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DEPARTMENT OF ENERGY

10 CFR Part 430

[Docket Number EERE–2011–BT–STD–0043]

RIN 1904-AC51

Energy Conservation Program: Energy Conservation Standards for Miscellaneous Refrigeration Products

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

ACTION: Direct final rule.

SYNOPSIS: The Energy Policy and Conservation Act of 1975, as amended, established the Energy Conservation Program for Consumer Products Other Than Automobiles. Based on provisions in EPCA that enable the Secretary of Energy to classify additional types of consumer products as covered products, the U.S. Department of Energy (DOE) classified miscellaneous refrigeration products as covered consumer products under EPCA. In this direct final rule, DOE is adopting new energy conservation standards for these products that correspond to the recommendations submitted jointly by interested persons that are fairly representative of relevant points of view. DOE has determined that the new energy conservation standards for these products would result in significant conservation of energy, and are technologically feasible and economically justified. A notice of proposed rulemaking that proposes identical energy efficiency standards is

published elsewhere in this Federal Register. If DOE receives adverse comment and determines that such comment may provide a reasonable basis for withdrawal, DOE will withdraw the direct final rule and will proceed with the proposed rule.

DATES: The effective date of this rule is **[INSERT DATE 120 DAYS AFTER DATE OF PUBLICATION IN THE FEDERAL REGISTER]** unless adverse comment is received by **[INSERT DATE 110 DAYS AFTER DATE OF PUBLICATION IN THE FEDERAL REGISTER]**. If adverse comments are received that DOE determines may provide a reasonable basis for withdrawal of the final rule, a timely withdrawal of this rule will be published in the Federal Register. If no such adverse comments are received, compliance with the new standards established in this direct final rule will be required for miscellaneous refrigeration products as detailed in the **SUPPLEMENTARY INFORMATION** section of this document. Compliance with these new standards for miscellaneous refrigeration products is required starting on October 28, 2019.

ADDRESSES: Any comments submitted must identify the direct final rule for Energy Conservation Standards for miscellaneous refrigeration products and provide docket number EERE-2011-BT-STD-0043 and/or regulatory information number (RIN) 1904-AC51. Comments may be submitted using any of the following methods:

1) Federal eRulemaking Portal: www.regulations.gov. Follow the instructions for submitting comments.

2) Email: WineChillers-2011-STD-0043@ee.doe.gov. Include the docket number and/or RIN in the subject line of the message. Submit electronic comments in WordPerfect, Microsoft Word, PDF, or ASCII file format, and avoid the use of special characters or any form of encryption.

3) Postal Mail: Appliance and Equipment Standards Program, U.S. Department of Energy, Building Technologies Office, Mailstop EE-5B, 1000 Independence Avenue, SW., Washington, DC, 20585-0121. If possible, please submit all items on a compact disc (CD), in which case it is not necessary to include printed copies.

4) Hand Delivery/Courier: Appliance and Equipment Standards Program, U.S. Department of Energy, Building Technologies Office, 950 L'Enfant Plaza, SW., 6th Floor, Washington, DC, 20024. Telephone: (202) 586-6636. If possible, please submit all items on a CD, in which case it is not necessary to include printed copies.

No telefacsimilies (faxes) will be accepted. For detailed instructions on submitting comments and additional information on the rulemaking process, see section VII of this document ("Public Participation").

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

A link to the docket web page can be found at: https://www.regulations.gov/docket?D=EERE-2011-BT-STD-0043. This webpage contains a link to the docket for this document on the www.regulations.gov site. The www.regulations.gov webpage contains simple instructions on how to access all documents, including public comments, in the docket. For further information on how to submit a comment, review other public comments and the docket, or participate in the public meeting, contact the Appliance and Equipment Standards Program Staff at (202) 586-6636 or by email: appliance_standards_public_meetings@ee.doe.gov.

FOR FURTHER INFORMATION CONTACT: Joseph Hagerman, U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, Building Technologies Office, EE-5B, 1000 Independence Avenue, SW., Washington, DC, 20585-0121. Telephone: (202) 586-4549. E-mail: refrigerators_and_freezers@ee.doe.gov.

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I. Synopsis of the Direct Final Rule

Title III, Part B[1] of the Energy Policy and Conservation Act of 1975 ("EPCA" or in context, "the Act"), Public Law 94-163 (42 U.S.C. 6291–6309, as codified), established the Energy Conservation Program for Consumer Products Other Than

[1] For editorial reasons, upon codification in the U.S. Code, Part B was redesignated Part A.

Automobiles.[2] In addition to specifying a list of covered residential products and commercial equipment, EPCA contains provisions that enable the Secretary of Energy to classify additional types of consumer products as covered products. (42 U.S.C. 6292(a)(20)) In a final determination of coverage published in the Federal Register on July 18, 2016 (the July 2016 Final Coverage Determination), DOE classified miscellaneous refrigeration products ("MREFs") as covered consumer products under EPCA. 81 FR 46768. The MREF category includes refrigeration products such as coolers (e.g., wine chillers) and combination cooler refrigeration products (e.g., wine chillers combined with a refrigerator, freezer, or refrigerator-freezer).

Pursuant to EPCA, any new or amended energy conservation standard 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)) Furthermore, the new or amended standard must result in a significant conservation of energy. (42 U.S.C. 6295(o)(3)(B))

DOE received a statement submitted jointly by interested persons that are fairly representative of relevant points of view (including representatives of manufacturers of the covered equipment at issue, States, and efficiency advocates) containing recommendations with respect to new energy conservation standards for MREFs (see section III.A of this document for a description of the jointly-submitted statement). DOE has determined that the recommended standards contained in the statement are in

[2] All references to EPCA in this document refer to the statute as amended through the Energy Efficiency Improvement Act of 2015, Public Law 114-11 (April 30, 2015).

accordance with 42 U.S.C. 6295(o), which prescribes the conditions under which DOE may adopt new standards. Under the authority provided by 42 U.S.C. 6295(p)(4), DOE is issuing this direct final rule to establish new energy conservation standards for MREFs.

The new MREF standards, which are expressed in maximum allowable annual energy use ("AEU") in kilowatt-hours per year ("kWh/yr") as a function of the calculated adjusted volume ("AV") in cubic feet ("ft^3"), are shown in Table I.1 and Table I.2. The standards will apply to all MREFs listed in Table I.1 and Table I.2 and manufactured in, or imported into, the United States starting on October 28, 2019.

Table I.1 Energy Conservation Standards for Coolers

Product Class	Maximum Allowable AEU (kWh/yr)
Built-in Compact	7.88AV[†] + 155.8
Built-in	
Freestanding Compact	
Freestanding	

[†] AV = Adjusted volume, in ft^3, as calculated according to title 10 of the Code of Federal Regulations ("CFR") part 430, subpart B, appendix A.

Table I.2 Energy Conservation Standards for Combination Cooler Refrigeration Products

Product Class Description	Product Class Designation*	Maximum Allowable AEU (kWh/yr)
Cooler with all-refrigerator—automatic defrost	C-3A	4.57AV[†] + 130.4
Built-in cooler with all-refrigerator—automatic defrost	C-3A-BI	5.19AV + 147.8
Cooler with upright freezers with automatic defrost without an automatic icemaker	C-9	5.58AV + 147.7
Built-in cooler with upright freezer with automatic defrost without an automatic icemaker	C-9-BI	6.38AV + 168.8
Cooler with upright freezer with automatic defrost with an automatic icemaker	C-9I	5.58AV + 231.7

Built-in cooler with upright freezer with automatic defrost with an automatic icemaker	C-9I-BI	6.38AV + 252.8
Compact cooler with all-refrigerator—automatic defrost	C-13A	5.93AV + 193.7
Built-in compact cooler with all-refrigerator—automatic defrost	C-13A-BI††	6.52AV + 213.1

* These product classes are consistent with the current product classes established for refrigerators, refrigerator-freezers, and freezers. 10 CFR 430.32.
† AV = Adjusted volume, in ft^3, as calculated according to 10 CFR part 430, subpart B, appendix A.
†† There is no current product class 13A-BI for refrigerators, refrigerator-freezers, or freezers.

A. Benefits and Costs to Consumers

Table I.3 presents DOE's evaluation of the economic impacts of the adopted standards on consumers of MREFs, as measured by the average life-cycle cost ("LCC") savings and the simple payback period ("PBP").[3] The average LCC savings are positive for all product classes affected by the adopted standards, and the PBPs are less than the average lifetime of MREFs, which is estimated to be at least 10 years (see section IV.F of this direct final rule).

[3] The average LCC savings are measured relative to the efficiency distribution in the compliance year in the absence of standards (see section IV.F of this document). The simple payback period, which is designed to compare specific efficiency levels, is measured relative to the lowest efficiency level in the no-new-standards case (see section IV.F.9 of this document).

Table I.3 Impacts of New Energy Conservation Standards on Consumers of MREFs

Product Class	Average LCC Savings* (2015$)	Simple Payback Period* (years)
Coolers		
Freestanding compact coolers	265	1.4
Built-in compact coolers	28	4.6
Freestanding coolers	153	1.8
Built-in coolers	77	6.1
Combination Cooler Refrigeration Products		
C-3A	n.a.	n.a.
C-3A-BI	n.a.	n.a.
C-9†	n.a.	n.a.
C-9-BI†	n.a.	n.a.
C-13A	32	4.3
C-13A-BI	n.a.	n.a.

* Calculation of savings and PBP is not applicable (n.a.) if the standard is set at an efficiency level that is already met or exceeded in the MREF market.
† Results for C-9 and C-9-BI are also applicable to C-9I and C-9I-BI.

DOE's analysis of the impacts of the adopted standards on consumers is described in section IV.F 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 (2016 to 2048). Using a real discount rate of 7.7 percent, DOE estimates that the INPV for manufacturers of MREFs in the case without standards is $263.3 million for coolers and $108.2 million for combination cooler refrigeration products in 2015$. Under the new standards, DOE expects that manufacturers may lose up to 20.8 percent of this INPV for coolers, which is approximately $54.8 million; and manufacturers may lose up to 0.7 percent of this INPV for combination cooler refrigeration products, which is approximately $0.8 million. Additionally, based on DOE's interviews with the manufacturers of MREFs, 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 MREFs adopted in this direct final rule.

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

C. National Benefits and Costs[4]

DOE's analyses indicate that the adopted energy conservation standards for MREFs would save a significant amount of energy. Relative to the no-new-standards case, the lifetime energy savings for MREFs purchased in the 30-year period that begins in the anticipated year of compliance with the new standards (2019–2048) amount to 1.5 quadrillion Btu ("quads").[5] This represents a savings of 58 percent relative to the energy use of these products in the no-new-standards case.

The cumulative net present value ("NPV") of total consumer costs and savings of the standards for MREFs ranges from $4.78 billion (at a 7-percent discount rate) to $11.02 billion (at a 3-percent discount rate). This NPV expresses the estimated total value of future operating-cost savings minus the estimated increased product costs for MREFs purchased in 2019–2048.

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[4] All monetary values in this section are expressed in 2015 dollars and, where appropriate, are discounted to 2016 unless explicitly stated otherwise. Energy savings in this section refer to the full-fuel-cycle ("FFC") savings (see section IV.H of this document for discussion).

[5] 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 of this document.

In addition, the standards for MREFs 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 91.8 million metric tons ("Mt")[6] of carbon dioxide ("CO_2"), 54.0 thousand tons of sulfur dioxide ("SO_2"), 164.0 tons of nitrogen oxides ("NO_X"), 387.1 thousand tons of methane ("CH_4"), 1.1 thousand tons of nitrous oxide ("N_2O"), and 0.2 tons of mercury ("Hg").[7] The cumulative reduction in CO_2 emissions through 2030 amounts to 20.2 Mt, which is equivalent to the emissions resulting from the annual electricity use of more than 2.8 million homes.

The value of the CO_2 reductions is calculated using a range of values per metric ton of CO_2 (otherwise known as the "Social Cost of Carbon," or "SCC") developed by a Federal interagency working group.[8] The derivation of the SCC values is discussed in section IV.L of this document. 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 \$0.679 billion and \$9.271 billion, with a value of \$3.047 billion using the central SCC case represented by \$40.6/t in 2015. DOE also estimates that the

[6] A metric ton is equivalent to 1.1 short tons. Results for NO_X and Hg are presented in short tons.
[7] DOE calculated emissions reductions relative to the no-new-standards-case, which reflects key assumptions in the Annual Energy Outlook 2015 ("AEO 2015") Reference case, which generally represents current legislation and environmental regulations for which implementing regulations were available as of October 31, 2014.
[8] United States Government–Interagency Working Group on Social Cost of Carbon. Technical Support Document: Technical Update of the Social Cost of Carbon for Regulatory Impact Analysis Under Executive Order 12866. May 2013. Revised July 2015. Available at https://www.whitehouse.gov/sites/default/files/omb/inforeg/scc-tsd-final-july-2015.pdf.

net present monetary value of the NO_X emissions reduction to be $0.142 billion at a 7-percent discount rate, and $0.326 billion at a 3-percent discount rate.[9]

Table I.4 summarizes the economic benefits and costs expected to result from the adopted standards for MREFs.

[9] DOE estimated the monetized value of NO_X emissions reductions associated with electricity savings using benefit per ton estimates from the Regulatory Impact Analysis for the Clean Power Plan Final Rule, published in August 2015 by EPA's Office of Air Quality Planning and Standards. Available at www.epa.gov/cleanpowerplan/clean-power-plan-final-rule-regulatory-impact-analysis. See section IV.L of this document for further discussion. The U.S. Supreme Court has stayed the rule implementing the Clean Power Plan until the current litigation against it concludes. Chamber of Commerce, et al. v. EPA, et al., Order in Pending Case, 577 U.S. (2016). However, the benefit-per-ton estimates established in the Regulatory Impact Analysis for the Clean Power Plan are based on scientific studies that remain valid irrespective of the legal status of the Clean Power Plan. DOE is primarily using a national benefit-per-ton estimate for NO_X emitted from the Electricity Generating Unit sector based on an estimate of premature mortality derived from the ACS study (Krewski, et al. 2009). If the benefit-per-ton estimates were based on the Six Cities study (Lepuele, et al. 2011), the values would be nearly two-and-a-half times larger.

Table I.4 Summary of Economic Benefits and Costs of New Energy Conservation Standards for MREFs*

Category	Present Value (Billion 2015$)	Discount Rate
Benefits		
Consumer Operating Cost Savings	6.4	7%
	13.9	3%
CO_2 Reduction (using mean SCC at 5% discount rate)**	0.7	5%
CO_2 Reduction (using mean SCC at 3% discount rate)**	3.0	3%
CO_2 Reduction (using mean SCC at 2.5% discount rate)**	4.8	2.5%
CO_2 Reduction (using 95th percentile SCC at 3% discount rate)**	9.3	3%
NO_X Reduction†	0.1	7%
	0.3	3%
Total Benefits††	9.6	7%
	17.3	3%
Costs		
Consumer Incremental Installed Costs	1.7	7%
	2.9	3%
Net Benefits		
Including CO_2 and NO_X Reduction Monetized Value††	8.0	7%
	14.4	3%

* This table presents the costs and benefits associated with MREFs shipped in 2019−2048. These results include benefits to consumers which accrue after 2048 from the products purchased in 2019−2048. The incremental installed costs include incremental equipment cost as well as installation costs. The CO_2 reduction benefits are global benefits due to actions that occur nationally. Note that the Benefits and Costs may not sum to the Net Benefits due to rounding.

** 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 integrated assessment models, at discount rates of 5%, 3%, and 2.5%. For example, for 2015 emissions, these values are $12.4/t, $40.6/t, and $63.2/t, in 2015$, respectively. The fourth set ($118/t in 2015$ for 2015 emissions), which represents the 95th percentile of the SCC distribution calculated using a 3% discount rate, is included to represent higher-than-expected impacts from temperature change further out in the tails of the SCC distribution. The SCC values are emission year specific. See section IV.L.1 of this document for more details.

† DOE estimated the monetized value of NO_X emissions reductions associated with electricity savings using benefit per ton estimates from the "Regulatory Impact Analysis for the Clean Power Plan Final Rule," published in August 2015 by EPA's Office of Air Quality Planning and Standards. (Available at www.epa.gov/cleanpowerplan/clean-power-plan-final-rule-regulatory-impact-analysis.) See section IV.L of this document for further discussion. DOE is primarily using a national benefit-per-ton estimate for NO_X emitted from the Electricity Generating Unit sector based on an estimate of premature mortality derived from the ACS study (Krewski et al. 2009). If the benefit-per-ton estimates were based on the Six Cities study (Lepuele et al. 2011), the values would be nearly two-and-a-half times larger.

†† Total Benefits for both the 3% and 7% cases are presented using only the average SCC with 3-percent discount rate.

The benefits and costs of the adopted standards for MREFs sold in 2019 to 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 product purchase prices and installation costs, plus (3) the value of the benefits of CO_2 and NO_X emission reductions, all annualized.[10]

The national operating cost savings are domestic private U.S. consumer monetary savings that occur as a result of purchasing the covered products. The national operating cost savings is measured for the lifetime of MREFs shipped in 2019–2048. The CO_2 reduction is a benefit that accrues globally due to decreased domestic energy consumption that is expected to result from this rule. Because CO_2 emissions have a very long residence time in the atmosphere, the SCC values in future years reflect future CO_2-emissions impacts that continue beyond 2100 through 2300.

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

[10] 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 (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.

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 $40.6/t in 2015),[11] the estimated cost of the standards in this rule is $153 million per year in increased equipment costs, while the estimated annual benefits are $593 million in reduced equipment operating costs, $165 million in CO_2 reductions, and $13.1 million in reduced NO_X emissions. In this case, the net benefit amounts to $619 million per year.

Using a 3-percent discount rate for all benefits and costs and the SCC series has a value of $40.6/t in 2015, the estimated cost of the standards is $157 million per year in increased equipment costs, while the estimated annual benefits are $754 million in reduced operating costs, $165 million in CO_2 reductions, and $17.7 million in reduced NO_X emissions. In this case, the net benefit amounts to $779 million per year.

[11] 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 of this document).

Table I.5 Annualized Benefits and Costs of New Standards for MREFs*

	Discount Rate	Primary Estimate	Low Net Benefits Estimate	High Net Benefits Estimate
		million 2015$/year		
Benefits				
Consumer Operating Cost Savings	7%	593	545	649
	3%	754	686	839
CO_2 Reduction (using mean SCC at 5% discount rate)**	5%	49	46	53
CO_2 Reduction (using mean SCC at 3% discount rate)**	3%	165	155	179
CO_2 Reduction (using mean SCC at 2.5% discount rate)**	2.5%	242	227	263
CO_2 Reduction (using 95th percentile SCC at 3% discount rate)**	3%	502	471	546
NO_X Reduction†	7%	13.1	12.4	31.6
	3%	17.7	16.6	43.6
Total Benefits††	7% plus CO_2 range	655 to 1,108	603 to 1,028	733 to 1,226
	7%	771	712	860
	3% plus CO_2 range	820 to 1,273	748 to 1,173	935 to 1,428
	3%	937	857	1,062
Costs				
Consumer Incremental Product Costs†††	7%	153	145	118
	3%	157	148	116
Net Benefits				
Total††	7% plus CO_2 range	503 to 956	459 to 884	615 to 1,108
	7%	619	568	742
	3% plus CO_2 range	663 to 1,116	601 to 1,026	819 to 1,312
	3%	779	709	946

* This table presents the annualized costs and benefits associated with MREFs shipped in 2019–2048. These results include benefits to consumers which accrue after 2048 from the MREFs purchased from 2019–2048. The incremental installed costs include incremental equipment cost as well as installation costs. The CO_2 reduction benefits are global benefits due to actions that occur nationally. The Primary, Low Benefits, and High Benefits Estimates utilize projections of energy prices and housing starts from the AEO 2015 Reference case, Low Economic Growth case, and High Economic Growth case, respectively. In addition, incremental product costs reflect a constant price trend in the Primary Estimate and the Low

Benefits Estimate, and a high decline rate in the High Benefits Estimate. The methods used to derive projected price trends are explained in section IV.F of this document. Note that the Benefits and Costs may not sum to the Net Benefits due to rounding.
** The CO_2 reduction benefits are calculated using 4 different sets of SCC values. The first three use the average SCC calculated using 5%, 3%, and 2.5% discount rates, respectively. The fourth represents the 95th percentile of the SCC distribution calculated using a 3% discount rate. The SCC values are emission year specific. See section IV.L.1 of this document for more details.
† DOE estimated the monetized value of NO_X emissions reductions associated with electricity savings using benefit per ton estimates from the "Regulatory Impact Analysis for the Clean Power Plan Final Rule," published in August 2015 by EPA's Office of Air Quality Planning and Standards. (Available at www.epa.gov/cleanpowerplan/clean-power-plan-final-rule-regulatory-impact-analysis.) See section IV.L of this document for further discussion. For the Primary Estimate and Low Net Benefits Estimate, DOE used a national benefit-per-ton estimate for NO_X emitted from the Electric Generating Unit sector based on an estimate of premature mortality derived from the ACS study (Krewski et al. 2009). For DOE's High Net Benefits Estimate, the benefit-per-ton estimates were based on the Six Cities study (Lepuele et al. 2011), which are nearly two-and-a-half times larger than those from the ACS study.
†† Total Benefits for both the 3% and 7% cases are presented using only the average SCC with 3-percent discount rate. 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.
††† The value of consumer incremental product costs is lower in the low net benefits estimate than it is in the primary estimate because both estimates use the same price trend and there are fewer shipments in the low net benefits estimate. The value of consumer incremental product costs is lower in the high net benefits scenario than it is in the primary case because the high net benefits scenario uses a highly declining price trend that more than offsets the increase in shipments due to higher economic growth.

DOE's analysis of the national impacts of the adopted standards is described in sections IV.H, IV.K, and IV.L of this document.

D. Conclusion

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

Under the authority provided by 42 U.S.C. 6295(p)(4), DOE is issuing this direct final rule to establish new energy conservation standards for MREFs.

II. Introduction

The following section briefly discusses the statutory authority underlying this direct final rule, as well as some of the relevant historical background related to the establishment of standards for MREFs.

A. Authority

As indicated above, EPCA includes provisions covering the products addressed by this Direct final rule. EPCA addresses, among other things, the energy efficiency of certain types of consumer products. Relevant provisions of the Act specifically include definitions (42 U.S.C. 6291), energy conservation standards (42 U.S.C. 6295), test procedures (42 U.S.C. 6293), labeling provisions (42 U.S.C. 6294), and the authority to require information and reports from manufacturers (42 U.S.C. 6296).

Under 42 U.S.C. 6292(a)(20), DOE may extend coverage over a particular type of consumer product provided that DOE determines that classifying products of such type as covered products is necessary or appropriate to carry out the purposes of EPCA and that the average annual per-household energy use by products of such type is likely to exceed 100 kilowatt-hours ("kWh") or its British thermal unit ("Btu") equivalent per year. See 42 U.S.C. 6292(b)(1). EPCA sets out the following additional requirements to establish energy conservation standards for a new covered product: (1) the average per household domestic energy use by such products exceeded 150 kWh or its Btu equivalent for any 12-month period ending before such determination; (2) the aggregate domestic household energy use by such products exceeded 4.2 million kWh or its Btu equivalent for any such 12-month period; (3) substantial energy efficiency of the products is technologically feasible; and (4) applying a labeling rule is unlikely to be sufficient to induce manufacturers to produce, and consumers and other persons to purchase, products of such type that achieve the maximum level of energy efficiency. See 42 U.S.C. 6295(l)(1).

Pursuant to EPCA, DOE's energy conservation program for covered products consists essentially of four parts: (1) testing; (2) labeling; (3) the establishment of Federal energy conservation standards; and (4) certification and enforcement procedures. The Federal Trade Commission ("FTC") is primarily responsible for labeling, and DOE implements the remainder of the program. Subject to certain criteria and conditions, DOE is required to develop test procedures to measure the energy efficiency, energy use, or estimated annual operating cost of each covered product. (42 U.S.C. 6295(o)(3)(A) and (r)) Manufacturers of covered products must use the prescribed DOE test procedure as the basis for certifying to DOE that their products comply with the applicable energy conservation standards adopted under EPCA and when making representations to the public regarding the energy use or efficiency of those products. (42 U.S.C. 6293(c) and 6295(s)) Similarly, DOE must use these test procedures to determine whether the products comply with standards adopted pursuant to EPCA. (42 U.S.C. 6295(s)) The DOE test procedure for MREFs currently appears at title 10 of the Code of Federal Regulations ("CFR") part 430, subpart B, appendix A (appendix A).

DOE follows specific criteria when prescribing new or amended standards for covered products. As indicated above, any new or amended standard for a covered product 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 products, including MREFs, if no test procedure has been established for the product, or (2) if DOE determines by rule that the new or amended standard is not technologically feasible or economically justified. (42 U.S.C. 6295(o)(3)(A)–(B)) In deciding whether a new or amended 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 considering, to the greatest extent practicable, the following seven factors:

1. The economic impact of the standard on manufacturers and consumers of the products subject to the standard;

2. The savings in operating costs throughout the estimated average life of the covered products in the type (or class) compared to any increase in the price, initial charges, or maintenance expenses for the covered products that are likely to result from the imposition of the standard;

3. The total projected amount of energy, or as applicable, water, savings likely to result directly from the imposition of the standard;

4. Any lessening of the utility or the performance of the covered products likely to result from the imposition of 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 imposition of the standard;

6. The need for national energy and water conservation; and

7. Other factors the Secretary of Energy (Secretary) considers relevant.

(42 U.S.C. 6295(o)(2)(B)(i)(I)–(VII))

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

EPCA 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 product. (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 product type (or class) of performance characteristics (including reliability), features, sizes, capacities, and volumes that are substantially the same as those generally available in the United States. (42 U.S.C. 6295(o)(4))

Additionally, DOE may set energy conservation standards for a covered product that has two or more subcategories. In those instances, DOE must specify a different standard level for a type or class of products that has the same function or intended use if DOE determines that products within such group: (A) consume a different kind of energy from that consumed by other covered products within such type (or class); or (B) have a capacity or other performance-related feature which other products within such type (or class) do not have and such feature justifies a higher or lower standard. (42 U.S.C. 6295(q)(1)) In determining whether a performance-related feature justifies a different standard for a group of products, 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))

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).

DOE is also required to address standby mode and off mode energy use. (42 U.S.C. 6295(gg)(3)) Specifically, when DOE adopts a standard for a covered product after that date, it must, if justified by the criteria for the adoption of standards under EPCA (42 U.S.C. 6295(o)), incorporate standby mode and off mode energy use into a single standard, or, if that is not feasible, adopt a separate standard for such energy use for that product. (42 U.S.C. 6295(gg)(3)(A)–(B)) DOE's test procedures for MREFs address standby mode and off mode energy use, as do the new standards adopted in this direct final rule.

With particular regard to direct final rules, the Energy Independence and Security Act of 2007 ("EISA 2007"), Public Law 110-140 (December 19, 2007), amended EPCA, in relevant part, to grant DOE authority to issue a type of final rule (i.e., a "direct final rule") establishing an energy conservation standard for a product on receipt of a statement that is submitted jointly by interested persons that are fairly representative of relevant points of view (including representatives of manufacturers of covered products, States, and efficiency advocates), as determined by the Secretary, and that contains recommendations with respect to an energy or water conservation standard. In the context of consumer products, if the Secretary determines that the recommended standard contained in the statement is in accordance with 42 U.S.C. 6295(o), the Secretary may issue a final rule establishing the recommended standard. A notice of proposed rulemaking ("NOPR") that proposes an identical energy efficiency standard is published simultaneously with the direct final rule. A public comment period of at least 110 days is provided. See 42 U.S.C. 6295(p)(4). Not later than 120 days after the date on which a direct final rule issued under this authority is published in the Federal Register, the Secretary shall withdraw the direct final rule if the Secretary receives one or more adverse public comments relating to the direct final rule or any alternative joint recommendation and based on the rulemaking record relating to the direct final rule, the Secretary determines that such adverse public comments or alternative joint recommendation may provide a reasonable basis for withdrawing the direct final rule under subsection 42 U.S.C. 6295(o) or any other applicable law. On withdrawal of a direct final rule, the Secretary shall proceed with the NOPR published simultaneously with the direct final rule and publish in the Federal Register the reasons why the direct final rule was withdrawn. This direct final rule provision applies to the products at issue in this direct final rule. See 42 U.S.C. 6295(p)(4).

DOE also notes that it typically finalizes its test procedures for a given regulated product or equipment prior to proposing new or amended energy conservation standards for that product or equipment, see 10 CFR part 430, subpart C, appendix A, sec. 7(c) ("Procedures, Interpretations and Policies for Consideration of New or Revised Energy Conservation Standards for Consumer Products" or "Process Rule"). In this instance, although DOE has finalized its test procedure for MREFs, rather than issue a notice of proposed rulemaking to set standards for these products, DOE is moving forward with a direct final rule. As part of the negotiated rulemaking that led to the Term Sheet setting out the standards that DOE is proposing, Working Group members recommended (with ASRAC's approval) that DOE implement the test procedure that DOE recently finalized. See 81 FR 46768 (July 18, 2016). The approach laid out in that final rule is consistent with the approach agreed upon by the various Working Group members who participated in the negotiated rulemaking. Accordingly, in accordance with section 14 of the Process Rule, DOE tentatively concludes that deviation from the Process Rule is appropriate here.

B. History of Standards Rulemaking for Miscellaneous Refrigeration Products

DOE has not previously established energy conservation standards for MREFs. Consistent with its statutory obligations, DOE sought to establish regulatory coverage over these products prior to establishing energy conservation standards to regulate MREF efficiency. On November 8, 2011, DOE published a notice of proposed determination of coverage ("NOPD") to address the potential coverage of those refrigeration products that do not use a compressor-based refrigeration system. 76 FR 69147. Rather than employing a compressor/condenser-based system typically installed in the refrigerators, refrigerator-freezers, and freezers found in most U.S. homes, these "non-compressor-based" refrigeration products use a variety of other means to introduce chilled air into the interior of the storage cabinet of the product. Two systems that DOE specifically examined were thermoelectric- and absorption-based systems.[12] The former of these systems is used in some wine chiller applications. With respect to the latter group of products, DOE indicated its belief that these types of products were used primarily in mobile applications and would likely fall outside of DOE's scope of coverage. See 42 U.S.C. 6292(a) (excluding from coverage "those consumer products designed solely for use in recreational vehicles and other mobile equipment").

[12] Chapter 3 of the direct final rule technical support document provides a detailed description of each of these refrigeration technologies.

On February 13, 2012, DOE published a document announcing the availability of the framework document, "Energy Conservation Standards Rulemaking Framework Document for Wine Chillers and Miscellaneous Refrigeration Products," and a public meeting to discuss the proposed analytical framework for the energy conservation standards rulemaking. 77 FR 7547. In the framework document, DOE described the procedural and analytical approaches it anticipated using to evaluate potential energy conservation standards for four types of consumer refrigeration products: wine chillers, non-compressor refrigerators, hybrid refrigerators (i.e., a wine chiller combined with a refrigerator), and ice makers.

DOE held a public meeting on February 22, 2012, to present the framework document, describe the analyses DOE planned to conduct during the rulemaking, seek comments from interested parties on these subjects, and inform them about, and facilitate their involvement in, the rulemaking. At the public meeting and during the comment period, DOE received multiple comments that addressed issues raised in the framework document and identified additional issues relevant to the rulemaking.

On October 31, 2013, DOE published in the Federal Register a supplemental notice of proposed determination of coverage (the "October 2013 SNOPD"), in which it tentatively determined that the four categories of consumer products addressed in the framework document (wine chillers, non-compressor refrigeration products, hybrid refrigerators, and ice makers) satisfy the provisions of 42 U.S.C. 6292(b)(1). 78 FR 65223.

DOE published a notice of public meeting and availability of the preliminary technical support document ("TSD") for the MREF energy conservation standards rulemaking on December 3, 2014. 79 FR 71705. The preliminary analysis considered potential standards for the products proposed for coverage in the October 2013 SNOPD. The preliminary TSD includes the results of the following DOE preliminary analyses: (1) market and technology assessment; (2) screening analysis; (3) engineering analysis; (4) markups analysis; (5) energy use analysis; (6) LCC and PBP analyses; (7) shipments analysis; (8) national impact analysis ("NIA"); and (9) preliminary manufacturer impact analysis ("MIA").

DOE held a public meeting on January 9, 2015, during which it presented preliminary results for the engineering and downstream economic analyses and sought comments from interested parties on these subjects. At the public meeting and during the comment period, DOE received comments that addressed issues raised in the preliminary analysis and identified additional issues relevant to this rulemaking. After reviewing the comments received in response to both the preliminary analysis and a test procedure NOPR published on December 16, 2014 (the "December 2014 Test Procedure NOPR," 79 FR 74894), DOE ultimately determined that the development of test procedures and potential energy conservation standards for MREFs would benefit from a negotiated rulemaking process.

On April 1, 2015, DOE published a notice of intent to establish an Appliance Standards and Rulemaking Federal Advisory Committee ("ASRAC") negotiated rulemaking working group for MREFs (the "MREF Working Group" or in context, the "Working Group") to discuss and, if possible, reach consensus on recommended scope of coverage, definitions, test procedures, and energy conservation standards. 80 FR 17355. The MREF Working Group consisted of 15 members, including two members from ASRAC and one DOE representative. The MREF Working Group met in person during six sets of meetings in 2015: May 4–5, June 11–12, July 15–16, August 11–12, September 16–17, and October 20.

On August 11, 2015, the MREF Working Group reached consensus on a term sheet to recommend a scope of coverage, set of definitions, and test procedures for MREFs ("Term Sheet #1").[13] That document laid out the scope of products that the Working Group recommended that DOE adopt with respect to MREFs, the definitions that would apply to MREFs and certain other refrigeration products, and the test procedure that manufacturers of MREFs would need to use when evaluating the energy usage of these products. On October 20, 2015, the MREF Working Group reached consensus on a term sheet to recommend energy conservation standards for coolers and combination cooler refrigeration products ("Term Sheet #2"). ASRAC approved Term Sheet #1 during an open meeting on December 18, 2015, and Term Sheet #2 during an open meeting on January 20, 2016. ASRAC subsequently sent the term sheets to the Secretary for consideration.

[13] The MREF Working Group term sheets are available in docket ID EERE-2011-BT-STD-0043 on http://regulations.gov.

In addition to these steps, DOE sought to ensure that it had obtained complete information and input regarding certain aspects related to manufacturers of thermoelectric refrigeration products. To this end, on December 15, 2015, DOE published a notice of data availability (the "December 2015 NODA") in which it requested additional public feedback on the methods and information used in the development of the MREF Working Group term sheets. 80 FR 77589. DOE noted in particular its interest in information related to manufacturers of thermoelectric refrigeration products. Id. at 77590.

After considering the MREF Working Group recommendations and comments received in response to the December 2015 NODA, DOE published an SNOPD and notice of proposed rulemaking (the "March 2016 SNOPD") on March 4, 2016. 81 FR 11454. The March 2016 SNOPD proposed establishing coverage, definitions, and terminology consistent with Term Sheet #1. It also proposed to determine that coolers and combination cooler refrigeration products—as defined under the proposal—would meet the requirements under EPCA to be considered covered products. Id. at 11456–11459.

The July 2016 Final Coverage Determination established coolers and combination cooler refrigeration products as covered products under EPCA. Because DOE did not receive any comments in response to the March 2016 SNOPD that would substantively alter its proposals, the findings of the final determination were unchanged from those presented in the March 2016 SNOPD. Moreover, DOE determined in the July 2016 Final

Coverage Determination that MREFs, on average, consume more than 150 kWh/yr, and that the aggregate annual national energy use of these products exceeds 4.2 TWh. Accordingly, these data indicate that MREFs satisfy at least two of the four criteria required under EPCA in order for the Secretary to set standards for a product whose coverage is added pursuant to 42 U.S.C. 6292(b). See 42 U.S.C. 6295(l)(1)(A)–(D). See also 81 FR 46768 at 46773–46775 (detailing the data used to evaluate the energy usage of MREF products).

In addition to establishing coverage, the July 2016 Final Coverage Determination established definitions for "miscellaneous refrigeration products," "coolers," and "combination cooler refrigeration products" in 10 CFR 430.2. The July 2016 Final Coverage Determination also amended the existing definitions for "refrigerator," "refrigerator-freezer," and "freezer" for consistency with the newly established MREF definitions. These definitions were generally consistent with the March 2016 SNOPD. Id. at 46775–46778.

III. General Discussion

A. Consensus Agreement

1. Background

As discussed in section II.B of this document, the MREF Working Group approved two term sheets that recommended a scope of coverage, definitions, test procedures, and energy conservation standards for MREFs. ASRAC approved the two term sheets during open meetings and sent them to the Secretary of Energy for consideration.

After carefully considering the consensus recommendations related to new energy conservation standards for MREFs submitted by the MREF Working Group and adopted by ASRAC, DOE has determined that these recommendations comprise a statement submitted by interested persons who are fairly representative of relevant points of view on this matter. In reaching this determination, DOE took into consideration the fact that the Working Group, in conjunction with ASRAC members who approved the recommendations, consisted of representatives of manufacturers of covered products, States, and efficiency advocates – all of which are groups specifically identified by Congress as potentially relevant parties to any consensus recommendation submitted by ASRAC. (42 U.S.C. 6295(p)(4)(A)) As delineated above, Term Sheet #2 was submitted by a broad cross-section of interests, including the manufacturers who produce the subject products, a trade association representing these manufacturers, environmental and energy-efficiency advocacy organizations, and an electric utility company. Although States were not direct signatories to the Term Sheet, the ASRAC Committee approving the Working Group's recommendations included one member representing the State of California.[14] Additionally, in spite of the MREF Working Group meetings already being publicized and open to all members of the public, DOE published the December 2015 NODA to present the data and analyses used in support of developing the term sheets to provide an opportunity for further comment from interested parties. 80 FR 77589

[14] The individual was David Hungerford (California Energy Commission).

(December 15, 2015). Moreover, DOE does not read the statute as requiring absolute agreement among all interested parties before the Department may proceed with issuance of a direct final rule. By explicit language of the statute, the Secretary has the discretion to determine when a joint recommendation for an energy or water conservation standard has met the requirement for representativeness (i.e., "as determined by the Secretary").

By its plain terms, the statute contemplates that the Secretary will exercise discretion to determine whether a given statement is submitted jointly by interested persons that are fairly representative of relevant points of view (including representatives of manufacturers of covered products, States, and efficiency advocates). In this case, given the broad range of persons participating in the process that led to the submission—in the Working Group and in ASRAC—and given the breadth of perspectives expressed in that process, DOE has determined that the statements it received meet this criterion.

Pursuant to 42 U.S.C. 6295(p)(4), the Secretary must also determine whether a jointly-submitted recommendation for an energy conservation standard satisfies the criteria presented in 42 U.S.C. 6295(o). To make this determination, DOE has conducted an analysis to evaluate whether the potential energy conservation standards under consideration would meet these requirements. This evaluation is the same comprehensive approach that DOE typically conducts whenever it considers potential energy conservation standards for a given type of product or equipment. DOE applies the same principles to any consensus recommendations it may receive to satisfy its statutory obligation to ensure that any energy conservation standard that it adopts achieves the maximum improvement in energy efficiency that is technologically feasible and economically justified and will result in the significant conservation of energy. Upon review, the Secretary determined that the standards recommended in Term Sheet #2 submitted to DOE through ASRAC meet the standard-setting criteria set forth under 42 U.S.C. 6295(o). The consensus-recommended efficiency levels were included as trial standard level ("TSL") 2 for coolers and TSL 1 for combination cooler refrigeration products (see section V.A of this document for a description of all of the considered TSLs). The details regarding how the consensus-recommended TSLs comply with the standard-setting criteria are discussed and demonstrated in the relevant sections throughout this document.

In sum, as the relevant criteria under 42 U.S.C. 6295(p)(4) have been satisfied, the Secretary has determined that it is appropriate to adopt the consensus-recommended energy conservation standards for MREFs as presented in Term Sheet #2 through this direct final rule.

Pursuant to the same statutory provision, DOE is also simultaneously publishing a NOPR proposing that the identical standard levels contained in this direct final rule be adopted. Consistent with the statute, DOE is providing a 110-day public comment period on this direct final rule. Based on the comments received during this period, the direct final rule will either become effective or DOE will withdraw it if: (1) one or more adverse comments is received; and (2) DOE determines that those comments, when viewed in light of the rulemaking record related to the direct final rule, provide a reasonable basis for withdrawal of the direct final rule under 42 U.S.C. 6295(o) and for DOE to continue this rulemaking under the NOPR. (Receipt of an alternative joint recommendation may also trigger a DOE withdrawal of the direct final rule in the same manner.) See 42 U.S.C. 6295(p)(4)(C). Typical of other rulemakings, it is the substance, rather than the quantity, of comments that will ultimately determine whether a direct final rule will be withdrawn. To this end, the substance of any adverse comment(s) received will be weighed against the anticipated benefits of the jointly-submitted recommendations and the likelihood that further consideration of the comment(s) would change the results of the rulemaking. DOE notes that, to the extent an adverse comment had been previously raised and addressed in the rulemaking proceeding, such a submission will not typically provide a basis for withdrawal of a direct final rule.

2. Recommendations

The MREF Working Group recommended standards for all MREF product classes of coolers and combination cooler refrigeration products. Table III.1 and Table III.2 show the recommended standard levels, which are expressed as an equation whose value varies based on the calculated AV of a given product. The MREF Working Group recommended that these standard levels take effect three years following the publication of the direct final rule. See Term Sheet #2.

Table III.1 Consensus-Recommended Standard Levels for Coolers

Product Class	**Maximum Allowable AEU** (kWh/yr)
Built-in Compact	$7.88AV^{\dagger} + 155.8$
Built-in	
Freestanding Compact	
Freestanding	

† AV = Adjusted volume, in ft^3, as calculated according to title 10 CFR part 430, subpart B, appendix A.

Table III.2 Consensus-Recommended Standard Levels for Combination Cooler Refrigeration Products

Product Class Description	**Product Class Designation***	**Maximum Allowable AEU** (kWh/yr)
Cooler with all-refrigerator—automatic defrost	C-3A	4.57AV† + 130.4
Built-in cooler with all-refrigerator—automatic defrost	C-3A-BI	5.19AV + 147.8
Cooler with upright freezers with automatic defrost without an automatic icemaker	C-9	5.58AV + 147.7
Built-in cooler with upright freezer with automatic defrost without an automatic icemaker	C-9-BI	6.38AV + 168.8
Cooler with upright freezer with automatic defrost with an automatic icemaker	C-9I	5.58AV + 231.7
Built-in cooler with upright freezer with automatic defrost with an automatic icemaker	C-9I-BI	6.38AV + 252.8
Compact cooler with all-refrigerator—automatic defrost	C-13A	5.93AV + 193.7
Built-in compact cooler with all-refrigerator—automatic defrost	C-13A-BI††	6.52AV + 213.1

* These product classes are consistent with the current product classes established for refrigerators, refrigerator-freezers, and freezers. 10 CFR 430.32.

† AV = Adjusted volume, in ft^3, as calculated according to 10 CFR part 430, subpart B, appendix A.

†† There is no current product class 13A-BI for refrigerators, refrigerator-freezers, or freezers.

B. Compliance Date

When establishing new standards for products not previously covered, EPCA provides that newly-established standards shall not apply to products manufactured within five years after the publication of the final rule. See 42 U.S.C. 6295(l)(2). As part of its set of comprehensive recommendations, the MREF Working Group recommended that DOE instead apply a 3-year lead time.

DOE has the authority under section 42 U.S.C. 6295(p)(4) to accept recommendations for compliance dates contained in a joint submission recommending amended standards. In DOE's view, the direct final rule authority provision specifies the finding DOE has to make. Specifically, Congress specified that if DOE determines that the recommended standard is in accordance with 42 U.S.C. 6295(o), DOE may issue a final rule establishing those standards. See 42 U.S.C. 6295(p)(4)(A)(i). Applying the direct final rule provision in this manner meets Congress's goal to promote consensus agreements that reflect broad input from interested parties who can fashion agreements that best promote the aims of the statute. In the absence of a consensus agreement, DOE notes that the more specific prescriptions of EPCA would ordinarily prevail. However, when DOE receives a recommendation resulting from the appropriate process—in this case, the detailed procedure laid out in the direct final rule provision of EPCA—that process provides the necessary fidelity to the statute, along with compliance with section 6295(o), that Congress instructed DOE to apply.

DOE notes that its analysis of whether the consensus-recommended and other TSLs satisfy the criteria presented in 42 U.S.C. 6295(o) contemplates two compliance periods. For consensus-recommended TSLs, the analysis is based on a 2019 compliance date, as recommended by the MREF Working Group. The analysis for all other TSLs is based on a 2021 compliance date consistent with EPCA, which provides that newly-established standards shall not apply to products manufactured within five years after the publication of the final rule. In other words, DOE followed the prescriptions of EPCA for all TSLs that were not recommended by the MREF Working Group. The two different compliance dates are indicated in the relevant sections throughout this document.

C. Scope of Coverage

In the preliminary analysis, DOE considered potential standards for four consumer product categories proposed for coverage in the October 2013 SNOPD: cooled cabinets, non-compressor refrigerators, ice makers, and hybrid products. See chapter 3 of the preliminary TSD.

Based on comments received in response to the preliminary analysis, and on the recommendations of the MREF Working Group, DOE subsequently proposed in the March 2016 SNOPD that consumer ice makers and non-compressor refrigerators would not be included within MREFs. DOE proposed to remove ice makers from the scope of MREFs because they are significantly different from the other product types being considered for coverage, consistent with the MREF Working Group's recommendation. For non-compressor refrigerators, DOE is not aware of any products available on the market that would be considered non-compressor refrigerators. Instead, non-compressor products available on the market would be considered coolers under the March 2016 SNOPD proposal. DOE also revised the proposed definitions for cooled cabinets and hybrid products to designate these products as coolers and combination cooler refrigeration products, respectively, in accordance with the definitions recommended by the MREF Working Group in Term Sheet #1. See 81 FR 11454, 11456, 11458–11459. Interested parties generally supported the scope of coverage, energy use analysis, and definitions proposed in the March 2016 SNOPD. Therefore, in the July 2016 Final Coverage Determination, DOE determined that MREFs (including coolers and combination cooler refrigeration products) are covered products under EPCA. The July 2016 Final Coverage Determination also established definitions for these products that are generally consistent with the March 2016 SNOPD proposal. 81 FR 46768. This direct final rule establishes energy conservation standards for MREFs as defined in the July 2016 Final Coverage Determination.

D. Product Classes

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

In this direct final rule, DOE is establishing energy conservation standards for four product classes of coolers and nine product classes of combination cooler refrigeration products. These product classes are consistent with those recommended by the MREF Working Group in Term Sheet #2. The product classes established in this direct final rule and their descriptions are provided in Table III.3.

Table III.3 MREF Product Classes

Product Class	Product Class Description
Coolers	
Built-in Compact	Total refrigerated volume less than 7.75 ft^3 and meeting the built-in definition requirements
Built-in	Total refrigerated volume 7.75 ft^3 or greater and meeting the built-in definition requirements
Freestanding Compact	Total refrigerated volume less than 7.75 ft^3 and not built-in
Freestanding	Total refrigerated volume 7.75 ft^3 or greater and not built-in
Combination Cooler Refrigeration Products	
C-3A	Cooler with all-refrigerator—automatic defrost
C-3A-BI	Built-in cooler with all-refrigerator—automatic defrost
C-9	Cooler with upright freezer with automatic defrost without an automatic icemaker
C-9-BI	Built-in cooler with upright freezer with automatic defrost without an automatic icemaker
C-9I	Cooler with upright freezer with automatic defrost with an automatic icemaker
C-9I-BI	Built-in cooler with upright freezer with automatic defrost with an automatic icemaker
C-13A	Compact cooler with all-refrigerator—automatic defrost
C-13A-BI	Built-In compact cooler with all-refrigerator—automatic defrost

E. Test Procedure

EPCA sets forth generally applicable criteria and procedures for DOE’s adoption and amendment of test procedures. (42 U.S.C. 6293) Manufacturers of covered products must use these test procedures to certify to DOE that their product complies with energy conservation standards and to quantify the efficiency of their product. Similarly, DOE must use these test procedures to determine compliance with its energy conservation standards. (42 U.S.C. 6295(s))

DOE published the December 2014 Test Procedure NOPR on December 16, 2014, in which it proposed to establish definitions and test procedures for the product categories proposed for coverage in the October 2013 SNOPD. The proposed test procedures would measure the energy efficiency, energy use, and estimated annual operating cost of these products during a representative average use period and that would not be unduly burdensome to conduct, as required under 42 U.S.C. 6293(b)(3). 79 FR 74894.

After reviewing comments responding to the December 2014 Test Procedure NOPR, DOE ultimately determined that developing the test procedures for these products would benefit from a negotiated rulemaking process. Therefore, DOE included potential test procedures within the scope of work for the MREF Working Group. On August 11, 2015, the MREF Working Group reached consensus on Term Sheet #1, which recommended scope of coverage, definitions, and test procedures for MREFs. The MREF Working Group generally agreed with the approach proposed in the December 2014 Test Procedure NOPR, but recommended updating usage factors, ambient temperatures, and volume adjustment factors. See Term Sheet #1. ASRAC approved the term sheet during an open meeting on December 18, 2015, and subsequently sent it to the Secretary for consideration.

The test procedures for MREFs, which are consistent with the MREF Working Group Recommendation, were codified in appendix A by the July 2016 Final Coverage Determination. 81 FR 46768. The test procedures, which follow a similar methodology to those in place for refrigerators, refrigerator-freezers, and freezers, provide the provisions for determining a product's annual energy usage (kWh/yr) and total AV, which are the basis of the energy conservation standards established in this direct final rule.

F. Technological Feasibility

1. General

To assess the technological feasibility of setting standards for a product, DOE conducts a screening analysis based on information gathered on all current technology options and prototype designs that could improve its efficiency. 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 products 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 product utility or availability; and (3) adverse impacts on health or safety. 10 CFR part 430, subpart C, appendix A, section 4(a)(4)(ii)–(iv). 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 direct final rule discusses the results of the screening analysis for MREFs, particularly the designs DOE considered, those it screened out, and those that are the basis for the standards considered in this rulemaking. For further details on the screening analysis for this rulemaking, see chapter 4 of the direct final rule TSD.

2. Maximum Technologically Feasible Levels

When DOE proposes to adopt a new standard for a type or class of covered product, it must determine the maximum improvement in energy efficiency or maximum reduction in energy use that is technologically feasible for such product. (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 MREFs, using the design parameters for the most efficient products available on the market or in working prototypes. The max-tech levels that DOE determined for this rulemaking are described in section IV.C of this direct final rule and in chapter 5 of the direct final rule TSD.

G. <u>Energy Savings</u>

1. Determination of Savings

For each TSL, DOE projected energy savings from application of the TSL to MREFs purchased in the 30-year period that begins in the year of compliance with any new standards (2019–2048 for the TSLs recommended by the MREF Working Group, 2021–2050 for all other TSLs).[15] The savings are measured over the entire lifetime of products 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 for a product would likely evolve in the absence of energy conservation standards.

DOE used its NIA spreadsheet models to estimate energy savings from potential standards for MREFs. The NIA spreadsheet model (described in section IV.H of this document) calculates savings in site energy, which is the energy directly consumed by products 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.[16] DOE's approach is based on the calculation of an FFC multiplier for each of the energy types used by covered products or equipment. For more information on FFC energy savings, see section IV.H.2 of this document. For natural gas, the primary energy savings are considered to be equal to the site energy savings.

[15] DOE also presents a sensitivity analysis that considers impacts for products shipped in a 9-year period.
[16] The FFC metric is discussed in DOE's statement of policy and notice of policy amendment. 76 FR 51282 (August 18, 2011), as amended at 77 FR 49701 (August 17, 2012).

2. Significance of Savings

To adopt standards for a covered product, 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 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, and, therefore, DOE considers them "significant" within the meaning of section 325 of EPCA.

H. 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)(I)–(VII)) The following sections discuss how DOE has addressed each of those seven factors in this rulemaking.

a. Economic Impact on Manufacturers and Consumers

In determining the impacts of potential energy conservation standards on manufacturers, DOE conducts a manufacturer impact analysis (i.e., 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) 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 consumers, measures of economic impact include the changes in LCC and PBP associated with new standards. These measures are discussed further in the following section. For consumers in the aggregate, DOE also calculates the national NPV of the economic impacts applicable to a particular rulemaking. DOE often also evaluates the LCC impacts of potential standards on identifiable subgroups of consumers that may be affected disproportionately by a national standard, such as low income and senior households. In the case of MREFs, the available house sample sizes for identifiable subgroups were insufficient to yield meaningful results.

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

The PBP is the estimated amount of time (in years) it takes consumers to recover the increased purchase cost (including installation) of a more-efficient product 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 assumes that consumers will purchase the covered products in the first year of compliance with new standards. The LCC savings for the considered efficiency levels are calculated relative to the case that reflects projected market trends in the absence of new standards (the no-new-standards case). DOE's LCC and PBP analysis is 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 national energy savings.

d. Lessening of Utility or Performance of Products

In establishing product 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 products. (42 U.S.C. 6295(o)(2)(B)(i)(IV)) Based on data available to DOE, the standards adopted in this direct final rule would not reduce the utility or performance of the products 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 proposed standard. (42 U.S.C. 6295(o)(1)(B)(i)(V)) Specifically, it instructs DOE to consider the impact of any lessening of competition, as determined in writing by the Attorney General that is likely to result from the imposition of the standard. DOE is simultaneously publishing a NOPR containing proposed energy conservation standards identical to those set forth in this direct final rule and has transmitted a copy of the rule and the accompanying TSD to the Attorney General, requesting that the U.S. Department of Justice ("DOJ") provide its determination on this issue. DOE will consider DOJ's comments on the direct final rule in determining whether to proceed with finalizing its standards. DOE will also publish and respond to the DOJ's comments in the Federal Register in a separate notice.

f. Need for National Energy Conservation

DOE also considers the need for national energy conservation in determining whether a new 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.0 of this document.

Additionally, apart from the savings described above, 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 document; 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

In determining whether a standard is economically justified, DOE may consider any other factors that it deems to be relevant. (42 U.S.C. 6295(o)(2)(B)(i)(VII)) In developing the direct final rule, DOE has considered the submission of the jointly-submitted Term Sheet #2 from the MREF Working Group. In DOE's view, the term sheet sets forth a statement by interested persons that are fairly representative of relevant points of view (including representatives of manufacturers of covered equipment, States, and efficiency advocates) and contains recommendations with respect to energy conservation standards that are in accordance with 42 U.S.C. 6295(o), as required by EPCA's direct final rule provision. See 42 U.S.C. 6295(p)(4). DOE has encouraged the submission of agreements such as the one developed and submitted by the MREF Working Group as a way to bring diverse stakeholders together, to develop an independent and probative analysis useful in DOE standard setting, and to expedite the rulemaking process. DOE also believes that the standard levels recommended in Term Sheet #2 may increase the likelihood for regulatory compliance, while decreasing the risk of litigation.

2. Rebuttable Presumption

As set forth in 42 U.S.C. 6295(o)(2)(B)(iii), EPCA creates a rebuttable presumption that an energy conservation standard is economically justified if the additional cost to the consumer of a product 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. DOE's LCC and PBP analyses generate values used to calculate the effect potential new energy conservation standards would have on the payback period for consumers. These analyses include, but are not limited to, the 3-year payback period contemplated under the rebuttable-presumption test. In addition, DOE routinely conducts an economic analysis that considers the full range of impacts to consumers, 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 direct final rule.

IV. Methodology and Discussion of Related Comments

This section addresses the analyses DOE has performed for this rulemaking with regard to MREFs. Separate subsections address each component of DOE's analyses.

DOE presented information on its initial analytical approach in the preliminary analysis. As discussed in section II.B of this direct final rule, DOE received comments from interested parties in response to both the preliminary analysis and the December 2014 Test Procedure NOPR indicating that these rulemakings would benefit from a negotiated rulemaking process. Based on the subsequent MREF Working Group discussions, in the July 2016 Final Coverage Determination, DOE revised its scope of coverage, product definitions, and test procedures for MREFs, which resulted in significant changes to the rulemaking analysis. 81 FR 46786. Because of these significant changes, many comments received in response to the preliminary analysis are no longer applicable.

Additionally, the substantive comments received in response to the preliminary analysis were from interested parties that were represented by members of the MREF Working Group. The Working Group discussed in detail all of the issues identified by these interested parties. As a result of these discussions, many MREF Working Group members revised their position on certain issues with respect to the analysis. To avoid presenting information that may not reflect the current opinions of Working Group members, DOE has not included summaries of comments received from Working Group members in response to the preliminary analysis in the following sections describing the direct final rule analyses. Rather, DOE has included summaries of the Working Group discussions, including citations to the relevant Working Group meeting transcripts that addressed issues with the preliminary analysis and recommended approaches for DOE in this direct final rule analysis.

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 national energy savings and net present value of total consumer 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/71. Additionally, DOE used output from the latest version of the Energy Information Administration's ("EIA") Annual Energy Outlook ("AEO"), a widely known energy forecast for the United States, for the emissions and utility impact analyses.

A. Market and Technology Assessment

1. Scope of Coverage

DOE develops information in the market and technology assessment that provides an overall picture of the market for the products concerned, including the purpose of the products, the industry structure, manufacturers, market characteristics, and technologies used in the products. This activity includes both quantitative and qualitative assessments, based primarily on publicly-available information. The subjects addressed in the market and technology assessment for this rulemaking include: (1) a determination of the scope of the rulemaking and product classes; (2) manufacturers and industry structure; (3) existing efficiency programs; (4) shipments information; (5) market and industry trends; and (6) technologies or design options that could improve the energy efficiency of MREFs. The key findings of DOE's market assessment are summarized below. See chapter 3 of the direct final rule TSD for further discussion of the market and technology assessment.

In the preliminary market and technology assessment, and consistent with the October 2013 SNOPD, DOE identified four consumer product categories that would be subject to potential energy conservation standards. These were: cooled cabinets, non-compressor refrigerators, hybrid refrigerators, and ice makers. DOE received multiple comments about the scope of coverage and the product classes considered in the preliminary analysis, summarized in the following sections. As described in section II.B of this document, the MREF Working Group discussed concerns regarding scope of coverage raised in comments received in response to the preliminary analysis.

The following sections describe how DOE has revised its scope of coverage for MREFs since the preliminary analysis and after considering the MREF Working Group recommendations. DOE initially proposed a revised scope of coverage in the March 2016 SNOPD (81 FR 11454), and finalized the scope of coverage in the July 2016 Final Coverage Determination. 81 FR 46768.

a. Coolers

In the December 2014 Test Procedure NOPR, DOE generally proposed to define the term “cooled cabinet” as a product with a refrigeration system that requires electric energy input only that does not meet the regulatory definition for “refrigerator” because its compartment temperatures are warmer than the 39 degrees Fahrenheit (°F) threshold established for refrigerators, as determined in a 72 °F ambient temperature. 79 FR 74894, 74901–74902 (December 16, 2014). In the preliminary analysis, DOE presented information regarding cooled cabinets that, based on the proposed definition, included those products using either vapor-compression or non-compressor refrigeration systems. See chapter 3 of the preliminary TSD.

The MREF Working Group's Term Sheet #1 recommended that DOE revise the term “cooled cabinet” to “cooler” and incorporated a number of other changes to the proposed definition of this new term. The Working Group recommended that compartment temperatures be determined during operation in a 90 °F ambient temperature to maintain consistency with the test conditions used for other refrigeration products. (ASRAC Public Meeting Transcript, No. 44 at pp. 158–202)[17] The Working Group also recommended excluding products designed to be used without doors, consistent with the exclusions DOE had proposed for the refrigerator, refrigerator-freezer, and freezer definitions in the December 2014 Test Procedure NOPR. 79 FR 74894,

[17] A notation in the form “ASRAC Public Meeting Transcript, No. 44 at pp. 158–202” identifies a comment: (1) made during an MREF Working Group public meeting; (2) recorded in document number 44 that is filed in the docket of this energy conservation standards rulemaking (Docket No. EERE-2011-BT-STD-0043) and available for review at www.regulations.gov; and (3) which appears on pages 158 through 202 of document number 44.

74900 (December 16, 2014). The purpose of the exclusion would be to differentiate between consumer products and commercial equipment — in other words, products designed for use without doors (e.g. reach-in freezers) would be treated as commercial equipment rather than consumer products, consistent with the statutory coverage of refrigerators, refrigerator-freezers, and freezers. See 42 U.S.C. 6292(a)(1). (ASRAC Public Meeting Transcript, No. 85 at pp. 9–11; No. 92 at pp. 18–25) The Working Group further recommended the requirement that coolers operate on single-phase, alternating current rather than simply specifying operation with electric energy input. This approach would exclude those products designed for direct current or 3-phase power supplies, which, because of the nature of these power sources, would likely apply to products intended for use in mobile or commercial applications, respectively. (ASRAC Public Meeting Transcript, No. 45 at pp. 83–97; No. 86 at pp. 19–21) See Term Sheet #1.

In the March 2016 SNOPD, DOE proposed to define coolers based on its proposed definition from the December 2014 Test Procedure NOPR but updated to reflect the Working Group's recommendations. 81 FR at 11458–11459. DOE did not receive any comments that would substantively change this proposed updated definition in response to the March 2016 SNOPD. Hence, in the July 2016 Final Coverage Determination, DOE established the definition for cooler as proposed in the March 2016 SNOPD, with minor revisions, in 10 CFR 430.2. 81 FR at 46775–46776.

b. Combination Cooler Refrigeration Products

In the December 2014 Test Procedure NOPR, DOE proposed the term "hybrid refrigeration product" to refer to products with a warm-temperature compartment (e.g., a wine chiller), making up at least 50 percent of a product's volume, combined with a fresh food and/or freezer compartment. 79 FR at 74903–74904. DOE conducted the preliminary analysis for hybrid refrigeration products using that proposal's definitional scope. See chapter 3 of the preliminary TSD.

The MREF Working Group discussed the proposed definition and recommended that DOE revise the term from "hybrid refrigeration product" to "combination cooler refrigeration product" to more clearly describe the product category. The Working Group also recommended that DOE refer to the warmer compartment within combination cooler refrigeration products as a "cooler compartment" (defined by the same temperature ranges as proposed for coolers) and that DOE drop the proposed requirement that cooler compartments make up at least 50 percent of a combination cooler refrigeration product's total volume. The Working Group noted that all products with cooler compartments would likely be used in the same way and asserted that the 50-percent threshold was an arbitrary cutoff. It further recommended that DOE exclude products designed for use without doors from the combination cooler refrigeration product definitions for the same reasons discussed for coolers (i.e., differentiating between commercial equipment and consumer products). (ASRAC Public Meeting Transcript, No. 85 at pp. 31–52; No. 91 at pp. 55-58) See Term Sheet #1.

DOE agreed with the recommended changes from the MREF Working Group and the Working Group's reasoning for each of them. The term "combination cooler refrigeration product" more clearly describes the characteristics of the products that would fall in this category. Additionally, the recommendation to remove the 50-percent threshold would limit the potential for circumvention by manufacturing products with cooler compartment volumes either just above or below the threshold. Removing the cooler compartment volume threshold ensures that all products with cooler compartments (which are likely to be used in the same way, as indicated by the MREF Working Group) are categorized consistently. Therefore, DOE proposed to define terms for combination cooler refrigeration products in the March 2016 SNOPD consistent with the definitions included in Term Sheet #1. See 81 FR at 11459 (detailing DOE's rationale for adopting the Working Group's approach). DOE did not receive any comments that would substantively change the proposed definitions of combination cooler refrigeration products in response to the March 2016 SNOPD; therefore, DOE subsequently codified the definition, with only minor revisions, in 10 CFR 430.2 through the July 2016 Final Coverage Determination. Further, the July 2016 Final Coverage Determination codified the definition for "cooler compartment" as recommended by the MREF Working Group into appendix A. See 81 FR at 46776–46777.

c. Ice Makers

In the preliminary analysis, DOE presented information regarding ice makers, which DOE tentatively defined as a consumer product other than a refrigerator, refrigerator-freezer, freezer, hybrid refrigeration product, non-compressor refrigerator, or cooled cabinet designed to automatically produce and harvest ice, but excluding any basic model that is certified under American National Standards Institute (ANSI)/NSF International (NSF) 12-2012 "Automatic Ice Making Equipment."[18] Such a product would also include a means for storing ice, dispensing ice, or storing and dispensing ice. See chapter 3 of the preliminary TSD.

In response to the preliminary analysis, DOE received feedback from several interested parties regarding ice maker coverage within MREFs. As such, the MREF Working Group discussed the issue of whether ice makers should be considered MREFs for coverage under EPCA. The MREF Working Group decided that ice makers are fundamentally different from the other product categories considered to be MREFs, as evidenced by DOE proposing a separate test procedure for ice makers in the December 2014 Test Procedure NOPR. The Working Group also noted that ice makers are currently covered as commercial equipment, and that there is no clear means to differentiate between consumer and commercial ice makers. (ASRAC Public Meeting Transcript, No. 44 at pp. 143–145, No. 45 at pp. 134–145; No. 92 at pp. 39–51) Accordingly, the Working Group recommended that DOE not maintain coverage of ice makers under MREFs. (ASRAC Public Meeting Transcript, No. 92 at p. 138) See Term Sheet #1.

Consistent with the MREF Working Group's recommendation, the March 2016 SNOPD proposed excluding ice makers from coverage as MREFs. 81 FR at 11456.

[18] ANSI/NSF 12-2012 is available for purchase online at http://www.techstreet.com/nsf.

DOE did not receive comments opposing this approach in response to the March 2016 SNOPD, and, therefore, excluded ice makers from coverage as MREFs in the July 2016 Final Coverage Determination. 81 FR at 46773. Accordingly, DOE has not analyzed or adopted standards for ice makers as part of this direct final rule.

d. Non-Compressor Refrigerators

EPCA specifies that refrigerators, refrigerator-freezers, and freezers with compressor and condenser units as integral parts of the cabinet assembly (i.e., products that utilize vapor-compression refrigeration technology) are covered consumer products. (42 U.S.C. 6292(a)(1)(B)) In the preliminary analysis, DOE stated that it had identified products that use thermoelectric and/or absorption technology that were sold as refrigerators but was unaware of any products using these technologies sold as refrigerator-freezers or freezers. For the preliminary analysis, DOE considered a non-compressor refrigerator as a cabinet that has a source of refrigeration that does not include a compressor and condenser unit, requires electric energy input only, and is capable of maintaining compartment temperatures above 32 °F (0 °C) and below 39 °F (3.9 °C) as determined in a 72 °F ambient temperature. See chapter 3 of the preliminary TSD.

DOE tested six non-compressor refrigerator models in support of the preliminary analysis. In that testing, DOE determined that none of the six models were able to maintain compartment temperatures in the specified refrigerator range when tested in a 90 °F ambient temperature consistent with the current DOE test procedure for refrigerators and the approach recommended by the Working Group. See chapter 5 of the preliminary TSD.

The MREF Working Group discussed whether non-compressor refrigerators should be considered MREFs. As discussed in the March 2016 SNOPD, the Working Group recommended that the compartment temperature ranges included in definitions be determined during product operation in a 90 °F ambient temperature. 81 FR at 11458–11460. Based on this suggested definition, the Working Group members stated that they were unaware of any products that would be considered non-compressor refrigerators available on the market, and recommended that DOE not establish a definition for this product category. (ASRAC Public Meeting Transcript, No. 45 at pp. 49–52; No. 91 at pp. 157–158) See Term Sheet #1.

In examining the merits of creating a separate product category and definition for non-compressor refrigerators, DOE conducted additional literature reviews and manufacturer interviews. DOE, however, did not find any non-compressor (thermoelectric or absorption) products available on the market that would be capable of maintaining compartment temperatures in the range necessary for a refrigerator as specified in 10 CFR 430.2 when tested in a 90 °F ambient temperature consistent with the current refrigerator test procedure and the approach ultimately recommended by the Working Group. Accordingly, in light of the Working Group's recommendation, DOE did not establish a separate product category for non-compressor refrigerators under MREFs, a discussed in the July 2016 Final Coverage Determination. See 81 FR at

46775–46776. DOE notes that products previously analyzed as non-compressor refrigerators would be covered as coolers under the MREF definitions established in the July 2016 Final Coverage Determination.

2. Product Classes

a. Coolers

In the preliminary analysis, DOE proposed a single product class for all coolers (at the time referred to as "cooled cabinets"). DOE was aware of both vapor-compression and non-compressor coolers available on the market; however, DOE did not analyze these products in separate product classes because it did not identify any unique consumer utility associated with the different refrigeration systems. See chapter 3 of the preliminary TSD.

The MREF Working Group discussed the topic of product classes when considering recommended standards for MREFs. For coolers, the Working Group agreed with DOE's preliminary analysis determination that there is no unique consumer utility associated with either thermoelectric or vapor-compression refrigeration systems. (ASRAC Public Meeting Transcript, No. 45 at pp. 13–14, 162) Working Group members also compared coolers to refrigerators, refrigerator-freezers, and freezers, and considered similar characteristics for differentiating product classes. Working Group members noted that compact and built-in coolers each provide unique consumer utility and have different energy use characteristics compared to full-size or freestanding coolers, respectively. (ASRAC Public Meeting Transcript, No. 44 at pp. 155–157; No. 45 at pp. 160-166)

Accordingly, the Working Group recommended that DOE establish definitions and energy conservation standards for four cooler product classes: built-in compact, built-in, freestanding compact, and freestanding. See Term Sheets #1 and #2.

DOE sought additional information related to the consideration of non-compressor products in the December 2015 NODA. 80 FR 77589. DOE did not receive any information indicating that the approach used by the MREF Working Group was inappropriate.

Based on the recommendations of the MREF Working Group, DOE proposed definitions for each of the cooler product classes in the March 2016 SNOPD, and subsequently codified the definitions in 10 CFR 430.2 in the July 2016 Final Coverage Determination. 81 FR at 11459; 81 FR at 46775–46776. The standards adopted in this direct final rule are based on these four cooler product classes discussed above.

b. Combination Cooler Refrigeration Products

In the preliminary analysis, DOE proposed that combination cooler refrigeration products (at the time referred to as "hybrid refrigeration products") would be subject to the same product class structure as currently in place for refrigerators, refrigerator-freezers, and freezers. See generally, 10 CFR 430.32(a) (detailing the different classes applicable to refrigerators, refrigerator-freezers, and freezers). Under this approach, the applicable product class would be determined based on the total product volume, the compartment temperature ranges for the non-cooler compartments, and any relevant product features (e.g., configuration, defrost type, ice making, etc.). See chapter 3 of the preliminary TSD.

The MREF Working Group discussed the topic of product classes when considering recommended standards for MREFs. Similar to coolers, the Working Group discussed how combination cooler refrigeration products are similar to refrigerators, refrigerator-freezers, and freezers. The Working Group considered whether the product class structure DOE proposed in the preliminary analysis would be appropriate. However, the Working Group indicated that because only certain of the previously considered product classes were available on the market or likely to become available on the market, DOE should only conduct analysis and consider potential standards for these product classes. Accordingly, the Working Group recommended that DOE establish eight product classes for combination cooler refrigeration products. These eight product classes represent the combination cooler refrigeration products that are either currently available on the market or very similar to products currently available (i.e., the associated freestanding equivalent to a built-in product). Although combination cooler refrigeration products are not currently available in each of the eight product classes, the MREF Working Group included the additional product classes as a means to prevent circumvention. For example, if DOE established only built-in product classes, a manufacturer could readily modify a product to be freestanding to avoid having to meet the MREF standards. Accordingly, the Working Group recommended product classes for both built-in and freestanding configurations for each product type currently available.

(ASRAC Public Meeting Transcript, No. 103 at pp. 55–67, 72–86, 104–109) See Term Sheets #1 and #2.

Based on the recommendations of the MREF Working Group, in this direct final rule, DOE is establishing eight product classes for combination cooler refrigeration products. DOE has determined that each product class offers a unique consumer utility and has different energy use characteristics, warranting separate product classes. Table I.2 of this direct final rule includes a description of the eight product classes. More detailed descriptions of each of the product classes can be found in chapter 3 of the direct final rule TSD.

3. Technology Options

In the preliminary analysis, DOE identified multiple technology options that may be used to improve MREF efficiencies. The preliminary analysis technology options are listed in Table IV.1 and described in chapter 3 of the preliminary TSD.

Table IV.1 Preliminary Analysis Technology Options

Technology Options	
Compressor	Improved compressor efficiency
	Variable-speed compressor
	Linear compressor
Evaporator	Increased surface area
	Enhanced heat exchanger
	Forced-convection evaporator
Condenser	Increased surface area
	Enhanced heat exchanger
	Forced-convection condenser
Fan and Fan Motor	Higher-efficiency fan motors
	Higher-efficiency fan blades
Insulation	Improved resistivity of insulation
	Increased insulation thickness
	Vacuum-insulated panels ("VIPs")
	Gas-filled panels
Gasket	Improved gaskets
	Double-door gaskets
	Improved door face frame
Doors	Improved resistivity of glass door
	Solid door
Expansion Valve	Improved: thermostatic expansion valves ("TXV") or electronic expansion valves ("EEV")
Cycling Losses	Fluid control or solenoid valve
Defrost	Off-cycle defrost
	Reduced energy
	Adaptive defrost
	Hot-gas bypass
Controls	Electronic temperature control
Alternative Refrigeration System	Conversion to alternative refrigeration system
Alternative Heat Transfer	Heat pipe
Other	Component location

After receiving feedback from interested parties, conducting manufacturer interviews, and participating in the MREF Working Group discussions, DOE did not identify any additional technology options beyond those considered in the preliminary analysis. In this direct final rule, DOE considered the same list of technology options as presented in Table IV.1.

B. Screening Analysis

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. Technologies that are not incorporated in commercial products or in working prototypes will not be considered further.

2. Practicability to manufacture, install, and service. If it is determined that mass production and reliable installation and servicing of a technology in commercial products 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 product 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 consumers or would result in the unavailability of any covered product type with performance characteristics (including reliability), features, sizes, capacities, and volumes that are substantially the same as products

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.

1. Screened-Out Technologies

In the preliminary analysis, DOE assessed the feasibility of each of the technologies listed in Table IV.1. Several of these technology options were found not to meet the four required screening criteria and were therefore screened out from further consideration in DOE's analysis. Table IV.2 lists the technology options DOE screened out for the preliminary analysis. More details on why these technology options were screened out can be found in chapter 4 of the preliminary TSD.

Table IV.2 Preliminary Analysis Screened Out Technology Options

Technology	Reason for Screening Out
Linear Compressors	Lack of information on commercially-available compressors, uncertainty on whether they would be readily incorporated on a widespread basis.
Increased Evaporator and Condenser Surface Area	No physical room to increase the face area or add tubes, would impact product utility by requiring larger cabinets.
Improved Evaporator Heat Exchange	Most fin enhancements would increase frost accumulation, decreasing product utility.
Improved Condenser Heat Exchange	Maintenance concerns requiring more frequent cleaning of heat-exchanger, impacting product utility.
Forced-Convection Condensers	Already in use by baseline products, hence eliminated from consideration in subsequent analyses.
Higher-Efficiency Fan Blades	Likely already in use in baseline products, lack of information to provide credible calculation of savings and costs.
Improved Resistivity of Insulation Panels	Lack of information on available options, not technologically feasible based on available information.
Gas-Filled Panels	Not commercially-available, not practicable to manufacture on the scale necessary for the market
Solid Doors (for coolers, and cooler compartments)	Would affect consumer utility (i.e., availability of glass-door units).
Improved Gaskets	Already in use by nearly all MREF products.
Improved Expansion Valves	Automatic valves or EEV's are typically oversized for these products, not practicable to manufacture on the scale necessary for the market.
Fluid-Control Valves	Potential decrease in product reliability, negatively impacting consumer utility.
Off-Cycle Defrost, Reduced Energy for Automatic Defrost, Adaptive Defrost, and Hot-Gas Bypass Defrost	Already in use by nearly all MREF products.
Electronic Temperature Control	Lack of data on costs and savings.
Conversion to Thermoelectric or Absorption Refrigeration Systems	Unlikely to result in energy savings.
Component Location (internal arrangement of components)	Already in use by nearly all MREF products.

For this direct final rule analysis, DOE has maintained one technology option for consideration in the engineering analysis that was screened out in the preliminary analysis. DOE is no longer screening out improved evaporator and condenser heat exchange. DOE received feedback during confidential manufacturer interviews that there may be opportunities to optimize evaporator and condenser designs for more effective heat transfer. For this direct final rule, DOE has continued to screen out the remaining technology options listed in Table IV.2.

2. Remaining Technologies

Through a review of each technology, DOE concludes that all of the other identified technology options listed in section IV.A.3 of this document meet all four screening criteria to be examined further as design options in the direct final rule engineering analysis. In summary, and as explained further in this section, DOE did not screen out the following technology options shown in Table IV.3.

Table IV.3 Direct Final Rule Remaining Design Options

Design Option
Improved compressor efficiency
Variable-speed compressors
Improved evaporator and condenser heat exchange
Higher-efficiency fan motors
Increased insulation thickness
Vacuum-insulated panels
Improved glass door resistivity
Conversion to vapor-compression
Heat pipes

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

C. Engineering Analysis

In the engineering analysis, DOE establishes the relationship between the manufacturer production cost ("MPC") and improved efficiency of MREFs. This relationship serves as the basis for cost-benefit calculations for individual consumers, manufacturers, and the Nation. DOE typically structures the engineering analysis using one of three approaches: (1) design-option; (2) efficiency-level; or (3) reverse-engineering (or cost assessment). The design-option approach involves adding the estimated cost and associated efficiency of various efficiency-improving design changes to the baseline product to model different levels of efficiency. The efficiency-level approach uses estimates of costs and efficiencies of products available on the market at distinct efficiency levels to develop the cost-efficiency relationship. The reverse-engineering approach involves testing products for efficiency and determining cost from a detailed bill of materials ("BOM") derived from reverse-engineering representative products. The efficiency ranges from that of the least-efficient MREFs sold today to the max-tech efficiency level. At each efficiency level examined, DOE determines the MPC; this relationship is referred to as a cost-efficiency curve.

1. Coolers

a. Methodology

In the preliminary analysis, DOE adopted a combined efficiency-level/design-option/reverse-engineering approach to develop cost-efficiency curves for coolers. DOE first established efficiency levels by defining annual energy use as a percent of the California Energy Commission ("CEC")-equivalent energy use. This is the maximum allowable energy use of the CEC energy standards for wine chillers with automatic defrost, adjusted to account for the fact that the CEC test procedure uses a different usage factor than DOE considered in its analysis. DOE based its analysis on the potential efficiency improvements associated with groups of design options. See chapter 5 of the preliminary TSD.

DOE then developed manufacturing cost models based on its reverse-engineering of various MREF products. These reverse-engineering efforts yielded additional information that helped support DOE's calculation of the incremental costs associated with efficiency improvements. To develop the analytically derived cost-efficiency curves, DOE collected information from various sources on the manufacturing costs and energy use reductions associated with each of the considered design options. DOE reviewed product literature, conducted testing and reverse-engineering of current products, and interviewed component and product manufacturers. DOE modeled energy use reductions associated with design options using the Efficient Refrigerator Analysis program developed for the 2011 residential refrigeration products rulemaking and modified for this MREF standards rulemaking analysis. The incremental cost estimates combined with test data and energy modeling results led to the cost-efficiency curves for coolers developed for the preliminary analysis. See chapter 5 of the preliminary TSD.

DOE did not receive any feedback on the overall methodology used for the coolers preliminary engineering analysis. In this direct final rule, DOE conducted the engineering analysis using the same approach as the preliminary analysis. However, DOE has updated its analysis to reflect the changes to the scope of coverage and product classes as discussed in sections IV.A.1 and IV.A.2 of this document. DOE also incorporated feedback from manufacturers obtained during additional interviews and information from MREF Working Group members during the Working Group discussions. Additional information on the methodology used for this direct final rule engineering analysis is available in chapter 5 of the direct final rule TSD.

b. Efficiency Levels

As described in section IV.C.1.a of this document, for the preliminary analysis, DOE considered efficiency levels defined by their performance with respect to the CEC-equivalent baseline level. DOE considered the CEC-equivalent standard level to be the baseline point of comparison for coolers; however, DOE observed that certain coolers performed worse than the CEC-equivalent standard level. From DOE’s test sample, the worst-performing unit was a non-compressor cooler that tested at 267 percent of the CEC-equivalent standard. DOE used this level as the baseline in its preliminary engineering analysis. The best-performing unit in DOE’s test sample was a vapor-compression cooler that tested at 48 percent of the CEC-equivalent standard. DOE estimates that this level represented the maximum efficiency available on the market. In the preliminary analysis, DOE considered efficiency levels beyond the maximum available by using energy modeling. The energy model for the maximum technologically feasible (max-tech) level was based on incorporating all applicable design options for coolers. That energy modeling resulted in an efficiency level at 32 percent of the CEC-equivalent standard level. DOE analyzed efficiency levels at 10-percent intervals between the CEC-equivalent and max-tech levels, and at somewhat larger intervals between the baseline and CEC-equivalent levels.

Table IV.4 lists the efficiency levels considered for coolers in the preliminary analysis. Chapter 5 of the preliminary TSD provides additional information on the development of the preliminary analysis efficiency levels.

Table IV.4 Preliminary Analysis Cooler Efficiency Levels

Efficiency Level	Percent of CEC-Equivalent Energy Consumption
Baseline	267
1	200
2	160
3	130
4 (CEC-Equivalent)	100
5	90
6	80
7	70
8	60
9	50
10	40
11 (Max-Tech)	32

For this direct final rule, DOE primarily relied on the same test data and modeling data as used in the preliminary analysis to evaluate efficiency levels. However, because

DOE is establishing four separate product classes for coolers, DOE used this information to determine appropriate efficiency levels for each product class.

The test data from the preliminary analysis apply to both the freestanding and freestanding compact product classes. Accordingly, DOE analyzed the same efficiency levels for these product classes as considered in the preliminary analysis. However, DOE also tested one additional freestanding unit with an energy consumption at approximately 300 percent of the CEC-equivalent level. DOE therefore revised the corresponding baseline efficiency level in this direct final rule to account for the higher energy consumption of this newly tested unit.

Table IV.5 Direct Final Rule Efficiency Levels – Freestanding and Freestanding Compact Coolers

Efficiency Level	Percent of CEC-Equivalent Energy Consumption
Baseline	300
1	250
2	200
3	150
4 (CEC-Equivalent)	100
5	90
6	80
7	70
8	60
9	50
10	40
11 (Max-Tech)	32

For the built-in product classes, DOE reviewed available market information and sought information on product availability from manufacturers during interviews and during the MREF Working Group discussions. DOE determined that all built-in coolers use vapor-compression refrigeration systems, and that there are no built-in coolers available at efficiencies lower than the CEC-equivalent level. So, for built-in coolers and built-in compact coolers, DOE established Efficiency Level 4 (100 percent of the CEC-equivalent) as the baseline efficiency level.

DOE also received feedback from MREF Working Group members indicating that built-in coolers use more energy than similarly constructed freestanding coolers, consistent with the higher maximum allowable annual energy use standards for built-in refrigerator, refrigerator-freezer, and freezer product classes as compared to their corresponding freestanding counterparts. The MREF Working Group recommended that DOE consider a similar energy adder for built-in coolers in its analysis. (ASRAC Public Meeting Transcript, No. 44 at pp. 155–157; No. 87 at pp. 74–77) DOE compared the built-in refrigerator, refrigerator-freezer, and freezer product classes to their equivalent freestanding counterparts, and determined that built-in products similar to coolers typically have approximately 10-percent higher energy use than freestanding products. See chapter 5 of the direct final rule TSD for the comparison of built-in and freestanding performance. DOE applied this 10-percent adder to its analysis for built-in coolers. DOE maintained intermediate efficiency levels at 10-percent CEC-equivalent intervals between the baseline and max-tech efficiency levels, so the built-in adder is only apparent at the max-tech efficiency level (i.e., 32 percent of CEC-equivalent for freestanding plus a 10-percent energy use adder equals 35 percent of CEC-equivalent).

Table IV.6 Direct Final Rule Efficiency Levels – Built-in and Built-in Compact Coolers

Efficiency Level	Percent of CEC-Equivalent Energy Consumption
4 (CEC-Equivalent)	100

5	90
6	80
7	70
8	60
9	50
10	40
11 (Max-Tech)	35

Additional details regarding the selection of efficiency levels for coolers are available in chapter 5 of the direct final rule TSD.

c. Manufacturer Production Costs

In the preliminary analysis, DOE developed cost-efficiency curves for coolers with total refrigerated volumes of 2 ft^3 and 6 ft^3. DOE focused its analysis on these product volumes because it determined they were most representative of products available on the market. The 2-ft^3 product represents the smaller units that would typically sit on a countertop, while the 6-ft^3 volume represents products designed to be installed underneath the counter.

For 2-ft^3 coolers, DOE developed a cost-efficiency curve using data from two reverse-engineered 2-ft^3 coolers and additional scaled data from reverse-engineered 6-ft^3 coolers to estimate costs at higher efficiencies. DOE used its cost model to estimate the MPCs of modeled units incorporating design options not included in the reverse-engineered units. For 2-ft^3 coolers, the cost-efficiency curve represents starting with a non-compressor cooler at the baseline efficiency level and converting to vapor-compression to reach the higher efficiency levels.

DOE followed a similar approach for developing a cost-efficiency curve for 6-ft^3 coolers in the preliminary analysis. DOE reverse-engineered three 6-ft^3 coolers at the CEC-equivalent efficiency level, a mid-efficiency level, and the maximum available efficiency level. DOE used its cost model to estimate the MPCs of modeled units incorporating design options not observed in the reverse-engineered units. For 6-ft^3 products, DOE was not aware of any non-compressor products available at the time of the preliminary analysis. Accordingly, DOE based the 6-ft^3 analysis only on vapor-compression coolers, with a baseline efficiency at the CEC-equivalent level.

Table IV.7 presents the cost-efficiency curves developed for 2-ft^3 and 6-ft^3 coolers in the preliminary analysis. Chapter 5 of the preliminary TSD provides additional discussion regarding the development of the preliminary cost-efficiency curves.

Table IV.7 Preliminary Analysis Cooler Cost-Efficiency Curves (2013$)

Efficiency Level (Percent of CEC-Equivalent Energy Consumption)	**Incremental MPC**	
	6-ft^3	**2-ft^3**
Baseline (267)	-	-
1 (200)	-	$21
2 (160)	-	$34
3 (130)	-	$44
4 (100 -- CEC-Equivalent)	-	$54
5 (90)	$12	$57
6 (80)	$21	$72
7 (70)	$33	$88
8 (60)	$47	$100
9 (50)	$62	$112
10 (40)	$135	$170
11 (32 -- Max-Tech)	$205	$225

DOE used the preliminary engineering analysis as the basis for the MPCs in this direct final rule engineering analysis. The primary updates made to the preliminary analysis MPCs reflected the incorporation of the four cooler product classes and updated market information.

Similar to the preliminary engineering analysis, DOE analyzed products at representative volumes in each of the four cooler product classes for this direct final rule. DOE did not reverse-engineer products at each of these volumes. To develop MPCs for those products, DOE used its cost model and scaled certain components to reflect the changes that would be necessary with different cabinet sizes. DOE also relied on market information to verify cost information and product specifications. Table IV.8 shows the representative product volumes DOE considered for this direct final rule engineering analysis.

Table IV.8 Representative Cooler Volumes

Product Class	**Representative Volumes**
Freestanding	8-ft^3, 12-ft^3, 16-ft^3
Built-in	8-ft^3, 12-ft^3, 16-ft^3
Freestanding Compact	2-ft^3, 4-ft^3, 6-ft^3
Compact Built-in	6-ft^3

After reviewing updated market information, DOE is now aware of products with volumes greater than 2 ft^3 that use non-compressor refrigeration systems. In particular, DOE identified non-compressor coolers with volumes up to 12 ft^3 available on the market. DOE observed non-compressor products for only the two freestanding product classes, so for these product classes, DOE analyzed the changes and costs associated with moving from a baseline non-compressor product (i.e., 300 percent of the CEC-equivalent standard) to the max-tech level. For the built-in product classes, which include only vapor-compression products, DOE analyzed the changes necessary to move from Efficiency Level 4 (the CEC-equivalent standard) to the max-tech.

For this direct final rule, DOE expects that manufacturers would rely on the same design changes as considered in the preliminary analysis to reach higher efficiency levels. DOE presented the design option changes associated with higher efficiencies to manufacturers during interviews conducted under non-disclosure agreements and to the MREF Working Group. Feedback from the manufacturers and Working Group members generally supported the design option changes and their corresponding efficiency increases.[19]

DOE used the preliminary analysis as the basis for the costs associated with these design changes; however, DOE updated its cost estimates based on feedback from manufacturer interviews and from the MREF Working Group. This updated information included feedback on specific component pricing and on the order in which manufacturers would apply the different design options.

In addition to the revised analysis, DOE also updated its cost estimates to 2015$, the most recent year for which full-year cost data was available at the time of the direct final rule analysis. Based on these updates to the preliminary analysis, DOE developed cost-efficiency curves presented in Table IV.9 for each of the analyzed volumes for the

[19] See document numbers 54, 58, and 75 in docket ID EERE-2011-BT-STD-0043 on http://www.regulations.gov for engineering materials presented to the MREF Working Group.

cooler product classes established in this direct final rule. Chapter 5 of the direct final rule TSD includes additional information on the engineering analysis.

Table IV.9 Direct Final Rule Cooler Cost-Efficiency Curves (2015$)

Efficiency Level	Compact (<7.75 ft^3)				Full-Size (≥7.75 ft^3)					
	Freestanding			Built-In	Freestanding			Built-In		
	2-ft^3	4-ft^3	6-ft^3	6-ft^3	8-ft^3	12-ft^3	16-ft^3	8-ft^3	12-ft^3	16-ft^3
Baseline	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
1	$0	$16	$14	$0	$27	$36	$0	$0	$0	$0
2	$0	$33	$28	$0	$53	$71	$0	$0	$0	$0
3	$0	$49	$42	$0	$80	$107	$0	$0	$0	$0
4	$54	$65	$56	$0	$106	$143	$0	$0	$0	$0
5	$57	$73	$64	$7	$118	$160	$22	$8	$10	$11
6	$65	$82	$73	$18	$129	$175	$41	$22	$29	$34
7	$76	$95	$88	$31	$149	$204	$74	$38	$51	$58
8	$89	$108	$102	$46	$163	$219	$91	$53	$66	$73
9	$102	$120	$113	$51	$173	$227	$98	$57	$68	$75
10	$147	$192	$198	$155	$235	$302	$181	$175	$236	$265
11	$237	$282	$288	$223	$378	$500	$403	$259	$337	$376

2. Combination Cooler Refrigeration Products

a. Methodology

In the preliminary analysis, DOE observed that combination coolers were very similar in design to refrigerators, refrigerator-freezers, and freezers. Because of these similarities, DOE did not conduct a full engineering analysis for these products. Instead, DOE considered whether it would be appropriate to apply the standards currently in place for refrigerators, refrigerator-freezers, and freezers to combination cooler refrigeration products. To do this, DOE modeled the heat loads for various combination product configurations at two representative product volumes (6 ft^3 and 12 ft^3) incorporating different combinations of design options. From the modeling results, DOE concluded that all of the product configurations would be capable of meeting the existing standard for the corresponding product class for all-refrigerators with automatic defrost. Although DOE determined that combination cooler refrigeration products would be able to reach that efficiency level by incorporating certain design options, DOE did not estimate the incremental MPCs associated with improving performance to that level. See chapter 5 of the preliminary TSD.

During the MREF Working Group discussions, Working Group members recommended that DOE conduct the full analysis, including establishing product classes, efficiency levels, and incremental MPC estimates for these products.[20]

For this direct final rule engineering analysis, DOE conducted the full engineering analysis as recommended by the MREF Working Group. DOE used an approach based on modeling different product configurations and design options to estimate performance. This approach was similar to what DOE used in the preliminary engineering analysis. DOE conducted its engineering analysis on three of the eight product classes of combination cooler refrigeration products, as discussed in section IV.A.2 of this document, and on the typical product configurations (i.e., compartment volumes and door types) available on the market. DOE did not test or reverse-engineer any combination cooler refrigeration products, so it relied on modeling to determine baseline performance and incremental efficiency improvements. DOE modeled the typical product configurations observed in products available on the market, and incorporated design options to improve the refrigeration system efficiency and reduce the thermal load on the

[20] See docket transcript documents EERE-2011-BT-STD-0043-0090 and EERE-2011-BT-STD-0043-0103 for the discussions of the combination cooler refrigeration products analysis.

unit. DOE concluded that combination cooler refrigeration products would rely on the same design options to improve efficiency as for coolers. Accordingly, DOE applied similar cost estimates to each design option. DOE used its cost model to scale the design option cost estimates, as necessary, based on the different product configurations for combination cooler refrigeration products. A more detailed description of the methodology used in this direct final rule engineering analysis is available in chapter 5 of the direct final rule TSD.

b. Efficiency Levels

For the preliminary engineering analysis, DOE did not specifically analyze different efficiency levels for combination cooler refrigeration products. DOE instead modeled sets of design options corresponding to the baseline and higher efficiencies to determine whether these products would be capable of meeting the existing energy conservation standards for refrigerators, refrigerator-freezers, and freezers.

In this direct final rule, DOE is establishing eight product classes for combination cooler refrigeration products, representing the product types either currently available on the market or likely to be available in the future. For the purposes of the engineering analysis, DOE analyzed only the product classes with current product offerings (C-3A, C-9, and C-13A). DOE applied this analysis to the remaining similar product classes in the downstream analyses. Based on market data, DOE identified a representative total refrigerated volume and configuration for each of these three analyzed product classes, as described in Table IV.10. For all three product classes, DOE observed that the cooler compartment typically had a glass door, while the fresh food or freezer compartment had a solid door.

Table IV.10 Representative Combination Cooler Refrigeration Product Configurations

Product Class	**Cooler Compartment Volume** (ft^3)	**Fresh Food or Freezer Compartment Volume** (ft^3)	**Total Refrigerated Volume** (ft^3)
C-3A	6	6	12
C-9	6	6	12
C-13A	1.2	3.6	4.8

DOE then used its modeling tool (discussed in detail in chapter 5 of the direct final rule TSD) to evaluate the thermal load on a typical baseline unit (i.e., thinnest insulation and baseline glass for the cooler compartment). DOE assumed that a baseline refrigeration system would be equivalent to the baseline refrigeration system for a corresponding refrigerator, refrigerator-freezer, or freezer. With the estimated thermal load and refrigeration system efficiency, DOE calculated the associated energy performance for the baseline combination cooler refrigeration products.

For performance at higher efficiency levels, DOE modeled the thermal load impacts of increased insulation thickness and improved glass door resistivity. These design changes would reduce the total thermal load for the refrigeration system to offset. At the higher efficiency levels DOE also considered improved refrigeration system efficiencies through higher-efficiency compressors and optimized heat exchangers, similar to the design options analyzed for coolers. DOE estimated max-tech performance by combining the lowest modeled thermal load with the highest-efficiency refrigeration system. DOE considered intermediate efficiency levels at even increments between the baseline and max-tech. For each product class, DOE analyzed an intermediate efficiency level corresponding to the equivalent level of the refrigerator, refrigerator-freezer, and freezer energy conservation standards that apply to those manufacturers who have received permission to use a test procedure waiver, which provides a usage factor that compensates for the less frequent door openings for these products.

Based on the updated product class structure and DOE's modeling analysis, DOE analyzed the efficiency levels as shown in Table IV.11. The values corresponding to each efficiency level reflect the modeled energy use relative to the existing standards for the corresponding refrigerator, refrigerator-freezer, or freezer product classes, where 100 percent represents the current standard level for products tested according to the existing test procedure waivers. Chapter 5 of the direct final rule TSD provides more information on the development of combination cooler refrigeration product efficiency levels.

Table IV.11 Direct Final Rule Combination Cooler Refrigeration Product Efficiency Levels

	Percent of DOE Refrigerator Standard Equivalent		
Efficiency Level	**C-3A**	**C-9**	**C-13A**
Baseline	136	145	171
1	128	128	149
2	100	106	128
3	85	100	100
4	77	85	85
5	68	77	77
6	60	68	68
7 (Max-tech)	46	58	60

c. Manufacturer Production Costs

As discussed in section IV.C.2.a of this document, DOE did not estimate the increases in MPC associated with improving combination cooler refrigeration product efficiencies in the preliminary analysis. For this direct final rule, DOE extended the engineering analysis to include the development of combination cooler refrigeration product cost-efficiency curves.

Because combination cooler refrigeration products are similar to coolers and refrigerators, DOE used data from the reverse-engineering of coolers and refrigerators to inform the cost estimates associated with design options. DOE also considered information from confidential manufacturer interviews to determine which design options would be appropriate for combination cooler refrigeration products and to gather feedback on cost estimates. DOE used its cost model to scale certain design options to the three typical volumes identified for each of the analyzed product classes, as described in section IV.C.2.b of this document. DOE presented its initial updates to the engineering analysis to the MREF Working Group[21] and made additional revisions based on feedback from Working Group members. (ASRAC Public Meeting Transcript, No. 90 at pp. 128–135)

To develop the cost-efficiency curves, DOE determined that manufacturers would likely make incremental improvements to both the thermal load and the refrigeration system when moving from baseline to max-tech. Table IV.12 presents the incremental

[21] See document numbers 78, 79, and 99 in docket ID EERE-2011-BT-STD-0043 on http://www.regulations.gov for engineering materials presented to the MREF Working Group.

MPCs, in 2015$, associated with these improvements for the three product classes considered in this engineering analysis. Chapter 5 of the direct final rule TSD includes additional information regarding the cost-efficiency curves.

Table IV.12 Direct Final Rule Combination Cooler Refrigeration Product Cost-Efficiency Curves

	Incremental MPC		
Efficiency Level	**C-3A**	**C-9**	**C-13A**
Baseline	$0	$0	$0
1	$6	$15	$6
2	$28	$45	$15
3	$42	$47	$35
4	$44	$50	$52
5	$65	$60	$100
6	$116	$132	$155
7 (Max-tech)	$256	$264	$207

D. Markups Analysis

The markups analysis develops appropriate markups (e.g., manufacturer markups, retailer markups, wholesaler markups, contractor markups) in the distribution chain and sales taxes to convert the MPC estimates derived in the engineering analysis to consumer prices, which are 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 product to cover business costs and profit margin.

For MREFs, the main distribution chain goes from manufacturers to appliance retailers, and then to consumers. DOE included only this distribution channel during the preliminary analysis. Based on feedback from manufacturers, and the MREF Working

Group, DOE understands a small fraction of freestanding coolers and combination cooler refrigeration products, and all built-in coolers and combination cooler refrigeration products, go through another distribution channel, in which manufacturers sell the products to wholesalers, who in turn sell the products to retailers and then to consumers. (ASRAC Public Meeting, No.85 at pp. 142–145)

The manufacturer markup converts MPC to manufacturer selling price ("MSP"). DOE developed an average manufacturer markup by examining the annual Securities and Exchange Commission ("SEC") 10-K reports filed by publicly-traded manufacturers engaged in producing MREFs.

For retailers and wholesalers, DOE developed separate markups for baseline products (baseline markups) and for the incremental cost of more-efficient products (incremental markups). Incremental markups are coefficients that relate the change in the MSP of higher-efficiency models to the change in the retailer sales price. DOE used the 2012 Annual Retail Trade Survey[22] and 2012 Annual Wholesale Trade Report[23] from the U.S. Census Bureau to estimate average baseline and incremental markups for retailers and wholesalers, respectively.

Chapter 6 of the direct final rule TSD provides details on DOE's development of markups for MREFs.

[22] U.S. Census Bureau, 2012 Annual Retail Trade Survey (2012) (Available at: http://www.census.gov/retail/index.html) (Last Accessed November 12, 2015)
[23] U.S. Census Bureau, 2012 Annual Wholesale Trade Report (2012), (Available at: http://www.census.gov/wholesale/index.html) (Last Accessed April 23, 2015)

E. Energy Use Analysis

The purpose of the energy use analysis is to determine the annual energy consumption of MREFs at different efficiencies in representative U.S. households, and to assess the energy savings potential of increased MREF efficiency. The energy use analysis estimates the range of energy use of MREFs in the field (i.e., as they are actually used by consumers). The energy use analysis provides the basis for other analyses DOE performs, particularly assessments of the energy savings and the savings in consumer operating costs that could result from the adoption of new standards.

DOE determined a range of annual energy use of MREFs as a function of unit volume. DOE developed a sample of households that use MREFs from surveys of MREF owners.[24] For each sample household, DOE randomly assigned a product volume from the volumes analyzed in the engineering analysis. For each volume and considered efficiency level, DOE derived the energy consumption as measured by the DOE test procedure in appendix A.

DOE developed distributions of product volumes for each product class based on the MREF models listed in DOE's Compliance Certification Management System

[24] J. B. Greenblatt et al. U.S. Residential Miscellaneous Refrigeration Products: Results from Amazon Mechanical Turk Surveys. 2014. Lawrence Berkeley National Laboratory: Berkeley, CA. Report No. LBNL-6537E. See also S. M. Donovan, S. J. Young and J. B. Greenblatt. Ice-Making in the U.S.: Results from an Amazon Mechanical Turk Survey. 2015. Lawrence Berkeley National Laboratory: Berkeley, CA. Report No. LBNL-183899.

("CCMS") database,[25] the CEC database,[26] the Natural Resources Canada ("NRCan") database,[27] as well as manufacturer and retailer websites.

Chapter 7 of the direct final rule TSD provides details on DOE's energy use analysis for MREFs.

F. Life-Cycle Cost and Payback Period Analysis

DOE conducted LCC and PBP analyses to evaluate the economic impacts on individual consumers of potential energy conservation standards for MREFs. The effect of new or amended energy conservation standards on individual consumers usually involves a reduction in operating cost and an increase in purchase cost. DOE used the following two metrics to measure consumer impacts:

- The LCC (life-cycle cost) is the total consumer expense of an appliance or product over the life of that product, consisting of total installed cost (MPC, manufacturer markups, distribution chain markups, sales tax, and installation costs) plus operating costs (expenses for energy use, maintenance, and repair). To compute the operating costs, DOE discounts future operating costs to the time of purchase and sums them over the lifetime of the product.

[25] For more information see: www.regulations.doe.gov/certification-data/CCMS-77803762689.html.
[26] Available at: https://cacertappliances.energy.ca.gov
[27] Available at: http://oee.nrcan.gc.ca/pml-lmp/index.cfm?action=app.search-recherche&appliance=REFRIGERATORS

- The PBP (payback period) is the estimated amount of time (in years) it takes consumers to recover the increased purchase cost (including installation) of a more-efficient product through lower operating costs. DOE calculates the PBP by dividing the change in purchase cost at higher efficiency levels by the change in annual operating cost for the year that amended or new standards are assumed to take effect.

For any given efficiency level, DOE measures the change in LCC relative to the LCC in the no-new-standards case, which reflects the estimated efficiency distribution of MREFs in the absence of new energy conservation standards. In contrast, the PBP for a given efficiency level is measured relative to the lowest efficiency level in the no-new-standards distribution.

For each considered efficiency level in each product class, DOE calculated the LCC and PBP for a nationally representative set of housing units. As stated previously, DOE developed household samples from the results of a study on MREFs using online surveys. For each sample household, DOE determined the energy consumption for the MREFs and the appropriate electricity price. By developing a representative sample of households, the analysis captured the variability in energy consumption and energy prices associated with the use of MREFs.

Inputs to the calculation of total installed cost include the cost of the product—which includes MPCs, manufacturer markups, retailer and distributor markups, and sales taxes—and installation costs. Inputs to the calculation of operating expenses include annual energy consumption, energy prices and price projections, repair and maintenance costs, product lifetimes, and discount rates. DOE created distributions of values for product lifetimes, discount rates, and sales taxes, with probabilities attached to each value, to account for their uncertainty and variability.

The computer model DOE uses to calculate the LCC and PBP, which incorporates Crystal Ball™ (a commercially-available software program), relies on a Monte Carlo simulation to incorporate uncertainty and variability into the analysis. The Monte Carlo simulations randomly sample input values from the probability distributions and MREF user samples. The model calculated the LCC and PBP for products at each efficiency level for 10,000 housing units per simulation run.

DOE calculated the LCC and PBP for all consumers as if each were to purchase a new product in the expected year of compliance with new standards. In its analysis, DOE used two different compliance dates. For the consensus-recommended TSLs, the analysis is based on a 2019 compliance date, as recommended by the MREF Working Group. The analysis for all other TSLs is based on a 2021 compliance date consistent with EPCA, which provides that newly-established standards shall not apply to products manufactured within five years after the publication of the final rule. In other words, DOE followed the prescriptions of EPCA for all TSLs that were not recommended by the MREF Working Group. The two different compliance dates are indicated in the relevant sections of the results and discussed in section III.B of this document.

Table IV.13 summarizes the approach and data DOE used to derive inputs to the LCC and PBP calculations. The subsections that follow provide further discussion. Details of the spreadsheet model, and of all the inputs to the LCC and PBP analyses, are contained in chapter 8 of the direct final rule TSD and its appendices.

Table IV.13 Summary of Inputs for the LCC and PBP Analysis*

Inputs	Source/Method
Product Cost	Derived by multiplying MPCs by manufacturer and retailer markups and sales tax, as appropriate.
Installation Costs	Did not include because no change with efficiency level.
Annual Energy Use	Annual weighted-average values are a function of energy use at each TSL and distribution of efficiencies observed on the market.
Energy Prices	Based on Edison Electric Institute ("EEI") Typical Bills and Average Rates reports for summer and winter 2014.
Energy Price Trends	Based on AEO 2015 price forecasts.
Repair and Maintenance Costs	Did not include because no change with efficiency level.
Product Lifetime	Based on MREF Working Group feedback and values previously determined for refrigerators and freezers.
Discount Rates	Approach involves identifying all possible debt or asset classes that might be used to purchase the considered appliances, or might be affected indirectly. Primary data source was the Federal Reserve Board's Survey of Consumer Finances.
Compliance Date	TSLs recommended by the MREF Working Group: 2019; Other TSLs: 2021.

* Collectively, the references for the data sources mentioned in this table are either provided in the sections following the table or in chapter 8 of the direct final rule TSD.

1. Product Cost

To calculate consumer product costs, DOE multiplied the MPCs developed in the engineering analysis by the markups described above (along with sales taxes). DOE used different markups for baseline products and higher-efficiency products, because DOE applies an incremental markup to the increase in MSP associated with higher-efficiency products.

Historical price data specific to MREFs are not available. Hence, DOE used a constant price assumption as the default product price trend to project the prices of MREFs sold in each year in the forecast period.

2. Installation Cost

Installation cost includes labor, overhead, and any miscellaneous materials and parts needed to install the product. DOE included installation cost as part of the LCC analysis during the preliminary analysis, but the cost did not vary with efficiency levels. As part of the MREF Working Group discussions, stakeholders confirmed that installation cost for MREFs does not vary between efficiency levels. (ASRAC Public Meeting, No.85 at pp. 155–157) As a result, DOE did not include installation cost as part of the analysis for this direct final rule.

3. Annual Energy Consumption

For each sampled household, DOE determined the energy consumption for MREFs at different efficiency levels using the approach described in section IV.E of this document.

4. Energy Prices

For the LCC and PBP analysis, DOE used average electricity prices (for baseline products) and marginal prices (for higher-efficiency products) which vary by region. DOE estimated these prices using data published with the EEI Typical Bills and Average

Rates reports for summer and winter 2014.[28] The report provides, for most of the major investor-owned utilities ("IOUs") in the country, the total bill assuming household consumption levels of 500, 750, and 1,000 kWh for the billing period.

DOE defined the average price as the ratio of the total bill to the total electricity consumption. DOE used the EEI data to also define a marginal price as the ratio of the change in the bill to the change in energy consumption.

Regional weighted-average values for each type of price were calculated for the nine census divisions and four large States (CA, FL, NY and TX). Each EEI utility in a division or large State was assigned a weight based on the number of consumers it serves. Consumer counts were taken from the most recent EIA Form 861 data (2012).[29] DOE adjusted these regional weighted-average prices to account for systematic differences between IOUs and publicly-owned utilities, as the latter are not included in the EEI data set. Appropriate prices were assigned to each sample household depending on its location.

To estimate future prices, DOE used the projected annual changes in average residential electricity prices in the Reference case projection in AEO 2015. The AEO price trends do not distinguish between marginal and average prices, so DOE used the

[28] Edison Electric Institute. Typical Bills and Average Rates Report. Winter 2014 published April 2014, Summer 2014 published October 2014. See http://www.eei.org/resourcesandmedia/products/Pages/Products.aspx.

[29] U. S. Department of Energy, Energy Information Administration. Form EIA-861 Annual Electric Power Industry Database. www.eia.doe.gov/cneaf/electricity/page/eia861.html

same trends for both. DOE reviewed the EEI data for the years 2007 to 2014 and determined that there is no systematic difference in the trends for marginal vs. average prices in the data.

5. Maintenance and Repair Costs

Repair costs are associated with repairing or replacing product components that have failed in an appliance; maintenance costs are associated with maintaining the operation of the product. DOE included maintenance and repair costs as part of the LCC analysis during the preliminary analysis, but the costs did not vary with efficiency levels. As part of the MREF Working Group discussions, stakeholders confirmed that maintenance and repair costs for MREFs do not vary between efficiency levels. (ASRAC Public Meeting, No. 85 at p. 171) As a result, DOE did not include maintenance and repair costs as part of the analysis for this direct final rule.

6. Product Lifetime

DOE is aware of only limited available data to be used in the modeling and analysis of MREF lifetimes. In the preliminary analysis, DOE estimated the average product lifetime for coolers based on survey data.[30] However, several MREF Working Group members indicated that the estimated lifetime for coolers was too short and that these products operate using the same refrigeration technology as currently covered refrigerators and refrigerator-freezers for which the projected lifetime is much longer.

[30] J. B. Greenblatt et al. U.S. Residential Miscellaneous Refrigeration Products: Results from Amazon Mechanical Turk Surveys. 2014. Lawrence Berkeley National Laboratory: Berkeley, CA. Report No. LBNL-6537E.

(ASRAC Public Meeting, No. 85 at pp. 164–170) Therefore, as part of the MREF Working Group deliberations, DOE applied the lifetime of related refrigeration products to all MREFs in this direct final rule.

For all full-size MREF product classes, DOE applied the lifetime distribution used for full-size refrigerators in the 2011 refrigerators, refrigerator-freezers, and freezers final rule, with an average lifetime of 17.4 years. 76 FR 57516 (September 15, 2011). For all compact MREF product classes, DOE scaled the lifetime distribution used for compact freezers in the 2011 refrigerators, refrigerator-freezers, and freezers final rule to match the estimated 10-year average lifetime provided by the Association of Home Appliance Manufacturers ("AHAM") and manufacturer feedback. (ASRAC Public Meeting, No. 85 at p. 160; ASRAC Public Meeting, No. 87 at pp. 93-94, 175-176) This resulted in an average lifetime of 10.3 years for compact MREF product classes. See chapter 8 of the direct final rule TSD.

7. Discount Rates

In calculating the LCC, DOE applies discount rates appropriate to households to estimate the present value of future operating costs. DOE estimated a distribution of residential discount rates for MREFs based on consumer financing costs and opportunity cost of funds related to appliance energy cost savings and maintenance costs.

To establish residential discount rates for the LCC analysis, DOE identified all relevant household debt or asset classes in order to approximate a consumer's opportunity cost of funds related to appliance energy cost savings. It estimated the average percentage shares of the various types of debt and equity by household income group using data from the Federal Reserve Board's Survey of Consumer Finances[31] ("SCF") for 1995, 1998, 2001, 2004, 2007, and 2010. Using the SCF and other sources, DOE developed a distribution of rates for each type of debt and asset by income group to represent the rates that may apply in the year in which new standards would take effect. DOE assigned each sample household a specific discount rate drawn from one of the distributions. The average rate across all types of household debt and equity and income groups, weighted by the shares of each type, is 5.1 percent. See chapter 8 of the direct final rule TSD for further details on the development of consumer discount rates.

8. Efficiency Distribution in the No-New-Standards Case

To accurately estimate the share of consumers that would be affected by a potential energy conservation standard at a particular efficiency level, DOE's LCC analysis considered the projected distribution (market shares) of product efficiencies in the no-new-standards case (i.e., the case without amended or new energy conservation standards).

DOE estimated the current distribution of product efficiencies using product owner surveys;[32] information from AHAM (AHAM, No. 106), and the databases

[31] The Federal Reserve Board, SCF 1989, 1992, 1995, 1998, 2001, 2004, 2007, 2010. http://www.federalreserve.gov/pubs/oss/oss2/scfindex.html

[32] J. B. Greenblatt et al. U.S. Residential Miscellaneous Refrigeration Products: Results from Amazon Mechanical Turk Surveys. 2014. Lawrence Berkeley National Laboratory: Berkeley, CA. Report No. LBNL-6537E. See also S. M. Donovan, S. J. Young and J. B. Greenblatt. Ice-Making in the U.S.: Results

maintained by DOE (CCMS),[33] the CEC,[34] and NRCan;[35] and information from manufacturer and retailer websites and manufacturer feedback. The approach is described in chapter 8 of the direct final rule TSD. DOE projected that the current distribution of product efficiencies would remain constant in future years in the absence of standards. Table IV.14 and Table IV.15 show the efficiency distributions that DOE used.

Table IV.14 Percentage of Coolers at Each Efficiency Level in the No-New-Standards Case

Efficiency Level	Product Class			
	Freestanding compact	Built-in compact	Freestanding	Built-in
EL0	10	0	3	0
EL1	14	0	0	0
EL2	24	0	1	0
EL3	25	0	7	0
EL4	9	17	28	47
EL5	6	50	25	20
EL6	7	17	23	27
EL7	3	17	11	7
EL8	2	0	1	0
EL9	0	0	0	0
EL10	0	0	0	0
EL11	1	0	0	0

Table IV.15 Percentage of Combination Cooler Refrigeration Products at Each Efficiency Level in the No-New-Standards Case

Efficiency Level	Product Class					
	C-3A	C-3A-BI	C-9	C-9-BI	C-13A	C-13A-BI

from an Amazon Mechanical Turk Survey. 2015. Lawrence Berkeley National Laboratory: Berkeley, CA. Report No. LBNL-183899.

[33] For more information see: www.regulations.doe.gov/certification-data/CCMS-77803762689.html.

[34] Available at: https://cacertappliances.energy.ca.gov

[35] Available at: http://oee.nrcan.gc.ca/pml-lmp/index.cfm?action=app.search-recherche&appliance=REFRIGERATORS

EL0	0	0	0	0	0	0
EL1	0	0	0	0	0	0
EL2	100	100	0	0	25	0
EL3	0	0	100	100	75	100
EL4	0	0	0	0	0	0
EL5	0	0	0	0	0	0
EL6	0	0	0	0	0	0
EL7	0	0	0	0	0	0

9. Payback Period Analysis

The PBP is the amount of time it takes the consumer to recover the additional installed cost of more-efficient products, compared to baseline products, through energy cost savings. PBPs are expressed in years. PBPs that exceed the life of the product mean that the increased total installed cost is not recovered in reduced operating expenses.

The inputs to the PBP calculation for each efficiency level are the change in total installed cost of the product and the change in the first-year annual operating expenditures relative to the baseline. The PBP calculation uses the same inputs as the LCC analysis, except that discount rates are not needed.

As noted above, EPCA, as amended, establishes a rebuttable presumption that a standard is economically justified if the Secretary finds that the additional cost to the consumer of purchasing a product complying with an energy conservation standard level will be less than three times the value of the first year's energy savings resulting from the standard, as calculated under the applicable test procedure. (42 U.S.C. 6295(o)(2)(B)(iii)) For each considered efficiency level, DOE determined the value of the first year's energy savings by calculating the energy savings in accordance with the applicable DOE test procedure, and multiplying those savings by the average energy price forecast for the year in which compliance with the new standards would be required.

G. Shipments Analysis

DOE uses forecasts of annual product shipments to calculate the national impacts of potential new energy conservation standards on energy use, NPV, and future manufacturer cash flows.[36] The shipments model takes an accounting approach, tracking market shares of each product class and the vintage of units in the stock. Stock accounting uses product shipments as inputs to estimate the age distribution of in-service product stocks for all years. The age distribution of in-service product stocks is a key input to calculations of both the NES and NPV, because operating costs for any year depend on the age distribution of the stock.

To estimate cooler shipments, DOE first estimated total stock based on estimates of market saturation and stock from manufacturer feedback and surveys on product ownership.[37] DOE then estimated annual shipments by dividing the estimated stock by the average product lifetime. DOE verified that the estimated shipments agreed with estimates from AHAM. (AHAM, No. 106) DOE estimated that shipments would

[36] DOE used data on manufacturer shipments as a proxy for national sales, as aggregate data on sales are lacking. In general one would expect a close correspondence between shipments and sales.

[37] J. B. Greenblatt et al. U.S. Residential Miscellaneous Refrigeration Products: Results from Amazon Mechanical Turk Surveys. 2014. Lawrence Berkeley National Laboratory: Berkeley, CA. Report No. LBNL-6537E. See also S. M. Donovan, S. J. Young and J. B. Greenblatt. Ice-Making in the U.S.: Results from an Amazon Mechanical Turk Survey. 2015. Lawrence Berkeley National Laboratory: Berkeley, CA. Report No. LBNL 183899.

increase in line with the projected increase in the housing stock from the AEO 2015[38] estimates in order to project shipments forward to 2050. DOE allocated shipments to each product class using the distribution of available models on the market and feedback from manufacturers, the MREF Working Group, and AHAM. (See, e.g., AHAM, No. 106)

For combination cooler refrigeration products, DOE used manufacturer feedback from confidential interviews to estimate the number of units shipped in 2014. DOE estimated that shipments would increase in line with the increase in housing stock in the United States in order to project shipments forward to 2050. DOE used the distribution of available models to allocate shipments to each product class.

MREFs are a discretionary product and sales would be expected to be sensitive to the product price. To estimate the effect of new standards on MREF shipments, which are expected to result in higher prices, DOE applied relative price elasticity in the shipments model. This approach gives some weight to the operating cost savings from higher-efficiency products. In general, price elasticity reflects the expectation that demand will decrease when prices increase. The price elasticity value is derived from data on refrigerators, clothes washers, and dishwashers.[39] Based on evidence that the price elasticity of demand is significantly different over the short run and long run for

[38] U.S. Department of Energy-Energy Information Administration. Annual Energy Outlook 2015 with projections to 2040. April 2015. Washington, D.C. DOE/EIA-0383(2015). Available for download at: http://www.eia.gov/forecasts/aeo/.

[39] Dale, L. and S. K. Fujita, An Analysis of the Price Elasticity of Demand of Household Appliances. 2008. Lawrence Berkeley National Laboratory: Berkeley, CA. Report No. LBNL-326E.

other consumer goods (i.e., automobiles), DOE assumed that the elasticity declines over time. DOE estimated shipments in each standards case using the relative price elasticity along with the change in the product price and operating costs between a standards case and the no-new-standards case.

For details on the shipments analysis, see chapter 9 of the direct final rule TSD.

H. National Impact Analysis

The NIA assesses the national energy savings (i.e., NES) and the national net present value (i.e., NPV) of total consumer costs and savings that would be expected to result from new or amended standards at specific efficiency levels.[40] ("Consumer" in this context refers to consumers of the product being regulated.) DOE calculates the NES and NPV based on projections of annual product shipments, along with the annual energy consumption and total installed cost data from the energy use and LCC analyses. For most of the TSLs considered in this direct final rule, DOE forecasted the energy savings, operating cost savings, product costs, and NPV of consumer benefits over the lifetime of MREFs sold from 2021-2050. For the TSLs that represent the MREF Working Group recommendations, DOE accounted for the lifetime impacts of MREFs sold from 2019-2048.

DOE evaluates the impacts of new and amended standards by comparing a case without such standards with standards-case projections. The no-new-standards case

[40] The NIA accounts for impacts in the 50 states and U.S. territories.

characterizes energy use and consumer costs for each product class in the absence of new or amended energy conservation standards. For this projection, DOE considers historical trends in efficiency and various forces that are likely to affect the mix of efficiencies over time. DOE compares the no-new-standards case with projections characterizing the market for each product class if DOE adopted new or amended standards at specific energy efficiency levels (i.e., the TSLs or standards cases) for that class. For the standards cases, DOE considers how a given standard would likely affect the market shares of products with efficiencies greater than the standard.

DOE uses a spreadsheet model to calculate the energy savings and the national consumer 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 typical values (as opposed to probability distributions) as inputs.

Table IV.16 summarizes the inputs and methods DOE used for the NIA analysis for this direct final rule. Discussion of these inputs and methods follows the table. See chapter 10 of the direct final rule TSD for further details.

Table IV.16 Summary of Inputs and Methods for the National Impact Analysis

Inputs	**Method**
Shipments	Annual shipments from shipments model.
Compliance Date of Standard	TSLs recommended by the MREF Working Group: 2019; Other TSLs: 2021
Efficiency Trends	Constant
Annual Energy Consumption per Unit	Annual weighted-average values are a function of energy use at each TSL.
Total Installed Cost per Unit	Annual weighted-average values are a function of cost at each TSL. Incorporates projection of constant future product prices.
Annual Energy Cost per Unit	Annual weighted-average values as a function of the annual energy consumption per unit and energy prices.
Energy Prices	AEO 2015 forecasts (to 2040) and extrapolation through 2050.
Energy Site-to-Primary and FFC Conversion	A time-series conversion factor based on AEO 2015.
Discount Rate	Three and seven percent.
Present Year	2016.

1. Product 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. As described in section IV.F.8 of this document, DOE developed an energy efficiency distribution for the no-new-standards case (which yields a shipment-weighted average efficiency) for each of the considered product classes. Because there are no data on trends in efficiency for MREFs, DOE assumed that these efficiency distributions will remain constant throughout the analysis period.

For the standards cases, DOE used a “roll-up” scenario to establish the shipment-weighted efficiency for the year that standards are assumed to become effective (2019 for TSLs from the MREF Working Group recommendations and 2021 for other TSLs). In this scenario, the market share of products in the no-new-standards case that do not meet the standard under consideration would “roll up” to meet the new standard level, and the market share of products above the standard would remain unchanged.

2. National Energy Savings

The national energy savings analysis involves a comparison of national energy consumption of the considered products in each potential standards case (TSL) with consumption in the case with no new or amended energy conservation standards. DOE calculated the national energy consumption by multiplying the number of units (stock) of each product (by vintage or age) by the unit energy consumption (also by vintage). DOE calculated annual NES based on the difference in national energy consumption for the no-new-standards case and for each higher efficiency standard case. DOE estimated energy consumption and savings based on site energy and converted the electricity consumption and savings to primary energy (i.e., the energy consumed by power plants to generate site electricity) using annual marginal conversion factors derived from AEO 2015. Cumulative energy savings are the sum of the NES for each year over the timeframe of the analysis.

In 2011, in response to the recommendations of a committee on “Point-of-Use and Full-Fuel-Cycle Measurement Approaches to Energy Efficiency Standards” appointed by the National Academy of Sciences, DOE announced its intention to use full-fuel-cycle ("FFC") measures of energy use and greenhouse gas and other emissions in the national impact analyses and emissions analyses included in future energy conservation standards rulemakings. 76 FR 51281 (August 18, 2011). After evaluating the approaches discussed in the August 18, 2011 notice, DOE published a statement of amended policy in which DOE explained its determination that EIA's National Energy Modeling System ("NEMS") is the most appropriate tool for its FFC analysis and its intention to use NEMS for that purpose. 77 FR 49701 (August 17, 2012). NEMS is a public domain, multi-sector, partial equilibrium model of the U.S. energy sector[41] that EIA uses to prepare its AEO. The approach used for deriving FFC measures of energy use and emissions is described in appendix 10B of the direct final rule TSD.

3. Net Present Value Analysis

The inputs for determining the NPV of the total costs and benefits experienced by consumers are: (1) total annual installed cost; (2) total annual operating costs; and (3) a discount factor to calculate the present value of costs and savings. DOE calculates net savings 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 installed costs. DOE calculates operating cost savings over the lifetime of each product shipped during the forecast period.

As discussed in section IV.F.1 of this document, DOE assumed a constant MREF price trend to forecast prices for each product class at each considered efficiency level throughout the analysis period.

[41] For more information on NEMS, refer to U.S. Energy Information Administration website (Available at: http://www.eia.gov/forecasts/aeo/assumptions/).

To evaluate the effect of uncertainty regarding the price trend estimates, DOE investigated the impact of different product price forecasts on the consumer NPV for the considered TSLs for MREFs. In addition to the default constant price trend, DOE considered two product price sensitivity cases: (1) a high price decline case based on the Producer Price Index ("PPI") for household refrigerator and home freezer manufacturing from 1991 to 2014;[42] and (2) a low price decline case based on the same PPI series from 1976 to 1990. The derivation of these price trends and the results of these sensitivity cases are described in appendix 10C of the direct final rule TSD.

The operating cost savings are energy cost savings, which are calculated using the estimated energy savings in each year and the projected price of electricity. To estimate energy prices in future years, DOE multiplied the average regional energy prices by the forecast of annual national-average residential energy price changes in the Reference case from AEO 2015, which has an end year of 2040. To estimate price trends after 2040, DOE used the average annual rate of change in prices from 2025 to 2040. As part of the NIA, DOE also analyzed scenarios that used inputs from the AEO 2015 Low Economic Growth and High Economic Growth cases. Those cases have higher and lower energy price trends compared to the Reference case. NIA results based on these cases are presented in appendix 10C of the direct final rule TSD.

In calculating the NPV, DOE multiplies the net savings in future years by a discount factor to determine their present value. For this direct final rule, DOE estimated

[42] Household refrigerator and home freezer manufacturing PPI series ID: PCU 335222335222 (Available at: http://www.bls.gov/ppi/).

the NPV of consumer benefits using both a 3-percent and a 7-percent real discount rate. DOE uses these discount rates in accordance with guidance provided by the Office of Management and Budget ('OMB') to Federal agencies on the development of regulatory analysis.[43] The discount rates for the determination of NPV are in contrast to the discount rates used in the LCC analysis, which are designed to reflect a consumer's perspective. 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 "social rate of time preference," which is the rate at which society discounts future consumption flows to their present value.

I. Consumer Subgroup Analysis

In analyzing the potential impact of new or amended standards on consumers, DOE evaluates the impact on identifiable subgroups of consumers that may be disproportionately affected by a new or amended national standard, such as low-income and senior households. DOE evaluates impacts on subgroups of consumers by analyzing the LCC impacts and PBP for those particular consumers from alternative standard levels. For this final rule, DOE analyzed the impacts of the considered standard levels on two subgroups: (1) low-income households and (2) senior-only households. The analysis used subsets of the full household sample composed of households that meet the criteria for the considered subgroups. DOE used the LCC and PBP spreadsheet model to estimate the impacts of the considered efficiency levels on these subgroups. Chapter 11 in the final rule TSD describes the consumer subgroup analysis.

[43] United States Office of Management and Budget. Circular A-4: Regulatory Analysis," (Sept. 17, 2003), section E (Available at: www.whitehouse.gov/omb/memoranda/m03-21.html).

J. Manufacturer Impact Analysis

1. Overview

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

The quantitative part of the MIA primarily relies on the Government Regulatory Impact Model (i.e., GRIM), an industry cash flow model with inputs specific to this rulemaking. The key GRIM inputs include data on the industry cost structure, unit production costs, product shipments, manufacturer markups, and investments in R&D and manufacturing capital required to produce compliant products. The key GRIM outputs are the INPV, which is the sum of industry annual cash flows over the analysis period, discounted using the industry-weighted average cost of capital, and the impact to domestic manufacturing employment. The model uses standard accounting principles to estimate the impacts of more-stringent energy conservation standards on a given industry by comparing changes in INPV and domestic manufacturing employment between a no-new-standards case and the various TSLs. To capture the uncertainty relating to manufacturer pricing strategy following new standards, the GRIM estimates a range of possible impacts under different markup scenarios.

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

DOE conducted the MIA for this rulemaking in three phases. In Phase 1 of the MIA, DOE prepared a profile of the MREF manufacturing industry based on the market and technology assessment, preliminary manufacturer interviews, and publicly-available information. This included a top-down analysis of MREF manufacturers that DOE used to derive preliminary financial inputs for the GRIM (e.g., revenues; materials, labor, overhead, and depreciation expenses; selling, general, and administrative expenses ("SG&A"); and R&D expenses). DOE used public sources of information to further calibrate its initial characterization of MREFs, including company SEC 10-K filings, corporate annual reports, the U.S. Census Bureau's Economic Census,[44] and Hoover's reports.[45]

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[44] U.S. Census Bureau, Annual Survey of Manufactures: General Statistics: Statistics for Industry Groups and Industries (Available at:

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

In addition, during Phase 2, DOE conducted structured, detailed interviews with manufacturers of MREFs in order to develop other key GRIM inputs, including product and capital conversion costs, and to gather additional information on the anticipated effects of energy conservation standards on revenues, direct employment, capital assets, industry competitiveness, and subgroup impacts. Before the interviews, DOE distributed an interview guide to interviewees. The interview guides are available in appendix 12A of the direct final rule TSD. See section IV.J.3 of this document for a description of the key issues raised by manufacturers during the interviews.

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http://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ASM_2011_31GS101&prodType=table).

[45] Hoovers Inc., Company Profiles, Various Companies (Available at: http://www.hoovers.com). Last Accessed December 15, 2015.

In Phase 3 of the MIA, DOE evaluated subgroups of manufacturers that may be disproportionately impacted by new standards or that may not be accurately represented by the average cost assumptions used to develop the industry cash flow analysis. Such manufacturer subgroups may include small business manufacturers, low-volume manufacturers ("LVMs"), niche players, and/or manufacturers exhibiting a cost structure that largely differs from the industry average. DOE identified two MREF manufacturer subgroups for which average cost assumptions may not hold: small businesses and domestic LVMs.

Small Businesses

Manufacturers of MREFs have primary North American Industry Classification System ("NAICS") codes of 335222, "Household Refrigerator and Home Freezer Manufacturing" and 333415, "Air-Conditioning and Warm Air Heating Equipment and Commercial and Industrial Refrigeration Equipment Manufacturing." Based on the size standards published by the Small Business Administration ("SBA"), to be categorized as a small business manufacturer of MREFs under NAICS codes 335222 or 333415, a MREF manufacturer and its affiliates may employ a maximum of 1,250 employees or less.[46] The employee threshold includes all employees in a business' parent company and any other subsidiaries. Using this classification in conjunction with a search of industry databases and the SBA member directory, DOE identified one manufacturer and one importer that qualify as small businesses.

[46] The size standards are codified at 13 CFR part 121. The standards are listed by North American Industry Classification System (NAICS) code and industry description and are available at https://www.sba.gov/sites/default/files/files/Size_Standards_Table.pdf.

Low-Volume Manufacturers

In addition to the small, domestic businesses described above, DOE identified three domestic manufacturers of niche MREF products that have much lower revenues than their diversified competitors. Although these manufacturers do not qualify as small businesses under the SBA definition, they are concentrated in the production of residential refrigeration products and, in some cases, commercial refrigeration equipment. DOE subsequently assigned these manufacturers to an LVM subgroup to evaluate any disproportionate impacts of new standards for MREFs on these manufacturers.

The MREF manufacturer subgroup analysis is discussed in greater detail in chapter 12 of the direct final rule TSD and in sections V.B.2 and VI.B of this document.

In addition, in Phase 3 of the MIA, DOE used feedback obtained from manufacturer interviews to assess the impacts of new standards on direct employment and manufacturing capacity within the MREF industry, and on the cumulative regulatory burdens felt by MREF manufacturers.

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, discounted cash-flow methodology 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 new energy conservation standards. The GRIM spreadsheet uses the inputs to arrive at a series of annual cash flows, beginning in 2016 (the base year of the analysis) and continuing to 2048 (the end of the analysis period for TSLs with a 3-year compliance period) or 2050 (the end of the analysis period for TSLs with a 5-year compliance period).[47] DOE calculated INPVs by summing the stream of annual discounted cash flows during this period. For MREF manufacturers, DOE used a real discount rate of 7.7 percent, which was derived from industry financials and feedback received during manufacturer interviews.

The GRIM calculates cash flows using standard accounting principles and compares changes in INPV between the 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 new energy conversation standards on manufacturers. DOE collected this information on the critical GRIM inputs from a number of sources, including publicly-available data, interviews with manufacturers, and MREF Working Group meetings, including information gathered from manufacturers by a third-party consultant on behalf of AHAM.[48] The GRIM results are shown in section

[47] As described in section III.B of this document, the MREF Working Group recommended a 3-year compliance period for the standards recommended in Term Sheet #2. DOE analyzed these recommended standards (TSL 2 for coolers and TSL 1 for combination cooler refrigeration products) using a 3-year compliance period. DOE analyzed all other TSLs in this direct final rule (representing standards not recommended by the MREF Working Group) using a 5-year compliance period consistent with the EPCA provisions for newly-established standards.

[48] Information presented during the MREF Working Group meeting which was a source of information for the MIA is available on http://regulations.gov under document ID EERE-2011-BT-STD-0043-0104.

V.B.2 of this document. Additional details about the GRIM, the discount rate, and other financial parameters can be found in chapter 12 of the direct final rule TSD.

a. Government Regulatory Impact Model Key Inputs

Manufacturer Production Costs

Manufacturing higher-efficiency products is typically more costly than manufacturing baseline products due to the use of more complex components, which are typically more expensive than baseline components. The changes in the MPC of the analyzed products can affect the revenues, gross margins, and cash flow of the industry, making these product 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 document and further detailed in chapter 5 of the direct final rule TSD. In addition, DOE used information from its teardown analysis, described in chapter 5 of the direct final rule TSD, to disaggregate the MPCs into material, labor, and overhead costs. To calculate the MPCs for products 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 were validated and revised based on manufacturer comments received during interviews and the MREF Working Group discussions.

Shipments Forecasts

The GRIM estimates manufacturer revenues based on total unit shipment forecasts and the distribution of these values by product class and efficiency level. Changes in sales volumes and efficiency mix over time can significantly affect manufacturer finances. For the MREF analysis, the GRIM used the shipments analysis to estimate shipments either from 2016 (the base year of the analysis) and continuing to 2048 (the end of the analysis period for TSLs with a 3-year compliance period) or 2050 (the end of the analysis period for TSLs with a 5-year compliance period). See chapter 9 of the direct final rule TSD for additional details.

Conversion Costs

A new energy conservation standard would 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 would be needed to comply with each considered efficiency level in each product 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 R&D, testing, marketing, and other non-capitalized costs necessary to make product designs comply with the new 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 products with new, compliant designs can be fabricated and assembled.

DOE used manufacturer interviews to gather data needed to evaluate the level of capital conversion expenditures manufacturers would likely incur to comply with new energy conservation standards at each efficiency level for MREFs. DOE also obtained information relating to capital conversion costs from manufacturers during the MREF Working Group meetings, including information gathered from manufacturers by a third-party consultant on behalf of AHAM.[49] DOE supplemented manufacturer comments with estimates of capital expenditure requirements derived from the engineering analysis.

DOE assessed the product conversion costs at each considered efficiency level by integrating data from quantitative and qualitative sources. DOE considered market-share-weighted feedback regarding the potential cost of each efficiency level from multiple manufacturers during confidential interviews and during the MREF Working Group meetings[50] to estimate product conversion costs, and validated those numbers against engineering estimates of redesign efforts. In general, DOE assumes that all conversion-related investments 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 V.B.2.a of this document. For additional information on the estimated product and capital conversion costs, see chapter 12 of the direct final rule TSD.

[49] The information presented during the MREF Working Group meeting is available on http://regulations.gov under document ID EERE-2011-BT-STD-0043-0104 at p. 6.
[50] Id.

b. Government Regulatory Impact Model Scenarios

Manufacturer Markup Scenarios

To calculate the MSPs in the GRIM, DOE applied manufacturer markups to the MPCs estimated in the engineering analysis for each product class and efficiency level. Modifying these manufacturer markups in the standards case yields different sets of manufacturer impacts. 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 new 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, which assumes that manufacturers would be able to maintain the same amount of profit as a percentage of revenues at all efficiency levels within a product 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 MREFs as well as comments from manufacturer interviews, DOE estimated the average manufacturer markups by product class as shown in Table IV.17.

Table IV.17 Baseline Manufacturer Markups

Product Class	Markup

Built-In Compact Coolers	1.41
Freestanding Compact Coolers	1.25
Built-In Coolers	1.41
Freestanding Coolers	1.41
C-3A/C-3A-BI	1.41
C-9/C-9-BI	1.41
C-13A/C-13A-BI	1.41

This markup scenario assumes that manufacturers would be able to maintain their gross margin percentage markup as production costs increase in response to a new energy conservation standard. Manufacturers stated that this scenario is optimistic and represents a high bound to industry profitability.

In the preservation of operating profit scenario, manufacturer markups are set so that operating profit one year after the compliance date of the new energy conservation standard is the same as in the no-new-standards case. Under this scenario, as the costs of production increase under a standards case, manufacturers are generally required to reduce their markups to a level that maintains no-new-standards case operating profit. The implicit assumption behind this markup scenario is that the industry can only maintain its operating profit in absolute dollars after compliance with the new standard is required. Therefore, operating margin in percentage terms is reduced between the no-new-standards case and standards case. DOE adjusted (i.e., lowered) the manufacturer markups in the GRIM at each TSL to yield approximately the same earnings before interest and taxes in the standards case as in the no-new-standards case. This markup scenario represents a low bound to industry profitability under a new energy conservation standard.

3. Manufacturer Interviews

To inform the MIA, DOE interviewed several manufacturers with an estimated total cooler market share of approximately 25 percent and an estimated total combination cooler refrigeration products market share of 60 to 70 percent. (The remaining manufacturers in the market consist of overseas companies or those who were contacted but declined to participate.) The information gathered during these interviews enabled DOE to tailor the GRIM to reflect the unique financial characteristics of the MREF industry. These confidential interviews provided information that DOE used to evaluate the impacts of new energy conservation standards on manufacturer cash flows, manufacturing capacity, and employment levels.

During the interviews, DOE asked manufacturers to describe the major issues they anticipate to result from new energy conservation standards for MREFs. The following sections describe the most significant issues identified by manufacturers.

Cumulative Regulatory Burden

During confidential interviews, multiple manufacturers expressed concerns related to the impact of cumulative regulatory burdens on the MREF industry if DOE finalizes new energy conservation standards for MREFs. Because most manufacturers produce other residential products and commercial equipment, they already face regulations by DOE, the Environmental Protection Agency ("EPA"), the European Union, and Canada, as well as third-party industry certifications and standards.

Complying with various overlapping regulatory and environmental standards puts a strain on manufacturers' resources and profitability. Additionally, smaller, domestic manufacturers of high-end MREFs expressed concern that they have significantly less human and capital resources to devote to regulatory compliance than larger, more diversified manufacturers. This has a direct impact on the amount of resources these companies are able to devote to product innovation, and thus MREF manufacturers expect that energy conservation standards would negatively impact their competitive position in the MREF industry.

Manufacturer Subgroup Impacts

Multiple manufacturers expressed concerns regarding the impact of new energy conservations standards for MREFs on smaller, domestic manufacturers (referred to as small businesses and LVMs in this direct final rule). These manufacturers stated that smaller, domestic manufacturers must devote a much larger percentage of their engineering resources to regulatory compliance than do the larger, multi-national companies selling MREFs in the United States. These manufacturers also noted that the smaller, domestic manufacturers have substantially fewer overall shipments than larger, diversified manufacturers, and MREFs make up a much larger portion of the smaller, domestic companies' sales. Finally, manufacturers commented that smaller, domestic manufacturers produce high-end, niche products. Accordingly, manufacturers stated that, depending on the stringency of new energy conservation standards for MREFs, the availability of these products could be threatened if these manufacturers are forced to drop certain product lines.

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 AEO 2015, as described in section IV.K of this document. The methodology is described in chapters 13 and 15 of the direct 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.[51] The FFC upstream emissions are estimated based on the methodology described in chapter 15 of the direct 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.

[51] Available at: http://www2.epa.gov/climateleadership/center-corporate-climate-leadership-ghg-emission-factors-hub.

The emissions intensity factors are expressed in terms of physical units per megawatt-hour (MWh) or million Btu of site energy savings. Total emissions reductions are estimated using the energy savings calculated in the NIA.

For CH_4 and N_2O, DOE calculated emissions reduction in tons and also in terms of units of carbon dioxide equivalent (CO_2eq). Gases are converted to CO_2eq by multiplying 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,[52] DOE used GWP values of 28 for CH_4 and 265 for N_2O.

The AEO incorporates the projected impacts of existing air quality regulations on emissions. AEO 2015 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

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

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.[53] 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,[54] 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 remanded the case for further proceedings consistent with the Supreme Court's opinion.[55] On October 23, 2014, the D.C. Circuit lifted the stay of CSAPR.[56] 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 AEO 2015, 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.

[53] 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).
[54] 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).
[55] 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.
[56] See Georgia v. EPA, Order (D. C. Cir. filed October 23, 2014) (No. 11-1302).

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

Beginning in 2016, however, SO_2 emissions will fall as a result of the Mercury and Air Toxics Standards (MATS) for power plants. 77 FR 9304 (Feb. 16, 2012). In the 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. AEO 2015 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.[57] 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.[58] Energy conservation standards are expected to have little effect on NO_X emissions in those States covered by CAIR because excess NO_X emissions allowances resulting from the lower electricity demand could be used to permit offsetting increases in NO_X emissions 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 considered in this direct 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 AEO 2015, which incorporates the MATS.

[57] 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 tentatively 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.

[58] 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.

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 consumer benefit, DOE considered the reduced emissions expected to result over the lifetime of products shipped in the forecast period for each TSL. This section summarizes the basis for the monetary values used for each of these emissions and presents the values considered in this direct final rule.

For this direct 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 direct 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) 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[59] 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

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

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 carbon dioxide 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 95th 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,[60] although preference is given to consideration of the global benefits of reducing CO_2 emissions. Table IV.18 presents the values in the 2010 interagency group report,[61] which is reproduced in appendix 14A of the direct final rule TSD.

Table IV.18 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 direct final rule 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).[62] Table IV.19 shows the updated sets of SCC estimates from

[60] 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.

[61] 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).

[62] 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: http://www.whitehouse.gov/sites/default/files/omb/inforeg/scc-tsd-final-july-2015.pdf).

the latest interagency update in 5-year increments from 2010 to 2050. The full set of annual SCC estimates between 2010 and 2050 is reported in appendix 14B of the direct 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.19 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.[63]

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 2015$ 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 $12.4, $40.6, $63.2, and $118 per metric ton avoided (values expressed in 2015$). 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.

[63] 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. In July 2015 OMB published a detailed summary and formal response to the many comments that were received. https://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.

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 from electricity generation using benefit per ton estimates from the "Regulatory Impact Analysis for the Clean Power Plan Final Rule," published in August 2015 by EPA's Office of Air Quality Planning and Standards.[64] The report includes high and low values for NO_X (as $PM_{2.5}$) for 2020, 2025, and 2030 using discount rates of 3 percent and 7 percent; these values are presented in chapter 14 of the direct final rule TSD. DOE primarily relied on the low estimates to be conservative.[65] 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 developed values specific to the end-use category for MREFs using a method described in appendix 14C of the direct final rule TSD.

[64] Available at www.epa.gov/cleanpowerplan/clean-power-plan-final-rule-regulatory-impact-analysis. See Tables 4A-3, 4A-4, and 4A-5 in the report. The U.S. Supreme Court has stayed the rule implementing the Clean Power Plan until the current litigation against it concludes. Chamber of Commerce, et al. v. EPA, et al., Order in Pending Case, 577 U.S. ___ (2016). However, the benefit-per-ton estimates established in the Regulatory Impact Analysis for the Clean Power Plan are based on scientific studies that remain valid irrespective of the legal status of the Clean Power Plan.

[65] For the monetized NO_X benefits associated with PM2.5, the related benefits 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.)

DOE multiplied the emissions reduction (in 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.

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 AEO 2015. 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 direct 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 any changes in the number of employees of manufacturers of the products subject to standards, their suppliers, and related service firms. 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 supplies by the utility industry; (3) increased consumer spending on new products 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").[66] BLS regularly publishes its estimates of the number of jobs per million dollars of economic activity in different sectors of the economy, as well as the jobs created elsewhere in the economy by this same economic activity. Data from BLS indicate that expenditures in the utility sector generally create fewer jobs (both directly and indirectly) than expenditures in other sectors of the economy.[67] 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 consumer utility bills. Because reduced consumer 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 levels considered in this direct final rule using an input/output model of the U.S. economy

[66] 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.
[67] 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).

called Impact of Sector Energy Technologies version 3.1.1 ("ImSET").[68] ImSET is a special-purpose version of the "U.S. Benchmark National Input-Output" (I–O) model, which was designed to estimate the national employment and income effects of energy-saving technologies. The ImSET software includes a computer-based I–O model having structural coefficients that characterize economic flows among 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, where these uncertainties are reduced. For more details on the employment impact analysis, see chapter 16 of the direct final rule TSD.

V. Analytical Results and Conclusions

The following section addresses the results from DOE's analyses with respect to the considered energy conservation standards for MREFs. It addresses the TSLs examined by DOE, the projected impacts of each of these levels if adopted as energy conservation standards for MREFs, and the standards levels that DOE is adopting in this

[68] J. M. Roop, M. J. Scott, and R. W. Schultz, ImSET 3.1: Impact of Sector Energy Technologies, PNNL-18412, Pacific Northwest National Laboratory (2009) (Available at: www.pnl.gov/main/publications/external/technical_reports/PNNL-18412.pdf).

direct final rule. Additional details regarding DOE's analyses are contained in the direct final rule TSD supporting this notice.

A. Trial Standard Levels

DOE analyzed the benefits and burdens of four TSLs for coolers and four TSLs for combination cooler refrigeration products. These TSLs were developed by combining specific efficiency levels for each of the product classes analyzed by DOE. DOE presents the results for the TSLs in this document, while the results for all efficiency levels that DOE analyzed are in the direct final rule TSD.

Table V.1 presents the TSLs and the corresponding efficiency levels for coolers. TSL 4 represents the max-tech efficiency levels for all product classes. TSL 3 consists of the efficiency levels with maximum consumer NPV at 7-percent discount rate. TSL 2 corresponds to the standard levels recommended by the MREF Working Group. TSL 1 represents the current CEC energy efficiency standard for wine chillers.

Table V.1 Efficiency Levels within each Trial Standard Level for Coolers

Product Class	**Trial Standard Levels**			
	1	**2**	**3**	**4**
Freestanding Compact Coolers	4	7	9	11
Built-in Compact Coolers	4	7	9	11
Freestanding Coolers	4	7	9	11
Built-in Coolers	4	7	9	11

Table V.2 presents the TSLs and the corresponding efficiency levels for combination cooler refrigeration products. TSL 4 represents the max-tech efficiency levels for all product classes. TSL 3 represents a mid-point between TSL 2 and TSL 4. TSL 2 consists of the efficiency levels with maximum consumer NPV at 7-percent discount rate. TSL 1 corresponds to the standard levels recommended by the MREF Working Group.

Table V.2 Efficiency Levels Within each Trial Standard Level for Combination Cooler Refrigeration Products

Product Class	**Trial Standard Levels**			
	1	**2**	**3**	**4**
C-3A	2	4	5	7
C-3A-BI	2	4	5	7
C-9*	3	5	6	7
C-9-BI*	3	5	6	7
C-13A	3	4	6	7
C-13A-BI	3	4	6	7

* Results for C-9 and C-9-BI are also applicable to C-9I and C-9I-BI.

In its analysis of the benefits and burdens of each TSL, DOE used two different compliance dates. For the consensus-recommended TSLs, the analysis is based on a 2019 compliance date as recommended by the MREF Working Group. For all other TSLs the analysis is based on a 2021 compliance date consistent with EPCA, which provides that newly-established standards shall not apply to products manufactured within five years after the publication of the final rule. In other words, DOE followed the prescriptions of EPCA for all TSLs that were not recommended by the MREF Working Group. The two different compliance dates are indicated in the relevant sections of the results and discussed in section III.B of this document.

B. Economic Justification and Energy Savings

1. Economic Impacts on Individual Consumers

DOE analyzed the economic impacts on MREF consumers by looking at the effects that potential new standards at each TSL would have on the LCC and PBP. These analyses are discussed below.

a. Life-Cycle Cost and Payback Period

In general, higher-efficiency products affect consumers in two ways: (1) purchase prices increase and (2) annual operating costs decrease. Inputs used for calculating the LCC and PBP include total installed costs (i.e., product price plus installation costs), and operating costs (i.e., annual energy use, energy prices, energy price trends, repair costs, and maintenance costs). The LCC calculation also uses product lifetime and a discount rate. Chapter 8 of the direct final rule TSD provides detailed information on the LCC and PBP analyses.

Table V.3 through Table V.22 show the LCC and PBP results for the TSL efficiency levels considered for each product class. In the first of each pair of tables, the simple payback is measured relative to the baseline product. In the second table, the impacts are measured relative to the efficiency distribution in the no-new-standards case in the compliance year (see section IV.F of this document). The average savings reflect the fact that some consumers purchase products with higher efficiency in the no-new-standards case, and the savings refer only to the other consumers who are affected by a standard at a given TSL. Consumers for whom the LCC increases at a given TSL experience a net cost.

Table V.3 Average LCC and PBP Results by Efficiency Level for Freestanding Compact Coolers

TSL*	EL	Average Costs (2015$)				Simple Payback (years)	Average Lifetime (years)
		Installed Cost	First Year's Operating Cost	Lifetime Operating Cost	LCC		
1	4	400	40	325	726	1.1	10.3
2	7	438	26	220	658	1.4	10.3
3	9	478	19	158	636	1.6	10.3
4	11	702	12	98	800	3.5	10.3

* For TSL 2, the results are forecasted over the lifetime of products sold in 2019. For the other TSLs, the results are forecasted over the lifetime of products sold in 2021.
Note: The results for each TSL are calculated assuming that all consumers use products at that efficiency level. The PBP is measured relative to the lowest efficiency level in the no-new-standards case efficiency distribution.

Table V.4 Average LCC Savings Relative to the No-New-Standards Case for Freestanding Compact Coolers

TSL*	EL	Average LCC Savings** (2015$)	Percent of Consumers that Experience Net Cost
1	4	279	6
2	7	265	9
3	9	288	12
4	11	123	51

* For TSL 2, the results are forecasted over the lifetime of products sold in 2019. For the other TSLs, the results are forecasted over the lifetime of products sold in 2021.
** The savings represent the average LCC savings for affected consumers.

Table V.5 Average LCC and PBP Results by Efficiency Level for Built-in Compact Coolers

TSL*	EL	Average Costs (2015$)				Simple Payback** (years)	Average Lifetime (years)
		Installed Cost	First Year's Operating Cost	Lifetime Operating Cost	LCC		
1	4	832	45	370	1202	n.a.	10.3
2	7	894	30	250	1144	4.6	10.3
3	9	934	22	180	1114	4.4	10.3
4	11	1281	15	123	1404	14.8	10.3

* For TSL 2, the results are forecasted over the lifetime of products sold in 2019. For the other TSLs, the results are forecasted over the lifetime of products sold in 2021.
** The PBP is measured relative to the lowest efficiency level in the no-new-standards case efficiency distribution. Calculation of PBP is not applicable (n.a.) when the efficiency level is already met or exceeded in the MREF market.
Note: The results for each TSL are calculated assuming that all consumers use products at that efficiency level.

Table V.6 Average LCC Savings Relative to the No-New-Standards Case for Built-in Compact Coolers

TSL*	EL	Average LCC Savings** (2015$)	Percent of Consumers that Experience Net Cost
1	4	n.a.	0
2	7	28	29
3	9	60	27
4	11	(230)	93

* For TSL 2, the results are forecasted over the lifetime of products sold in 2019. For the other TSLs, the results are forecasted over the lifetime of products sold in 2021.
** The savings represent the average LCC savings for affected consumers. Calculation of savings is not applicable (n.a.) when the efficiency level is already met or exceeded in the MREF market.

Table V.7 Average LCC and PBP Results by Efficiency Level for Freestanding Coolers

TSL*	EL	Average Costs (2015$)				Simple Payback (years)	Average Lifetime (years)
		Installed Cost	First Year's Operating Cost	Lifetime Operating Cost	LCC		
1	4	1303	58	728	2032	1.0	17.4

2	7	1418	38	497	1915	1.8	17.4
3	9	1460	28	359	1819	1.8	17.4
4	11	1955	17	226	2180	4.8	17.4

* For TSL 2, the results are forecasted over the lifetime of products sold in 2019. For the other TSLs, the results are forecasted over the lifetime of products sold in 2021.
Note: The results for each TSL are calculated assuming that all consumers use products at that efficiency level. The PBP is measured relative to the lowest efficiency level in the no-new-standards case efficiency distribution.

Table V.8 Average LCC Savings Relative to the No-New-Standards Case for Freestanding Coolers

TSL*	EL	Average LCC Savings** (2015$)	Percent of Consumers that Experience Net Cost
1	4	648	0
2	7	153	22
3	9	240	9
4	11	(121)	78

* For TSL 2, the results are forecasted over the lifetime of products sold in 2019. For the other TSLs, the results are forecasted over the lifetime of products sold in 2021.
** The savings represent the average LCC savings for affected consumers.

Table V.9 Average LCC and PBP Results by Efficiency Level for Built-in Coolers

TSL*	EL	Average Costs (2015$)				Simple Payback** (years)	Average Lifetime (years)
		Installed Cost	First Year's Operating Cost	Lifetime Operating Cost	LCC		
1	4	1679	58	728	2407	n.a.	17.4
2	7	1785	38	497	2281	6.1	17.4
3	9	1819	28	359	2178	4.7	17.4
4	11	2372	19	248	2619	17.7	17.4

* For TSL 2, the results are forecasted over the lifetime of products sold in 2019. For the other TSLs, the results are forecasted over the lifetime of products sold in 2021.
** The PBP is measured relative to the lowest efficiency level in the no-new-standards case efficiency distribution. Calculation of PBP is not applicable (n.a.) when the efficiency level is already met or exceeded in the MREF market.
Note: The results for each TSL are calculated assuming that all consumers use products at that efficiency level.

Table V.10 Average LCC Savings Relative to the No-New-Standards Case for Built-in Coolers

TSL*	EL	Average LCC Savings** (2015$)	Percent of Consumers that Experience Net Cost
1	4	n.a.	0
2	7	77	22
3	9	187	7
4	11	(254)	86

* For TSL 2, the results are forecasted over the lifetime of products sold in 2019. For the other TSLs, the results are forecasted over the lifetime of products sold in 2021.
** The savings represent the average LCC savings for affected consumers. Calculation of savings is not applicable (n.a.) when the efficiency level is already met or exceeded in the MREF market.

Table V.11 Average LCC and PBP Results by Efficiency Level for C-3A

TSL*	EL	Average Costs (2015$)				Simple Payback** (years)	Average Lifetime (years)
		Installed Cost	First Year's Operating Cost	Lifetime Operating Cost	LCC		
1	2	5839	28	360	6199	n.a.	17.4
2	4	5868	22	278	6146	4.1	17.4
3	5	5904	20	247	6152	6.8	17.4
4	7	6246	13	168	6413	25.3	17.4

* For TSL 1, the results are forecasted over the lifetime of products sold in 2019. For the other TSLs, the results are forecasted over the lifetime of products sold in 2021.
** The PBP is measured relative to the lowest efficiency level in the no-new-standards case efficiency distribution. Calculation of PBP is not applicable (n.a.) when the efficiency level is already met or exceeded in the MREF market.
Note: The results for each TSL are calculated assuming that all consumers use products at that efficiency level.

Table V.12 Average LCC Savings Relative to the No-New-Standards Case for C-3A

TSL*	EL	Average LCC Savings** (2015$)	Percent of Consumers that Experience Net Cost
1	2	n.a.	0
2	4	58	4
3	5	53	26
4	7	(209)	92

* For TSL 1, the results are forecasted over the lifetime of products sold in 2019. For the other TSLs, the results are forecasted over the lifetime of products sold in 2021.

** The savings represent the average LCC savings for affected consumers. Calculation of savings is not applicable (n.a.) when an efficiency level is already met or exceeded in the MREF market.

Table V.13 Average LCC and PBP Results by Efficiency Level for C-3A-BI

TSL*	EL	Average Costs (2015$)				Simple Payback** (years)	Average Lifetime (years)
		Installed Cost	First Year's Operating Cost	Lifetime Operating Cost	LCC		
1	2	8594	32	406	9000	n.a.	17.4
2	4	8627	25	314	8941	4.1	17.4
3	5	8668	22	279	8947	6.8	17.4
4	7	9055	15	189	9243	25.4	17.4

* For TSL 1, the results are forecasted over the lifetime of products sold in 2019. For the other TSLs, the results are forecasted over the lifetime of products sold in 2021.
** The PBP is measured relative to the lowest efficiency level in the no-new-standards case efficiency distribution. Calculation of PBP is not applicable (n.a.) when the efficiency level is already met or exceeded in the MREF market.
Note: The results for each TSL are calculated assuming that all consumers use products at that efficiency level.

Table V.14 Average LCC Savings Relative to the No-New-Standards Case for C-3A-BI

TSL*	EL	Average LCC Savings** (2015$)	Percent of Consumers that Experience Net Cost
1	2	n.a.	0
2	4	66	4
3	5	59	26
4	7	(237)	92

* For TSL 1, the results are forecasted over the lifetime of products sold in 2019. For the other TSLs, the results are forecasted over the lifetime of products sold in 2021.
** The savings represent the average LCC savings for affected consumers. Calculation of savings is not applicable (n.a.) when an efficiency level is already met or exceeded in the MREF market.

Table V.15 Average LCC and PBP Results by Efficiency Level for C-9

TSL*	EL	Average Costs (2015$)				Simple Payback** (years)	Average Lifetime (years)
		Installed Cost	First Year's Operating Cost	Lifetime Operating Cost	LCC		
1	3	4373	36	465	4837	n.a.	17.4
2	5	4396	29	359	4755	2.6	17.4
3	6	4523	26	319	4841	12.1	17.4
4	7	4757	22	269	5026	23.3	17.4

* For TSL 1, the results are forecasted over the lifetime of products sold in 2019. For the other TSLs, the results are forecasted over the lifetime of products sold in 2021.
** The PBP is measured relative to the lowest efficiency level in the no-new-standards case efficiency distribution. Calculation of PBP is not applicable (n.a.) when the efficiency level is already met or exceeded in the MREF market.
Note: The results for each TSL are calculated assuming that all consumers use products at that efficiency level.

Table V.16 Average LCC Savings Relative to the No-New-Standards Case for C-9

TSL*	EL	Average LCC Savings** (2015$)	Percent of Consumers that Experience Net Cost
1	3	n.a.	0
2	5	89	0
3	6	3	62
4	7	(182)	90

* For TSL 1, the results are forecasted over the lifetime of products sold in 2019. For the other TSLs, the results are forecasted over the lifetime of products sold in 2021.
** The savings represent the average LCC savings for affected consumers. Calculation of savings is not applicable (n.a.) when an efficiency level is already met or exceeded in the MREF market.

Table V.17 Average LCC and PBP Results by Efficiency Level for C-9-BI

TSL*	EL	Average Costs (2015$)				Simple Payback** (years)	Average Lifetime (years)
		Installed Cost	First Year's Operating Cost	Lifetime Operating Cost	LCC		
1	3	6438	41	530	6968	n.a.	17.4
2	5	6464	33	410	6874	2.6	17.4
3	6	6608	29	364	6972	12.0	17.4

4	7	6874	25	307	7181	23.2	17.4

* For TSL 1, the results are forecasted over the lifetime of products sold in 2019. For the other TSLs, the results are forecasted over the lifetime of products sold in 2021.
** The PBP is measured relative to the lowest efficiency level in the no-new-standards case efficiency distribution. Calculation of PBP is not applicable (n.a.) when the efficiency level is already met or exceeded in the MREF market.
Note: The results for each TSL are calculated assuming that all consumers use products at that efficiency level.

Table V.18 Average LCC Savings Relative to the No-New-Standards Case for C-9-BI

TSL*	EL	Average LCC Savings** (2015$)	Percent of Consumers that Experience Net Cost
1	3	n.a.	0
2	5	102	0
3	6	4	63
4	7	(205)	90

* For TSL 1, the results are forecasted over the lifetime of products sold in 2019. For the other TSLs, the results are forecasted over the lifetime of products sold in 2021.
** The savings represent the average LCC savings for affected consumers. Calculation of savings is not applicable (n.a.) when an efficiency level is already met or exceeded in the MREF market.

Table V.19 Average LCC and PBP Results by Efficiency Level for C-13A

TSL*	EL	Average Costs (2015$)				Simple Payback (years)	Average Lifetime (years)
		Installed Cost	First Year's Operating Cost	Lifetime Operating Cost	LCC		
1	3	2062	30	248	2310	4.3	10.3
2	4	2092	26	214	2306	5.0	10.3
3	6	2275	21	170	2446	13.3	10.3
4	7	2368	18	149	2517	16.0	10.3

* For TSL 1, the results are forecasted over the lifetime of products sold in 2019. For the other TSLs, the results are forecasted over the lifetime of products sold in 2021.
Note: The results for each TSL are calculated assuming that all consumers use products at that efficiency level. The PBP is measured relative to the lowest efficiency level in the no-new-standards case efficiency distribution.

Table V.20 Average LCC Savings Relative to the No-New-Standards Case for C-13A

TSL*	EL	Average LCC Savings** (2015$)	Percent of Consumers that Experience Net Cost
1	3	32	6
2	4	17	44
3	6	(123)	94
4	7	(194)	96

* For TSL 1, the results are forecasted over the lifetime of products sold in 2019. For the other TSLs, the results are forecasted over the lifetime of products sold in 2021.
** The savings represent the average LCC savings for affected consumers.

Table V.21 Average LCC and PBP Results by Efficiency Level for C-13A-BI

TSL*	EL	Average Costs (2015$)				Simple Payback** (years)	Average Lifetime (years)
		Installed Cost	First Year's Operating Cost	Lifetime Operating Cost	LCC		
1	3	3019	33	273	3292	n.a.	10.3
2	4	3054	29	235	3289	6.5	10.3
3	6	3261	23	187	3448	21.6	10.3
4	7	3366	20	164	3530	24.6	10.3

* For TSL 1, the results are forecasted over the lifetime of products sold in 2019. For the other TSLs, the results are forecasted over the lifetime of products sold in 2021.
** The PBP is measured relative to the lowest efficiency level in the no-new-standards case efficiency distribution. Calculation of PBP is not applicable (n.a.) when the efficiency level is already met or exceeded in the MREF market.
Note: The results for each TSL are calculated assuming that all consumers use products at that efficiency level.

Table V.22 Average LCC Savings Relative to the No-New-Standards Case for C-13A-BI

TSL*	EL	Average LCC Savings** (2015$)	Percent of Consumers that Experience Net Cost
1	3	n.a.	0
2	4	8	49
3	6	(151)	97
4	7	(232)	98

* For TSL 1, the results are forecasted over the lifetime of products sold in 2019. For the other TSLs, the results are forecasted over the lifetime of products sold in 2021.

** The savings represent the average LCC savings for affected consumers. Calculation of savings is not applicable (n.a.) when an efficiency level is already met or exceeded in the MREF market.

b. Consumer Subgroup Analysis

In the consumer subgroup analysis, DOE estimated the impact of the considered TSLs on low-income households and senior-only households. DOE is not presenting the consumer subgroup results in this final rule, because the household sample sizes for the above subgroups were not large enough to yield meaningful results. For information purposes, chapter 11 of the final rule TSD presents the LCC and PBP results for the subgroups.

c. Rebuttable Presumption Payback

As discussed in section III.H.2 of this document, EPCA establishes a rebuttable presumption that an energy conservation standard is economically justified if the increased purchase cost for a product that meets the standard is less than three times the value of the first-year energy savings resulting from the standard. In calculating a rebuttable presumption payback period for each of the considered TSLs, DOE used discrete values, and, as required by EPCA, based the energy use calculation on the DOE test procedures for MREFs.

Table V.23 presents the rebuttable-presumption payback periods for the considered TSLs. While DOE examined the rebuttable-presumption criterion, it considered whether the standard levels evaluated for this rule are economically justified through a more detailed analysis of the economic impacts of those levels, pursuant to 42 U.S.C. 6295(o)(2)(B)(i), which considers the full range of impacts to the consumer, manufacturer, Nation, and environment. The results of that 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.23 Rebuttable-Presumption Payback Period (in years) for MREFs

	Trial Standard Level			
Product Class	**1**	**2**	**3**	**4**
Coolers				
Freestanding Compact Coolers	1.1	1.4	1.6	3.5
Built-in Compact Coolers	n.a.*	4.6	4.4	14.8
Freestanding Coolers	1.0	1.8	1.8	4.8
Built-in Coolers	n.a.	6.1	4.7	17.7
Combination Cooler Refrigeration Products				
C-3A	n.a.	4.1	6.8	25.3
C-3A-BI	n.a.	4.1	6.8	25.4
C-9	n.a.	2.6	12.1	23.3
C-9-BI	n.a.	2.6	12.0	23.2
C-13A	4.3	5.0	13.3	16.0
C-13A-BI	n.a.	6.5	21.6	24.6

* Calculation of PBP is not applicable (n.a.) if the efficiency level is already met or exceeded in the MREF market.

2. Economic Impacts on Manufacturers

DOE performed an MIA to estimate the impact of new energy conservation standards on manufacturers of MREFs. The section below describes the expected impacts on manufacturers at each TSL. Chapter 12 of the direct 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 INPV) of new energy conservation standards on manufacturers of MREFs, as well as the conversion costs that DOE estimates manufacturers would incur for each product class at each TSL. To evaluate the range of cash flow impacts on MREF manufacturers, DOE modeled two different markup scenarios using different assumptions that correspond to the range of anticipated market responses to potential new energy conservation standards: (1) the preservation of gross margin percentage, and (2) the preservation of per-unit operating profit. Each of these scenarios is discussed below.

To assess the lower (less severe) end of the range of potential impacts, DOE modeled a preservation of gross margin percentage markup scenario, in which a uniform "gross margin percentage" markup is applied across all 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. During confidential interviews, manufacturers indicated that it is optimistic to assume that they would be able to maintain the same gross margin markup as their production costs increase in response to a new energy conservation standard, particularly at higher TSLs.

To assess the higher (more severe) end of the range of potential impacts, DOE modeled the preservation of per-unit operating profit markup scenario, which assumes that manufacturers would be able to earn the same operating margin in absolute dollars per-unit in the standards case as in the no-new-standards case. In this scenario, while manufacturers make the necessary investments required to convert their facilities to produce new standards-compliant products, operating profit does not change in absolute dollars per unit and 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 results from the sum of discounted cash flows from the base year 2016 through 2048 (the end of the analysis period for TSLs with a 3-year compliance period, as recommended by the MREF Working Group) or 2050 (the end of the analysis period for TSLs with a 5-year compliance period).[69] To provide perspective on the short-run cash flow impact, DOE includes in the discussion of the results below a comparison on free cash flow between the no-new-standards case and the standards case at each TSL in the year before new 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.

DOE modeled separate INPV impacts for the cooler and combination cooler refrigeration product industries. Table V.24 and Table V.25 display the potential INPV impacts on the cooler industry under the preservation of gross margin markup scenario and preservation of operating profit markup scenarios, respectively. Table V.26 and Table V.27 contain estimated INPV impacts for the combination cooler refrigeration

[69] As described in section III.B of this document, the MREF Working Group recommended a 3-year compliance period for the standards recommended in Term Sheet #2. DOE analyzed these recommended standards (TSL 2 for coolers and TSL 1 for combination cooler refrigeration products) using a 3-year compliance period. DOE analyzed all other TSLs in this direct final rule (representing standards not recommended by the MREF Working Group) using a 5-year compliance period consistent with the EPCA provisions for newly-established standards.

product industry under the preservation of gross margin markup scenario and preservation of operating profit markup scenarios, respectively.

Table V.24 Manufacturer Impact Analysis for Coolers - Preservation of Gross Margin Percentage Markup Scenario*

	Units	No-New-Standards Case	Trial Standard Level			
			1	**2****	**3**	**4**
INPV	2015$ M	263.3	264.0	253.3	226.5	283.8
Change in INPV	2015$ M	-	0.7	(10.0)	(36.8)	20.5
	%	-	0.3	(3.8)	(14.0)	7.8
Product Conversion Costs	2015$ M	-	12.1	54.8	74.6	84.1
Capital Conversion Costs	2015$ M	-	13.7	19.7	63.8	105.0
Total Conversion Costs	2015$ M	-	25.8	74.6	138.4	189.1
Free Cash Flow in 2020 (2018 for TSL 2)	2015$ M	16.7 (16.3 for TSL 2)	7.1	(8.3)	(35.2)	(57.9)
Free Cash Flow change from no-new-standards case in 2020 (2018 for TSL 2)	%	-	(57.7)	(151.0)	(310.0)	(446.0)

* Values in parentheses are negative values. All values have been rounded to the nearest tenth.
** TSL recommended by the MREF Working Group with 2019 compliance date (i.e. a 3-year compliance period); all other TSLs have a modeled compliance date of 2021 (i.e. a 5-year compliance period).

Table V.25 Manufacturer Impact Analysis for Coolers - Preservation of Operating Profit Markup Scenario*

	Units	No-New-Standards Case	Trial Standard Level			
			1	2**	3	4
INPV	2015$ M	263.3	244.3	208.5	168.4	110.5
Change in INPV	2015$ M	-	(19.0)	(54.8)	(94.8)	(152.8)
	%	-	(7.2)	(20.8)	(36.0)	(58.0)
Product Conversion Costs	2015$ M	-	12.1	54.8	74.6	84.1
Capital Conversion Costs	2015$ M	-	13.7	19.7	63.8	105.0
Total Conversion Costs	2015$ M	-	25.8	74.6	138.4	189.1
Free Cash Flow in 2020 (2018 for TSL 2)	2015$ M	16.7 (16.3 for TSL 2)	7.1	(8.3)	(35.2)	(57.9)
Free Cash Flow change from no-new-standards case in 2020 (2018 for TSL 2)	%	-	(57.7)	(151.0)	(310.0)	(446.0)

* Values in parentheses are negative values. All values have been rounded to the nearest tenth.
** TSL recommended by the MREF Working Group with 2019 compliance date (i.e. a 3-year compliance period); all other TSLs have a modeled compliance date of 2021 (i.e. a 5-year compliance period).

At TSL 1, DOE estimates impacts on INPV of cooler manufacturers to range from $244.3 million to $264.0 million, or a change in INPV of -7.2 percent to 0.3 percent under the preservation of per-unit operating profit markup scenario and preservation of gross margin percentage markup scenario, respectively. At TSL 1, industry free cash flow is expected to decrease by approximately 57.7 percent to $7.1 million, compared to the no-new-standards case value of $16.7 million in 2020, the year prior to the 2021 compliance year.

An estimated 71 percent of cooler industry shipments are below the efficiency level corresponding to TSL 1 (EL 4, the CEC-equivalent level for all cooler product classes). DOE estimated that compliance with TSL 1 will require a total industry investment of $25.8 million. Implicit in this estimate is that DOE expects approximately two-thirds of cooler models using non-vapor-compression refrigeration systems will switch to vapor-compression refrigeration systems to reach TSL 1. Industry conversion costs are related to the integration of heat pipes for a portion of the non-vapor-compression coolers remaining on the market, increased production capacity for vapor-compression coolers, and testing and marketing costs associated with all cooler models.

At TSL 2, the TSL recommended by the MREF Working Group, DOE estimates INPV for cooler manufacturers to range from $208.5 million to $253.3 million, or a change in INPV of -20.8 percent to -3.8 percent. At this standard level, industry free cash flow is estimated to decrease by as much as 151.0 percent to -$8.3 million, compared to the no-new-standards case value of $16.3 million in 2018, the year prior to the 2019 compliance year.

An estimated 95 percent of cooler industry shipments are below the efficiency level corresponding to TSL 2 (EL 7 for all cooler product classes). DOE estimated that compliance with TSL 2 will require a total industry investment of $74.6 million. DOE assumed that, at this level, the majority of cooler models using non-vapor-compression refrigeration systems will not be able to reach TSL 2, and the corresponding share of the market will switch to coolers using vapor-compression refrigeration systems. Major sources of industry conversion costs include the integration of heat pipes and insulation changes for a portion of the non-vapor-compression coolers remaining on the market, increased production capacity for vapor-compression coolers, and testing and marketing costs associated with all cooler models.

At TSL 3, DOE estimates impacts on INPV for cooler manufacturers to range from $168.4 million to $226.5 million, or a change in INPV of -36.0 percent to -14.0 percent. At this standard level, industry free cash flow is estimated to decrease by as much as 310.0 percent to -$35.2 million, compared to the no-new-standards case value of $16.7 million in 2020.

An estimated 99 percent of cooler industry shipments are below the efficiency level corresponding to TSL 3 (EL 9 for all cooler product classes). DOE estimated that compliance with TSL 3 will require a total industry investment of $138.4 million. Again, implicit in this estimate is that the majority of cooler models using non-vapor-compression refrigeration systems will not be able to reach TSL 3, and the corresponding share of the market will switch to coolers using vapor-compression refrigeration systems. Industry conversion costs are related to the integration of heat pipes and insulation changes for all non-vapor-compression coolers remaining on the market. For vapor-compression coolers, industry conversion costs are related to improved glass, increases in insulation thickness, the integration of forced-convection evaporators, more efficient compressors, and increased production capacity for vapor-compression coolers. Finally, all cooler models would incur testing and marketing costs.

At TSL 4, DOE estimates impacts on INPV for cooler manufacturers to range from $110.5 million to $283.8 million, or a change in INPV of -58.0 percent to 7.8 percent. At TSL 4, industry free cash flow is estimated to decrease by as much as 446.0 percent to -$57.9 million, compared to the no-new-standards case value of $16.7 million in 2020.

Similar to TSL 3, an estimated 99 percent of cooler industry shipments are below the efficiency level corresponding to TSL 4 (EL 11 for all cooler product classes). DOE estimated that compliance with TSL 4 will require a total industry investment of $189.1 million. At TSL 4, DOE assumed that none of the cooler models using non-vapor-compression refrigeration systems will be able to reach TSL 4, and the corresponding share of the market will switch to coolers using vapor-compression refrigeration systems. For vapor-compression coolers, in addition to the design changes associated with reaching TSL 3, industry conversion costs are related to improved heat exchangers, the integration of VIPs and triple-pane glass, and switching to brushless direct current (DC) condenser fan motors and variable-speed compressors.

Table V.26 Manufacturer Impact Analysis for Combination Cooler Refrigeration Products - Preservation of Gross Margin Percentage Markup Scenario*

	Units	No-New-Standards Case	Trial Standard Level			
			1**	**2**	**3**	**4**
INPV	2015$ M	108.2	107.6	107.5	117.7	128.5
Change in INPV	2015$ M	-	(0.5)	(0.6)	9.6	20.3
	%	-	(0.5)	(0.6)	8.9	18.8
Product Conversion Costs	2015$ M	-	0.5	3.1	4.3	4.6
Capital Conversion Costs	2015$ M	-	0.5	3.7	5.2	6.7
Total Conversion Costs	2015$ M	-	1.0	6.8	9.5	11.3
Free Cash Flow in 2020 (2018 for TSL 1)	2015$ M	6.9 (6.7 for TSL 1)	6.3	4.3	3.3	2.6
Free Cash Flow change from no-new-standards case in 2020 (2018 for TSL 1)	%	-	(5.7)	(36.9)	(51.9)	(62.9)

* Values in parentheses are negative values. All values have been rounded to the nearest tenth.
** TSL recommended by the MREF Working Group with 2019 compliance date (i.e. a 3-year compliance period); all other TSLs have a modeled compliance date of 2021 (i.e. a 5-year compliance period).

Table V.27 Manufacturer Impact Analysis for Combination Cooler Refrigeration Products - Preservation of Operating Profit Markup Scenario*

	Units	No-New-Standards Case	Trial Standard Level			
			1*	**2**	**3**	**4**
INPV	2015$ M	108.2	107.4	103.7	101.6	100.1
Change in INPV	2015$ M	-	(0.8)	(4.4)	(6.5)	(8.1)
	%	-	(0.7)	(4.1)	(6.0)	(7.5)
Product Conversion Costs	2015$ M	-	0.5	3.1	4.3	4.6
Capital Conversion Costs	2015$ M	-	0.5	3.7	5.2	6.7
Total Conversion Costs	2015$ M	-	1.0	6.8	9.5	11.3
Free Cash Flow in 2020 (2018 for TSL 1)	2015$ M	6.9 (6.7 for TSL 1)	6.3	4.3	3.3	2.6
Free Cash Flow change from no-new-standards case in 2020 (2018 for TSL 1)	%	-	(5.7)	(36.9)	(51.9)	(62.9)

* Values in parentheses are negative values. All values have been rounded to the nearest tenth.
** TSL recommended by the MREF Working Group with 2019 compliance date (i.e. a 3-year compliance period); all other TSLs have a modeled compliance date of 2021 (i.e. a 5-year compliance period).

TSL 1, the MREF Working Group recommended level, corresponds to EL 2 for combination cooler refrigeration product classes C-3A and C-3A-BI, and EL 3 for product classes C-9, C-9-BI, C-13A and C-13A-BI. At TSL 1, DOE estimates INPV for combination cooler refrigeration product manufacturers to range from $107.4 million to $107.6 million, or a change in INPV of -0.7 percent to -0.5 percent, relative to the no-new-standards case. At this TSL, industry free cash flow is estimated to decrease by as much as 5.7 percent to $6.3 million, compared to the no-new-standards case value of $6.7 million in 2018, the year before the 2019 compliance year.

An estimated 11 percent of combination cooler refrigeration product industry shipments are below the efficiency levels corresponding to TSL 1. Products with efficiencies below those corresponding to TSL 1 are concentrated in product class C-13A. At TSL 1, DOE estimated that manufacturers of C-13A combination cooler refrigeration products will incur conversion costs of $1.0 million in order to comply with the 2019 standard. The design changes associated with this conversion cost estimate include increased compressor efficiency and increased insulation thickness.

At TSL 2, DOE estimates INPV for combination cooler refrigeration product manufacturers to range from $103.7 million to $107.5 million, or a change in INPV of -4.1 percent to -0.6 percent. At this TSL, industry free cash flow is estimated to decrease by as much as 36.9 percent to $4.3 million, compared to the no-new-standards case value of $6.9 million in 2020.

In contrast to TSL 1, an estimated 100 percent of combination cooler refrigeration product industry shipments are below the efficiency levels corresponding to TSL 2 (EL 4 for product classes C-3A, C-3A-BI, C-13A and C-13A-BI; EL 5 for product classes C-9 and C-9-BI). DOE estimated that compliance with TSL 2 will require a total industry investment of $6.8 million by 2021. The design changes associated with this conversion cost estimate include increased compressor efficiency, changes to insulation thickness, and the incorporation of VIPs.

At TSL 3, DOE estimates INPV for combination cooler refrigeration product manufacturers to range from $101.6 million to $117.7 million, or a change in INPV of -6.0 percent to 8.9 percent. At this TSL, industry free cash flow is estimated to decrease by as much as 51.9 percent to $3.3 million, compared to the no-new-standards case value of $6.9 million in 2020.

An estimated 100 percent of combination cooler refrigeration product industry shipments are below the efficiency levels corresponding to TSL 3 (EL 5 for product classes C-3A, C-3A-BI; EL 6 for product classes C-13A, C-13A-BI, C-9, and C-9-BI). DOE estimated that compliance with TSL 3 will require a total industry investment of $9.5 million by 2021. Again, the design changes associated with this conversion cost estimate relate increased compressor efficiency, changes to insulation thickness, and the incorporation of VIPs. Incorporation of high efficiency glass would also be required for some product classes at TSL 3.

At TSL 4, DOE estimates INPV for combination cooler refrigeration product manufacturers to range from $100.1 million to $128.5 million, or a change in INPV of -7.5 percent to 18.8 percent. At this TSL, industry free cash flow is estimated to decrease by as much as 62.9 percent to $2.6 million, compared to the no-new-standards case value of $6.9 million in 2020.

An estimated 100 percent of combination cooler refrigeration product industry shipments are below the efficiency levels corresponding to TSL 4 (EL 7 for all combination cooler product classes). DOE estimated that compliance with TSL 4 will require a total industry investment of $11.3 million by 2021. Again, the design changes associated with this conversion cost estimate relate increased compressor efficiency, changes to insulation thickness, and the incorporation of VIPs. Incorporation of high-efficiency glass would also be required for all product classes at TSL 4.

b. Impacts on Direct Employment

To quantitatively asses the impacts of energy conservation standards on direct employment in the MREF industry, DOE used the GRIM to estimate the domestic labor expenditures and number of employees in the no-new-standards case and at each TSL from 2016 through either 2048 or 2050, the end of the analysis period depending on the TSL. DOE used statistical data from the U.S. Census Bureau’s 2011 Annual Survey of Manufactures ("ASM"),[70] the results of the engineering analysis, and interviews with manufacturers to determine the inputs necessary to calculate industry-wide labor expenditures and domestic employment levels. Labor expenditures related to manufacturing of the product are a function of the labor intensity of the product, the 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.

The total labor expenditures in the GRIM were then converted to domestic production employment levels by dividing production labor expenditures by the annual payment per production worker (production worker hours multiplied by the labor rate found in the U.S. Census Bureau’s 2011 ASM). DOE estimates that approximately 8 percent of coolers and 43 percent of combination cooler refrigeration products sold in the

[70] "Annual Survey of Manufactures (ASM)," U.S. Census Bureau (2011) (Available at: http://www.census.gov/manufacturing/asm/).

United States are manufactured domestically. The estimates of production workers in this section include line-supervisors who are directly involved in fabricating and assembling a product within the manufacturing 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 products covered by this rulemaking. Thus, the estimated number of impacted employees in the MIA is separate and distinct from the total number of employees used to determine whether a manufacturer is a small business. Finally, this analysis also does not factor in the dependence by some manufacturers on production volumes to make their operations viable.

In the GRIM, DOE used the labor content of each product and manufacturing production costs from the engineering analysis to estimate the annual labor expenditures in the MREF manufacturing industry. DOE used information gained through interviews with manufacturers to estimate the portion of the total labor expenditures that can be attributed to domestic production labor. The employment impacts shown in Table V.28 represent the range of potential production employment impacts in the cooler industry that could result in the compliance year of new energy conservation standards and Table V.29 represents the range of potential production employment impacts in the combination cooler refrigeration product industry that could result in the compliance year of new energy conservation standards.

The upper end of the results in the tables represents the maximum increase in the number of production workers after the implementation of new energy conservation standards and assumes that manufacturers would continue to produce the same covered products within the United States. This corresponds to the direct employment impacts calculated in the GRIM. In general, more efficient products are more complex and more labor intensive to manufacture. Per-unit labor requirements and production time requirements increase with a higher energy conservation standard. As a result, if shipments remain relatively steady, the model forecasts job growth at the upper bound of direct employment impacts.

The lower bound assumes that as the standard increases, manufacturers choose to retire sub-standard product lines (or to move production of sub-standard product lines abroad) rather than invest in domestic manufacturing facility conversions and product redesigns. In this scenario, there is a loss of employment because manufacturers consolidate and operate fewer domestic production lines. To estimate this lower bound, DOE assumed that the percentage loss in employment relative to the no-new-standards case would be equal to the percentage of non-compliant, domestically-produced platforms relative to all domestically-produced platforms. Because this represents a worst-case scenario for employment, there is no consideration given to the fact that there may be employment growth in higher-efficiency product lines.

DOE estimates that in the absence of new energy conservation standards, there would be 168 and 173 domestic production workers in the cooler industry in 2019 and 2021, respectively, and 130 and 134 domestic production workers in the combination cooler refrigeration product industry in 2019 and 2021, respectively.

Table V.28 Potential Changes in the Number of Industry Production Worker Employment for Coolers in Compliance Year*

	Trial Standard Level**				
	No-New-Standards Case	**1**	**2**	**3**	**4**
Total Number of Domestic Production Workers in Compliance Year	173 (168 for TSL 2)	145 to 194	66 to 207	20 to 232	12 to 307
Potential Changes in Domestic Production Workers in Compliance Year	-	(28) to 21	(102) to 39	(153) to 59	(161) to 134

*The standards compliance year is 2019 for TSL 2, as recommended by the MREF Working Group; all other TSLs have a modeled compliance year of 2021.
**Numbers in parentheses represent negative values.

Table V.29 Potential Changes in the Number of Industry Production Worker Employment for Combination Cooler Refrigeration Products in Compliance Year*

	Trial Standard Level**				
	No-New-Standards Case	**1**	**2**	**3**	**4**
Total Number of Domestic Production Workers in Compliance Year	134 (130 for TSL 1)	130 to 130	0 to 141	0 to 160	0 to 180
Potential Changes in Domestic Production Workers in Compliance Year	-	0 to 0	(134) to 7	(134) to 26	(134) to 46

*The standards compliance year is 2019 for TSL 1, as recommended by the MREF Working Group; all other TSLs have a modeled compliance year of 2021.
**Numbers in parentheses represent negative values.

Direct production employment impacts are also detailed in chapter 12 of the direct final rule TSD.

DOE notes that the direct employment impacts discussed here are independent of the indirect employment impacts to the broader U.S. economy, which are documented in chapter 16 of the direct final rule TSD.

c. Impacts on Manufacturing Capacity

Based on feedback from domestic MREF manufacturers during confidential interviews and MREF Working Group meetings, DOE does not expect significant impacts on domestic manufacturing capacity for the industry as a whole to result from the standards for MREFs adopted in this direct final rule. However, at more stringent standard levels than those adopted in this direct final rule, disproportionate impacts experienced by domestic manufacturers could lead these manufacturers to abandon certain niche production lines.

Additionally, although DOE does not believe the standards adopted in this direct final rule will lead to a decrease in manufacturing capacity for the MREF industry as a whole, DOE recognizes that standards will likely lead to decreased manufacturing capacity for cooler products using non-vapor-compression cooling technologies.

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 disproportionately affected by new energy conservation standards for MREFs. Using average cost assumptions developed for an industry cash-flow estimate is adequate to assess differential impacts among manufacturer subgroups. For the MREF industry, DOE identified and evaluated the impact of new energy conservation standards on two subgroups: small businesses and domestic LVMs.

Small Businesses

The SBA defines a "small business" as having 1,250 employees or less for both NAICS 335222 ("Household Refrigeration and Home Freezer Manufacturing") and NAICS 333415 ("Air-Conditioning and Warm Air Heating Equipment and Commercial and Industrial Refrigeration Equipment Manufacturing"). Based on the SBA employee threshold of 1,250 employees, DOE identified two entities involved in the sale of MREF products in the United States that qualify as small businesses. One of these businesses is a manufacturer of MREF products. The other small business imports and rebrands MREFs for sale in the United States. For a discussion of the potential impacts on the small manufacturer subgroup, see section VI.B of this document and chapter 12 of the TSD.

Domestic, Low-Volume Manufacturers

In addition to the small businesses discussed previously, DOE identified three domestic LVMs of MREFs that could be disproportionately affected by a DOE energy conservation standard for MREFs. Unlike the larger, diversified manufacturers selling MREFs in the United States, these businesses are highly concentrated in specific market segments (refrigeration) and/or earn a greater proportion of their sales from products covered by this rulemaking. Additionally, although the LVMs do not qualify as small businesses according to the SBA criteria discussed above (i.e., employee count exceeds 1,250), these manufacturers are significantly smaller in terms of annual revenues than the larger, diversified manufacturers selling MREFs in the United States. Table V.30 lists the range of the product offerings and annual sales figures for the LVMs. Table V.31 contains the range of annual sales figures for some of the large, diversified manufacturers selling MREFs in the U.S. market. Table V.31 also contains the range of segment concentration for these larger manufacturers.

Table V.30 LVM 2014 Revenues and Product Offerings

Manufacturer Type	Annual Revenues (2015$ M)*	Product Offering
LVMs	216 - 1,600**	High-end, built-in or fully integrated residential refrigeration products (undercounter and standard), commercial refrigeration equipment, and cooking products.

* Annual sales values are from Hoovers: http://www.hoovers.com/
** This range reflects parent company revenues, where an LVM is owned by another company.

Table V.31 2014 Revenues and Segment Concentration for Large MREF Manufacturers

Manufacturer Type	Annual Revenues (2015$ M)*	Concentration in Segment Containing Residential Refrigeration Products
Larger, Diversified Manufacturers	11,400 - 150,000	5% - 76%

* Annual sales values are from Hoovers: http://www.hoovers.com/

Based on manufacturer feedback, DOE believes that the three LVMs, along with the small domestic manufacturer identified by DOE, are four of only five manufacturers producing MREFs domestically. In contrast, the entities with the greatest estimated overall market share in the U.S. MREF market rebrand coolers and combination cooler refrigeration products sourced from foreign original equipment manufacturers ("OEMs").

DOE has estimated that two of the LVMs and the small MREF manufacturer account for approximately 50 percent of built-in cooler basic models (both compact and full-size) that are currently available in the U.S. market. DOE estimates that the standard adopted in this direct final rule (70 percent of the CEC-Equivalent) will require the LVMs to update over 70 percent of their cooler models (overall, and for built-in coolers only).[71]

Additionally, two of the LVMs are the only manufacturers producing combination cooler refrigeration products domestically. Combined, these two LVMs account for 40 percent of combination cooler refrigeration product basic models that are currently available in the United States. One of these LVMs is the only company to manufacture a combination cooler refrigeration product classified as C-3A-BI. The other LVM produces a C-13A-BI combination cooler refrigeration product. Both products have rated energy consumptions at the standard level established in this direct final rule. Accordingly, both manufacturers would incur product and capital conversion expenses to

[71] This estimate is based on the LVM models for which energy use values are available.

reach standard efficiency levels beyond those adopted in this direct final rule for combination cooler refrigeration products.

Generally, manufacturers indicated during confidential interviews that the MREF products produced by the domestic LVMs are niche products and are more expensive to produce (and, therefore, have higher selling prices) than the majority of the MREFs sold in the United States. The LVMs generally utilize a two-tier distribution system for MREFs, unlike large-scale manufacturers that sell directly to large-volume retail outlets. (ASRAC Public Meeting, No. 85 at p. 144) Accordingly, the cost and markup structure of these two types of manufacturers are significantly different.

Manufacturers also expressed during confidential interviews that LVMs (along with the small manufacturer) typically pay higher prices for components because of lower purchasing volumes, while their large competitors likely receive volume purchasing discounts. Despite the fact that the MREF industry as a whole is a relatively low-volume industry, larger manufacturers, with a significantly larger proportion of their total sales derived from the sale of other products (non-MREF products), are able to purchase components in high quantities due to the similarities between MREFs and the other higher-volume products they sell (e.g., refrigerators and freezers). Alternatively, these larger manufacturers may produce their own components in-house.

LVMs may also be disproportionately affected by product and capital conversion costs. Product redesign, testing, and certification costs tend to be fixed per basic model and do not scale with sales volume. Both large manufacturers and LVMs must make investments in R&D to redesign their products, but LVMs lack the sales volumes to sufficiently recoup these upfront investments without substantially marking up their products' selling prices. Furthermore, the LVMs and major re-branders both offer similar numbers of MREF basic models. Up-front capital investments in new manufacturing for each platform redesign and any depreciated manufacturing capital would be spread across a lower volume of shipments for LVMs.

To this end, feedback from LVMs received during confidential interviews suggested that new energy conservation standards for MREFs could result in such a significant increase in their costs (both per-unit and upfront costs) that selling prices would increase beyond what consumers are willing to pay. This could cause the LVMs to discontinue certain model lines that, in turn, would negatively impact customer choice, competition, and domestic employment within the MREF industry.

Finally, the LVMs considered in this analysis have fewer resources to devote to the cumulative regulations impacting the appliance industry. According to manufacturer feedback received during confidential interviews, the LVMs will be particularly challenged in meeting amended energy conservation standards for commercial refrigeration equipment (with an estimated compliance date of 2017) and for residential refrigerators and freezers (with an estimated compliance date of 2020), in addition to the EPA Significant New Alternatives Policy Program (SNAP) program restrictions relating to foam blowing agents and any future restrictions relating to acceptable refrigerants for use in consumer refrigeration products. Table V.32 lists the impending DOE energy conservation standards that may have a significant impact on the MREF LVMs, the corresponding expected industry conversion costs (where available), and the LVM U.S. market share for the products being regulated.

Table V.32 Other Federal Energy Conservation Standards Affecting MREF LVMs

Regulation	Expected Effective Date(s)	Expected Total Industry Investment	LVM U.S. Market Share
Commercial Refrigeration Equipment	2017	$184 M (2012$)[72]	41% of commercial refrigerator market[73]
Refrigerators and Freezers	2020	TBD	75% of built-in under-counter refrigerator market; 5% of compact refrigerator market[74]

In summary, DOE recognizes that, depending on the TSL selected, new energy conservation standards may have disproportionate impacts on the LVMs relative to the larger, diversified competitors, and that this could impact domestic MREF production as well as the availability of certain MREF product types. In this industry, larger manufacturers may have a competitive advantage compared to the LVMs due to overall production volumes and the ability to procure components at a lower cost (either by purchasing component parts at a discount or producing components in-house).

[72] Estimated industry conversion expenses were published in the TSD for the March 2014 commercial refrigeration energy conservation standards final rule. 79 FR 17725 (March 28, 2014).
[73] 2008 market share estimates were published in the TSD for the March 2014 commercial refrigeration equipment energy conservation standards final rule. 79 FR 17725 (March 28, 2014). Estimates are from Appliance Magazine, which does not provide a precise definition of what a commercial refrigerator is. It is therefore unclear what specific types of equipment that data covers—whether it is equipment that is self-contained or remote condensing, or equipment with doors or without doors.
[74] 2007 market share estimates were published in the TSD for the September 2011 residential refrigerators, refrigerator-freezers, and freezers energy conservation standards final rule. 76 FR 57516 (Sept. 15, 2011).

e. Cumulative Regulatory Burden

One aspect of assessing manufacturer burden involves looking at the cumulative impact of multiple DOE standards and the regulatory actions of other Federal agencies and States that affect the manufacturers of a covered product or equipment. A standard level is not economically justified if it contributes to an unacceptable cumulative regulatory burden. While any one regulation may not impose a significant burden on manufacturers, the combined effects of several existing or impending regulations may have serious consequences for some manufacturers, groups of manufacturers, or an entire industry. Multiple regulations affecting the same manufacturer can strain profits and lead companies to abandon product lines or markets with lower expected future returns than competing products. For these reasons, DOE conducts an analysis of cumulative regulatory burden as part of its rulemakings pertaining to appliance efficiency.

DOE aims to recognize and seeks to mitigate the overlapping effects on manufacturers of new or revised DOE standards and other regulatory actions affecting the same products, components, and other equipment. DOE estimates that there are approximately 48 entities selling MREFs in the United States. Only approximately 16 of these entities are OEMs of MREF products. In addition to new energy conservation standards for MREFs, DOE identified a number of requirements that MREF manufacturers will face for products they manufacture approximately 3 years prior to and 3 years after the estimated compliance date of these new standards. The following section addresses key concerns that manufacturers raised during interviews regarding cumulative regulatory burden.

Table V.33 Other Federal Energy Conservation Standards Affecting MREF Manufacturers

Federal Energy Conservation Standard	Number of Manufacturers*	Number of MREF Manufacturers from This Rule**	Approx. Standards Year	Industry Conversion Costs (Millions $)	Industry Conversion Costs / Revenue***
Microwave Ovens 78 FR 36316 (June 17, 2013)	12	2	2016	43.1 (2011$)	< 1%
Commercial Refrigeration Equipment 79 FR 17725 (March 28, 2014)	54	3	2017	184 (2012$)	2.0%
Commercial Clothes Washers 79 FR 74492 (December 15, 2014)	6	1	2018	10.2 (2013$)	2.2%
Residential Clothes Washers 77 FR 32308 (May 31, 2012)	16	3	2018	418.5 (2010$)†	4.8%
Residential Dehumidifiers 81 FR 38338 (June 13, 2016)	24	1	2019	52.5 (2014$)	4.5%
Residential Kitchen Ranges and Ovens†† 80 FR 33030 (June 10, 2015)	20	5	2019	109.9 (2014$)	1.1%
Residential Boilers 81 FR 2320 (January 15, 2016)	27	1	2021	2.48 (2014$)	< 1%

*This column presents the total number of manufacturers identified in the energy conservation standard rule contributing to cumulative regulatory burden.
**This column presents the number of manufacturers producing MREFs that are also listed as manufacturers in the listed energy conservation standard contributing to cumulative regulatory burden.
***This column presents conversion costs as a percentage of cumulative revenue for the industry during the conversion period. The conversion period is the timeframe over which manufacturers must make conversion costs investments and lasts from the announcement year of the final rule to the standards year of the final rule. This period typically ranges from 3 to 5 years, depending on the energy conservation standard.
†Energy conservation standards for residential clothes washers (77 FR 32308) are tiered, with standards years of 2015 and 2018. The conversion costs presented are for both the 2015 and 2018 standards.
††The final rule for this energy conservation standard has not been published. The compliance date and analysis of conversion costs have not been finalized at this time. Values in this row are estimates for the standard level proposed in the NOPR.

In addition to Federal energy conservation standards, DOE identified other Federal-level and state-level regulatory burdens and third-party standard programs that would affect MREF manufacturers. For more details, see chapter 12 of the direct final rule TSD.

DOE will evaluate its approach to assessing cumulative regulatory burden for use in future rulemakings to ensure that it is effectively capturing the overlapping impacts of its regulations. In particular, DOE will assess whether looking at rules where any portion of the compliance period potentially overlaps with the compliance period for the subject rulemaking would yield a more accurate reflection of cumulative regulatory burdens.

3. National Impact Analysis

a. Significance of Energy Savings

To estimate the energy savings attributable to potential standards for MREFs, DOE compared the energy consumption of those products under the no-new-standards case to their anticipated energy consumption under each TSL. The savings are measured over the entire lifetime of products purchased in the 30-year period that begins in the year of anticipated compliance with new standards (2019-2048 for the TSLs that represent the MREF Working Group recommendations and 2021-2050 for other TSLs). Table V.34 and Table V.35 present DOE's projections of the national energy savings for each TSL considered for coolers and combination cooler refrigeration products, respectively. The savings were calculated using the approach described in section IV.H of this document.

Table V.34 Cumulative National Energy Savings for Coolers

	Trial Standard Level*			
	1	2	3	4
	Quads			
Primary energy	1.08	1.44	1.76	1.93
FFC energy	1.13	1.51	1.84	2.02

* For TSL 2, the results are forecasted over the lifetime of products sold from 2019-2048. For the other TSLs, the results are forecasted over the lifetime of products sold from 2021-2050.

Table V.35 Cumulative National Energy Savings for Combination Cooler Refrigeration Products

	Trial Standard Level*			
	1	2	3	4
	Quads			
Primary energy	0.000802	0.00705	0.0117	0.0153
FFC energy	0.000838	0.00737	0.0123	0.0160

* For TSL 1, the results are forecasted over the lifetime of products sold from 2019-2048. For the other TSLs, the results are forecasted over the lifetime of products sold from 2021-2050.

OMB Circular A-4[75] 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 nine, rather than 30, years of product shipments. The choice of a 9-year period is a proxy for the timeline in EPCA for the review of certain energy conservation standards and potential revision of and compliance with such revised standards.[76] The review timeframe established in EPCA is generally not

[75] U.S. Office of Management and Budget, "Circular A-4: Regulatory Analysis" (Sept. 17, 2003) (Available at: http://www.whitehouse.gov/omb/circulars_a004_a-4/).
[76] Section 325(m) of 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. 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

synchronized with the product lifetime, product manufacturing cycles, or other factors specific to MREFs. Thus, such results are presented for informational purposes only and are not indicative of any change in DOE's analytical methodology. The NES sensitivity analysis results for coolers and combination cooler refrigeration products based on a 9-year analytical period are presented in Table V.36 and Table V.37 respectively.

Table V.36 Cumulative National Energy Savings for Coolers; Nine Years of Shipments

	Trial Standard Level*			
	1	**2**	**3**	**4**
	Quads			
Primary energy	0.294	0.389	0.479	0.513
FFC energy	0.307	0.407	0.500	0.537

* For TSL 2, the results are forecasted over the lifetime of products sold from 2019-2027. For the other TSLs, the results are forecasted over the lifetime of products sold from 2021-2029.

Table V.37 Cumulative National Energy Savings for Combination Cooler Refrigeration Products; Nine Years of Shipments

	Trial Standard Level*			
	1	**2**	**3**	**4**
	Quads			
Primary energy	0.000216	0.00191	0.00317	0.00414
FFC energy	0.000226	0.00200	0.00331	0.00432

* For TSL 1, the results are forecasted over the lifetime of products sold from 2019-2027. For the other TSLs, the results are forecasted over the lifetime of products sold from 2021-2029.

b. Net Present Value of Consumer Costs and Benefits

DOE estimated the cumulative NPV of the total costs and savings for consumers that would result from the TSLs considered for MREFs. In accordance with OMB's

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.

guidelines on regulatory analysis,[77] DOE calculated NPV using both a 7-percent and a 3-percent real discount rate. Table V.38 and Table V.39 show the consumer NPV results with impacts counted over the lifetime of products purchased in the relevant analysis period for each TSL.

Table V.38 Cumulative Net Present Value of Consumer Benefits for Coolers

Discount rate	Trial Standard Level*			
	1	2	3	4
	Billion 2015$			
3 percent	8.34	11.02	12.19	6.83
7 percent	3.41	4.78	4.81	1.81

* For TSL 2, the results are forecasted over the lifetime of products sold from 2019-2048. For the other TSLs, the results are forecasted over the lifetime of products sold from 2021-2050.

Table V.39 Cumulative Net Present Value of Consumer Benefits for Combination Cooler Refrigeration Products

Discount rate	Trial Standard Level*			
	1	2	3	4
	Billion 2015$			
3 percent	0.00447	0.0347	(0.0575)	(0.142)
7 percent	0.00172	0.0110	(0.0422)	(0.0904)

* For TSL 1, the results are forecasted over the lifetime of products sold from 2019-2048. For the other TSLs, the results are forecasted over the lifetime of products sold from 2021-2050.

The NPV results based on the aforementioned 9-year analytical period are presented in Table V.40 and Table V.41. As mentioned previously, such results are presented for informational purposes only and are not indicative of any change in DOE's analytical methodology or decision criteria.

[77] U.S. Office of Management and Budget, "Circular A-4: Regulatory Analysis," section E, (Sept. 17, 2003) (Available at: http://www.whitehouse.gov/omb/circulars_a004_a-4/).

Table V.40 Cumulative Net Present Value of Consumer Benefits for Coolers; Nine Years of Shipments

Discount rate	Trial Standard Level*			
	1	2	3	4
	Billion 2015$			
3 percent	2.73	3.60	3.97	2.02
7 percent	1.48	2.06	2.07	0.68

* For TSL 2, the results are forecasted over the lifetime of products sold from 2019-2027. For the other TSLs, the results are forecasted over the lifetime of products sold from 2021-2029.

Table V.41 Cumulative Net Present Value of Consumer Benefits for Combination Cooler Refrigeration Products; Nine Years of Shipments

Discount rate	Trial Standard Level*			
	1	2	3	4
	Billion 2015$			
3 percent	0.00142	0.0110	-0.0218	-0.0516
7 percent	0.000719	0.00456	-0.0199	-0.0420

* For TSL 1, the results are forecasted over the lifetime of products sold from 2019-2027. For the other TSLs, the results are forecasted over the lifetime of products sold from 2021-2029.

The above results reflect the use of a constant default trend to estimate the change in price for MREFs over the analysis period (see section IV.H.3 of this document). DOE also conducted a sensitivity analysis that considered one scenario with low price decline and one scenario with high price decline. The results of these alternative cases are presented in appendix 10C of the direct final rule TSD.

c. Indirect Impacts on Employment

DOE expects energy conservation standards for MREFs to reduce energy bills for consumers of those products, with the resulting net savings being redirected to other forms of economic activity. These expected shifts in spending and economic activity could affect the demand for labor. 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. DOE understands that there are uncertainties involved in projecting employment impacts, especially changes in the later years of the analysis. Therefore, DOE generated results within five years of the compliance date, where these uncertainties are reduced.

The results suggest that the adopted standards are likely to have a negligible impact on the net demand for labor in the economy. 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 direct final rule TSD presents detailed results regarding anticipated indirect employment impacts.

4. Impact on Utility or Performance of Products

As discussed in section IV.A.2.a of this document and chapter 3 of the direct final rule TSD, DOE has concluded that the standards adopted in this direct final rule would not reduce the utility or performance of the MREFs under consideration in this rulemaking. Manufacturers of these products currently offer units that meet or exceed the adopted standards.

5. Impact of Any Lessening of Competition

As discussed in section III.H.1.e of this document, the Attorney General of the United States (Attorney General) determines the impact, if any, of any lessening of competition likely to result from a proposed standard and transmits such determination in writing to the Secretary, together with an analysis of the nature and extent of the impact. DOE published a proposed rule containing energy conservation standards identical to those set forth in this direct final rule and transmitted a copy of this direct final rule and the accompanying TSD to the Attorney General, requesting that DOJ provide its determination on this issue. DOE will consider DOJ's comments on the rule in determining whether to proceed with the direct final rule. DOE will also publish and respond to DOJ's comments in the Federal Register in a separate document.

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 direct 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 standards for MREFs is expected to yield environmental benefits in the form of reduced emissions of air pollutants and greenhouse gases. Table V.42 and Table V.43 provide DOE's estimate of cumulative emissions reductions expected to result from the TSLs considered in this rulemaking. The tables include both power sector emissions and upstream emissions. The emissions were calculated using the multipliers discussed in section IV.K of this document. DOE reports annual emissions reductions for each TSL in chapter 13 of the direct final rule TSD. The energy conservation standards being adopted by this direct final rule are economically justified under EPCA with regard to the added benefits achieved through reduced emissions of air pollutants and greenhouse gases.

Table V.42 Cumulative Emissions Reduction for Coolers

	Trial Standard Level*			
	1	2	3	4
Power Sector Emissions				
CO_2 (million metric tons)	64.3	87.0	104.7	114.9
SO_2 (thousand tons)	38.7	53.1	63.0	69.1
NO_X (thousand tons)	70.7	95.1	115.1	126.3
Hg (tons)	0.1	0.2	0.2	0.3
CH_4 (thousand tons)	5.6	7.6	9.0	9.9
N_2O (thousand tons)	0.8	1.1	1.3	1.4
Upstream Emissions				
CO_2 (million metric tons)	3.6	4.8	5.9	6.4
SO_2 (thousand tons)	0.7	0.9	1.1	1.2
NO_X (thousand tons)	51.7	68.7	84.2	92.5
Hg (tons)	0.0	0.0	0.0	0.0
CH_4 (thousand tons)	285.6	379.5	465.3	510.9
N_2O (thousand tons)	0.0	0.0	0.1	0.1
Total FFC Emissions				
CO_2 (million metric tons)	67.9	91.8	110.6	121.3
SO_2 (thousand tons)	39.4	54.0	64.1	70.3
NO_X (thousand tons)	122.4	163.9	199.4	218.8
Hg (tons)	0.1	0.2	0.2	0.3
CH_4 (thousand tons)	291.1	387.1	474.3	520.9
CH_4 (thousand tons CO_2eq) **	8151.8	10839.3	13281.4	14583.8
N_2O (thousand tons)	0.8	1.1	1.3	1.5
N_2O (thousand tons CO_2eq) **	217.0	296.9	353.4	387.2

* For TSL 2, the results are forecasted over the lifetime of products sold from 2019-2048. For the other TSLs, the results are forecasted over the lifetime of products sold from 2021-2050.
** CO_2eq is the quantity of CO_2 that would have the same global warming potential (GWP).

Table V.43 Cumulative Emissions Reduction for Combination Cooler Refrigeration Products

	Trial Standard Level*			
	1	2	3	4
Power Sector Emissions				
CO_2 (million metric tons)	0.0483	0.4173	0.6941	0.9075
SO_2 (thousand tons)	0.0295	0.2501	0.4163	0.5440
NO_X (thousand tons)	0.0528	0.4595	0.7640	0.9991
Hg (tons)	0.0001	0.0009	0.0015	0.0020
CH_4 (thousand tons)	0.0042	0.0359	0.0597	0.0781
N_2O (thousand tons)	0.0006	0.0051	0.0085	0.0110
Upstream Emissions				
CO_2 (million metric tons)	0.0027	0.0235	0.0391	0.0512
SO_2 (thousand tons)	0.0005	0.0043	0.0072	0.0095
NO_X (thousand tons)	0.0382	0.3377	0.5610	0.7341
Hg (tons)	0.000001	0.000009	0.000016	0.000021
CH_4 (thousand tons)	0.2107	1.8657	3.0996	4.0559
N_2O (thousand tons)	0.00002	0.0002	0.0004	0.0005
Total FFC Emissions				
CO_2 (million metric tons)	0.051	0.441	0.733	0.959
SO_2 (thousand tons)	0.030	0.254	0.423	0.553
NO_X (thousand tons)	0.091	0.797	1.325	1.733
Hg (tons)	0.0001	0.001	0.002	0.002
CH_4 (thousand tons)	0.215	1.902	3.159	4.134
CH_4 (thousand tons CO_2eq) **	6.02	53.24	88.46	115.75
N_2O (thousand tons)	0.001	0.005	0.009	0.012
N_2O (thousand tons CO_2eq) **	0.165	1.403	2.335	3.052

* For TSL 1, the results are forecasted over the lifetime of products sold from 2019-2048. For the other TSLs, the results are forecasted over the lifetime of products sold from 2021-2050.
** CO_2eq is the quantity of CO_2 that would have the same global warming potential (GWP).

As part of the analysis for this rule, DOE estimated monetary benefits likely to result from the reduced emissions of CO_2 and NO_X that DOE estimated for each of the considered TSLs for MREFs. As discussed in section IV.L of this document, for CO_2, DOE used the most recent values for the SCC developed by an interagency process. The four sets of SCC values for CO_2 emissions reductions in 2015 resulting from that process (expressed in 2015$) are represented by $12.4/metric ton (the average value from a distribution that uses a 5-percent discount rate), $40.6/metric ton (the average value from a distribution that uses a 3-percent discount rate), $63.2/metric ton (the average value from a distribution that uses a 2.5-percent discount rate), and $118/metric ton (the 95th-percentile value from a distribution that uses a 3-percent discount rate). The values for later years are higher due to increasing damages (public health, economic and environmental) as the projected magnitude of climate change increases.

Table V.44 and Table V.45 present the global value of CO_2 emissions reductions at each TSL. For each of the four cases, DOE calculated a present value of the stream of annual values using the same discount rate as was used in the studies upon which the dollar-per-ton values are based. DOE calculated domestic values as a range from 7 percent to 23 percent of the global values; these results are presented in chapter 14 of the direct final rule TSD.

Table V.44 Estimates of Global Present Value of CO_2 Emissions Reduction for Coolers

TSL**	SCC Case*			
	5% discount rate, average	3% discount rate, average	2.5% discount rate, average	3% discount rate, 95th percentile
	Million 2015$			
Power Sector Emissions				
1	453	2073	3292	6321
2	644	2886	4561	8787
3	737	3373	5358	10285
4	805	3691	5865	11255
Upstream Emissions				
1	25	115	183	351
2	35	157	249	480
3	41	187	298	572
4	44	205	327	627
Total FFC Emissions				
1	478	2189	3476	6673
2	679	3044	4810	9266
3	777	3561	5656	10856
4	849	3897	6192	11882

* For each of the four cases, the corresponding SCC value for emissions in 2015 is $12.4, $40.6, $63.2, and $118 per metric ton (2015$). The values are for CO_2 only (i.e., not CO_{2eq} of other greenhouse gases).

** For TSL 2, the results are forecasted over the lifetime of products sold from 2019-2048. For the other TSLs, the results are forecasted over the lifetime of products sold from 2021-2050.

Table V.45 Estimates of Global Present Value of CO_2 Emissions Reduction for Combination Cooler Refrigeration Products

TSL**	SCC Case*			
	5% discount rate, average	3% discount rate, average	2.5% discount rate, average	3% discount rate, 95th percentile
	Million 2015$			
Power Sector Emissions				
1	0.36	1.60	2.54	4.89
2	2.84	13.15	20.95	40.08
3	4.75	21.96	34.97	66.95
4	6.18	28.64	45.63	87.31
Upstream Emissions				
1	0.02	0.09	0.14	0.27
2	0.16	0.74	1.17	2.24
3	0.26	1.23	1.96	3.74
4	0.34	1.60	2.55	4.88
Total FFC Emissions				
1	0.38	1.69	2.67	5.15
2	2.99	13.88	22.13	42.32
3	5.01	23.19	36.93	70.69
4	6.53	30.24	48.18	92.19

* For each of the four cases, the corresponding SCC value for emissions in 2015 is $12.4, $40.6, $63.2, and $118 per metric ton (2015$). The values are for CO_2 only (i.e., not CO_{2eq} of other greenhouse gases).

** For TSL 1, the results are forecasted over the lifetime of products sold from 2019-2048. For the other TSLs, the results are forecasted over the lifetime of products sold from 2021-2050.

DOE is well aware that scientific and economic knowledge about the contribution of CO_2 and other GHG emissions to changes in the future global climate and the potential resulting damages to the world economy continues to evolve rapidly. Thus, any value placed on reduced CO_2 emissions in this rulemaking is subject to change. DOE, together with other Federal agencies, will continue to review various methodologies for estimating the monetary value of reductions in CO_2 and other GHG emissions. This ongoing review will consider the comments on this subject that are part of the public record for this and other rulemakings, as well as other methodological assumptions and issues. However, consistent with DOE's legal obligations, and taking into account the uncertainty involved with this particular issue, DOE has included in this rule the most recent values and analyses resulting from the interagency review process.

DOE also estimated the cumulative monetary value of the economic benefits associated with NO_X emissions reductions anticipated to result from the considered TSLs for MREFs. The dollar-per-ton value that DOE used is discussed in section IV.L of this document. Table V.46 and Table V.47 present the cumulative present values for NO_X emissions for each TSL, for coolers and combination cooler refrigeration products respectively, calculated using 7-percent and 3-percent discount rates.

Table V.46 Estimates of Present Value of NO_X Emissions Reduction for Coolers

TSL*	3% discount rate	7% discount rate
	Million 2015$	
Power Sector Emissions		
1	133.86	54.53
2	191.46	84.35
3	217.63	88.51
4	237.63	96.02
Upstream Emissions		
1	95.75	38.02
2	134.60	57.52
3	155.70	61.73
4	170.25	67.08
Total FFC Emissions		
1	229.60	92.55
2	326.06	141.86
3	373.33	150.23
4	407.87	163.10

* For TSL 2, the results are forecasted over the lifetime of products sold from 2019-2048. For the other TSLs, the results are forecasted over the lifetime of products sold from 2021-2050.

Table V.47 Estimates of Present Value of NO_X Emissions Reduction for Combination Cooler Refrigeration Products

TSL*	3% discount rate	7% discount rate
	Million 2015$	
Power Sector Emissions		
1	0.11	0.05
2	0.84	0.33
3	1.40	0.55
4	1.82	0.72
Upstream Emissions		
1	0.07	0.03
2	0.60	0.23
3	1.01	0.39
4	1.31	0.50
Total FFC Emissions		
1	0.18	0.08
2	1.44	0.56
3	2.40	0.94
4	3.13	1.22

* For TSL 1, the results are forecasted over the lifetime of products sold from 2019-2048. For the other TSLs, the results are forecasted over the lifetime of products sold from 2021-2050.

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)) In developing the direct final rule, DOE has considered the submission of the jointly-submitted Term Sheet #2 from the MREF Working Group and approved by ASRAC. In DOE's view, Term Sheet #2 sets forth a statement by interested persons that are fairly representative of relevant points of view (including representatives of manufacturers of covered equipment, States, and efficiency advocates) and contains recommendations with respect to energy conservation standards that are in accordance with 42 U.S.C. 6295(o), as required by EPCA's direct final rule provision.

See 42 U.S.C. 6295(p)(4). DOE has encouraged the submission of agreements such as the one developed and submitted by the MREF Working Group as a way to bring diverse stakeholders together, to develop an independent and probative analysis useful in DOE standard setting, and to expedite the rulemaking process. DOE also believes that standard levels recommended in Term Sheet #2 may increase the likelihood for regulatory compliance, while decreasing the risk of litigation.

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 consumer savings calculated for each TSL considered in this rulemaking. Table V.48 and Table V.49 present the NPV value that results from adding the estimates of the potential economic benefits resulting from reduced CO_2 and NO_X emissions in each of four valuation scenarios to the NPV of consumer savings calculated for each TSL considered in this rulemaking for coolers and combination cooler refrigeration products, 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.48 Net Present Value of Consumer Savings Combined with Present Value of Monetized Benefits from CO_2 and NO_X Emissions Reductions for Coolers

TSL*	Consumer NPV at 3% Discount Rate added with:			
	SCC Case $12.4/ metric ton and 3% NO_X Value	SCC Case $40.6/ metric ton and 3% NO_X Value	SCC Case $63.2/ metric ton and 3% NO_X Value	SCC Case $118/ metric ton and 3% NO_X Value
	Billion 2015$			
1	9.0	10.8	12.0	15.2
2	12.0	14.4	16.2	20.6
3	13.3	16.1	18.2	23.4
4	8.1	11.1	13.4	19.1
TSL*	**Consumer NPV at 7% Discount Rate added with:**			
	SCC Case $12.4/ metric ton and 7% NO_X Value	SCC Case $40.6/ metric ton and 7% NO_X Value	SCC Case $63.2/ metric ton and 7% NO_X Value	SCC Case $118/ metric ton and 7% NO_X Value
	Billion 2015$			
1	4.0	5.7	7.0	10.2
2	5.6	8.0	9.7	14.2
3	5.7	8.5	10.6	15.8
4	2.8	5.9	8.2	13.9

* For TSL 2, the results are forecasted over the lifetime of products sold from 2019-2048. For the other TSLs, the results are forecasted over the lifetime of products sold from 2021-2050.

Table V.49 Net Present Value of Consumer Savings Combined with Present Value of Monetized Benefits from CO_2 and NO_X Emissions Reductions for Combination Cooler Refrigeration Products

TSL	Consumer NPV at 3% Discount Rate added with:			
	SCC Case \$12.4/ metric ton and 3% NO_X Value	SCC Case \$40.6/ metric ton and 3% NO_X Value	SCC Case \$63.2/ metric ton and 3% NO_X Value	SCC Case \$118/ metric ton and 3% NO_X Value
	Billion 2015\$			
1	0.005	0.006	0.007	0.010
2	0.039	0.050	0.058	0.078
3	(0.050)	(0.032)	(0.018)	0.016
4	(0.132)	(0.108)	(0.090)	(0.046)
TSL	Consumer NPV at 7% Discount Rate added with:			
	SCC Case \$12.4/ metric ton and 7% NO_X Value	SCC Case \$40.6/ metric ton and 7% NO_X Value	SCC Case \$63.2/ metric ton and 7% NO_X Value	SCC Case \$118/ metric ton and 7% NO_X Value
	Billion 2015\$			
1	0.002	0.003	0.004	0.007
2	0.015	0.025	0.034	0.054
3	(0.036)	(0.018)	(0.004)	0.029
4	(0.083)	(0.059)	(0.041)	0.003

Parentheses indicate negative (-) values.
* For TSL 1, the results are forecasted over the lifetime of products sold from 2019-2048. For the other TSLs, the results are forecasted over the lifetime of products sold from 2021-2050.

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 products shipped in the applicable analysis period.

Because CO_2 emissions have a very long residence time in the atmosphere,[78] the SCC values in future years reflect future climate-related impacts that continue beyond 2100.

9. Conclusion

When considering standards, the new or amended energy conservation standards that DOE adopts for any type (or class) of covered product must be designed to achieve the maximum improvement in energy efficiency that the Secretary determines is technologically feasible and economically justified. (42 U.S.C. 6295(o)(2)(A)) 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))

For this direct final rule, DOE considered the impacts of new standards for MREFs 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.

[78] 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,'" 110 J. Geophys. Res. D14105 (2005).

To aid the reader as DOE discusses the benefits and/or burdens of each TSL, tables in this section present a summary of the results of DOE's quantitative analysis for each TSL. In addition to the quantitative results presented in the tables, DOE also considers other burdens and benefits that affect economic justification.

DOE also notes that the economics literature provides a wide-ranging discussion of how consumers trade off upfront costs and energy savings in the absence of government intervention. Much of this literature attempts to explain why consumers appear to undervalue energy efficiency improvements. There is evidence that consumers undervalue future energy savings as a result of: (1) a lack of information; (2) a lack of sufficient salience of the long-term or aggregate benefits; (3) a lack of sufficient savings to warrant delaying or altering purchases; (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 (for example, between renters and owners, or builders and purchasers). Having less than perfect foresight and a high degree of uncertainty about the future, consumers may trade off these types of investments at a higher than expected rate between current consumption and uncertain future energy cost savings.

In DOE's current regulatory analysis, potential changes in the benefits and costs of a regulation due to changes in consumer purchase decisions are included in two ways. First, if consumers forego the purchase of a product in the standards case, this decreases sales for product manufacturers, and the impact on manufacturers attributed to lost revenue is included in the MIA. Second, DOE accounts for energy savings attributable only to products actually used by consumers in the standards case; if a regulatory option decreases the number of products purchased by consumers, this decreases the potential energy savings from an energy conservation standard. DOE provides estimates of shipments and changes in the volume of product purchases in chapter 9 of the direct final rule TSD. However, DOE's current analysis does not explicitly control for heterogeneity in consumer preferences, preferences across subcategories of products or specific features, or consumer price sensitivity variation according to household income.[79]

While DOE is not prepared at present to provide a fuller quantifiable framework for estimating the benefits and costs of changes in consumer purchase decisions due to an energy conservation standard, DOE is committed to developing a framework that can support empirical quantitative tools for improved assessment of the consumer welfare impacts of appliance standards. DOE has posted a paper that discusses the issue of consumer welfare impacts of appliance energy conservation standards, and potential enhancements to the methodology by which these impacts are defined and estimated in the regulatory process.[80] DOE welcomes comments on how to more fully assess the potential impact of energy conservation standards on consumer choice and how to quantify this impact in its regulatory analysis in future rulemakings.

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[79] P.C. Reiss and M.W. White, Household Electricity Demand, Revisited, Review of Economic Studies (2005) 72, 853–883.

[80] Alan Sanstad, Notes on the Economics of Household Energy Consumption and Technology Choice. Lawrence Berkeley National Laboratory (2010) (Available online at: http://www1.eere.energy.gov/buildings/appliance_standards/pdfs/consumer_ee_theory.pdf).

a. Benefits and Burdens of TSLs Considered for Coolers

Table V.50 and Table V.51 summarize the quantitative impacts estimated for each TSL for coolers. The national impacts are measured over the lifetime of coolers purchased in the 30-year period that begins in the anticipated year of compliance with new standards (2019–2048 for TSL 2, and 2021–2050 for the other TSLs). The energy savings, emissions reductions, and value of emissions reductions refer to full-fuel-cycle results. The efficiency levels contained in each TSL are described in section V.A of this document.

Table V.50 Summary of Analytical Results for Coolers: National Impacts

Category	TSL 1*	TSL 2*	TSL 3*	TSL 4*
Cumulative FFC National Energy Savings (quads)				
Quads	1.13	1.51	1.84	2.02
NPV of Consumer Costs and Benefits (2015$ billion)				
3% discount rate	8.34	11.02	12.19	6.83
7% discount rate	3.41	4.78	4.81	1.81
Cumulative FFC Emissions Reduction (Total FFC Emissions)				
CO_2 (million metric tons)	67.91	91.76	110.61	121.30
SO_2 (thousand tons)	39.38	54.04	64.13	70.26
NO_X (thousand tons)	122.38	163.86	199.36	218.79
Hg (tons)	0.15	0.20	0.24	0.26
CH_4 (thousand tons)	291.14	387.12	474.33	520.85
CH_4 (thousand tons CO_2eq)**	8151.79	10839.31	13281.37	14583.83
N_2O (thousand tons)	0.82	1.12	1.33	1.46
N_2O (thousand tons CO_2eq)**	217.02	296.92	353.41	387.24
Value of Emissions Reduction (Total FFC Emissions)				
CO_2 (2015$ billion) †	0.478 to 6.673	0.679 to 9.266	0.777 to 10.856	0.849 to 11.882
NO_X – 3% discount rate (2015$ million)	229.6 to 523.5	326.1 to 743.4	373.3 to 851.2	407.9 to 929.9
NO_X – 7% discount rate (2015$ million)	92.5 to 208.7	141.9 to 319.9	150.2 to 338.7	163.1 to 367.8

Parentheses indicate negative (-) values.
* For TSL 2, the results are forecasted over the lifetime of products sold from 2019–2048. For the other TSLs, the results are forecasted over the lifetime of products sold from 2021–2050.
** 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.51 Summary of Analytical Results for Coolers: Manufacturer and Consumer Impacts

Category	TSL 1*	TSL 2*	TSL 3*	TSL 4*
Manufacturer Impacts				
Industry NPV (2015$ million) (No-new-standards case INPV = 263.3)	244.3 to 264.0	208.5 to 253.3	168.4 to 226.5	110.5 to 283.8
Industry NPV (% change)	-7.2 to 0.3	-20.8 to -3.8	-36.0 to -14.0	-58.0 to 7.8
Consumer Average LCC Savings (2015$)				
Freestanding Compact Coolers	279	265	288	123
Built-in Compact Coolers	n.a.**	28	60	(230)
Freestanding Coolers	648	153	240	(121)
Built-in Coolers	n.a.	77	187	(254)
Consumer Simple PBP (years)				
Freestanding Compact Coolers	1.1	1.4	1.6	3.5
Built-in Compact Coolers	n.a.	4.6	4.4	14.8
Freestanding Coolers	1.0	1.8	1.8	4.8
Built-in Coolers	n.a.	6.1	4.7	17.7
% of Consumers that Experience Net Cost				
Freestanding Compact Coolers	6	9	12	51
Built-in Compact Coolers	0	29	27	93
Freestanding Coolers	0	22	9	78
Built-in Coolers	0	22	7	86

Parentheses indicate negative (-) values.
* For TSL 2, the results are forecasted over the lifetime of products sold from 2019–2048. For the other TSLs, the results are forecasted over the lifetime of products sold from 2021–2050.
** Calculation of savings and PBP is not applicable (n.a.) for an efficiency level that is already met or exceeded in the MREF market.

DOE first considered TSL 4, which represents the max-tech efficiency levels. TSL 4 would save 2.02 quads of energy, an amount DOE considers significant. Under TSL 4, the NPV of consumer benefit would be $1.81 billion using a discount rate of 7 percent, and $6.83 billion using a discount rate of 3 percent.

The cumulative emissions reductions at TSL 4 are 121.3 Mt of CO_2, 70.3 thousand tons of SO_2, 218.8 thousand tons of NO_X, 0.26 ton of Hg, 520.9 thousand tons of CH_4, and 1.5 thousand tons of N_2O. The estimated monetary value of the CO_2 emissions reduction at TSL 4 ranges from $849 million to $11,882 million.

At TSL 4, the average LCC savings range from -$254 to $123. The simple payback period ranges from 3.5 years to 17.7 years. The fraction of consumers experiencing a net LCC cost ranges from 51 percent to 93 percent.

At TSL 4, the projected change in INPV ranges from a decrease of $152.8 million to an increase of $20.5 million, which correspond to a decrease of 58.0 percent to an increase of 7.8 percent, respectively. Manufacturer feedback during confidential interviews indicated that all cooler segments are highly price sensitive, and therefore the lower bound of INPV impacts is more likely to occur. Additionally, at TSL 4, disproportionate impacts on the LVMs may be severe. This could have a direct impact on domestic manufacturing capacity and production employment in the cooler industry.

The Secretary concludes that at TSL 4 for coolers, the benefits of energy savings, positive NPV of consumer benefits, emission reductions, and the estimated monetary value of the emissions reductions would be outweighed by the economic burden on some consumers, and the impacts on manufacturers, including the conversion costs and profit margin impacts that could result in a large reduction in INPV. Consequently, the Secretary has concluded that TSL 4 is not economically justified.

DOE then considered TSL 3, which would save an estimated 1.84 quads of energy, an amount DOE considers significant. Under TSL 3, the NPV of consumer benefit would be $4.81 billion using a discount rate of 7 percent, and $12.19 billion using a discount rate of 3 percent.

The cumulative emissions reductions at TSL 3 are 110.6 Mt of CO_2, 64.1 thousand tons of SO_2, 199.4 thousand tons of NO_X, 0.24 tons of Hg, 474.3 thousand tons of CH_4, and 1.33 thousand tons of N_2O. The estimated monetary value of the CO_2 emissions reduction at TSL 3 ranges from $777 million to $10,856 million.

At TSL 3, the average LCC savings range from $60 to $288. The simple payback period ranges from 1.6 years to 4.7 years. The fraction of consumers experiencing a net LCC cost ranges from 7 percent to 27 percent.

At TSL 3, the projected change in INPV ranges from a decrease of $94.8 million to a decrease of $36.8 million, which correspond to decreases of 36.0 percent and 14.0 percent, respectively. Manufacturer feedback from confidential interviews indicated that all cooler segments are highly price sensitive, and therefore the lower bound of INPV impacts is more likely to occur. Again, at TSL 3, disproportionate impacts on the LVMs may be severe. This could have a direct impact on domestic manufacturing capacity and production employment in the cooler industry.

The Secretary concludes that at TSL 3 for coolers, the benefits of energy savings, positive NPV of consumer benefits, emission reductions, and the estimated monetary value of the emissions reductions would be outweighed by the impacts on manufacturers, including the conversion costs and profit margin impacts that could result in a large reduction in INPV. Consequently, the Secretary has concluded that TSL 3 is not economically justified.

DOE then considered TSL 2, which reflects the standard levels recommended by the MREF Working Group. TSL 2 would save an estimated 1.51 quads of energy, an amount DOE considers significant. Under TSL 2, the NPV of consumer benefit would be $4.78 billion using a discount rate of 7 percent, and $11.02 billion using a discount rate of 3 percent.

The cumulative emissions reductions at TSL 2 are 91.8 Mt of CO_2, 54.0 thousand tons of SO_2, 163.9 thousand tons of NO_X, 0.20 tons of Hg, 387.1 thousand tons of CH_4, and 1.12 thousand tons of N_2O. The estimated monetary value of the CO_2 emissions reduction at TSL 2 ranges from $679 million to $9,266 million.

At TSL 2, the average LCC savings range from $28 to $265. The simple payback period ranges from 1.4 years to 6.1 years. The fraction of consumers experiencing a net LCC cost ranges from 9 percent to 29 percent.

At TSL 2, the projected change in INPV ranges from a decrease of $54.8 million to a decrease of $10.0 million, which represent decreases of 20.8 percent and 3.8 percent, respectively. Feedback from the LVMs indicated that TSL 2 would not impede their ability to maintain their current MREF product offerings.

After considering the analysis and weighing the benefits and burdens, DOE has determined that the recommended standards for coolers are in accordance with 42 U.S.C. 6295(o). Specifically, the Secretary has determined the benefits of energy savings, positive NPV of consumer benefits, emission reductions, the estimated monetary value of the emissions reductions, and positive average LCC savings would outweigh the negative impacts on some consumers and on manufacturers, including the conversion costs that could result in a reduction in INPV for manufacturers. Accordingly, the Secretary has concluded that TSL 2 would offer the maximum improvement in efficiency that is technologically feasible and economically justified, and would result in the significant conservation of energy.

Under the authority provided by 42 U.S.C. 6295(p)(4), DOE is issuing this direct final rule that establishes new energy conservation standards for coolers at TSL 2. The new energy conservation standards for coolers, which are expressed as maximum annual energy use, in kWh/yr, as a function of AV, in ft^3, are shown in Table V.52.

Table V.52 New Energy Conservation Standards for Coolers

Product Class	**Maximum Allowable AEU** (kWh/yr)
Built-in Compact	$7.88AV^{\dagger} + 155.8$
Built-in	
Freestanding Compact	
Freestanding	

† AV = Adjusted volume, in ft^3, as calculated according to title 10 CFR part 430, subpart B, appendix A.

b. Benefits and Burdens of TSLs Considered for Combination Cooler Refrigeration Products

Table V.53 and Table V.54 summarize the quantitative impacts estimated for each TSL for combination cooler refrigeration products. The national impacts are measured over the lifetime of products purchased in the 30-year period that begins in the anticipated year of compliance with new standards (2019–2048 for TSL 1, and 2021–2050 for the other TSLs). The energy savings, emissions reductions, and value of emissions reductions refer to FFC results. The efficiency levels contained in each TSL are described in section V.A of this document.

Table V.53 Summary of Analytical Results for Combination Cooler Refrigeration Product TSLs: National Impacts

Category	TSL 1*	TSL 2*	TSL 3*	TSL 4*
Cumulative FFC National Energy Savings (quads)				
Quads	0.00084	0.007	0.012	0.016
NPV of Consumer Costs and Benefits (2015$ billion)				
3% discount rate	0.0045	0.035	(0.06)	(0.14)
7% discount rate	0.0017	0.011	(0.04)	(0.09)
Cumulative FFC Emissions Reduction (Total FFC Emissions)				
CO_2 (million metric tons)	0.05	0.44	0.73	0.96
SO_2 (thousand tons)	0.03	0.25	0.42	0.55
NO_X (thousand tons)	0.09	0.80	1.32	1.73
Hg (tons)	0.00	0.00	0.00	0.00
CH_4 (thousand tons)	0.21	1.90	3.16	4.13
CH_4 (thousand tons CO_2eq)**	6.02	53.24	88.46	115.75
N_2O (thousand tons)	0.00	0.01	0.01	0.01
N_2O (thousand tons CO_2eq)**	0.16	1.40	2.34	3.05
Value of Emissions Reduction (Total FFC Emissions)				
CO_2 (2015$ billion) †	0.000 to 0.005	0.003 to 0.042	0.005 to 0.071	0.007 to 0.092
NO_X – 3% discount rate (2015$ million)	0.2 to 0.4	1.4 to 3.3	2.4 to 5.5	3.1 to 7.1
NO_X – 7% discount rate (2015$ million)	0.1 to 0.2	0.6 to 1.3	0.9 to 2.1	1.2 to 2.7

Parentheses indicate negative (-) values.
* For TSL 1, the results are forecasted over the lifetime of products sold from 2019–2048. For the other TSLs, the results are forecasted over the lifetime of products sold from 2021–2050.
** 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.54 Summary of Analytical Results for Combination Cooler Refrigeration Product TSLs: Manufacturer and Consumer Impacts

Category	TSL 1*	TSL 2*	TSL 3*	TSL 4*
Manufacturer Impacts				
Industry NPV (2015$ million) (No-new-standards case INPV = 108.2)	107.4 to 107.6	103.7 to 107.5	101.6 to 117.7	100.1 to 128.5
Industry NPV (% change)	-0.7 to -0.5	-4.1 to -0.6	-6.0 to 8.9	-7.5 to 18.8
Consumer Average LCC Savings (2015$)				
C-3A	n.a.**	58	53	(209)
C-3A-BI	n.a.	66	59	(237)
C-9	n.a.	89	3	(182)
C-9-BI	n.a.	102	4	(205)
C-13A	32	17	(123)	(194)
C-13A-BI	n.a.	8	(151)	(232)
Consumer Simple PBP (years)				
C-3A	n.a.	4.1	6.8	25.3
C-3A-BI	n.a.	4.1	6.8	25.4
C-9	n.a.	2.6	12.1	23.3
C-9-BI	n.a.	2.6	12.0	23.2
C-13A	4.3	5.0	13.3	16.0
C-13A-BI	n.a.	6.5	21.6	24.6
% of Consumers that Experience Net Cost				
C-3A	0	4	26	92
C-3A-BI	0	4	26	92
C-9	0	0	62	90
C-9-BI	0	0	63	90
C-13A	6	44	94	96
C-13A-BI	0	49	97	98

Parentheses indicate negative (-) values.
* For TSL 1, the results are forecasted over the lifetime of products sold from 2019–2048. For the other TSLs, the results are forecasted over the lifetime of products sold from 2021–2050.
** Calculation of savings and PBP is not applicable (n.a.) for an efficiency level that is already met or exceeded in the MREF market.

DOE first considered TSL 4, which represents the max-tech efficiency levels. TSL 4 would save 0.016 quads of energy, an amount DOE considers significant. Under TSL 4, the NPV of consumer benefit would be -$0.09 billion using a discount rate of 7 percent, and -$0.14 billion using a discount rate of 3 percent.

The cumulative emissions reductions at TSL 4 are 0.96 Mt of CO_2, 0.55 thousand tons of SO_2, 1.73 thousand tons of NO_X, 0.0 ton of Hg, 4.13 thousand tons of CH_4, and 0.01 thousand tons of N_2O. The estimated monetary value of the CO_2 emissions reduction at TSL 4 ranges from $7 million to $92 million.

At TSL 4, the average LCC savings range from -$237 to -$182. The simple payback period ranges from 16.0 years to 25.4 years. The fraction of consumers experiencing a net LCC cost ranges from 90 percent to 98 percent.

At TSL 4, the projected change in INPV ranges from a decrease of $8.1 million to an increase of $20.3 million, which correspond to a decrease of 7.5 percent to an increase of 18.8 percent, respectively. Similar to coolers, manufacturer feedback from confidential interviews indicated that combination cooler refrigeration products are highly price sensitive, and therefore the lower bound of INPV impacts is more likely to occur. Additionally, in the context of new standards for coolers and other cumulative regulatory burdens, at TSL 4, disproportionate impacts on domestic LVMs of combination cooler refrigeration products may be severe. This could have a direct impact on the availability of certain niche combination cooler refrigeration products, as well as on competition, domestic manufacturing capacity, and production employment related to the combination cooler refrigeration product industry.

The Secretary concludes that at TSL 4 for combination cooler refrigeration products, the benefits of energy savings, emission reductions, and the estimated monetary value of the emissions reductions would be outweighed by the negative NPV of consumer benefits, the economic burden on some consumers, and the disproportionate impacts on the LVMs, which could directly impact the availability of certain niche combination cooler products. Consequently, the Secretary has concluded that TSL 4 is not economically justified.

DOE then considered TSL 3, which would save an estimated 0.012 quads of energy, an amount DOE considers significant. Under TSL 3, the NPV of consumer benefit would be -$0.04 billion using a discount rate of 7 percent, and -$0.06 billion using a discount rate of 3 percent.

The cumulative emissions reductions at TSL 3 are 0.73 Mt of CO_2, 0.42 thousand tons of SO_2, 1.32 thousand tons of NO_X, 0.00 tons of Hg, 3.16 thousand tons of CH_4, and 0.01 thousand tons of N_2O. The estimated monetary value of the CO_2 emissions reduction at TSL 3 ranges from $5 million to $71 million.

At TSL 3, the average LCC savings range from -$151 to $59. The simple payback period ranges from 6.8 years to 21.6 years. The fraction of consumers experiencing a net LCC cost ranges from 26 percent to 97 percent.

At TSL 3, the projected change in INPV ranges from a decrease of $6.5 million to an increase of $9.6 million, which represent a decrease of 6.0 percent and an increase of 8.9 percent, respectively. Again, manufacturers indicated that combination cooler refrigeration products are highly price sensitive, and therefore the lower bound of INPV impacts is more likely to occur. In the context of new standards for coolers and other cumulative regulatory burdens, at TSL 3, disproportionate impacts on domestic LVMs of combination cooler refrigeration products may be severe. This could have a direct impact on the availability of certain niche combination cooler refrigeration products, as well as on competition, domestic manufacturing capacity and production employment related to the combination cooler refrigeration product industry.

The Secretary concludes that at TSL 3 for combination cooler refrigeration products, the benefits of energy savings, emission reductions, and the estimated monetary value of the emissions reductions would be outweighed by the negative NPV of consumer benefits and disproportionate impacts on the LVMs, which could directly impact the availability of certain niche combination cooler products. Consequently, the Secretary has concluded that TSL 3 is not economically justified.

DOE then considered TSL 2, which reflects the efficiency levels with maximum consumer NPV at seven percent discount rate. TSL 2 would save an estimated 0.007 quads of energy, an amount DOE considers significant. Under TSL 2, the NPV of consumer benefit would be $0.011 billion using a discount rate of 7 percent, and $0.035 billion using a discount rate of 3 percent.

The cumulative emissions reductions at TSL 2 are 0.44 Mt of CO_2, 0.25 thousand tons of SO_2, 0.8 thousand tons of NO_X, 0.00 tons of Hg, 1.90 thousand tons of CH_4, and

0.013 thousand tons of N_2O. The estimated monetary value of the CO_2 emissions reduction at TSL 2 ranges from $3 million to $42 million.

At TSL 2, the average LCC savings range from $8 to $102. The simple payback period ranges from 2.6 years to 6.5 years. The fraction of consumers experiencing a net LCC cost ranges from zero percent to 49 percent.

At TSL 2, the projected change in INPV ranges from a decrease of $4.4 million to a decrease of $0.6 million, which represent decreases of 4.1 percent and 0.6 percent, respectively. Again, in the context of new standards for coolers and other cumulative regulatory burdens, at TSL 2, disproportionate impacts on domestic LVMs may be severe. This could have a direct impact on the availability of certain niche combination cooler refrigeration products, as well as on competition, domestic manufacturing capacity and production employment related to the combination cooler refrigeration product industry.

The Secretary concludes that at TSL 2 for combination cooler refrigeration products, the benefits of energy savings, positive NPV of consumer benefits, emission reductions, and the estimated monetary value of the emissions reductions would again be outweighed by the disproportionate impacts on the domestic LVMs, which could directly impact the availability of certain niche combination cooler products. Consequently, the Secretary has concluded that TSL 2 is not economically justified.

DOE then considered TSL 1, which reflects the standard levels recommended by the MREF Working Group. TSL 1 would save an estimated 0.00084 quads of energy, an amount DOE considers significant. Under TSL 1, the NPV of consumer benefit would be $0.0017 billion using a discount rate of 7 percent, and $0.0045 billion using a discount rate of 3 percent.

The cumulative emissions reductions at TSL 1 are 0.05 Mt of CO_2, 0.03 thousand tons of SO_2, 0.09 thousand tons of NO_X, 0.00 tons of Hg, 0.21 thousand tons of CH_4, and 0.00 thousand tons of N_2O. The estimated monetary value of the CO_2 emissions reduction at TSL 1 ranges from $0 million to $5 million.

At TSL 1, the combination cooler refrigeration products currently available on the market already meet or exceed the corresponding efficiency levels in all product classes except for C-13A. As a result, for five of the product classes, no consumers experience a net cost, and the LCC savings and simple payback period are not applicable. For product class C-13A, the average LCC savings is $32, the simple payback period is 4.3 years, and the fraction of consumers experiencing a net LCC cost is 6 percent.

At TSL 1, the projected change in INPV ranges from a decrease of $0.8 million to a decrease of $0.5 million, which represent decreases of 0.7 percent and 0.5 percent, respectively. DOE estimated that all combination cooler refrigeration products manufactured domestically by LVMs currently meet the standard levels corresponding to

TSL 1. Therefore, at TSL 1, DOE believes that domestic manufacturers will continue to offer the same combination cooler refrigeration products as those they currently offer.

After considering the analysis and weighing the benefits and burdens, DOE has determined that the recommended standards for combination cooler refrigeration products are in accordance with 42 U.S.C. 6295(o). Specifically, the Secretary has determined the benefits of energy savings, positive NPV of consumer benefits, emission reductions, the estimated monetary value of the emissions reductions, and positive average LCC savings would outweigh the negative impacts on some consumers and on manufacturers, including the conversion costs that could result in a reduction in INPV for manufacturers. Accordingly, the Secretary has concluded that TSL 1 would offer the maximum improvement in efficiency that is technologically feasible and economically justified, and would result in the significant conservation of energy.

Under the authority provided by 42 U.S.C. 6295(p)(4), DOE is issuing this direct final rule that establishes new energy conservation standards for combination cooler refrigeration products at TSL 1. The new energy conservation standards for combination cooler refrigeration products, which are expressed as maximum annual energy use, in kWh/yr, as a function of AV, in ft^3, are shown in Table V.55.

Table V.55 New Energy Conservation Standards for Combination Cooler Refrigeration Products

Product Class Description	**Product Class Designation**	**Maximum Allowable AEU** (kWh/yr)
Cooler with all-refrigerator—automatic defrost	C-3A	4.57AV† + 130.4
Built-in cooler with all-refrigerator—automatic defrost	C-3A-BI	5.19AV + 147.8
Cooler with upright freezers with automatic defrost without an automatic icemaker	C-9	5.58AV + 147.7
Built-in cooler with upright freezer with automatic defrost without an automatic icemaker	C-9-BI	6.38AV + 168.8
Cooler with upright freezer with automatic defrost with an automatic icemaker	C-9I	5.58AV + 231.7
Built-in cooler with upright freezer with automatic defrost with an automatic icemaker	C-9I-BI	6.38AV + 252.8
Compact cooler with all-refrigerator—automatic defrost	C-13A	5.93AV + 193.7
Built-in compact cooler with all-refrigerator—automatic defrost	C-13A-BI	6.52AV + 213.1

† AV = Adjusted volume, in ft^3, as calculated according to title 10 CFR part 430, subpart B, appendix A.

c. 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 2015$) of the benefits from operating products that meet the adopted standards (consisting primarily of operating cost savings from using less energy, minus increases in product purchase costs, and (2) the annualized monetary value of the benefits of CO_2 and NO_X emission reductions.[81]

[81] To convert the time-series of costs and benefits into annualized values, DOE calculated a present value in 2016, the year used for discounting the NPV of total consumer costs and savings. For the benefits, DOE

Table V.56 shows the annualized values for MREFs under TSL 2 for coolers and TSL 1 for combination cooler refrigeration products, expressed in 2015$. 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 $40.6/t in 2015),[82] the estimated cost of the standards in this rule is $153 million per year in increased equipment costs, while the estimated annual benefits are $593 million in reduced equipment operating costs, $165 million in CO_2 reductions, and $13.1 million in reduced NO_X emissions. In this case, the net benefit amounts to $619 million per year.

Using a 3-percent discount rate for all benefits and costs and the SCC series has a value of $40.6/t in 2015, the estimated cost of the standards is $157 million per year in increased equipment costs, while the estimated annual benefits are $754 million in reduced operating costs, $165 million in CO_2 reductions, and $17.1 million in reduced NO_X emissions. In this case, the net benefit amounts to $779 million per year.

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 2016. 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. 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.

[82] 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 of this document).

Table V.56 Annualized Benefits and Costs of New Standards for MREFs*

	Discount Rate	Primary Estimate	Low Net Benefits Estimate	High Net Benefits Estimate
		Million 2015$/year		
Benefits				
Consumer Operating Cost Savings	7%	593	545	649
	3%	754	686	839
CO_2 Reduction (using mean SCC at 5% discount rate)**	5%	49	46	53
CO_2 Reduction (using mean SCC at 3% discount rate)**	3%	165	155	179
CO_2 Reduction (using mean SCC at 2.5% discount rate)**	2.5%	242	227	263
CO_2 Reduction (using 95th percentile SCC at 3% discount rate)**	3%	502	471	546
NO_X Reduction Value†	7%	13.1	12.4	31.6
	3%	17.7	16.6	43.6
Total Benefits††	7% plus CO_2 range	655 to 1,108	603 to 1,028	733 to 1,226
	7%	771	712	860
	3% plus CO_2 range	820 to 1,273	748 to 1,173	935 to 1,428
	3%	937	857	1,062
Costs				
Consumer Incremental Product Costs†††	7%	153	145	118
	3%	157	148	116
Net Benefits				
Total††	7% plus CO_2 range	503 to 956	459 to 884	615 to 1,108
	7%	619	568	742
	3% plus CO_2 range	663 to 1,116	601 to 1,026	819 to 1,312
	3%	779	709	946

* This table presents the annualized costs and benefits associated with MREFs shipped in 2019–2048. These results include benefits to consumers which accrue after 2048 from the MREFs purchased from 2019–2048. The incremental installed costs include incremental equipment cost as well as installation costs. The CO_2 reduction benefits are global benefits due to actions that occur nationally. The Primary, Low Benefits, and High Benefits Estimates utilize projections of energy prices and housing starts from the AEO 2015 Reference case, Low Economic Growth case, and High Economic Growth case, respectively. In

addition, incremental product costs reflect a constant price trend in the Primary Estimate and the Low Benefits Estimate, and a high decline rate in the High Benefits Estimate. The methods used to derive projected price trends are explained in section IV.F of this document. Note that the Benefits and Costs may not sum to the Net Benefits due to rounding.
** The CO_2 reduction benefits are calculated using 4 different sets of SCC values. The first three use the average SCC calculated using 5%, 3%, and 2.5% discount rates, respectively. The fourth represents the 95th percentile of the SCC distribution calculated using a 3% discount rate. The SCC values are emission year specific. See section IV.L.1 of this document for more details.
† DOE estimated the monetized value of NO_X emissions reductions associated with electricity savings using benefit per ton estimates from the "Regulatory Impact Analysis for the Clean Power Plan Final Rule," published in August 2015 by EPA's Office of Air Quality Planning and Standards. (Available at www.epa.gov/cleanpowerplan/clean-power-plan-final-rule-regulatory-impact-analysis.) See section IV.L of this document for further discussion. For the Primary Estimate and Low Net Benefits Estimate, DOE used a national benefit-per-ton estimate for NO_X emitted from the Electric Generating Unit sector based on an estimate of premature mortality derived from the ACS study (Krewski et al. 2009). For DOE's High Net Benefits Estimate, the benefit-per-ton estimates were based on the Six Cities study (Lepuele et al. 2011), which are nearly two-and-a-half times larger than those from the ACS study.
†† Total Benefits for both the 3% and 7% cases are presented using only the average SCC with 3-percent discount rate. 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.
††† The value of consumer incremental product costs is lower in the low net benefits estimate than it is in the primary estimate because both estimates use the same price trend and there are fewer shipments in the low net benefits estimate. The value of consumer incremental product costs is lower in the high net benefits scenario than it is in the primary case because the high net benefits scenario uses a highly declining price trend that more than offsets the increase in shipments due to higher economic growth.

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 MREFs are intended to address are as follows:

(1) Insufficient information and the high costs of gathering and analyzing relevant information leads some consumers 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, which is likely to result in the least costly equipment being purchased rather than more efficient alternatives that would benefit the users of that equipment.

(3) There are external benefits resulting from improved energy efficiency of MREFs that are 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 the proposed regulatory action is a significant regulatory action under section (3)(f) of Executive Order 12866. Accordingly, pursuant to section 6(a)(3)(B) of the Order, DOE has provided to OIRA: (i) The text of the draft regulatory action, together with a reasonably detailed description of the need for the regulatory action and an explanation of how the regulatory action will meet that need; and (ii) An assessment of the potential costs and benefits of the regulatory action, including an explanation of the manner in which the regulatory action is consistent with a statutory mandate. DOE has included these documents in the rulemaking record.

In addition, the Administrator of OIRA has determined that the proposed regulatory action is an "economically" significant regulatory action under section (3)(f)(1) of Executive Order 12866. Accordingly, pursuant to section 6(a)(3)(C) of the Order, DOE has provided to OIRA an assessment, including the underlying analysis, of benefits and costs anticipated from the regulatory action, together with, to the extent feasible, a quantification of those costs; and an assessment, including the underlying analysis, of costs and benefits of potentially effective and reasonably feasible alternatives to the planned regulation, and an explanation of why the planned regulatory action is preferable to the identified potential alternatives. These assessments can be found in the technical support document for this rulemaking.

DOE has also reviewed this regulation pursuant to Executive Order 13563, issued on January 18, 2011. 76 FR 3281 (January 21, 2011). Executive Order 13563 is supplemental to and explicitly reaffirms the principles, structures, and definitions governing regulatory review established in Executive Order 12866. To the extent permitted by law, agencies are required by Executive Order 13563 to: (1) propose or adopt a regulation only upon a reasoned determination that its benefits justify its costs (recognizing that some benefits and costs are difficult to quantify); (2) tailor regulations to impose the least burden on society, consistent with obtaining regulatory objectives, taking into account, among other things, and to the extent practicable, the costs of cumulative regulations; (3) select, in choosing among alternative regulatory approaches, those approaches that maximize net benefits (including potential economic, environmental, public health and safety, and other advantages; distributive impacts; and equity); (4) to the extent feasible, specify performance objectives, rather than specifying the behavior or manner of compliance that regulated entities must adopt; and (5) identify and assess available alternatives to direct regulation, including providing economic incentives to encourage the desired behavior, such as user fees or marketable permits, or providing information upon which choices can be made by the public.

DOE emphasizes as well that Executive Order 13563 requires agencies to use the best available techniques to quantify anticipated present and future benefits and costs as accurately as possible. In its guidance, 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 direct final rule is consistent with these principles, including the requirement that, to the extent permitted by law, benefits justify costs and that net benefits are maximized.

B. Review Under the Regulatory Flexibility Act

The Regulatory Flexibility Act (5 U.S.C. 601 et seq.) requires preparation of an initial regulatory flexibility analysis ("IRFA") for any rule that by law must be proposed for public comment and a final regulatory flexibility analysis ("FRFA") for any such rule that an agency adopts as a final rule, unless the agency certifies that the rule, if promulgated, will not have a significant economic impact on a substantial number of small entities. A regulatory flexibility analysis examines the impact of the rule on small entities and considers alternative ways of reducing negative effects. 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 reviewed this direct final rule and corresponding NOPR (published elsewhere in this Federal Register) pursuant to the Regulatory Flexibility Act and the procedures and policies discussed above. DOE has concluded that this rule would not have a significant impact on a substantial number of small entities. The factual basis for this certification is set forth below. DOE will consider any comments on the certification or economic impacts of the rule in determining whether to adopt the standards contained in this direct final rule.

For manufacturers of MREFs, the SBA has set a size threshold, which defines those entities classified as "small businesses" for the purposes of the statute. Manufacturers of MREFs have primary NAICS codes of 335222, "Household Refrigerator and Home Freezer Manufacturing" and 333415, "Air-Conditioning and Warm Air Heating Equipment and Commercial and Industrial Refrigeration Equipment Manufacturing." The SBA sets a threshold of 1,250 employees or less for an entity to be considered as a small business for both NAICS 335222 and NAICS 333415.

DOE conducted a market survey using available public information to identify potential small manufacturers. DOE first attempted to identify all potential MREF manufacturers by researching the CEC[83] and NRCan[84] product databases, individual company websites, market research tools (e.g., Hoovers reports[85]), and information from the 2011 energy conservation standards rulemaking for residential refrigerators, refrigerator-freezers, and freezers. 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, as necessary, to determine whether they met the SBA's definition of a small business manufacturer of covered MREFs. DOE screened out companies that do not offer products covered by this rulemaking, do not meet the definition of a "small business," or are foreign-owned.

The MREF industry in the United States is primarily an import industry. DOE estimated that less than 8 percent of coolers sold in the United States are produced domestically. The percentage of domestic production of the niche combination cooler refrigeration products is much larger (approximately 40 percent), although total shipments for the combination cooler refrigeration products segment equal only approximately 2 percent of cooler shipments in the United States. DOE estimates that there are approximately 48 entities involved in the sale and/or manufacture of MREFs

[83] CEC. California Energy Commission Appliance Database. Last Accessed December 14, 2015. https://cacertappliances.energy.ca.gov/Pages/ApplianceSearch.aspx.
[84] NRCan. Natural Resources Canada EnerGuide. Last Accessed August 6, 2015. http://oee.nrcan.gc.ca/pml-lmp/index.cfm?action=app.search-recherche&appliance=REFRIGERATORS.
[85] Hoovers. www.hoovers.com/.

sold in the U.S. market. Based on manufacturer interview feedback and publicly-available information, DOE determined that 46 of these entities either exceed the size thresholds defined by SBA or are completely foreign-owned and operated. DOE determined that the remaining two companies meet the SBA's definition of a "small business."

One of the two small, domestic businesses selling MREFs in the United States, accounting for an estimated 1 percent of MREF shipments, does not manufacture any of the MREFs covered by this rulemaking but instead outsources the manufacture of them to foreign OEMs. Because this business does not manufacture MREFs, DOE believes that this company would incur no fixed capital costs related to new energy conservation standards for MREFs. However, this entity may incur costs related to testing, certification, and marketing in order to comply with the standards adopted in this direct final rule. As discussed in section VII.B of the July 2016 Final Coverage Determination, DOE assumes that existing cooler models that are being sold in the United States have already been tested according to test methods similar to those established in the July 2016 Final Coverage Determination and would require only an adjustment of the calculated energy use. Using the costs of adjusting calculated energy use outlined in section VII.B of the July 2016 Final Coverage Determination, as well as an estimate of $50,000 for updates to product literature and marketing materials as a result of new MREF standards, DOE conservatively estimates that the small importer may incur approximately $63,000 in product conversion costs in order to maintain its current MREF product offering. 81 FR at 46786–46787. DOE assumes these upfront costs will be spread over a 3-year period leading up to the compliance year. Accordingly, on an annual basis, the estimated upfront product conversion costs equate to less than 0.1 percent of this entity's annual revenues.

The second small, domestic business identified by DOE manufactures compact coolers. Based on DOE's research, this manufacturer accounts for less than 1 percent of MREF market share in the United States. The models produced and sold by this manufacturer correspond with an estimated four unique platforms with associated efficiencies at or just below (less efficient than) the standard efficiency levels for coolers adopted in this direct final rule. DOE expects that this manufacturer will likely be able to comply with the standards adopted in this direct final rule by making component changes within its existing products (i.e., a more efficient compressor, improved glass, or targeted integration of VIPs). DOE, therefore, determined that this manufacturer would likely not incur fixed capital costs. DOE estimated that this small manufacturer may incur approximately $900,000 in upfront product conversion costs (related to research and development, testing, certification and marketing) in order to maintain its current product offering. DOE assumes these upfront costs will be spread over a 3-year period leading up to the compliance year. Accordingly, on an annual basis, the estimated upfront product conversion costs equate to roughly 8 percent of this manufacturer's annual revenues from its U.S. sales of MREFs. Overall annual sales figures for this manufacturer are not publicly-available. However, this manufacturer's product line also includes commercial bar and beverage equipment.

As discussed above, although the small manufacturer and small importer will incur some costs related to compliance with new MREF standards, the costs to these entities represent a small portion of their annual revenues. For this reason, DOE certifies that the standards for MREFs set forth in this direct final rule would not have a significant economic impact on a substantial number of small entities. Accordingly, DOE has not prepared a regulatory flexibility analysis for this rulemaking. DOE will transmit this certification to the SBA as required by 5 U.S.C. 605(b).

C. Review Under the Paperwork Reduction Act

DOE has determined that MREFs are a covered product under EPCA. 81 FR 46768 (July 18, 2016). Because MREFs are a covered product, manufacturers would need to certify to DOE that their products comply with any applicable energy conservation standards. In certifying compliance, manufacturers must test their products according to the DOE test procedures for MREFs, 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 MREFs. See generally 10 CFR part 429. 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 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 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 direct final rule. DOE's CX determination for this direct final 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 direct 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 products that are the subject of this direct 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 (February 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 direct final rule meets the relevant standards of Executive Order 12988.

G. Review Under the Unfunded Mandates Reform Act of 1995

Title II of the Unfunded Mandates Reform Act of 1995 ("UMRA") requires each Federal agency to assess the effects of Federal regulatory actions on State, local, and Tribal governments and the private sector. Public Law 104-4, sec. 201 (codified at 2 U.S.C. 1531). For 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.

DOE reviewed this rule and determined that it does not contain a Federal intergovernmental mandate, nor is it expected to require expenditures of $100 million or more in any one year by the private sector. As a result, no further assessment or analysis is required under UMRA.

H. Review Under the Treasury and General Government Appropriations Act, 1999

Section 654 of the Treasury and General Government Appropriations Act, 1999 (Public Law 105-277) requires Federal agencies to issue a Family Policymaking Assessment for any rule that may affect family well-being. This direct final rule will 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 direct final rule will 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 direct 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 energy conservation standards for MREFs, 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 direct 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, issued its Final Information Quality Bulletin for Peer Review (the Bulletin). 70 FR 2664 (January 14, 2005). The Bulletin establishes that certain scientific information shall be peer reviewed by qualified specialists before it is disseminated by the Federal Government, including influential scientific information related to agency regulatory actions. The purpose of the bulletin is to enhance the quality and credibility of the Government's scientific information. Under the Bulletin, the energy conservation standards rulemaking analyses are "influential scientific information," which the Bulletin defines as "scientific information the agency reasonably can determine will have, or does have, a clear and substantial impact on important public policies or private sector decisions." 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: www1.eere.energy.gov/buildings/appliance_standards/peer_review.html.

M. Congressional Notification

As required by 5 U.S.C. 801, DOE will report to Congress on the promulgation of this rule prior to its effective date. The report will state that it has been determined that the direct final rule is a "major rule" as defined by 5 U.S.C. 804(2).

VII. Public Participation

DOE will accept comments, data, and information regarding this rule until the date provided in the **DATES** section at the beginning of this rule. Interested parties may submit comments, data, and other information using any of the methods described in the **ADDRESSES** section at the beginning of this rule.

DOE welcomes comments on any aspect of the analysis as described in this direct final rule. DOE is also interested in receiving comments and views of interested parties concerning the following issues:

1. Whether the standards outlined in this rulemaking would result in any lessening of utility for MREFs, including whether certain features would be eliminated from these products. See sections III.H.1.d and IV.2 of this rule.

2. The incremental manufacturer production costs DOE estimated at each efficiency level. See section IV.C of this rule.

3. DOE's method to estimate MREF shipments under the no-new-standards case and under potential energy conservation standards levels. See section IV.G of this rule.

4. The assumption that installation, maintenance, and repair costs do not vary for MREFs at higher efficiency levels. See section IV.F of this rule.

5. The manufacturer conversion costs (both product and capital) used in DOE's analysis. See section V.B.2.d this rule.

6. The cumulative regulatory burden to MREF manufacturers associated with the standards in this direct final rule and on the approach DOE used in evaluating cumulative regulatory burden, including the timeframes and regulatory dates evaluated. See section V.B.2.e of this rule.

Submitting comments via www.regulations.gov. The www.regulations.gov webpage will require you to provide your name and contact information. Your contact information will be viewable to DOE Building Technologies staff only. Your contact information will not be publicly viewable except for your first and last names, organization name (if any), and submitter representative name (if any). If your comment is not processed properly because of technical difficulties, DOE will use this information to contact you. If DOE cannot read your comment due to technical difficulties and cannot contact you for clarification, DOE may not be able to consider your comment.

However, your contact information will be publicly viewable if you include it in the comment itself or in any documents attached to your comment. Any information that you do not want to be publicly viewable should not be included in your comment, nor in any document attached to your comment. Otherwise, persons viewing comments will see only first and last names, organization names, correspondence containing comments, and any documents submitted with the comments.

Do not submit to www.regulations.gov information for which disclosure is restricted by statute, such as trade secrets and commercial or financial information (hereinafter referred to as Confidential Business Information (CBI)). Comments submitted through www.regulations.gov cannot be claimed as CBI. Comments received through the website will waive any CBI claims for the information submitted. For information on submitting CBI, see the Confidential Business Information section below.

DOE processes submissions made through www.regulations.gov before posting. Normally, comments will be posted within a few days of being submitted. However, if large volumes of comments are being processed simultaneously, your comment may not be viewable for up to several weeks. Please keep the comment tracking number that www.regulations.gov provides after you have successfully uploaded your comment.

Submitting comments via email, hand delivery/courier, or mail. Comments and documents submitted via email, hand delivery/courier, or mail also will be posted to www.regulations.gov. If you do not want your personal contact information to be publicly viewable, do not include it in your comment or any accompanying documents. Instead, provide your contact information in a cover letter. Include your first and last names, email address, telephone number, and optional mailing address. The cover letter will not be publicly viewable as long as it does not include any comments

Include contact information each time you submit comments, data, documents, and other information to DOE. If you submit via mail or hand delivery/courier, please provide all items on a CD, if feasible, in which case it is not necessary to submit printed copies. No telefacsimiles (faxes) will be accepted.

Comments, data, and other information submitted to DOE electronically should be provided in PDF (preferred), Microsoft Word or Excel, WordPerfect, or text (ASCII) file format. Provide documents that are not secured, that are written in English, and that are free of any defects or viruses. Documents should not contain special characters or any form of encryption and, if possible, they should carry the electronic signature of the author.

Campaign form letters. Please submit campaign form letters by the originating organization in batches of between 50 to 500 form letters per PDF or as one form letter with a list of supporters' names compiled into one or more PDFs. This reduces comment processing and posting time.

Confidential Business Information. Pursuant to 10 CFR 1004.11, any person submitting information that he or she believes to be confidential and exempt by law from public disclosure should submit via email, postal mail, or hand delivery/courier two well-marked copies: one copy of the document marked "confidential" including all the information believed to be confidential, and one copy of the document marked "non-confidential" with the information believed to be confidential deleted. Submit these documents via email or on a CD, if feasible. DOE will make its own determination about the confidential status of the information and treat it according to its determination.

Factors of interest to DOE when evaluating requests to treat submitted information as confidential include: (1) A description of the items; (2) whether and why such items are customarily treated as confidential within the industry; (3) whether the information is generally known by or available from other sources; (4) whether the information has previously been made available to others without obligation concerning its confidentiality; (5) an explanation of the competitive injury to the submitting person that would result from public disclosure; (6) when such information might lose its confidential character due to the passage of time; and (7) why disclosure of the information would be contrary to the public interest.

It is DOE's policy that all comments may be included in the public docket, without change and as received, including any personal information provided in the comments (except information deemed to be exempt from public disclosure).

VIII. Approval of the Office of the Secretary

The Secretary of Energy has approved publication of this direct final rule.

List of Subjects in 10 CFR Part 430

Administrative practice and procedure, Confidential business information, Energy conservation, Household appliances, Imports, Intergovernmental relations, Reporting and recordkeeping requirements, Small businesses.

Issued in Washington, DC, on October 4, 2016.

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David J. Friedman,
Acting Assistant Secretary,
Energy Efficiency and Renewable Energy.

For the reasons set forth in the preamble, DOE amends part 430 of chapter II, subchapter D, of title 10 of the Code of Federal Regulations, as set forth below:

PART 430 - ENERGY CONSERVATION PROGRAM FOR CONSUMER PRODUCTS

1. The authority citation for part 430 continues to read as follows:

Authority: 42 U.S.C. 6291-6309; 28 U.S.C. 2461 note.

2. Amend §430.32 by adding paragraph (aa) to read as follows:

§ 430.32 Energy and water conservation standards and their compliance dates.

*   *   *   *   *

(aa) Miscellaneous refrigeration products. The energy standards as determined by the equations of the following table(s) shall be rounded off to the nearest kWh per year. If the equation calculation is halfway between the nearest two kWh per year values, the standard shall be rounded up to the higher of these values.

(1) Coolers manufactured starting on October 28, 2019 shall have Annual Energy Use (AEU) no more than:

Product Class	AEU (kWh/yr)
1. Built-in compact	7.88AV + 155.8
2. Built-in	
3. Freestanding compact	
4. Freestanding	

AV = Total adjusted volume, expressed in ft^3, as calculated according to appendix A of subpart B of this part.

(2) Combination cooler refrigeration products manufactured starting on October 28, 2019 shall have Annual Energy Use (AEU) no more than:

Product Class	**AEU (kWh/yr)**
C-3A. Cooler with all-refrigerator—automatic defrost.	4.57AV + 130.4
C-3A-BI. Built-in cooler with all-refrigerator—automatic defrost.	5.19AV + 147.8
C-9. Cooler with upright freezers with automatic defrost without an automatic icemaker.	5.58AV + 147.7
C-9-BI. Built-in cooler with upright freezer with automatic defrost without an automatic icemaker.	6.38AV + 168.8
C-9I. Cooler with upright freezer with automatic defrost with an automatic icemaker.	5.58AV + 231.7
C-9I-BI. Built-in cooler with upright freezer with automatic defrost with an automatic icemaker.	6.38AV + 252.8
C-13A. Compact cooler with all-refrigerator—automatic defrost	5.93AV + 193.7
C-13A-BI. Built-in compact cooler with all-refrigerator—automatic defrost	6.52AV + 213.1

AV = Total adjusted volume, expressed in ft^3, as calculated according to appendix A of subpart B of this part.

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