Average LCC and PBP Results for Class A, Propane*

TSL	EL	% of Baseline Energy Use	Average Costs 2014$				Simple Payback Period** years	Average Lifetime years
			Installed Cost	First Year's Operating Cost	Lifetime Operating Cost	LCC		
-	0	100	2,908	513	5,246	8,154	---	13.5
1,3	1	95	2,916	505	5,165	8,081	1.1	13.5
2	2	90	2,925	497	5,084	8,010	1.2	13.5
-	3	85	2,937	464	4,748	7,686	0.6	13.5
4	4	80	2,960	457	4,668	7,627	0.9	13.5
-	5	75	3,030	515	5,243	8,274	N/A	13.5
-	6	70	3,215	507	5,162	8,377	N/A	13.5
-	7	65	3,399	534	5,431	8,830	N/A	13.5
5	8	62	3,519	529	5,379	8,897	N/A	13.5

* The results for each EL are calculated assuming that all customers use equipment at that efficiency level or higher. The PBP is measured relative to the baseline equipment.
** Values of N/A indicate paybacks that are not possible, given that more efficient equipment is not only more expensive to purchase, but also costs more to operate.

Table V.6 Average LCC Savings Relative to the No-New-Standards Case Efficiency Distribution for Class A, Propane

TSL	EL	% of Baseline Energy Use	Life-Cycle Cost Savings	
			% of Customers that Experience a Net Cost	Average Life-Cycle Cost Savings* 2014$
-	0	100	---	---
1,3	1	95	0	0
2	2	90	0	71
-	3	85	0	395
4	4	80	0	454
-	5	75	94	(193)
-	6	70	96	(296)
-	7	65	100	(749)
5	8	62	100	(817)

* The calculation includes customers with zero LCC savings (no impact). Parentheses indicate negative values.

Table V.7 Average LCC and PBP Results for Class B, CO_2*

TSL	EL	% of Baseline Energy Use	Average Costs 2014$				Simple Payback Period** years	Average Lifetime years
			Installed Cost	First Year's Operating Cost	Lifetime Operating Cost	LCC		
-	0	100	2,320	522	5,354	7,674	---	13.5
-	1	95	2,324	513	5,261	7,585	0.4	13.5
1	2	90	2,328	505	5,169	7,496	0.4	13.5
-	3	85	2,332	496	5,076	7,408	0.4	13.5
2	4	80	2,336	507	5,181	7,517	1.0	13.5
-	5	75	2,340	498	5,089	7,429	0.8	13.5
3	6	70	2,348	497	5,073	7,422	1.1	13.5
-	7	65	2,362	488	4,981	7,343	1.3	13.5
-	8	60	2,388	456	4,644	7,033	1.0	13.5
4	9	55	2,449	532	5,408	7,857	N/A	13.5
-	10	50	2,665	523	5,315	7,980	N/A	13.5
-	11	45	2,973	514	5,222	8,195	85.6	13.5
5	12	40	3,298	505	5,127	8,425	58.8	13.5

* The results for each EL are calculated assuming that all customers use equipment at that efficiency level or higher. The PBP is measured relative to the baseline equipment.
** Values of N/A indicate paybacks that are not possible, given that more efficient equipment is not only more expensive to purchase, but also costs more to operate.

Table V.8 Average LCC Savings Relative to the No-New-Standards Case Efficiency Distribution for Class B, CO_2

TSL	EL	% of Baseline Energy Use	Life-Cycle Cost Savings	
			% of Customers that Experience a Net Cost	Average Life-Cycle Cost Savings* 2014$
-	0	100	---	---
-	1	95	0	0
1	2	90	0	0
-	3	85	0	0
2	4	80	0	0
-	5	75	0	38
3	6	70	8	42
-	7	65	0	109
-	8	60	0	375
4	9	55	99	(448)
-	10	50	99	(572)
-	11	45	99	(787)
5	12	40	100	(1,017)

* The calculation includes customers with zero LCC savings (no impact). Parentheses indicate negative values.

Table V.9 Average LCC and PBP Results for Class B, Propane*

TSL	EL	% of Baseline Energy Use	Average Costs 2014$				Simple Payback Period years	Average Lifetime years
			Installed Cost	First Year's Operating Cost	Lifetime Operating Cost	LCC		
-	0	100	2,359	515	5,283	7,642	---	13.5
-	1	95	2,363	506	5,191	7,553	0.4	13.5
1	2	90	2,366	505	5,169	7,535	0.7	13.5
-	3	85	2,370	496	5,076	7,446	0.6	13.5
2	4	80	2,374	487	4,984	7,358	0.6	13.5
-	5	75	2,379	479	4,891	7,270	0.5	13.5
3	6	70	2,384	470	4,798	7,182	0.5	13.5
-	7	65	2,389	481	4,904	7,293	0.9	13.5
-	8	60	2,397	480	4,888	7,285	1.1	13.5
4	9	55	2,414	471	4,796	7,210	1.3	13.5
-	10	50	2,538	492	5,000	7,538	7.7	13.5
-	11	45	2,752	514	5,222	7,974	632.2	13.5
5	12	40	2,982	505	5,127	8,109	64.7	13.5

* The results for each EL are calculated assuming that all customers use equipment at that efficiency level or higher. The PBP is measured relative to the baseline equipment.

Table V.10 Average LCC Savings Relative to the No-New-Standards Case Efficiency Distribution for Class B, Propane

TSL	EL	% of Baseline Energy Use	Life-Cycle Cost Savings	
			% of Customers that Experience a Net Cost	Average Life-Cycle Cost Savings* 2014$
-	0	100	---	---
-	1	95	0	5
1	2	90	3	8
-	3	85	0	96
2	4	80	0	185
-	5	75	0	273
3	6	70	0	361
-	7	65	1	250
-	8	60	3	257
4	9	55	1	333
-	10	50	59	4
-	11	45	91	(432)
5	12	40	93	(566)

* The calculation includes customers with zero LCC savings (no impact). Parentheses indicate negative values.

Table V.11 Average LCC and PBP Results for Combination A, CO_2*

TSL	EL	% of Baseline Energy Use	Average Costs 2014$				Simple Payback Period years	Average Lifetime years
			Installed Cost	First Year's Operating Cost	Lifetime Operating Cost	LCC		
-	0	100	2,768	561	5,771	8,539	---	13.5
1	1	95	2,771	550	5,654	8,424	0.2	13.5
-	2	90	2,773	539	5,537	8,310	0.2	13.5
2	3	85	2,776	528	5,420	8,196	0.2	13.5
-	4	80	2,781	517	5,303	8,084	0.3	13.5
-	5	75	2,786	506	5,186	7,972	0.3	13.5
-	6	70	2,791	495	5,069	7,860	0.3	13.5
-	7	65	2,796	484	4,952	7,748	0.4	13.5
-	8	60	2,801	504	5,148	7,949	0.6	13.5
-	9	55	2,813	493	5,031	7,844	0.7	13.5
-	10	50	2,832	466	4,753	7,586	0.7	13.5
3	11	45	2,856	455	4,636	7,492	0.8	13.5
-	12	40	2,954	480	4,885	7,839	2.3	13.5
4	13	35	3,189	545	5,527	8,716	26.1	13.5
-	14	30	3,717	534	5,410	9,127	35.0	13.5
5	15	27	4,130	526	5,331	9,462	39.4	13.5

* The results for each EL are calculated assuming that all customers use equipment at that efficiency level or higher. The PBP is measured relative to the baseline equipment.

Table V.12 Average LCC Savings Relative to the No-New-Standards Case Efficiency Distribution for Combination A, CO_2

TSL	EL	% of Baseline Energy Use	Life-Cycle Cost Savings	
			% of Customers that Experience a Net Cost	Average Life-Cycle Cost Savings* 2014$
-	0	100	---	---
1	1	95	0	57
-	2	90	0	172
2	3	85	0	286
-	4	80	0	398
-	5	75	0	510
-	6	70	0	622
-	7	65	0	733
-	8	60	0	533
-	9	55	0	638
-	10	50	0	896
3	11	45	0	990
-	12	40	2	643
4	13	35	76	(234)
-	14	30	86	(645)
5	15	27	93	(980)

* The calculation includes customers with zero LCC savings (no impact). Parentheses indicate negative values.

Table V.13 Average LCC and PBP Results for Combination A, Propane*

TSL	EL	% of Baseline Energy Use	Average Costs 2014$				Simple Payback Period years	Average Lifetime years
			Installed Cost	First Year's Operating Cost	Lifetime Operating Cost	LCC		
-	0	100	2,914	561	5,771	8,685	---	13.5
1	1	95	2,915	550	5,654	8,569	0.1	13.5
-	2	90	2,916	539	5,537	8,453	0.1	13.5
2	3	85	2,917	528	5,420	8,337	0.1	13.5
-	4	80	2,919	517	5,303	8,222	0.1	13.5
-	5	75	2,923	506	5,186	8,109	0.2	13.5
-	6	70	2,928	495	5,069	7,997	0.2	13.5
-	7	65	2,932	484	4,952	7,884	0.2	13.5
-	8	60	2,937	473	4,835	7,772	0.3	13.5
-	9	55	2,943	484	4,939	7,882	0.4	13.5
-	10	50	2,952	482	4,914	7,866	0.5	13.5
3	11	45	2,967	480	4,889	7,855	0.7	13.5
-	12	40	2,988	444	4,519	7,508	0.6	13.5
4	13	35	3,066	469	4,768	7,834	1.7	13.5
-	14	30	3,433	534	5,410	8,844	19.2	13.5
5	15	27	3,765	526	5,331	9,097	24.7	13.5

* The results for each EL are calculated assuming that all customers use equipment at that efficiency level or higher. The PBP is measured relative to the baseline equipment.

Table V.14 Average LCC Savings Relative to the No-New-Standards Case Efficiency Distribution for Combination A, Propane

TSL	EL	% of Baseline Energy Use	Life-Cycle Cost Savings	
			% of Customers that Experience a Net Cost	Average Life-Cycle Cost Savings* 2014$
-	0	100	---	---
1	1	95	0	58
-	2	90	0	174
2	3	85	0	290
-	4	80	0	405
-	5	75	0	518
-	6	70	0	630
-	7	65	0	743
-	8	60	0	855
-	9	55	0	745
-	10	50	0	761
3	11	45	0	772
-	12	40	0	1,119
4	13	35	1	793
-	14	30	74	(217)
5	15	27	82	(470)

* The calculation includes customers with zero LCC savings (no impact). Parentheses indicate negative values.

Table V.15 Average LCC and PBP Results for Combination B, CO_2*

TSL	EL	% of Baseline Energy Use	Average Costs 2014$				Simple Payback Period** years	Average Lifetime years
			Installed Cost	First Year's Operating Cost	Lifetime Operating Cost	LCC		
-	0	100	2,418	511	5,239	7,657	---	13.5
1	1	95	2,419	502	5,149	7,568	0.1	13.5
-	2	90	2,420	494	5,058	7,479	0.1	13.5
2	3	85	2,422	485	4,968	7,390	0.1	13.5
-	4	80	2,423	477	4,878	7,301	0.1	13.5
-	5	75	2,425	468	4,787	7,212	0.2	13.5
-	6	70	2,429	460	4,697	7,126	0.2	13.5
-	7	65	2,434	451	4,607	7,040	0.3	13.5
-	8	60	2,441	452	4,608	7,049	0.4	13.5
3	9	55	2,454	444	4,517	6,971	0.5	13.5
-	10	50	2,467	464	4,717	7,184	1.0	13.5
4	11	45	2,491	464	4,718	7,209	1.6	13.5
-	12	40	2,538	526	5,336	7,874	N/A	13.5
5	13	32	3,250	512	5,188	8,438	N/A	13.5

* The results for each EL are calculated assuming that all customers use equipment at that efficiency level or higher. The PBP is measured relative to the baseline equipment.

** Values of N/A indicate paybacks that are not possible, given that more efficient equipment is not only more expensive to purchase, but also costs more to operate.

Table V.16 Average LCC Savings Relative to the No-New-Standards Case Efficiency Distribution for Combination B, CO_2

TSL	EL	% of Baseline Energy Use	Life-Cycle Cost Savings	
			% of Customers that Experience a Net Cost	Average Life-Cycle Cost Savings* 2014$
-	0	100	---	---
1	1	95	0	30
-	2	90	0	89
2	3	85	0	179
-	4	80	0	268
-	5	75	0	356
-	6	70	0	443
-	7	65	0	528
-	8	60	0	519
3	9	55	0	597
-	10	50	2	384
4	11	45	7	359
-	12	40	83	(306)
5	13	32	97	(870)

* The calculation includes customers with zero LCC savings (no impact). Parentheses indicate negative values.

Table V.17 Average LCC and PBP Results for Combination B, Propane*

TSL	EL	% of Baseline Energy Use	Average Costs 2014$				Simple Payback Period** years	Average Lifetime years
			Installed Cost	First Year's Operating Cost	Lifetime Operating Cost	LCC		
-	0	100	2,538	511	5,239	7,777	---	13.5
1	1	95	2,539	502	5,149	7,688	0.1	13.5
-	2	90	2,540	494	5,058	7,598	0.1	13.5
2	3	85	2,541	485	4,968	7,509	0.1	13.5
-	4	80	2,542	477	4,878	7,420	0.1	13.5
-	5	75	2,543	468	4,787	7,330	0.1	13.5
-	6	70	2,544	460	4,697	7,241	0.1	13.5
-	7	65	2,547	451	4,607	7,153	0.1	13.5
-	8	60	2,552	443	4,516	7,068	0.2	13.5
3	9	55	2,561	444	4,517	7,078	0.3	13.5
-	10	50	2,571	435	4,427	6,998	0.4	13.5
4	11	45	2,585	455	4,626	7,212	0.8	13.5
-	12	40	2,613	456	4,628	7,240	1.4	13.5
5	13	32	2,933	512	5,188	8,121	N/A	13.5

* The results for each EL are calculated assuming that all customers use equipment at that efficiency level or higher. The PBP is measured relative to the baseline equipment.
** Values of N/A indicate paybacks that are not possible, given that more efficient equipment is not only more expensive to purchase, but also costs more to operate.

Table V.18 Average LCC Savings Relative to the No-New-Standards Case Efficiency Distribution for Combination B, Propane

TSL	EL	% of Baseline Energy Use	Life-Cycle Cost Savings	
			% of Customers that Experience a Net Cost	Average Life-Cycle Cost Savings* 2014$
-	0	100	---	---
1	1	95	0	30
-	2	90	0	89
2	3	85	0	179
-	4	80	0	268
-	5	75	0	358
-	6	70	0	447
-	7	65	0	535
-	8	60	0	620
3	9	55	0	610
-	10	50	0	690
4	11	45	1	476
-	12	40	3	447
5	13	32	86	(433)

* The calculation includes customers with zero LCC savings (no impact). Parentheses indicate negative values.

b. Customer Subgroup Analysis

Using the LCC spreadsheet model, DOE estimated the impacts of the TSLs on manufacturing and/or industrial facilities that purchase their own beverage vending machines. This subgroup typically has higher discount rates and lower electricity prices relative to the average customer. DOE estimated the average LCC savings and simple PBP for this subgroup as shown in Table V.19 through Table V.26.

The results of the customer subgroup analysis indicate that the manufacturing/ industrial subgroup fares slightly worse than the average customer, with that subgroup showing lower LCC savings and longer payback periods than a typical customer shows. At TSL 3, all but one equipment class have positive LCC savings for the subgroup (Class A, Propane has LCC savings of 0), although the savings are not as great in magnitude as for all customers. Chapter 11 of the final rule TSD provides a more detailed discussion on the customer subgroup analysis and results.

Table V.19 Comparison of Impacts for Manufacturing/Industrial Subgroup Relative to All Customers, Class A, CO_2

TSL	LCC Savings* 2014$		Simple Payback Period** years	
	Manufacturing Subgroup	All Customers	Manufacturing Subgroup	All Customers
1	47	65	2.6	2.0
2	(245)	(217)	N/A	N/A
3	47	65	2.6	2.0
4	(982)	(937)	N/A	N/A
5	(1,535)	(1,424)	N/A	N/A

* Parentheses indicate negative values.
** Values of N/A indicate paybacks that are not possible, given that more efficient equipment is not only more expensive to purchase, but also costs more to operate.

Table V.20 Comparison of Impacts for Manufacturing/Industrial Subgroup Relative to All Customers, Class A, Propane

TSL	LCC Savings* 2014$		Simple Payback Period** years	
	Manufacturing Subgroup	All Customers	Manufacturing Subgroup	All Customers
1	0	0	1.3	1.1
2	53	71	1.4	1.2
3	0	0	1.3	1.1
4	391	454	1.0	0.9
5	(917)	(817)	N/A	N/A

* Parentheses indicate negative values.
** Values of N/A indicate paybacks that are not possible, given that more efficient equipment is not only more expensive to purchase, but also costs more to operate.

Table V.21 Comparison of Impacts for Manufacturing/Industrial Subgroup Relative to All Customers, Class B, CO_2

TSL	LCC Savings* 2014$		Simple Payback Period** Years	
	Manufacturing Subgroup	All Customers	Manufacturing Subgroup	All Customers
1	0	0	0.5	0.4
2	0	0	2.0	1.0
3	22	42	2.0	1.1
4	(506)	(448)	N/A	N/A
5	(1,138)	(1,017)	N/A	58.8

* Parentheses indicate negative values.
** Values of N/A indicate paybacks that are not possible, given that more efficient equipment is not only more expensive to purchase, but also costs more to operate.

Table V.22 Comparison of Impacts for Manufacturing/Industrial Subgroup Relative to All Customers, Class B, Propane

TSL	LCC Savings* 2014$		Simple Payback Period** years	
	Manufacturing Subgroup	All Customers	Manufacturing Subgroup	All Customers
1	3	8	1.1	0.7
2	138	185	0.7	0.6
3	272	361	0.7	0.5
4	188	333	2.0	1.3
5	(756)	(566)	N/A	64.7

* Parentheses indicate negative values.
** Values of N/A indicate paybacks that are not possible, given that more efficient equipment is not only more expensive to purchase, but also costs more to operate.

Table V.23 Comparison of Impacts for Manufacturing/Industrial Subgroup Relative to All Customers, Combination A, CO_2

TSL	LCC Savings* 2014$		Simple Payback Period** years	
	Manufacturing Subgroup	All Customers	Manufacturing Subgroup	All Customers
1	44	57	0.3	0.2
2	220	286	0.3	0.2
3	716	990	1.1	0.8
4	(529)	(234)	N/A	26.1
5	(1,318)	(980)	874.3	39.4

* Parentheses indicate negative values.
** Values of N/A indicate paybacks that are not possible, given that more efficient equipment is not only more expensive to purchase, but also costs more to operate.

Table V.24 Comparison of Impacts for Manufacturing/Industrial Subgroup Relative to All Customers, Combination A, Propane

TSL	LCC Savings* 2014$		Simple Payback Period years	
	Manufacturing Subgroup	All Customers	Manufacturing Subgroup	All Customers
1	45	58	0.1	0.1
2	224	290	0.1	0.1
3	505	772	0.9	0.7
4	476	793	2.4	1.7
5	(808)	(470)	546.6	24.7

* Parentheses indicate negative values.

Table V.25 Comparison of Impacts for Manufacturing/Industrial Subgroup Relative to All Customers, Combination B, CO_2

TSL	LCC Savings* 2014$		Simple Payback Period** years	
	Manufacturing Subgroup	All Customers	Manufacturing Subgroup	All Customers
1	23	30	0.2	0.1
2	138	179	0.2	0.1
3	436	597	0.7	0.5
4	168	359	2.7	1.6
5	(1,094)	(870)	N/A	N/A

* Parentheses indicate negative values.
** Values of N/A indicate paybacks that are not possible, given that more efficient equipment is not only more expensive to purchase, but also costs more to operate.

Table V.26 Comparison of Impacts for Manufacturing/Industrial Subgroup Relative to All Customers, Combination B, Propane

TSL	LCC Savings* 2014$		Simple Payback Period** years	
	Manufacturing Subgroup	All Customers	Manufacturing Subgroup	All Customers
1	23	30	0.1	0.1
2	138	179	0.1	0.1
3	448	610	0.4	0.3
4	282	476	1.3	0.8
5	(658)	(433)	N/A	N/A

* Parentheses indicate negative values.
** Values of N/A indicate paybacks that are not possible, given that more efficient equipment is not only more expensive to purchase, but also costs more to operate.

c. Rebuttable Presumption Payback

As discussed in section III.F.2 of this final rule, EPCA provides a rebuttable presumption that an energy conservation standard is economically justified if the additional cost to the customer of the equipment that meets the new or amended standard level is less than three times the value of the first-year energy savings resulting from the standard. (42 U.S.C. 6295(o)(1)(B)(iii)) 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, including those to the customer, manufacturer, nation, and environment, as required under 42 U.S.C. 6295(o)(2)(B)(i). The results of this analysis serve as the basis for DOE to definitively evaluate the economic justification for a potential standard level, thereby supporting or rebutting the results of any preliminary determination of economic justification. Table V.27 shows the rebuttable presumption payback periods for TSL 3, for all equipment classes and both CO_2 and propane refrigerants.

Table V.27 Rebuttable Presumption Payback Periods at TSL 3 for All Refrigerants and Equipment Classes

Refrigerant	**Rebuttable Presumption Payback Period years**			
	Class A	**Class B**	**Combination A**	**Combination B**
CO_2	2.0	0.5	0.7	0.5
Propane	1.1	0.5	0.4	0.3

2. Economic Impacts on Manufacturers

DOE performed an MIA to estimate the impact of new and amended energy conservation standards on manufacturers of beverage vending machines. The section below 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 illustrate the estimated financial impacts (represented by changes in industry net present value, or INPV) of energy conservation standards on manufacturers of beverage vending machines, as well as the conversion costs that DOE expects manufacturers would incur for all equipment classes at each TSL.

As discussed in sections IV.J and V.B.2.b of this final rule, DOE modeled two different markup scenarios to evaluate the range of cash flow impacts on the BVM industry: (1) the preservation of gross margin percentage markup scenario; and (2) the preservation of per-unit operating profit markup scenario.

To assess the less severe end of the range of potential impacts, DOE modeled a preservation of gross margin percentage markup scenario, in which a uniform "gross margin percentage" markup is applied across all potential efficiency levels. In this scenario, DOE assumed that a manufacturer's absolute dollar markup would increase as production costs increase in the standards case.

To assess the more severe end of the range of potential impacts, DOE modeled the preservation of per unit operating profit markup scenario, which reflects manufacturer concerns surrounding their inability to maintain margins as manufacturing production costs increase to meet more stringent efficiency levels. In this scenario, as manufacturers make the necessary investments required to convert their facilities to produce new standards-compliant equipment and incur higher costs of goods sold, their percentage markup decreases. Operating profit does not change in absolute dollars but decreases as a percentage of revenue.

Each of the modeled scenarios results in a unique set of cash flows and corresponding industry values at each TSL. In the following discussion, the INPV results refer to the difference in industry value between the no-new-standards case and each standards case that result from the sum of discounted cash flows from the reference year 2015 through 2048, the end of the analysis period. To provide perspective on the short-run cash flow impact, DOE includes in the discussion of the results a comparison of free cash flow between the no-new-standards case and the standards case at each TSL in the year before amended standards would take effect. This figure provides an understanding of the magnitude of the required conversion costs relative to the cash flow generated by the industry in the no-new-standards case.

Table V.28 and Table V.29 present a range of results reflecting both the preservation of gross margin percentage markup scenario and the preservation of per-unit operating profit markup scenario. As noted, the preservation of per-unit operating profit scenario accounts for the more severe impacts presented. Estimated conversion costs and free cash flow in the year prior to the effective date of amended standards do not vary with markup scenario.

Table V.28 Manufacturer Impact Analysis under the Preservation of Gross Margin Percentage Markup Scenario for Analysis Period (2015–2048)

	Units	No-New-Standards Case	Trial Standard Level				
			1	2	3	4	5
INPV	2014$M	94.8	94.4	94.7	95.2	98.8	112.6
Change in INPV	2014$M*	-	(0.4)	(0.1)	0.4	4.0	17.9
	% Change*	-	(0.4)	(0.1)	0.4	4.2	18.9
Product Conversion Costs	2014$M	-	0.58	0.58	0.58	1.19	3.27
Capital Conversion Costs	2014$M	-	0.30	0.30	0.30	1.14	4.29
Total Conversion Costs	2014$M	-	0.88	0.88	0.88	2.33	7.56
Free Cash Flow	2014$M	10.4	10.1	10.1	10.1	9.5	7.4
	% Change*	-	(3.1)	(3.1)	(3.1)	(8.5)	(28.4)

* Parentheses indicate negative values.

Table V.29 Manufacturer Impact Analysis under the Preservation of Per-Unit Operating Profit Markup Scenario for Analysis Period (2015–2048)

	Units	No-New-Standards Case	Trial Standard Level				
			1	2	3	4	5
INPV	2014$M	94.8	94.1	94.0	94.0	91.5	79.3
Change in INPV	2014$M*	-	(0.6)	(0.8)	(0.7)	(3.2)	(15.5)
	% Change*	-	(0.7)	(0.8)	(0.8)	(3.4)	(16.4)
Product Conversion Costs	2014$M	-	0.6	0.6	0.6	1.2	3.3
Capital Conversion Costs	2014$M	-	0.3	0.3	0.3	1.1	4.3
Total Conversion Costs	2014$M	-	0.9	0.9	0.9	2.3	7.6
Free Cash Flow	2014$M	10.4	10.1	10.1	10.1	9.5	7.4
	% Change*	-	(3.1)	(3.1)	(3.1)	(8.5)	(28.4)

* Parentheses indicate negative values.

At TSL 1, DOE estimates the impact on INPV for manufacturers of beverage vending machine to range from -$0.6 million to -$0.4 million, or a change in INPV of -0.7 percent and -0.4 percent under the preservation of per-unit operating profit markup scenario and preservation of gross margin percentage markup scenario, respectively. At this TSL, industry free cash flow is estimated to decrease by approximately 3.1 percent to $10.1 million, compared to the no-new-standards case value of $10.4 million in the year before the compliance date (2018).

At TSL 1, the industry as a whole is expected to incur $0.6 million in product conversion costs and would be expected to incur $0.3 in capital conversion costs necessary to manufacture redesigned platforms associated with amended energy conservation standards compliance. DOE's engineering analysis indicates that the most cost-effective design options to reach TSL 1 are component swaps and software modifications such as automatic lighting controls, LED lighting, a refrigeration low power state mode, evaporator fan controls, incorporation of a permanent split capacitor evaporator fan motor, or enhanced evaporator coils. Manufacturer feedback indicated that such component swaps do not incur large product or capital conversion costs.

At TSL 2, DOE estimates the impact on INPV for manufacturers of beverage vending machines to range from -$0.8 million to -$0.1 million, or a change in INPV of -0.8 percent and -0.1 percent under the preservation of gross margin percentage markup scenario and the preservation of per-unit operating profit markup scenario, respectively. At this TSL, industry free cash flow is estimated to decrease by approximately 3.1

percent to $10.1 million, compared to the no-new-standards case value of $10.4 million in the year before the compliance date (2018).

At TSL 2, the industry as a whole is expected to incur $0.6 million in product conversion costs and $0.3 in capital conversion costs to manufacturer equipment requiring platform redesigns. DOE's engineering analysis indicates that the most cost-effective design options to reach TSL 2 are component swaps and software modifications such as incorporating an enhanced evaporator coil, automatic lighting controls, LED lighting, improved single speed reciprocating compressor, or a low power state, incorporating a permanent split capacitor condenser fan motor, electronically-commutated evaporator fan motor, enhanced condenser coil, or evaporator fan controls. Manufacturer feedback indicated that such component swaps do not incur large product or capital conversion costs.

At TSL 3, DOE estimates the impact on INPV for manufacturers of beverage vending machines to range from -$0.7 million to $0.4 million, or a change in INPV of -0.8 percent to 0.4 percent under the preservation of gross margin percentage markup scenario and the preservation of per-unit operating profit markup scenario, respectively. At this TSL, industry free cash flow is estimated to decrease by approximately 3.1 percent to $10.1 million, compared to the no-new-standards case value of $10.4 million in the year before the compliance date (2018).

At TSL 3, the industry as a whole is expected to spend $0.6 million in product conversion costs, as well as $0.3 million in capital conversion costs to manufacture redesigned platforms. As at TSLs 1 and 2, DOE's engineering analysis indicates that the most cost-effective design options to reach TSL 3 are component swaps and software modifications such as incorporating an enhanced evaporator coil, automatic lighting controls, LED lighting, improved single speed reciprocating compressor, or a low power state, incorporating a permanent split capacitor condenser fan motor, electronically-commutated evaporator fan motor, enhanced condenser coil, or evaporator fan controls. Manufacturer feedback indicated that such component swaps do not incur large product or capital conversion costs.

At TSL 4, DOE estimates the impact on INPV for manufacturers of beverage vending machines to range from -$3.2 million to $4.0 million, or a change in INPV of -3.4 percent to 4.2 percent under the preservation of gross margin percentage markup scenario and the preservation of per-unit operating profit markup scenario, respectively. At this TSL, industry free cash flow is estimated to decrease by approximately 8.5 percent to $9.5 million, compared to the no-new-standards case value of $10.4 million in the year before the compliance date (2018).

At TSL 4, the industry as a whole is expected to spend $1.2 million in product conversion costs, as well as $1.1 million in capital conversion costs for platform redesigns. At TSL 4, depending on the equipment, some manufacturers will likely be required to increase the thickness of their equipment's insulation, switch to an electronically-commutated condenser fan motor and incorporate vacuum insulated panels (VIPs). Additionally, many manufacturers of Combination A machines will most likely be required to integrate enhanced glass packs or double pane glass in order to achieve the required efficiency.

At TSL 5, DOE estimates the impact on INPV for manufacturers of beverage vending machines to range from -$15.5 million to $17.9 million, or a change in INPV of -16.4 percent to 18.9 percent under the preservation of gross margin percentage markup scenario and the preservation of per-unit operating profit markup scenario, respectively. At this TSL, industry free cash flow is estimated to decrease by approximately 28.4 percent to $7.4 million, compared to the no-new-standards case value of $10.4 million in the year before the compliance date (2018).

At TSL 5, the industry as a whole is expected to spend $3.3 million in product conversion costs associated with the research and development and testing and certification, as well as $4.3 million in one-time investments in PP&E for platform redesigns. The conversion cost burden for manufacturers of all equipment increases substantially at TSL 5. At this level, manufacturers will likely be required to integrate VIPs to achieve the required efficiency. VIPs are an unproven technology in the BVM industry and would likely require substantial effort and cost to incorporate.

At TSL 5, there is approximately a 7-percent decrease in total industry shipments in 2019 relative to the no-new-standards case. Under the preservation of gross margin percentage markup scenario, this decrease in shipments and increased conversion costs are outweighed by a relatively larger increase in industry MPCs, resulting in a positive change in INPV. Under the preservation of per-unit operating profit markup scenario, the increase in MPCs at TSL 5 is outweighed by the decrease in shipments and the increase in industry conversion costs. This results in a decrease in INPV.

b. Impacts on Direct Employment

To quantitatively assess the potential impacts of amended energy conservation standards on direct employment, DOE used the GRIM to estimate the domestic labor expenditures and number of direct employees in the no-new-standards case and at each TSL from 2014 through 2048. DOE used data from the U.S. Census Bureau's 2013 Annual Survey of Manufacturers,[80] the results of the engineering analysis, and interviews with manufacturers to determine the inputs necessary to calculate industry-wide labor expenditures and domestic direct employment levels. Labor expenditures related to manufacturing of beverage vending machines are a function of labor intensity, sales volume, and an assumption that wages remain fixed in real terms over time. The total labor expenditures in each year are calculated by multiplying the MPCs by the labor percentage of MPCs. DOE estimates that 90 percent of BVM units are produced domestically.

The total labor expenditures in the GRIM were then converted to domestic production employment levels by dividing production labor expenditures by the annual

[80] U.S. Census Bureau. Annual Survey of Manufacturers: General Statistics: Statistics for Industry Groups and Industries (2013). Available at www.census.gov/manufacturing/asm/index.html.

payment per production worker (production worker hours times the labor rate found in the U.S. Census Bureau's 2013 Annual Survey of Manufacturers). The production worker estimates in this section only cover workers up to the line-supervisor level who are directly involved in fabricating and assembling a piece of equipment within an original equipment manufacturer (OEM) facility. Workers performing services that are closely associated with production operations, such as materials handling tasks using forklifts, are also included as production labor. DOE's estimates only account for production workers who manufacture the specific equipment covered by this rulemaking.

Because production employment expenditures are assumed to be a fixed percentage of cost of goods sold and the MPCs typically increase with more efficient equipment, labor tracks the increased prices in the GRIM. As efficiency of beverage vending machines increase, so does the complexity of the equipment, generally requiring more labor to produce. Based on industry feedback, DOE believes that manufacturers that use domestic production currently will continue to produce the same scope of covered equipment in domestic production facilities. DOE does not expect production to shift to lower labor cost countries. To estimate a lower bound to employment, DOE assumed that employment tracks closely with industry shipments, and any percentage decrease in shipments will result in a commensurate percentage decrease in employment. A complete description of the assumptions used to generate these upper and lower bounds can be found in chapter 12 of the final rule TSD.

Using the GRIM, DOE estimates that in the absence of amended energy conservation standards, there would be 653 domestic production workers in the BVM industry. As noted previously, DOE estimates that 90 percent of BVM units sold in the United States are manufactured domestically. Table V.30 shows the range of the impacts of potential amended energy conservation standards on U.S. production workers of beverage vending machines.

Table V.30 Potential Changes in the Total Number of Beverage Vending Machine Production Workers in 2019

		Trial Standard Level				
	No-New-Standards Case*	**1**	**2**	**3**	**4**	**5**
Potential Changes in Domestic Production Workers in 2019**	-	0 to 2	0 to 7	0 to 6	(5) to 46	(49) to 233

* No-new-standards case estimates 653 domestic production workers in the BVM industry in 2019.
** Parentheses indicate negative values.

The upper end of the range estimates the maximum increase in the number of production workers in the BVM industry after implementation of an emended energy conservation standard. It assumes that manufacturers would continue to produce the same scope of covered equipment within the United States and would require some additional labor to produce more efficient equipment.

The lower end of the range represents the maximum decrease in total number of U.S. production workers that could result from an amended energy conservation standard. During interviews, manufacturers noted that, due to the high shipping costs associated with beverage vending machines, they would be hesitant to move any major production operations outside the United States. Therefore, the lower bound of direct employment impacts assumes domestic production of beverage vending machines would decrease by the same relative percentage decrease in industry shipments as a result of an amended energy conservation standard.

This conclusion is independent of any conclusions regarding indirect employment impacts in the broader U.S. economy, which are documented in chapter 16 of the TSD.

c. Impacts on Manufacturing Capacity

In reference to the amended standard levels proposed in the 2015 BVM ECS NOPR, DOE received comments from multiple small, domestic BVM manufacturers stating that the proposed standards could result in one or more small manufacturers exiting the BVM market altogether. As detailed in section IV.J.3, DOE notes that, in response to stakeholder feedback relating to the 2015 BVM ECS NOPR, it has updated its engineering analysis and standard efficiency levels for this final rule, resulting in less burdensome standard levels for all equipment classes of beverage vending machines relative to the NOPR proposal. DOE believes that manufactures will be able to maintain production capacity levels sufficient to meet market demand under the final rule standard levels.

Additionally, manufacturers have expressed concern regarding the potential strain on technical resources associated with having to comply with both DOE amended energy conservation standards and the EPA's R-134a phaseout for beverage vending machines (see SNAP Final Rule 20 (80 FR 42870, 42917–42920 (July 20, 2015))) by 2019. Few manufacturers have experience with CO_2 designs, and no beverage vending machines in the domestic market currently use propane. The switch to CO_2 and propane will require all manufacturers to redesign the majority of their equipment. Manufacturers are concerned they do not have the technical capacity to redesign for new refrigerants and amended energy conservation standards. DOE accounted for the forthcoming R-134a phaseout in its analysis by estimating CO_2- and propane-specific cost-efficiency curves and industry conversion costs related to energy conservation standards compliance, as well as a one-time investment required for the industry to switch all BVM production to CO_2- and propane. Cost-efficiency curves are presented in chapter 5 of the final rule TSD, and information regarding conversion costs is contained in chapter 12.

d. Impacts on Subgroups of Manufacturers

Small manufacturers, niche equipment manufacturers, and manufacturers exhibiting a cost structure substantially different from the industry average could be affected disproportionately. Using average cost assumptions to develop an industry cash-flow estimate is inadequate to assess differential impacts among manufacturer subgroups.

For BVM equipment, DOE identified and evaluated the impact of amended energy conservation standards on one subgroup: small manufacturers. The SBA defines a “small business” as having 1,000 employees or less for NAICS 333318, “Other Commercial and Service Industry Machinery Manufacturing.” Based on this definition, DOE identified five manufacturers in the BVM equipment industry that are small businesses.

For a discussion of the impacts on the small manufacturer subgroup, see the Regulatory Flexibility Analysis in section VI.B of this final rule 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 several impending regulations may have serious consequences for some manufacturers, groups of manufacturers, or an entire industry. Assessing the impact of a single regulation may overlook this cumulative regulatory burden. Multiple regulations affecting the same manufacturer can strain profits and can lead companies to abandon product lines or markets with lower expected future returns than competing equipment. For these reasons, DOE conducts an analysis of cumulative regulatory burden as part of its rulemakings pertaining to appliance efficiency.

For the cumulative regulatory burden analysis, DOE considers other DOE regulations that could affect BVM manufacturers that will take effect approximately 3 years before or after the 2019 compliance date of amended energy conservation standards. The compliance years and expected industry conversion costs of energy conservation standards that may also impact BVM manufacturers are indicated in Table V.31.

Table V.31 Compliance Dates and Expected Conversion Expenses of Federal Energy Conservation Standards Affecting BVM Manufacturers

Regulation	Compliance Date(s)	Expected Expenses / Impacts
Commercial Refrigeration Equipment 79 FR 17725 (Mar. 28, 2014)	3/27/2017	$43.1 million

Manufacturers cited ENERGY STAR standards for beverage vending machines as a source of regulatory burden. DOE notes that ENERGY STAR is a voluntary program that is not federally mandated. As such, DOE does not consider the ENERGY STAR program in its analysis of cumulative regulatory burden.

In interviews and in public comments made in response to the 2015 BVM ECS NOPR, manufactures cited the EPA's SNAP Rule 20 phaseout of HFCs in beverage vending machines by 2019 (80 FR 42870 (July 20, 2015)) as a major source of additional burden accompanying potential amended efficiency standards. As detailed in section IV.J, based on feedback in interviews, DOE assumed that each manufacturer would need to invest $750,000 to update their equipment to comply with Rule 20. DOE assumed this one-time SNAP investment would apply to all eight manufacturers in the year leading up to the phaseout (i.e., 2018), resulting in an additional burden to the industry of $6 million. This one-time cost occurs in both the no-new-standards case and in the standards case.

3. National Impact Analysis

a. Significance of Energy Savings

DOE estimated the NES by calculating the difference in annual energy consumption for the no-new-standards case scenario and standards case scenario at each TSL for each equipment class and summing up the annual energy savings for the beverage vending machines purchased during the 30-year 2019 through 2048 analysis period. Energy impacts include the 30-year period, plus the life of equipment purchased in the last year of the analysis, or roughly 2019 through 2078. The energy consumption calculated in the NIA is 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.2 of this final rule.

Table V.32 presents the source NES for all equipment classes at each TSL and the sum total of NES for each TSL.

Table V.32 Cumulative National Primary Energy Savings for Equipment Purchased in 2019–2048 (Quads)

Equipment Class	Standard Level				
	TSL 1	**TSL 2**	**TSL 3**	**TSL 4**	**TSL 5**
Class A	0.012	0.031	0.012	0.070	0.138
CO_2	0.012	0.024	0.012	0.047	0.087
Propane	0.000	0.008	0.000	0.024	0.051
Class B	0.001	0.010	0.026	0.059	0.091
CO_2	0.000	0.000	0.007	0.026	0.045
Propane	0.001	0.010	0.019	0.033	0.046
Combination A	0.002	0.012	0.051	0.061	0.067
CO_2	0.001	0.007	0.031	0.036	0.040
Propane	0.001	0.005	0.020	0.024	0.027
Combination B	0.001	0.007	0.028	0.035	0.044
CO_2	0.001	0.004	0.017	0.021	0.026
Propane	0.000	0.003	0.011	0.014	0.018
Total*	**0.016**	**0.061**	**0.117**	**0.225**	**0.340**

* Numbers may not add to totals, due to rounding.

Table V.33 presents FFC energy savings at each TSL for each equipment class. The NES increases from 0.017 quads at TSL 1 to 0.355 quads at TSL 5.

Table V.33 Cumulative National Energy Savings including Full-Fuel-Cycle for Equipment Purchased in 2019–2048 (Quads)

Equipment Class	Standard Level				
	TSL 1	**TSL 2**	**TSL 3**	**TSL 4**	**TSL 5**
Class A	0.012	0.033	0.012	0.073	0.144
CO_2	0.012	0.025	0.012	0.049	0.091
Propane	0.000	0.008	0.000	0.025	0.054
Class B	0.001	0.011	0.027	0.061	0.095
CO_2	0.000	0.000	0.007	0.027	0.047
Propane	0.001	0.011	0.020	0.035	0.048
Combination A	0.003	0.013	0.053	0.063	0.070
CO_2	0.002	0.008	0.032	0.038	0.042
Propane	0.001	0.005	0.021	0.025	0.028
Combination B	0.001	0.007	0.029	0.037	0.046
CO_2	0.001	0.004	0.018	0.022	0.027
Propane	0.000	0.003	0.012	0.015	0.019
Total*	**0.017**	**0.063**	**0.122**	**0.235**	**0.355**

* Numbers may not add to totals, due to rounding.

OMB Circular A-4[81] 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 equipment 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.[82] DOE notes that the review timeframe established in EPCA generally does not overlap with the equipment lifetime, equipment manufacturing cycles

[81] U.S. Office of Management and Budget. Circular A-4: Regulatory Analysis. September 17, 2003. Available at www.whitehouse.gov/omb/circulars_a004_a-4/.

[82] EPCA requires DOE to review its standards at least once every 6 years, and requires, for certain products, a 3-year period after any new standard is promulgated before compliance is required, except that in no case may any new standards be required within 6 years of the compliance date of the previous standards. (42 U.S.C. 6295(m)) While adding a 6-year review to the 3-year compliance period adds up to 9 years, DOE notes that it may undertake reviews at any time within the 6-year period and that the 3-year compliance date may yield to the 6-year backstop. A 9-year analysis period may not be appropriate given the variability that occurs in the timing of standards reviews and the fact that for some consumer products, the compliance period is 5 years rather than 3 years.

or other factors specific to beverage vending machines. 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.34. The impacts are counted over the lifetime of equipment purchased in 2019 through 2027.

Table V.34 National Full-Fuel-Cycle Energy Savings for 9 Years of Shipments (2019–2027) (Quads)

Equipment Class	Standard Level				
	TSL 1	**TSL 2**	**TSL 3**	**TSL 4**	**TSL 5**
Class A	0.003	0.007	0.003	0.017	0.033
CO_2	0.003	0.006	0.003	0.011	0.020
Propane	0.000	0.002	0.000	0.006	0.012
Class B	0.000	0.002	0.006	0.014	0.021
CO_2	0.000	0.000	0.002	0.006	0.010
Propane	0.000	0.002	0.005	0.008	0.011
Combination A	0.001	0.003	0.012	0.014	0.016
CO_2	0.000	0.002	0.007	0.009	0.009
Propane	0.000	0.001	0.005	0.006	0.006
Combination B	0.000	0.002	0.007	0.008	0.010
CO_2	0.000	0.001	0.004	0.005	0.006
Propane	0.000	0.001	0.003	0.003	0.004
Total**	**0.004**	**0.014**	**0.028**	**0.054**	**0.080**

* Numbers may not add to totals, due to rounding.

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.35 and Table V.36 show the customer NPV results for each of the TSLs DOE considered for beverage vending machines at both 7-percent and 3-percent discount rates. In each case, the impacts cover the expected lifetime of equipment purchased from 2019 through 2048. 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 all equipment classes. This is consistent with the results of LCC analysis results for TSL 5, which showed significant increase in LCC and significantly higher PBPs. Efficiency levels for TSL 3 were chosen to correspond to the highest NPV at a 7-percent discount rate for all classes. Consequently, the total NPV for beverage vending machines was highest for TSL 3, with a value of $0.207 billion (2014$) at a 7-percent discount rate. TSL 1 showed the second highest total NPV, with a value of $0.030 billion (2014$) at a 7-percent discount rate. TSL 2, TSL 4 and TSL 5 have a total NPV lower than TSL 1 or 3.

Table V.35 Net Present Value at a 7-percent Discount Rate for Equipment Purchased in 2019–2048 (billion 2014$)

Equipment Class	Standard Level*				
	TSL 1	TSL 2	TSL 3	TSL 4	TSL 5
Class A	0.021	(0.058)	0.021	(0.213)	(0.645)
CO_2	0.021	(0.074)	0.021	(0.314)	(0.464)
Propane	0.000	0.016	0.000	0.101	(0.181)
Class B	0.001	0.021	0.047	(0.041)	(0.235)
CO_2	0.000	0.000	0.007	(0.078)	(0.169)
Propane	0.001	0.021	0.041	0.037	(0.065)
Combination A	0.005	0.027	0.085	0.015	(0.075)
CO_2	0.003	0.016	0.056	(0.015)	(0.056)
Propane	0.002	0.011	0.029	0.030	(0.019)
Combination B	0.003	0.016	0.053	0.035	(0.063)
CO_2	0.002	0.009	0.032	0.019	(0.047)
Propane	0.001	0.006	0.022	0.017	(0.016)
Total	**0.030**	**0.006**	**0.207**	**(0.204)**	(1**.017**)

* Values in parentheses are negative numbers.

Table V.36 Net Present Value at a 3-percent Discount Rate for Equipment Purchased in 2019–2048 (billion 2014$)

Equipment Class	Standard Level*				
	TSL 1	TSL 2	TSL 3	TSL 4	TSL 5
Class A	0.054	(0.124)	0.054	(0.450)	(1.281)
CO_2	0.054	(0.163)	0.054	(0.694)	(0.923)
Propane	0.000	0.039	0.000	0.244	(0.358)
Class B	0.002	0.050	0.116	(0.079)	(0.435)
CO_2	0.000	0.000	0.018	(0.172)	(0.319)
Propane	0.002	0.050	0.098	0.093	(0.116)
Combination A	0.013	0.065	0.208	0.056	(0.117)
CO_2	0.008	0.039	0.137	(0.019)	(0.091)
Propane	0.005	0.026	0.071	0.075	(0.026)
Combination B	0.006	0.038	0.129	0.089	(0.116)
CO_2	0.004	0.023	0.077	0.048	(0.086)
Propane	0.003	0.015	0.052	0.041	(0.029)
Total	**0.076**	**0.029**	**0.508**	**(0.0384)**	(**1.949**)

* Values in parentheses are negative numbers.

The NPV results based on the aforementioned 9-year analysis period are presented in Table V.37 and Table V.38. The impacts are counted over the lifetime of equipment purchased in 2019–2027. As mentioned previously in section V.B.3.a of this final rule, 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.37 Net Present Value at a 7-percent Discount Rate for 9 Years of Shipments (2019–2027) (billion 2014$)

Equipment Class	Standard Level*				
	TSL 1	TSL 2	TSL 3	TSL 4	TSL 5
Class A	0.009	(0.026)	0.009	(0.093)	(0.279)
CO_2	0.009	(0.032)	0.009	(0.0135)	(0.200)
Propane	0.000	0.006	0.000	0.041	(0.079)
Class B	0.000	0.008	0.019	(0.020)	(0.104)
CO_2	0.000	0.000	0.003	(0.034)	(0.074)
Propane	0.000	0.008	0.016	0.014	(0.030)
Combination A	0.002	0.011	0.034	0.004	(0.035)
CO_2	0.001	0.007	0.022	(0.008)	(0.025)
Propane	0.001	0.004	0.011	0.012	(0.009)
Combination B	0.001	0.006	0.021	0.014	(0.029)
CO_2	0.001	0.004	0.013	0.007	(0.021)
Propane	0.000	0.003	0.009	0.006	(0.008)
Total	**0.012**	**(0.000)**	**0.083**	**(0.096)**	(**0.446**)

* Values in parentheses are negative numbers.

Table V.38 Net Present Value at a 3-percent Discount Rate for 9 Years of Shipments (2019–2027) (billion 2014$)

Equipment Class	Standard Level*				
	TSL 1	TSL 2	TSL 3	TSL 4	TSL 5
Class A	0.015	(0.041)	0.015	(0.144)	(0.405)
CO_2	0.015	(0.052)	0.015	(0.216)	(0.290)
Propane	0.000	0.011	0.000	0.072	(0.115)
Class B	0.001	0.014	0.033	(0.030)	(0.142)
CO_2	0.000	0.000	0.005	(0.055)	(0.102)
Propane	0.001	0.014	0.028	0.025	(0.040)
Combination A	0.004	0.019	0.059	0.011	(0.043)
CO_2	0.002	0.011	0.039	(0.009)	(0.032)
Propane	0.002	0.008	0.020	0.021	(0.011)
Combination B	0.002	0.011	0.037	0.024	(0.040)
CO_2	0.001	0.007	0.022	0.013	(0.029)
Propane	0.001	0.004	0.015	0.011	(0.011)
Total	**0.022**	**0.003**	**0.144**	**(0.138)**	(**0.630**)

* Values in parentheses are negative numbers.

c. Indirect Impacts on Employment

DOE expects energy conservation standards for beverage vending machines to reduce energy costs for equipment owners, with the resulting net savings being redirected to other forms of economic activity. Those shifts in spending and economic activity 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 beverage vending machines. As described in section IV.N of this final rule, DOE used an input/output model of the U.S. economy to estimate indirect employment impacts of the TSLs that DOE considered in this rulemaking (see chapter 16 of the final rule TSD for more details). DOE understands that there are uncertainties involved in projecting employment impacts, especially changes in the later years of the analysis. Therefore, DOE generated results for near-term time frames (2020–2025), where these uncertainties are reduced.

The results suggest that these adopted standards would be likely to have negligible impact on the net demand for labor in the economy. All TSLs increase net demand for labor by fewer than 1000 jobs. The net change in jobs is so small that it would be imperceptible in national labor statistics and might be offset by other, unanticipated effects on employment. Chapter 16 of the final rule TSD presents more detailed results about anticipated indirect employment impacts. As shown in Table V.39, DOE estimates that net indirect employment impacts from a BVM amended standard are small relative to the national economy.

Table V.39 Net Short-Term Change in Employment (Jobs)

Trial Standard Level	2020	2025
1	2	7
2	22	85
3	43	173
4	71	294
5	(42)*	24

* Values in parentheses are negative numbers.

4. Impact on Utility or Performance of Equipment

In its analyses, DOE has considered potential impacts of amended standards, including the use of design options considered in the engineering analysis, on the performance and utility of BVM equipment. This includes the ability to achieve and maintain the necessary vending temperatures, the ability to display and vend product upon receipt of payment, and other factors core to the utility of vending machine operation. DOE has concluded that the new and amended standards in this final rule will not lessen the utility or performance of beverage vending machines.

5. Impact of Any Lessening of Competition

As discussed in section III.F.1.e, the Attorney General of the United States (Attorney General) determines the impact, if any, of any lessening of competition likely to result from an adopted standard and transmits such determination in writing to the Secretary within 60 days of the publication of a proposed rule, together with an analysis of the nature and extent of the impact. (42 U.S.C. 6295(o)(2)(B)(i)(V) and (B)(ii)) To assist the Attorney General in making such determination, DOE provided the Department of Justice (DOJ) with copies of the 2015 BVM ECS NOPR and the TSD for review. In its assessment letter responding to DOE, DOJ concluded that the proposed energy conservation standards for beverage vending machines are unlikely to have a significant adverse impact on competition. The Attorney General's assessment is published as an appendix at the end of this final rule.

6. Need of the Nation to Conserve Energy

Enhanced energy efficiency, where economically justified, improves the Nation's energy security, strengthens the economy, and reduces the environmental impacts (costs) of energy production. Reduced electricity demand due to energy conservation standards is also likely to reduce the cost of maintaining the reliability of the electricity system, particularly during peak-load periods. As a measure of this reduced demand, chapter 15 in the final rule TSD presents the estimated reduction in generating capacity, relative to the no-new-standards case, for the TSLs that DOE considered in this rulemaking.

Energy conservation resulting from new and amended standards for the BVM equipment classes covered in this final rule will also produce environmental benefits in the form of reduced emissions of air pollutants and greenhouse gases associated with electricity production. Table V.40 provides DOE's estimate of cumulative emissions reductions to result from the TSLs considered in this rulemaking. The table includes both power sector emissions and upstream emissions. The upstream emissions were calculated using the multipliers discussed in section IV.K of this final rule. DOE reports annual CO_2, NO_X, and Hg emissions reductions for each TSL in chapter 13 of the final rule TSD.

Table V.40 Cumulative Emissions Reduction for Potential Standards for Beverage Vending Machines

	TSL				
	1	**2**	**3**	**4**	**5**
Power Sector and Site Emissions					
CO_2 (million metric tons)	0.97	3.61	6.98	13.39	20.23
NO_X (thousand tons)	1.06	3.97	7.66	14.70	22.22
Hg (tons)	0.00	0.01	0.02	0.03	0.05
N_2O (thousand tons)	0.01	0.04	0.09	0.16	0.25
CH_4 (thousand tons)	0.08	0.31	0.60	1.16	1.75
SO_2 (thousand tons)	0.59	2.18	4.22	8.09	12.22
Upstream Emissions					
CO_2 (million metric tons)	0.05	0.20	0.39	0.75	1.13
NO_X (thousand tons)	0.78	2.90	5.60	10.74	16.24
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)	4.30	16.01	30.92	59.34	89.70
SO_2 (thousand tons)	0.01	0.04	0.07	0.14	0.21
Total Emissions					
CO_2 (million metric tons)	1.02	3.81	7.37	14.14	21.36
NO_X (thousand tons)	1.84	6.86	13.26	25.44	38.45
Hg (tons)	0.00	0.01	0.02	0.03	0.05
N_2O (thousand tons)	0.01	0.05	0.09	0.17	0.26
CH_4 (thousand tons)	4.38	16.32	31.52	60.50	91.45
SO_2 (thousand tons)	0.60	2.22	4.29	8.23	12.43

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 estimated for each of the TSLs considered for beverage vending machines. As discussed in section IV.L of this final rule, for CO_2, 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 2014$, are $12.2 per metric ton, $40.0 per metric ton, $62.3 per metric ton, and $117 per metric ton for discount rates of 2.5 percent, 3 percent, 5 percent, and 3 percent respectively. The values for later years are higher due to increasing emissions-related costs as the magnitude of projected climate change increases.

Table V.41 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.41 Global Present Value of CO2 Emissions Reduction for Potential Standards for Beverage Vending Machines

TSL	SCC Case*			
	5% Discount Rate, Average*	3% Discount Rate, Average*	2.5% Discount Rate, Average*	3% Discount Rate, 95th Percentile*
	million 2014$			
Primary Energy Emissions				
1	7	30	48	92
2	24	113	180	344
3	47	218	347	664
4	90	418	666	1,275
5	136	631	1,005	1,925
Upstream Emissions				
1	0	2	3	5
2	1	6	10	19
3	3	12	19	37
4	5	23	37	71
5	7	35	56	107
Total Emissions				
1	7	32	51	97
2	26	119	190	363
3	49	230	366	701
4	95	441	703	1,345
5	143	666	1,061	2,031

* For each of the four cases, the corresponding SCC value for emissions in 2015 is $12.2, $40.0, $62.3, and $117 per metric ton (2014$), respectively.

DOE is 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 review considered 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 included in this final rule the most recent values and analyses resulting from the interagency review process.

DOE also estimated a range for the cumulative monetary value of the economic benefits associated with NO_X emissions reductions anticipated to result from amended standards for the BVM equipment that is the subject of this final rule. The dollar-per-ton values that DOE used are discussed in section IV.L of this final rule. Table V.42 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. This table presents values that use the low dollar-per-ton values, which reflect DOE's primary estimate. Results that reflect the range of NO_X dollar-per-ton values are presented in Table V.44

Table V.42 Present Value of NO_X Emissions Reduction for Potential Standards for Beverage Vending Machines*

TSL	3% Discount Rate	7% Discount Rate
	million 2014$	
Power Sector Emissions		
1	3	1
2	13	5
3	24	9
4	47	18
5	70	27
Upstream Emissions		
1	2	1
2	9	3
3	17	7
4	33	13
5	51	19
Total Emissions		
1	6	2
2	22	8
3	42	16
4	80	31
5	121	46

* Results are based on the low benefit-per-ton values.

7. Other Factors

The Secretary of Energy, in determining whether a standard is economically justified, may consider any other factors that the Secretary deems to be relevant. (42 U.S.C. 6295(o)(2)(B)(i)(VII)) No other factors were considered in this analysis.

8. Summary of National Economic Impacts

The NPV of the monetized benefits associated with emissions reductions can be viewed as a complement to the NPV of the customer savings calculated for each TSL considered in this rulemaking. Table V.43 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 customer savings calculated for each TSL considered in this rulemaking, at both a 7-percent and 3-percent discount rate. The CO_2 values used in the columns of each table correspond to the four sets of SCC values discussed above.

Table V.43 Net Present Value of Customer Savings Combined with Present Value of Monetized Benefits from CO_2 and NO_X Emissions Reductions

TSL	Customer NPV at 3% Discount Rate added with:			
	SCC Case $12.2/ metric ton and 3% Low NO_X Value	**SCC Case $40.0/ metric ton and 3% Low NO_X Value**	**SCC Case $62.3/ metric ton and 3% Low NO_X Value**	**SCC Case $117/ metric ton and 3% Low NO_X Value**
	billion 2014$*			
1	0.088	0.114	0.132	0.179
2	0.077	0.170	0.241	0.414
3	0.599	0.780	0.916	1.251
4	(0.209)	0.137	0.398	1.041
5	(1.685)	(1.162)	(0.767)	0.203
TSL	**Customer NPV at 7% Discount Rate added with:**			
	SCC Case $12.2/ metric ton and 7% Low NO_X Value	**SCC Case $40.0/ metric ton and 7% Low NO_X Value**	**SCC Case $62.3/ metric ton and 7% Low NO_X Value**	**SCC Case $117/ metric ton and 7% Low NO_X Value**
	billion 2014$*			
1	0.039	0.065	0.083	0.130
2	0.040	0.133	0.204	0.377
3	0.272	0.453	0.589	0.924
4	(0.078)	0.268	0.530	1.173
5	(0.827)	(0.305)	0.090	1.061

* Parentheses indicate negative values.
Note: The SCC case values represent the global SCC in 2015, in 2014$, for each case.

In considering the above results, two issues are relevant. First, the national operating cost savings are domestic U.S. monetary savings that occur as a result of market transactions, while the value of CO_2 reductions is based on a global value. Second, the assessments of operating cost savings and the SCC are performed with different methods that use different time frames for analysis. The national operating cost savings is measured for the lifetime of equipment shipped in 2019 to 2048. Because CO_2

emissions have a very long residence time in the atmosphere,[83] the SCC values in future years reflect future climate-related impacts that continue beyond 2100.

C. Conclusion

When considering standards, the new or amended energy conservation standards that DOE adopts for any type (or class) of covered equipment 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)) In determining whether a standard is economically justified, the Secretary must determine whether the benefits of the standard exceed its burdens by, to the greatest extent practicable, considering the seven statutory factors discussed previously. (42 U.S.C. 6295(o)(2)(B)(i)). The new or amended standard must also result in significant conservation of energy. (42 U.S.C. 6295(o)(3)(B))

In this final rule, DOE considered the impacts of the standards for beverage vending machines at each TSL, beginning with the maximum technologically feasible level, to determine whether that level was economically justified. Where 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.

[83] The atmospheric lifetime of CO_2 is estimated of the order of 30–95 years. Jacobson, MZ. "Correction to 'Control of fossil-fuel particulate black carbon and organic matter, possibly the most effective method of slowing global warming.'" J. Geophys. Res. 110. pp. D14105 (2005).

To aid the reader in understanding the benefits and/or burdens of each TSL, tables in this section 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 of this final rule. In addition to the quantitative results presented in the tables, DOE also considers other burdens and benefits that affect economic justification. These include the impacts on identifiable subgroups of customers who may be disproportionately affected by a national standard, impacts on employment, technological feasibility, manufacturer costs, and impacts on competition may affect the economic results presented. SectionV.B.1.b of this final rule presents the estimated impacts of each TSL for these subgroups. DOE discusses the impacts on direct employment in BVM manufacturing in section V.B.2 of this final rule, and discusses the indirect employment impacts in section V.B.3.c of this final rule.

1. Benefits and Burdens of TSLs Considered for BVM Standards

Table V.44, Table V.45, and Table V.46 summarize the quantitative impacts estimated for each TSL for beverage vending machines. The national impacts are measured over the lifetime of beverage vending machines purchased in the 30-year period that begins in the year of compliance with amended standards (2019–2048). The energy savings, emissions reductions, and value of emissions reductions refer to FFC results.

Table V.44 Summary of Analytical Results for Beverage Vending Machines: National Impacts

Category	TSL 1	TSL 2	TSL 3	TSL 4	TSL 5
National FFC Energy Savings (quads)	0.02	0.06	0.12	0.24	0.36
NPV of Customer Benefits (2014$ billion)					
3% Discount Rate	0.08	0.03	0.51	(0.38)	(1.95)
7% Discount Rate	0.03	0.01	0.21	(0.20)	(1.02)
Cumulative Emissions Reduction (Total FFC Emissions)*					
CO_2 (MMt)	1.02	3.81	7.37	14.14	21.36
NO_x (kt)	1.84	6.86	13.26	25.44	38.45
Hg (t)	0.002	0.01	0.02	0.03	0.05
N_2O (kt)	0.01	0.05	0.09	0.17	0.26
N_2O (kt CO_2eq)	3.28	12.23	23.63	45.34	68.47
CH_4 (kt)	4.38	16.32	31.52	60.50	91.45
CH_4 (kt CO_2eq)	122.70	457.00	882.67	1,693.88	2,560.72
SO_2 (kt)	0.60	2.22	4.29	8.23	12.43
Value of Cumulative Emissions Reduction (Total FFC Emissions)					
CO_2 (2014$ million)**	7 to 97	26 to 363	49 to 701	95 to 1,345	143 to 2,031
NO_X – 3% Discount Rate (2014$ million)	6 to 13	22 to 48	42 to 92	80 to 177	121 to 267
NO_X – 7% Discount Rate (2014$ million)	2 to 5	8 to 19	16 to 36	31 to 69	46 to 104

* MMT is million metric ton. kt is thousand tons. t is ton. 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.

Table V.45 NPV of Customer Benefits by Equipment Class

Equipment Class	Discount Rate %	Trial Standard Level*				
		1	2	3	4	5
		billion 2014$				
Class A	3	0.054	(0.124)	0.054	(0.450)	(1.281)
	7	0.021	(0.058)	0.021	(0.213)	(0.645)
Class B	3	0.002	0.050	0.116	(0.079)	(0.435)
	7	0.001	0.021	0.047	(0.041	(0.235)
Combination A	3	0.013	0.065	0.208	0.056	(0.117)
	7	0.005	0.027	0.085	0.015	(0.075)
Combination B	3	0.006	0.038	0.129	0.089	(0.116)
	7	0.003	0.016	0.053	0.035	(0.063)
Total -- All Classes	**3**	**0.076**	**0.029**	**0.508**	**(0.384)**	(**1.949**)
	7	**0.030**	**0.006**	**0.207**	**(0.204)**	(**1.017**)

* Parentheses indicate negative values.

Table V.46 Summary of Analytical Results for Beverage Vending Machines: Manufacturer and Customer Impacts

	TSL 1	TSL 2	TSL 3	TSL 4	TSL 5
Manufacturer Impacts					
Industry NPV relative to a case without standards value of 94.8 (million 2014$)	94.1 to 94.4	94.0 to 94.7	94.0 to 95.2	91.5 to 98.8	79.3 to 112.6
Industry NPV (% Change)	-0.7 to -0.4	-0.8 to -0.1	-0.8 to 0.4	-3.4 to 4.2	-16.4 to 18.9
Customer Mean LCC Savings* (2014$)					
Class A CO_2	65	(217)	65	(937)	(1,424)
Class A Propane	0	71	0	454	(817)
Class B CO_2	0	0	42	(448)	(1,017)
Class B Propane	8	185	361	333	(566)
Combination A CO_2	57	286	990	(234)	(980)
Combination A Propane	58	290	772	793	(470)
Combination B CO_2	30	179	597	359	(870)
Combination B Propane	30	179	610	476	(433)
Customer Simple PBP (years)**					
Class A CO_2	2.0	N/A	2.0	N/A	N/A
Class A Propane	1.1	1.2	1.1	0.9	N/A
Class B CO_2	0.4	1.0	1.1	N/A	58.8
Class B Propane	0.7	0.6	0.5	1.3	64.7
Combination A CO_2	0.2	0.2	0.8	26.1	39.4
Combination A Propane	0.1	0.1	0.7	1.7	24.7
Combination B CO_2	0.1	0.1	0.5	1.6	N/A
Combination B Propane	0.1	0.1	0.3	0.8	N/A
Distribution of Customer LCC Impacts – Net Cost (%)					
Class A CO_2	0	100	0	100	100
Class A Propane	0	0	0	0	100
Class B CO_2	0	0	8	99	100
Class B Propane	3	0	0	1	93
Combination A CO_2	0	0	0	76	93
Combination A Propane	0	0	0	1	82
Combination B CO_2	0	0	0	7	97
Combination B Propane	0	0	0	1	86

* Parentheses indicate negative values.
** Values of N/A indicate paybacks that are not possible, given that more efficient equipment is not only more expensive to purchase, but also costs more to operate.

DOE also notes that the economic literature provides a wide-ranging discussion of how customers trade-off upfront costs and energy savings in the absence of government intervention. Much of this literature attempts to explain why customers appear to undervalue energy efficiency improvements. There is evidence that customers 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, customers 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 customer purchase decisions due to new and amended energy conservation standards, DOE is committed to developing a framework that can support empirical quantitative tools for improved assessment of the customer welfare impacts of appliance standards. DOE posted a paper that discusses the issue of customer 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.[84]

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

As mentioned previously, in this final rule, DOE considered the impacts of the standards for beverage vending machines at each TSL, beginning with the maximum technologically feasible level, to determine whether that level was economically justified. Where 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.

Accordingly, DOE first considered TSL 5, which 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 2019 to 2048. The estimated energy savings from TSL 5 are 0.36 quads of energy, an amount DOE considers significant. TSL 5 has an estimated NPV of customer benefit of negative $1.017 billion using a 7-percent discount rate, and negative $1.949 billion using a 3-percent discount rate.

The cumulative emissions reductions at TSL 5 are 21.4 million metric tons of CO_2, 12.4 thousand tons of SO_2, 38.5 thousand tons of NO_X, 0.05 tons of Hg, 91.5 thousand tons of CH_4, and 0.3 thousand tons of N_2O. The estimated monetary value of the CO_2 emissions reductions at TSL 5 ranges from $143 million to $2,031 million.

At TSL 5, the average LCC savings range from negative $1,424 to negative $433, depending on equipment class. The fraction of customers incurring a net cost range from

82 percent for Combination A machines with propane refrigerant to 100 percent for all Class A machines and Class B machines with CO_2 refrigerant. Accordingly, approximately 90 percent of customers purchasing Class B propane equipment, Combination A CO_2 equipment, Combination B CO_2, and Combination B propane equipment would incur next cost, or 93, 93, 97, and 86 percent of customers, respectively.

At TSL 5, the projected change in INPV ranges from a decrease of $15.5 million to an increase of $17.9 million. If the lower bound of the range of impacts is reached, TSL 5 could result in a net loss of up to 16.4 percent in INPV for manufacturers.

Based on these results, the Secretary concludes that at TSL 5 for beverage vending machines, the benefits of energy savings, emission reductions, and the estimated monetary value of the CO_2 emissions reductions would be outweighed by the negative NPV, negative LCC savings, and the negative INPV on manufacturers. Consequently, DOE has concluded that TSL 5 is not economically justified.

Next DOE considered TSL 4, which saves an estimated total of 0.24 quads of energy, an amount DOE considers significant. TSL 4 has an estimated NPV of customer benefit of negative $0.20 billion using a 7-percent discount rate, and negative $0.38 billion using a 3-percent discount rate.

The cumulative emissions reductions at TSL 4 are 14.1 million metric tons of CO_2, 8.2 thousand tons of SO_2, 25.4 thousand tons of NO_X, 0.03 tons of Hg, 60.5 thousand tons of CH_4, and 0.2 thousand tons of N_2O. The estimated monetary value of the CO_2 emissions reductions at TSL 4 ranges from $95 million to $1,345 million.

At TSL 4, the average LCC savings ranges from negative $937 to positive $793, depending on equipment class. The fraction of customers incurring a net cost range from 0 percent, for Class A propane equipment, to 100 percent, for Class A CO_2 equipment, depending on equipment class. As shown in Table V.46, a large percentage of Class B and Combination A CO_2 equipment incur a net cost, and overall, a majority of customers (53.8 percent) would experience a net cost at TSL 4.

Regarding impacts on manufacturers, at TSL 4, the projected change in INPV ranges from a decrease of $3.2 million to an increase of $4.0 million. At TSL 4, 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, as DOE expects, TSL 4 could result in a net loss of up to 3.4 percent in INPV for manufacturers.

Based on these results, the Secretary concludes that at TSL 4 for beverage vending machines, the benefits of energy savings, emission reductions, and the estimated monetary value of the CO_2 emissions reductions would be outweighed by the negative

NPV, negative LCC savings, and the negative INPV on manufacturers. Consequently, DOE has concluded that TSL 4 is not economically justified.

Next DOE considered TSL 3, which saves an estimated total of 0.12 quads of energy, an amount DOE considers significant. TSL 3 has an estimated NPV of customer benefit of $0.20 billion using a 7-percent discount rate, and $0.51 billion using a 3-percent discount rate.

The cumulative emissions reductions at TSL 3 are 7.4 million metric tons of CO_2, 4.3 thousand tons of SO_2, 13.3 thousand tons of NO_X, 0.02 tons of Hg, 31.5 thousand tons of CH_4, and 0.09 thousand tons of N_2O. The estimated monetary value of the CO_2 emissions reductions at TSL 3 ranges from $49 million to $701 million.

At TSL 3, the average LCC savings ranges from $0 to $990, depending on equipment class. There are no customers incurring a net cost for almost all equipment classes, except for Class B equipment with CO_2 refrigerant for which 8 percent of customers experience a net cost.

At TSL 3, the projected change in INPV ranges from a decrease of $0.7 million to an increase of $0.4 million. If the lower bound of the range of impacts is reached, as DOE expects, TSL 3 could result in a net loss of up to 0.8 percent in INPV for manufacturers.

After carefully considering the analysis results and weighing the benefits and burdens of TSL 3, DOE believes that setting the standards for beverage vending machines at TSL 3 represents the maximum improvement in energy efficiency that is technologically feasible and economically justified. TSL 3 is technologically feasible because the technologies required to achieve these levels already exist in the current market and are available from multiple manufacturers. TSL 3 is economically justified because the benefits to the nation in the form of energy savings, customer NPV at both a 3-percent and 7-percent discount rate, and emissions reductions outweigh the costs associated with reduced INPV and potential effects of reduced manufacturing capacity.

Therefore, DOE is adopting new and amended energy conservation standards for beverage vending machines at TSL 3 as indicated in Table V.47.

Table V.47 Adopted Energy Conservation Standards for Beverage Vending Machines

Equipment Class*	Adopted Energy Conservation Standards** Maximum Daily Energy Consumption (MDEC) kWh/day†
A	0.052 × V + 2.43‡
B	0.052 × V + 2.20‡
Combination A	0.086 × V + 2.66‡
Combination B	0.111 × V + 2.04‡

* See section IV.A.1 of the final rule for a discussion of equipment classes.
** "V" is the representative value of refrigerated volume (ft^3) of the BVM model, as measured in accordance with the method for determining refrigerated volume adopted in the recently amended DOE test procedure for beverage vending machines and appropriate sampling plan requirements. 80 FR 45758 (July 31, 2015). See section III.B and V.A for more details.
† kilowatt hours per day
‡ Trial Standard Level (TSL) 3

2. Summary of Annualized Benefits and Costs of the Adopted Standards

The benefits and costs of the adopted standards can also be expressed in terms of annualized values. The annualized net benefit is the sum of: (1) the annualized national economic value (expressed in 2014$) of the benefits from operating equipment that meet the adopted standards (consisting primarily of operating cost savings from using less energy, minus increases in equipment purchase costs, and (2) the annualized monetary value of the benefits of CO_2 and NO_X emission reductions.[85]

Table V.48 shows the annualized values for beverage vending machines under TSL 3, expressed in 2014$. The results under the primary estimate are as follows. Using a 7-percent discount rate for benefits and costs other than CO_2 reductions (for which DOE used a 3-percent discount rate along with the average SCC series corresponding to a value of $40.0 per metric ton in 2015 (2014$)), the estimated cost of the adopted standards for BVM equipment is $1.8 million per year in increased equipment costs, while the estimated benefits are $22.2 million per year in reduced equipment operating costs, $12.8 million per year in CO_2 reductions, and $1.6 million per year in reduced NO_X emissions. In this case, the net benefit amounts to $35 million per year.

Using a 3-percent discount rate for all benefits and costs and the average SCC series corresponding to a value of $40.0 per metric ton in 2015 (in 2014$), the estimated

[85] To convert the time-series of costs and benefits into annualized values, DOE calculated a present value in 2015, the year used for discounting the NPV of total consumer costs and savings. For the benefits, DOE calculated a present value associated with each year's shipments in the year in which the shipments occur (2020, 2030, etc.), and then discounted the present value from each year to 2015. The calculation uses discount rates of 3 and 7 percent for all costs and benefits except for the value of CO2 reductions, for which DOE used case-specific discount rates. Using the present value, DOE then calculated the fixed annual payment over a 30-year period, starting in the compliance year that yields the same present value.

cost of the adopted standards for beverage vending machines is $1.9 million per year in increased equipment costs, while the estimated annual benefits are $30.2 million in reduced operating costs, $12.8 million in CO_2 reductions, and $2.3 million in reduced NO_X emissions. In this case, the net benefit amounts to $43 million per year.

Table V.48 Annualized Benefits and Costs of Adopted Standards (TSL 3) for Beverage Vending Machines

	Discount Rate	Primary Estimate*	Low Net Benefits Estimate*	High Net Benefits Estimate*
		million 2014$/year		
Benefits				
Customer Operating Cost Savings	7%	22	14	27
	3%	30	18	36
CO_2 Reduction Value ($12.2/metric ton)**	5%	4	2	4
CO_2 Reduction Value ($40.0/metric ton)**	3%	13	8	14
CO_2 Reduction Value ($62.3/metric ton)**	2.5%	19	12	21
CO_2 Reduction Value ($117/metric ton)**	3%	39	26	44
NO_X Reduction Value†	7%	2	1	4
	3%	2	2	6
Total Benefits††	7% range	28 to 63	17 to 41	36 to 75
	7%	37	23	46
	3% range	36 to 72	22 to 46	46 to 86
	3%	45	28	56
Costs				
Customer Incremental Equipment Costs	7%	1.79	0.98	2.10
	3%	1.89	1.01	2.13
Net Benefits				
Total††	7% range	26 to 61	16 to 40	34 to 73
	7%	35	22	44
	3% range	34 to 70	21 to 45	44 to 84
	3%	43	27	54

* This table presents the annualized costs and benefits associated with beverage vending machines shipped in 2019–2048. These results include benefits to customers that accrue after the last year of analyzed shipments (2048) from the equipment purchased in during the 30-year analysis period. The results account for the incremental variable and fixed costs incurred by manufacturers due to the standard, some of which may be incurred in preparation for the

rule. The primary, low benefits, and high benefits estimates utilize projections of energy prices from the AEO2015 Reference case, Low Economic Growth case, and High Economic Growth case, respectively as well as the default shipments scenario along with the low and high shipments scenarios. In addition, incremental equipment costs reflect a medium decline rate for projected equipment price trends in the primary estimate, a low decline rate for projected equipment price trends in the low benefits estimate, and a high decline rate for projected equipment price trends in the high benefits estimate. The methods used to derive projected price trends are explained in appendix 8C of the technical support document.

** The CO_2 values represent global monetized SCC values, in 2014$, in 2015 under several scenarios. The first three cases use the averages of SCC distributions calculated using 5-percent, 3-percent, and 2.5-percent discount rates, respectively. The fourth case represents the 95th percentile of the SCC distribution calculated using a 3-percent discount rate. The SCC time series incorporates an escalation factor.
† The $/ton values used for NO_X are described in section IV.L.2. The Primary and Low Benefits Estimates used the values at the low end of the ranges estimated by EPA, while the High Benefits Estimate uses the values at the high end of the ranges.
†† Total benefits for both the 3-percent and 7-percent cases are derived using the series corresponding to the average SCC with a 3-percent discount rate ($40.0/metric ton case). In the rows labeled "7% plus CO_2 range" and "3% plus CO_2 range," the operating cost and NO_X benefits are calculated using the labeled discount rate, and those values are added to the full range of CO_2 values.

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 the adopted standards for beverage vending machines are intended to 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 equipment that is not captured by the users of such equipment. These benefits include externalities related to public health, environmental protection and national energy 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. DOE attempts to qualify some of the external benefits through use of social cost of carbon values.

The Administrator of the Office of Information and Regulatory Affairs (OIRA) in the OMB has determined that this regulatory action is not a significant regulatory action under section (3)(f) of Executive Order 12866. Section 6(a)(3)(A) of the Executive Order states that absent a material change in the development of the planned regulatory action, regulatory action not designated as significant will not be subject to review under section 6(a)(3) unless, within 10 working days of receipt of DOE's list of planned regulatory actions, the Administrator of OIRA notifies the agency that OIRA has determined that a planned regulation is a significant regulatory action within the meaning of the Executive order.

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, OIRA 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 a final regulatory flexibility analysis (FRFA) for any final rule. As required by Executive Order 13272, "Proper Consideration of Small Entities in Agency Rulemaking," 67 FR 53461 (August 16, 2002), DOE published procedures and policies on February 19, 2003, to ensure that the potential impacts of its rules on small entities are properly considered during the rulemaking process. 68 FR 7990. DOE has made its procedures and policies available on the Office of the General Counsel's website (http://energy.gov/gc/office-general-counsel). DOE has prepared the following FRFRA for the equipment that are the subject of this rulemaking.

For manufacturers of BVM equipment, the SBA has set a size threshold, which defines those entities classified as "small businesses" for the purposes of the statute. DOE used the SBA's small business size standards to determine whether any small entities would be subject to the requirements of the rule. See 13 CFR part 121. The size standards are listed by North American Industry Classification System (NAICS) code and industry description and are available at www.sba.gov/content/table-small-business-size-standards. BVM equipment manufacturing is classified under NAICS 333318, "Other Commercial and Service Industry Machinery Manufacturing." The SBA sets a threshold of 1,000 employees or less for an entity to be considered as a small business for this category.

1. Description of Estimated Number of Small Entities Regulated

During its market survey, DOE used available public information to identify potential small manufacturers. DOE's research involved public databases (e.g., DOE's Compliance Certification Management System (CCMS),[86] and ENERGY STAR[87] databases), individual company Web sites, and market research tools (e.g., Hoovers reports[88]) to create a list of companies that manufacture or sell equipment covered by this rulemaking. DOE also asked stakeholders and industry representatives during manufacturer interviews and at DOE public meetings if they were aware of any other small manufacturers. 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 BVM equipment. DOE screened out companies that do not offer equipment covered by this rulemaking, do not meet the definition of a "small business," or are foreign-owned.

DOE identified eight companies selling BVM equipment in the United States. Four are small domestic manufacturers and one is a small foreign manufacturer with domestic-sited subsidiary that serves as its marketing arm in the United States. DOE contacted all identified BVM manufacturers for interviews. Ultimately, DOE interviewed manufacturers representing approximately 78 percent of BVM equipment industry shipments and approximately 50 percent of the small business shipments.

[86] "CCMS." CCMS. www.regulations.doe.gov/certification-data/.
[87] ENERGY STAR Certified Vending Machines. June 6, 2013. www.energystar.gov/products/certified-products.
[88] Hoovers. www.hoovers.com/.

2. Description and Estimate of Compliance Requirements

The four small domestic BVM manufacturers account for approximately 15–20 percent of BVM equipment shipments. The small domestic manufacturers are Automated Merchandising Systems, Multi-Max Systems, Seaga, and Wittern.

In general, the small manufacturers focus on the Combination A and Combination B market segments. Together, the four domestic and one foreign small manufacturer account for 74 percent of Combination A and Combination B sales. Based on the shipments analysis, Combination A and Combination B shipments account for roughly 18 percent of the total BVM market. The market share estimates are based on aggregate information compiled through manufacturer interviews. The interview process is described in section IV.J.1 of this notice and chapter 12 of the TSD. The interview guide used for interviews was published as Appendix 12B of the NOPR TSD. The shipments percentages are from shipments analysis, which is explained in section IV.G of this notice.

The remaining 82 percent of BVM shipments are Class A and Class B units. Based on data obtained during manufacturer interviews, DOE estimated that small business manufacturers (including the one foreign small manufacturer) account for approximately 5 percent of the market for each of the Class A and Class B market segments. The remaining 95 percent of both Class A and Class B market segments are held by the three large manufacturers: Crane, Royal Vendors, and SVA.

DOE derived industry conversion using a top-down approach described in methodology section IV.J.2.a. Using product platform counts by equipment type (i.e., Class A, Class B, Combination A, Combination B) and manufacturer, DOE estimated the distribution of industry conversion costs between small manufacturers and large manufacturers. Using its count of manufacturers, DOE calculated capital conversion costs (Table VI.1) and product conversion costs (Table VI.2) for an average small manufacturer versus an average large manufacturer. To provide context on the size of the conversion costs relative to the size of the businesses, DOE presents the conversion costs relative to annual revenue and annual operating profit under the final standard level, as shown in **Error! Reference source not found.**. The current annual revenue and annual operating profit estimates are derived from the GRIM's industry revenue calculations and the market share breakdowns of small versus large manufacturers.

Table VI.1 Comparison of Typical Small and Large Manufacturer's Capital Conversion Costs*

Trial Standard Level	Capital Conversion Costs for Typical Small Manufacturer 2014$ millions	Capital Conversion Costs for Typical Large Manufacturer 2014$ millions
TSL 1	0.03	0.06
TSL 2	0.03	0.06
TSL 3	0.03	0.06
TSL 4	0.11	0.20
TSL 5	0.31	0.70

* Capital conversion costs are the capital investments made during the 3-year period between the publication of the final rule and the compliance year of the final standard.

Table VI.2 Comparison of Typical Small and Large Manufacturer's Product Conversion Costs*

Trial Standard Level	Product Conversion Costs for Typical Small Manufacturer 2014$ millions	Product Conversion Costs for Typical Large Manufacturer 2014$ millions
TSL 1	0.06	0.09
TSL 2	0.06	0.09
TSL 3	0.06	0.09
TSL 4	0.12	0.19
TSL 5	0.23	0.54

* Product conversion costs are the R&D and other product development investments made during the 3-year period between the publication of the final rule and the compliance year of the final standard.

Table VI.3 Comparison of Conversion Costs for an Average Small and an Average Large Manufacturer at TSL 3

	Capital Conversion Cost 2014$ millions	Product Conversion Cost 2014$ millions	Conversion Costs / Annual Revenue	Conversion Costs / Annual Operating Profit	Conversion Costs / Conversion Period Revenue*	Conversion Costs / Conversion Period Operating Profit*
Small Manufacturer	0.03	0.06	1.5%	26.4%	0.5%	8.8%
Large Manufacturer	0.06	0.09	0.3%	5.8%	0.1%	1.9%

* The conversion period, the time between the final rule publication year and the compliance year for this rulemaking, is 3 years.

At the established standard level, DOE estimates total conversion costs associated with new and amended energy conservation standards for an average small manufacturer to be $87,000, which is approximately 1.5 percent of annual revenue and 26.4 percent of annual operating profit. This suggests that an average small manufacturer would need to reinvest roughly 8.8 percent of its operating profit per year over the conversion period to comply with standards. In addition, DOE found that 17 of 19 Class A models in the combined CCMS and ENERGY STAR databases will be compliant with standards as amended in this final rule, with no modification required under appendix A. This includes units from AMS, Wittern, and Seaga (all small manufacturers), in addition to Royal, Crane, and SandenVendo (all large manufacturers).

The total conversion costs associated with new and amended energy conservation standards for an average large manufacturer is $150,000, which is approximately 0.3 percent of annual revenue and 5.8 percent of annual operating profit. This suggests that an average large manufacturer would need to reinvest roughly 1.9 percent of its operating profit per year over the 3-year conversion period.

Product conversion costs, which include one-time investments such as equipment redesigns and industry certification, are a key driver of conversion investments to comply with the established level of standards. Product conversion costs tend to be fixed and do not scale with sales volume. For each equipment platform, small businesses must make redesign investments that are similar to their large competitors. However, because small manufacturers' costs are spread over a lower volume of units, it takes longer for small manufacturers to recover their investments. Similarly, capital conversion costs are spread across a lower volume of shipments for small business manufacturers. DOE notes that all small manufacturers manufacturer both conventional (i.e., Class A and Class B equipment) as well as combination equipment; there are no small manufacturers that manufacturer only combination equipment. DOE's product research suggests the combination and conventional equipment from the same manufacturer often share design elements, such as cabinet and glass pack designs. Manufacturers that produce both combination and conventional equipment using shared design elements would experience conversion costs lower than those estimated since a single redesign effort could be leveraged across models in multiple equipment classes.

DOE notes that, in response to stakeholder feedback relating to the 2015 BVM ECS NOPR, it has updated its engineering analysis and standard efficiency levels for this final rule, resulting in less burdensome standard levels for small manufacturers of beverage vending machines relative to the 2015 BVM ECS NOPR proposal. In the 2015 BVM ECS NOPR, DOE estimated that the average small manufacturer would incur costs of $217,000 as a result of proposed standards. For this final rule, DOE estimates that the average small manufacturer will incur costs of $87,000 as a result of final standards.

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 today's final rule.

4. Significant Alternatives to the Rule

DOE received two comments concerning alternative programs. SVA expressed the belief that voluntary programs such as ENERGY STAR are more effective in driving the market towards more efficient equipment than mandatory energy conservation standards. (SVA, Public Meeting Transcript, No. 48 at p. 117) ASAP commented that while ENERGY STAR has been effective in moving the market towards more efficient equipment, DOE's final standards can achieve far greater savings. (ASAP, Public Meeting Transcript, No. 48 at p. 118) Neither comment provided any supporting data. In addition, SBA Advocacy stated its belief that DOE did not adequately analyze the impact of any alternatives presented in the RIA on small manufacturers and questioned

DOE's analysis of lower TSLs as alternatives to the proposed standard if EPCA restricts DOE from selecting such less burdensome standards. (SBA Advocacy, No. 61 at p. 4).

DOE thanks SVA and ASAP for their comments regarding the efficacy of ENERGY STAR in driving the market towards increased efficiency and agrees with the ASAP assessment of ENERGY STAR and DOE's energy conservation standards as being complementary and more effective than voluntary standards alone. In particular, in response to SVA's comment regarding the efficacy of voluntary programs like ENEGY STAR in achieving energy savings, DOE considered such alternatives in the Regulatory Impact Analysis. However, DOE notes that it is difficult to confidently estimate the future impacts of voluntary or market-based programs because DOE does not control the stringency of any such programs compared to the current equipment efficiency distributions. Further, unlike the energy conservation standards adopted in this final rule, compliance with such programs or incentives is voluntary, and it is therefore difficult to estimate savings since it is unclear if and how many manufacturers or customers will choose to participate. In addition, as noted by ASAP, the benefits of any such voluntary programs would likely be significantly less than DOE's amended energy conservation standards, since it is unlikely that there would be significant percent market penetration or commensurately more-stringent energy efficiency targets for beverage vending machines.

In response to SBA Advocacy's comment regarding DOE's analysis of the impacts of regulatory alternatives on small businesses, the discussion in the previous section analyzes impacts on small businesses that would result from DOE's final rule, TSL 3. In reviewing alternatives to the final rule, DOE examined energy conservation standards set at lower efficiency levels. As a result of these updates, DOE found that TSL 1 and TSL 2 would not reduce the impacts on small business manufacturers (relative to TSL 3) and both would come at the expense of a reduction in energy savings and a reduction in consumer NPV. TSL 1 achieves 86 percent lower energy savings compared to the energy savings at TSL 3. TSL 2 achieves 48 percent lower energy savings compared to the energy savings at TSL 3. The estimated conversion costs for small business manufacturers are estimated to be the same at TSL 1 and TSL 2 as at TSL 3 ($87,000).

Additionally, DOE considered standards at higher efficiency levels, corresponding to TSL 4 and TSL 5. TSL 4 achieves approximately 94 percent higher savings than TSL 3, and TSL 5 achieves approximately 191 percent higher savings than TSL 3. However, DOE rejected this TSL due to the negative NPV results.

Furthermore, the estimated conversion costs for small business manufacturers are significantly higher at TSL 4 and TSL 5 than at TSL 3. To comply with TSL 4, the average small manufacturer must make $228,000 in conversion cost investments, which is $141,000 more than at TSL 3. To comply with TSL 5, the average small manufacturer must make $542,000 in conversion cost investments, which is $455,000 more than at TSL 3.

DOE believes that establishing standards at TSL 3 balances the benefits of the energy savings at TSL 3 with the potential burdens placed on beverage vending machine manufacturers, including small business manufacturers. Accordingly, DOE is declining to adopt one of the other TSLs considered in the analysis, or the other policy alternatives detailed as part of the regulatory impacts analysis included in chapter 17 of the final rule TSD.

Regarding SBA Advocacy's comment questioning DOE's analysis of lower TSLs are reasonable regulatory alternatives, DOE is following SBA Advocacy's public guidance to Federal agencies for how to comply with the Regulatory Flexibility Analysis Act, wherein SBA Advocacy states that agencies "should consider a variety of mechanisms to reach the regulatory objective without regard to whether that mechanism is statutorily permitted."[89]

DOE also notes that additional compliance flexibilities may be available through other means. EPCA provides that a manufacturer whose annual gross revenue from all of its operations does not exceed $8 million 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,

[89] U.S. Small Business Administration Office of Advocacy. A Guide for Government Agencies, How to Comply with the Regulatory Flexibility Act. May 2012. https://www.sba.gov/sites/default/files/rfaguide_0512_0.pdf

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.

DOE believes that establishing standards at TSL 3 balances the benefits of the energy savings at TSL 3 with the potential burdens placed on refrigerated beverage vending machine manufacturers, including small business manufacturers. Accordingly, DOE is declining to adopt one of the other TSLs considered in the analysis, or the other policy alternatives detailed as part of the regulatory impacts analysis included in Chapter 17 of this NOPR TSD.

C. Review Under the Paperwork Reduction Act

Manufacturers of beverage vending machines must certify to DOE that their equipment comply with any applicable energy conservation standards. In certifying compliance, manufacturers must test their equipment according to the DOE test procedures for beverage vending machines, 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 beverage vending machines. 76 FR 12422 (March 7, 2011); 80 FR 5099 (Jan. 30, 2015). 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 30 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 the 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 App. B, B(1)–(5). The final rule fits within this 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 rule is available at http://energy.gov/nepa/categorical-exclusion-cx-determinations-cx.

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. DOE has examined this final rule and has determined that it would not have a substantial direct effect on the States, on the relationship between the national government and the States, or on the distribution of power and responsibilities among the various levels of government. EPCA governs and prescribes Federal preemption of State regulations as to energy conservation for the equipment that is 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) Therefore, 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; (3) provide a clear legal standard for affected conduct rather than a general standard; and (4) promote simplification and burden reduction. 61 FR 4729 (Feb. 7, 1996). Regarding the review required by section 3(a), 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. Pub. L. 104-4, sec. 201 (codified at 2 U.S.C. 1531). For a 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 them. 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/sites/prod/files/gcprod/documents/umra_97.pdf.

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 this document 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(d), (f), and (o), 6313(e), and 6316(a), this final rule would establish new and amended energy conservation standards for beverage vending machines that are designed to achieve the maximum improvement in energy efficiency that DOE has determined to be both technologically feasible and economically justified. A full discussion of the alternatives considered by DOE is presented in the "Regulatory Impact Analysis" section of the TSD for this 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 final 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

Pursuant to Executive Order 12630, "Governmental Actions and Interference with Constitutionally Protected Property Rights," 53 FR 8859 (March 18, 1988), DOE has determined that this final rule 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 information quality guidelines established by each agency pursuant to general guidelines issued by OMB. OMB's guidelines were published at 67 FR 8452 (Feb. 22, 2002), and DOE's guidelines were published at 67 FR 62446 (Oct. 7, 2002). DOE has reviewed 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 new and amended energy conservation standards for beverage vending machines, is not a significant energy action because the 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 this 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 (Jan. 14, 2005). The Bulletin establishes that certain scientific information shall be peer reviewed by qualified specialists before it is disseminated by the Federal Government, including influential scientific information related to agency regulatory actions. The purpose of the bulletin is to enhance the quality and credibility of the Government's scientific information. Under the Bulletin, the energy conservation standards rulemaking analyses are "influential scientific information," which the Bulletin defines as "scientific information the agency reasonably can determine will have, or does have, a clear and substantial impact on important public policies or private sector decisions." Id at FR 2667.

In response to OMB's Bulletin, DOE conducted formal in-progress peer reviews of the energy conservation standards development process and analyses and has prepared a Peer Review Report pertaining to the energy conservation standards rulemaking analyses. Generation of this report involved a rigorous, formal, and documented evaluation using objective criteria and qualified and independent reviewers to make a judgment as to the technical/scientific/business merit, the actual or anticipated results, and the productivity and management effectiveness of programs 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: http://energy.gov/eere/buildings/downloads/energy-conservation-standards-rulemaking-peer-review-report.

M. Review Under Section 32 of the Federal Energy Administration Act of 1974

Under section 301 of the Department of Energy Organization Act (Pub. L. 95-91; 42 U.S.C. 7101), DOE must comply with section 32 of the Federal Energy Administration Act of 1974, as amended by the Federal Energy Administration Authorization Act of 1977. (15 U.S.C. 788; FEAA) Section 32 essentially provides in relevant part that, where a proposed rule authorizes or requires use of commercial standards, the notice of proposed rulemaking must inform the public of the use and background of such standards. In addition, section 32(c) requires DOE to consult with the Attorney General and the Chairman of the Federal Trade Commission (FTC) concerning the impact of the commercial or industry standards on competition.

This final rule incorporates testing methods contained in the following standard: ASTM Standard E 1084-86, "Standard Test Method for Solar Transmittance (Terrestrial) of Sheet Materials Using Sunlight." DOE has evaluated this standard and is unable to conclude whether it fully complies with the requirements of section 32(b) of the Federal Energy Administration Act (i.e., whether they were developed in a manner that fully provides for public participation, comment, and review).

DOE has consulted with both the Attorney General and the Chairwoman of the FTC about the impact on competition of using the methods contained in this standard and has received no comments objecting to its use.

N. 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 this final rule.

List of Subjects

10 CFR Part 429

Confidential business information, Energy conservation, Household appliances, Imports, Reporting and recordkeeping requirements.

10 CFR Part 431

Administrative practice and procedure, Confidential business information, Energy conservation, Incorporation by reference, Reporting and recordkeeping requirements.

Issued in Washington, DC, on December 23, 2015.

David J. Friedman
Principal Deputy Assistant Secretary
Energy Efficiency and Renewable Energy

For the reasons set forth in the preamble, DOE amends parts 429 and 431 of chapter II of title 10 of the Code of Federal Regulations, as set forth below:

PART 429 – CERTIFICATION, COMPLIANCE, AND ENFORCEMENT FOR CONSUMER PRODUCTS AND COMMERCIAL AND INDUSTRIAL EQUIPMENT

1. The authority citation for part 429 continues to read as follows:

Authority: 42 U.S.C. 6291–6317.

2. Section 429.52 is amended by adding paragraph (a)(3) to read as follows:

§ 429.52 Refrigerated bottled or canned beverage vending machines.

(a) * * *

(3) The representative value of refrigerated volume of a basic model reported in accordance with paragraph (b)(2) of this section shall be the mean of the refrigerated volumes measured for each tested unit of the basic model and determined in accordance with the test procedure in §431.296.

* * * * *

3. Section 429.134 is amended by adding paragraph (g) to read as follows:

§ 429.134 Product-specific enforcement provisions.

* * * * *

(g) <u>Refrigerated Bottled or Canned Beverage Vending Machines.</u> (1) <u>Verification of Refrigerated Volume</u>. The refrigerated volume (V) of each tested unit of the basic model will be measured pursuant to the test requirements of 10 CFR 431.296. The results of the measurement(s) will be compared to the representative value of refrigerated volume certified by the manufacturer. The certified refrigerated volume will be considered valid only if the measurement(s) (either the measured refrigerated volume for a single unit sample or the average of the measured refrigerated volumes for a multiple unit sample) is within five percent of the certified refrigerated volume.

(i) If the representative value of refrigerated volume is found to be valid, the certified refrigerated volume will be used as the basis for calculation of maximum daily energy consumption for the basic model.

(ii) If the representative value of refrigerated volume is found to be invalid, the average measured refrigerated volume determined from the tested unit(s) will serve as the basis for calculation of maximum daily energy consumption for the tested basic model.

(2) Verification of Surface Area, Transparent, and Non-Transparent Areas. The percent transparent surface area on the front side of the basic model will be measured pursuant to these requirements for the purposes of determining whether a given basic model meets the definition of Class A or Combination A, as presented at 10 CFR 431.292. The transparent and non-transparent surface areas shall be determined on the front side of the beverage vending machine at the outermost surfaces of the beverage vending machine cabinet, from edge to edge, excluding any legs or other protrusions that extend beyond the dimensions of the primary cabinet. Determine the transparent and non-transparent areas on each side of a beverage vending machine as described in paragraphs (g)(2)(i) and (ii) of this section. For combination vending machines, disregard the surface area surrounding any refrigerated compartments that are not designed to be refrigerated

(as demonstrated by the presence of temperature controls), whether or not it is transparent. Determine the percent transparent surface area on the front side of the beverage vending machine as a ratio of the measured transparent area on that side divided by the sum of the measured transparent and non-transparent areas, multiplying the result by 100.

(i) Determination of Transparent Area. Determine the total surface area that is transparent as the sum of all surface areas on the front side of a beverage vending machine that meet the definition of transparent at 10 CFR 431.292. When determining whether or not a particular wall segment is transparent, transparency should be determined for the aggregate performance of all the materials between the refrigerated volume and the ambient environment; the composite performance of all those materials in a particular wall segment must meet the definition of transparent for that area be treated as transparent.

(ii) Determination of Non-Transparent Area. Determine the total surface area that is not transparent as the sum of all surface areas on the front side of a beverage vending machine that are not considered part of the transparent area, as determined in accordance with paragraph (g)(2)(i) of this section.

PART 431 - ENERGY EFFICIENCY PROGRAM FOR CERTAIN COMMERCIAL AND INDUSTRIAL EQUIPMENT

4. The authority citation for part 431 continues to read as follows:

Authority: 42 U.S.C. 6291–6317.

5. Section 431.292 is amended by:

a. Revising the definitions for “Class A”, “Class B”, and “Combination vending machine”; and

b. Adding, in alphabetical order, definitions for “Combination A,” “Combination B,” and “Transparent”.

The revisions and additions read as follows:

§ 431.292 Definitions concerning refrigerated bottled or canned beverage vending machines.

* * * * *

Class A means a refrigerated bottled or canned beverage vending machine that is not a combination vending machine and in which 25 percent or more of the surface area on the front side of the beverage vending machine is transparent.

Class B means a refrigerated bottled or canned beverage vending machine that is not considered to be Class A and is not a combination vending machine.

Combination A means a combination vending machine where 25 percent or more of the surface area on the front side of the beverage vending machine is transparent.

Combination B means a combination vending machine that is not considered to be Combination A.

Combination vending machine means a bottled or canned beverage vending machine containing two or more compartments separated by a solid partition, that may or may not share a product delivery chute, in which at least one compartment is designed to be refrigerated, as demonstrated by the presence of temperature controls, and at least one compartment is not.

* * * * *

Transparent means greater than or equal to 45 percent light transmittance, as determined in accordance with ASTM E 1084 - 86 (Reapproved 2009), (incorporated by reference, see §431.293) at normal incidence and in the intended direction of viewing.

* * * * *

6. Section 431.293 is amended by adding paragraph (c) to read as follows:

§431.293 Materials incorporated by reference.

* * * * *

(c) ASTM. ASTM International, 100 Barr Harbor Drive, PO Box C700, West Conshohocken, PA, 19428-2959, (877) 909-2786, or go to www.astm.org.

(1) ASTM E 1084 - 86 (Reapproved 2009), "Standard Test Method for Solar Transmittance (Terrestrial) of Sheet Materials Using Sunlight," approved April 1, 2009, IBR approved for §431.292.

(2) [Reserved]

7. Section 431.296 is revised to read as follows:

§431.296 Energy conservation standards and their effective dates.

(a) Each refrigerated bottled or canned beverage vending machine manufactured on or after August 31, 2012 and before **[INSERT DATE 3 YEARS AFTER DATE OF PUBLICATION IN THE FEDERAL REGISTER]**, shall have a daily energy consumption (in kilowatt hours per day), when measured in accordance with the DOE test procedure at §431.294, that does not exceed the following:

Equipment Class	Maximum Daily Energy Consumption kilowatt hours per day
Class A	$0.055 \times V^{\dagger} + 2.56$
Class B	$0.073 \times V^{\dagger} + 3.16$
Combination Vending Machines	[RESERVED]

† "V" is the representative value of refrigerated volume (ft^3) of the BVM model, as calculated pursuant to 10 CFR 429.52(a)(3).

(b) Each refrigerated bottled or canned beverage vending machine manufactured on or after **[INSERT DATE 3 YEARS AFTER DATE OF PUBLICATION IN THE FEDERAL REGISTER]**, shall have a daily energy consumption (in kilowatt hours per day), when measured in accordance with the DOE test procedure at §431.294, that does not exceed the following:

Equipment Class	Maximum Daily Energy Consumption kilowatt hours per day
Class A	$0.052 \times V^{\dagger} + 2.43$
Class B	$0.052 \times V^{\dagger} + 2.20$
Combination A	$0.086 \times V^{\dagger} + 2.66$
Combination B	$0.111 \times V^{\dagger} + 2.04$

† "V" is the representative value of refrigerated volume (ft^3) of the BVM model, as calculated pursuant to 10 CFR 429.52(a)(3).

* * * * *

Note: The following letter will not appear in the Code of Federal Regulations.

U.S.DEPARTMENT OF JUSTICE

Antitrust Division

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October 19, 2015

Anne Harkavy

Deputy General Counsel for Litigation, Regulation and Enforcement

1000 Independence Ave. S.W.

U.S. Department of Energy Washington, DC 20585

Re: Energy Conservation Standards for Refrigerated Beverage Vending Machines; Doc. No. EERE-2013-BT-STD-0022

Dear Deputy General Counsel Harkavy:

I am responding to your August 20, 2015, letter seeking the views of the Attorney General about the potential impact on competition of proposed energy conservation standards for refrigerated beverage vending machines. 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 or increasing industry concentration. 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 (80 Fed. Reg. 50462, Aug. 19, 2015) (NOPR) and the related Technical Support Documents. We have also reviewed supplementary information submitted to the Attorney General by the Department of Energy, as well as materials presented at the public meeting held on the proposed standards on September 29, 2015. Based on this review, our conclusion is that the proposed energy conservation standards for refrigerated beverage vending machines are unlikely to have a significant adverse impact on competition.

Sincerely,

William J. Baer