DOE is providing this redline document in accordance with its obligations under Executive Order 12866 to identify the substantive changes between the draft submitted to OIRA for review and the action subsequently announced.

[6450-01-P]

DEPARTMENT OF ENERGY

10 CFR Part 430

[EERE-2020-BT-STD-0039]

RIN 1904-AF62

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.

SUMMARY: The Energy Policy and Conservation Act, as amended ("EPCA"), prescribes energy conservation standards for various consumer products and certain commercial and industrial equipment, including miscellaneous refrigeration products**.** In this direct final rule, the U.S. Department of Energy ("DOE") is adopting amended energy conservation standards for miscellaneous refrigeration products. DOE has determined that the amended energy conservation standards for these products would result in significant conservation of energy, and are technologically feasible and economically justified.

DATES: The effective date of this rule is **[INSERT DATE 120 DAYS AFTER DATE OF PUBLICATION IN THE *FEDERAL REGISTER*].** If adverse ~~comment~~comments are received by **[INSERT DATE 110 DAYS AFTER DATE OF PUBLICATION IN THE *FEDERAL REGISTER*]** and DOE determines that such comments may provide a reasonable basis for withdrawal of the direct final rule under 42 U.S.C. 6295(o), a timely withdrawal of this rule will be published in the *Federal Register*. If no such adverse comments are received, compliance with the amended standards established for miscellaneous refrigeration products in this direct final rule is required on and after

January 31, 2029. Comments regarding the likely competitive impact of the standards contained in this direct final rule should be sent to the Department of Justice contact listed in the **ADDRESSES** section on or before [**INSERT DATE 30 DAYS AFTER DATE OF PUBLICATION IN THE *FEDERAL REGISTER***].

ADDRESSES: The docket for this rulemaking, 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, not all documents listed in the index may be publicly available, such as information that is exempt from public disclosure.

The docket webpage can be found at *www.regulations.gov/docket/EERE-2020-BT-STD-0039*. The docket webpage contains instructions on how to access all documents, including public comments, in the docket.

For further information on how to submit a comment or review other public comments and the docket, contact the Appliance and Equipment Standards Program staff at (202) 287-1445 or by email: *ApplianceStandardsQuestions@ee.doe.gov*.

The U.S. Department of Justice Antitrust Division invites input from market participants and other interested persons with views on the likely competitive impact of the standards contained in this direct final rule. Interested persons may contact the Antitrust Division at *www.energy.standards@usdoj.gov* on or before the date specified in the **DATES** section. Please indicate in the "Subject" line of your email the title and Docket Number of this direct final rule.

FOR FURTHER INFORMATION CONTACT:

Mr. Lucas Adin, 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) 287-5904. Email: *ApplianceStandardsQuestions@ee.doe.gov*.

Ms. Kristin Koernig, U.S. Department of Energy, Office of the General Counsel, GC-33, 1000 Independence Avenue, SW., Washington, DC, 20585-0121. Telephone: (240) 243-3383. Email: *kristin.koernig@hq.doe.gov*.

SUPPLEMENTARY INFORMATION:

Table of Contents

I. Synopsis of the Direct Final Rule

The Energy Policy and Conservation Act, Public Law 94-163, as amended ("EPCA"),[1] authorizes DOE to regulate the energy efficiency of a number of consumer products and certain industrial equipment. (42 U.S.C. 6291–6317, as codified) Title III, Part B of EPCA[2] established the Energy Conservation Program for Consumer Products Other Than Automobiles. (42 U.S.C. 6291–6309, as codified) These products include miscellaneous refrigeration products ("MREFs"), the subject of this direct final rule.

Pursuant to EPCA, any new or amended energy conservation standard must, among other things, be designed to achieve the maximum improvement in energy efficiency that DOE determines is technologically feasible and economically justified. (42 U.S.C. 6295(o)(2)(A)) Furthermore, the new or amended standard must result in significant conservation of energy. (42 U.S.C. 6295(o)(3)(B))

In light of the statutory authority above and under the authority provided by 42 U.S.C. 6295(p)(4), DOE is issuing this direct final rule amending the energy conservation standards for MREFs.

The adopted standard levels in this direct final rule were proposed in a letter submitted to DOE jointly by groups representing manufacturers, energy and environmental advocates, consumer groups, and a utility. This letter, titled "Energy Efficiency Agreement of 2023" (hereafter, the "Joint Agreement"[3]), recommends specific

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[1] All references to EPCA in this document refer to the statute as amended through the Energy Act of 2020, Public Law 116-260 (Dec. 27, 2020), which reflect the last statutory amendments that impact Parts A and A-1 of EPCA.

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

[3] This document is available in the docket at: *www.regulations.gov/document/ EERE-2020-BT-STD-0039-0034*.

energy conservation standards for MREFs that, in the commenters' view, would satisfy the EPCA requirements in 42 U.S.C. 6295(o). DOE subsequently received letters of support from states, including California, Massachusetts, and New York,[4] as well as San Diego Gas and Electric ("SDG&E") and Southern California Edison ("SCE") advocating for the adoption of the recommended standards.[5]

In accordance with the direct final rule provisions at 42 U.S.C. 6295(p)(4), DOE has determined that the recommendations contained therein are compliant with 42 U.S.C. 6295(o). As required by 42 U.S.C. 6295(p)(4)(A)(i), DOE is also simultaneously publishing a notice of proposed rulemaking ("NOPR") that contains the identical standards to those adopted in this direct final rule. Consistent with the statute, DOE is providing a 110-day public comment period on the direct final rule. (42 U.S.C. 6295(p)(4)(B)) If DOE determines that any comments received may provide a reasonable basis for withdrawal of the direct final rule under 42 U.S.C. 6295(o), or any other applicable law, DOE will publish the reasons for withdrawal and continue the rulemaking under the NOPR. (42 U.S.C. 6295(p)(4)(C)) See section II.A of this document for more details on DOE's statutory authority.

The amended standards that DOE is adopting in this direct final rule are the efficiency levels recommended in the Joint Agreement (shown in Table I.1) expressed in terms of kilowatt hours per year ("kWh/yr") as measured according to DOE's current MREF test procedure codified at title 10 of the Code of Federal Regulations ("CFR") part 430, subpart B, appendix A ("appendix A").

[4] This document is available in the docket at: *www.regulations.gov/document/EERE-2020-BT-STD-0039-0035.*

[5] This document is available in the docket at: *www.regulations.gov/document/EERE-2020-BT-STD-0039-0036.*

The amended standards recommended in the Joint Agreement are represented as trial standard level ("TSL") 4 in this document (hereinafter the "Recommended TSL") and are described in section V.A of this document. The Joint Agreement's standards for MREFs apply to all products listed in Table I.1 and manufactured in or imported into the United States starting on January 31, 2029.

Table I.1 Energy Conservation Standards for MREFs (Compliance Starting January 31. 2029)

Product Class ("PC")	Equations for maximum energy use (kWh/yr)
	Based on AV (ft^3)
1. Freestanding Compact Coolers (FCC)	5.52AV +109.1
2. Freestanding Coolers (FC)	5.52AV +109.1
3. Built-in Compact Coolers (BICC)	5.52AV +109.1
4. Built-in Coolers (BIC)	6.30AV + 124.6
C-3A. Cooler with all-refrigerator – automatic defrost	4.11AV + 117.4
C-3A-BI. Built-in cooler with all-refrigerator – automatic defrost	4.67AV + 133.0
C-5-BI. Built-in cooler with refrigerator-freezer – automatic defrost with bottom-mounted freezer	5.47AV + 196.2 +28I
C-9. Cooler with upright freezer with automatic defrost without an automatic icemaker	5.58AV + 147.7 + 28I
C-9-BI. Built-in cooler with upright freezer with automatic defrost without an automatic icemaker	6.38AV + 168.8 + 28I
C-13A. Compact cooler with all-refrigerator – automatic defrost	4.74AV + 155.0
C-13A-BI. Built-in compact cooler with all-refrigerator – automatic defrost	5.22AV + 170.5
AV = Total adjusted volume, expressed in ft^3, as determined in appendices A and B of subpart B of 10 CFR part 430. av = Total adjusted volume, expressed in Liters. I = 1 for a product with an automatic icemaker and = 0 for a product without an automatic icemaker.	

A. Benefits and Costs to Consumers

Table I.2 summarizes 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")[6] The average LCC savings are positive

[6] The average LCC savings refer to consumers that are affected by a standard and are measured relative to the efficiency distribution in the no-new-standards case, which depicts the market in the compliance year in the absence of new or amended standards (see section IV.F.9 of this document). The simple PBP, which is designed to compare specific efficiency levels, is measured relative to the baseline product (see section IV.C of this document).

for all product classes, and the PBP is less than the average lifetime of MREFs, which varies by product class (see section IV.F of this document).

Table I.2 Impacts of Adopted Energy Conservation Standards on Consumers of MREFs (The Recommended TSL)

MREF Class	Average LCC Savings *2022$*	Simple Payback Period ~~years~~Years
BIC	53.56	4.4
BICC	1.53	8.1
C-13A	10.60	7.3
C-13A-BI	12.81	7.1
C-3A	30.95	1.7
C-3A-BI	36.19	1.6
FC	26.22	8.5
FCC	12.97	6.8

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[7]

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 (2024-2058). Using a real discount rate of 7.7 percent, DOE estimates that the INPV for manufacturers of MREFs in the case without amended standards is $807.7 million. Under the adopted standards, which align with the Recommended TSL (*i.e.*, TSL 4) for MREFs, DOE estimates the change in INPV to range from -11.4 percent to -7.5 percent, which is approximately -$92.1 million to -$60.3 million. In order to bring products into compliance with amended standards, it is estimated that industry will incur total conversion costs of $130.7 million.

[7] All monetary values in this document are expressed in 2022 dollars. unless indicated otherwise. For purposes of discounting future monetary values, the present year in the analysis was 2024.

DOE's analysis of the impacts of the adopted standards on manufacturers is described in sections IV.J and V.B.2 of this document.

C. National Benefits and Costs

DOE's analyses indicate that the adopted energy conservation standards for MREFs would save a significant amount of energy. Relative to the case without amended standards, the lifetime energy savings for MREFs purchased in the 30-year period that begins in the anticipated year of compliance with the amended standards (2029–2058) amount to 0.32 quadrillion British thermal units ("Btu"), or quads.[8] This represents a savings of 26 percent relative to the energy use of these products in the case without amended standards (referred to as the "no-new-standards case").

The cumulative net present value ("NPV") of total consumer benefits of the standards for MREFs ranges from $0.~~11~~17 billion (at a 7-percent discount rate) to $0.~~64~~77 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 2029–2058.

In addition, the adopted standards for MREFs are projected to yield significant environmental benefits. DOE estimates that the standards will result in cumulative emission reductions (over the same period as for energy savings) of 5.85 million metric tons ("Mt")[9] of carbon dioxide ("CO_2"), 1.84 thousand tons of sulfur dioxide ("SO_2"),

[8] The quantity refers to full-fuel-cycle ("FFC") energy savings. FFC energy savings includes the energy consumed in extracting, processing, and transporting primary fuels (*i.e.*, coal, natural gas, petroleum fuels), and, thus, presents a more complete picture of the impacts of energy efficiency standards. For more information on the FFC metric, see section IV.H.1 of this document.

[9] A metric ton is equivalent to 1.1 short tons. Results for emissions other than CO_2 are presented in short tons.

10.77 -thousand tons of nitrogen oxides ("NO_X"), 48.64 thousand tons of methane ("CH_4"), 0.06 thousand tons of nitrous oxide ("N_2O"), and 0.01 tons of mercury ("Hg").[10]

DOE estimates the value of climate benefits from a reduction in greenhouse gases ("GHG") using four different estimates of the social cost of CO_2 ("SC-CO_2"), the social cost of methane ("SC-CH_4"), and the social cost of nitrous oxide ("SC-N_2O"). Together these represent the social cost of GHG ("SC-GHG"). DOE used interim SC-GHG values (in terms of benefit per ton of GHG avoided) developed by an Interagency Working Group on the Social Cost of Greenhouse Gases ("IWG").[11] The derivation of these values is discussed in section IV.L of this document. For presentational purposes, the climate benefits associated with the average SC-GHG at a 3-percent discount rate are estimated to be $0.32 billion. DOE does not have a single central SC-GHG point estimate and it emphasizes the ~~importance and~~ value of considering the benefits calculated using all four sets of SC-GHG estimates. DOE notes, however, that the adopted standards would be economically justified even without inclusion of the estimated monetized benefits of reduced GHG emissions.

DOE estimated the monetary health benefits of SO_2 and NO_X emissions reductions, using benefit per ton estimates from the Environmental Protection Agency ("EPA"),[12] as discussed in section IV.L of this document. DOE estimated the present

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[10] DOE calculated emissions reductions relative to the no-new-standards-case, which reflects key assumptions in the *Annual Energy Outlook 2023* ("*AEO2023*"). *AEO2023* represents current Federal and State legislation and final implementation of regulations as of the time of its preparation. See section IV.K of this document for further discussion of *AEO2023* assumptions that affect air pollutant emissions.

[11] To monetize the benefits of reducing GHG emissions this analysis uses the interim estimates presented in the *Technical Support Document: Social Cost of Carbon, Methane, and Nitrous Oxide Interim Estimates Under Executive Order 13990* published in February 2021 by the IWG. ("February 2021 SC-GHG TSD"). *www.whitehouse.gov/wp-content/uploads/2021/02/TechnicalSupportDocument_SocialCostofCarbonMethaneNitrousOxide.pdf* (last accessed November 29, 2023.)

[12] U.S. EPA. Estimating the Benefit per Ton of Reducing Directly Emitted PM2.5, PM2.5 Precursors and Ozone Precursors from 21 Sectors. Available at *www.epa.gov/benmap/estimating-benefit-ton-reducing-pm25-precursors-21-sectors* (last accessed November 29, 2023.)

value of the health benefits would be \$0.24 billion using a 7-percent discount rate, and \$0.62 billion using a 3-percent discount rate.[13] DOE is currently only monetizing health benefits from changes in ambient fine particulate matter ("$PM_{2.5}$") concentrations from two precursors (SO_2 and NO_X), and from changes in ambient ozone from one precursor (for NO_X), but will continue to assess the ability to monetize other effects such as health benefits from reductions in direct $PM_{2.5}$ emissions.

Table I.3 summarizes the monetized benefits and costs expected to result from the amended standards for MREFs. There are other important unquantified effects, including certain unquantified climate benefits, unquantified public health benefits from the reduction of toxic air pollutants and other emissions, unquantified energy security benefits, and distributional effects, among others.

[13] DOE estimates the economic value of these emissions reductions resulting from the considered TSLs for the purpose of complying with the requirements of Executive Order 12866.

Table I.3 Summary of Monetized Benefits and Costs of Adopted Energy Conservation Standards for Miscellaneous Refrigeration Products Shipped in 2029-2058 (TSL 4, the Recommended TSL)

	Billion $2022
3% discount rate	
Consumer Operating Cost Savings	2.00
Climate Benefits*	0.32
Health Benefits**	0.62
Total Benefits†	2.94
Consumer Incremental Product Costs‡	1.~~37~~23
Net Benefits	1.~~57~~71
Change in Producer Cashflow (INPV)‡‡	(0.09) - (0.06)
7% discount rate	
Consumer Operating Cost Savings	0.86
Climate Benefits* (3% discount rate)	0.32
Health Benefits**	0.24
Total Benefits†	1.42
Consumer Incremental Product Costs‡	0.~~75~~69
Net Benefits	0.~~67~~73
Change in Producer Cashflow (INPV)‡‡	(0.09) - (0.06)

Note: This table presents the costs and benefits associated with MREFs shipped during the period 2029−2058. These results include consumer, climate, and health benefits that accrue after 2058 from the products shipped in 2029−2058.
* Climate benefits are calculated using four different estimates of the social cost of carbon (SC-CO_2), methane (SC-CH_4), and nitrous oxide (SC-N_2O) (model average at 2.5 percent, 3 percent, and 5 percent discount rates; 95th percentile at 3 percent discount rate) (see section IV.L of this document). Together these represent the global SC-GHG. For presentational purposes of this table, the climate benefits associated with the average SC-GHG at a 3 percent discount rate are shown; however, DOE emphasizes the importance and value of considering the benefits calculated using all four sets of SC-GHG estimates. To monetize the benefits of reducing GHG emissions, this analysis uses the interim estimates presented in the *Technical Support Document: Social Cost of Carbon, Methane, and Nitrous Oxide Interim Estimates Under Executive Order 13990* published in February 2021 by the IWG.
** Health benefits are calculated using benefit-per-ton values for NO_X and SO_2. DOE is currently only monetizing (for SO_2 and NO_X) $PM_{2.5}$ precursor health benefits and (for NO_X) ozone precursor health benefits but will continue to assess the ability to monetize other effects such as health benefits from reductions in direct $PM_{2.5}$ emissions. See section IV.L of this document for more details.
† Total and net benefits include those consumer, climate, and health benefits that can be quantified and monetized. For presentation purposes, total and net benefits for both the 3-percent and 7-percent cases are presented using the average SC-GHG with 3-percent discount rate.
‡ Costs include incremental equipment costs.
‡‡Operating Cost Savings are calculated based on the life cycle costs analysis and national impact analysis as discussed in detail below. See sections IV.F and IV.H of this document. DOE's national impacts analysis includes all impacts (both costs and benefits) along the distribution chain beginning with the increased costs to the manufacturer to manufacture the product and ending with the increase in price experienced by the consumer. DOE also separately conducts a detailed analysis on the impacts on

manufacturers (*i.e.*, manufacturer impact analysis, or "MIA"). See section IV.J of this document. In the detailed MIA, DOE models manufacturers' pricing decisions based on assumptions regarding investments, conversion costs, cashflow, and margins. The MIA produces a range of impacts, which is the rule's expected impact on the INPV. The change in INPV is the present value of all changes in industry cash flow, including changes in production costs, capital expenditures, and manufacturer profit margins. Change in INPV is calculated using the industry weighted average cost of capital value of 7.7 percent that is estimated in the manufacturer impact analysis (see chapter 12 of the direct final rule TSD for a complete description of the industry weighted average cost of capital). For MREFs, the change in INPV ranges from -$92 million to -$60 million. DOE accounts for that range of likely impacts in analyzing whether a trial standard level is economically justified. See section V.C of this document. DOE is presenting the range of impacts to the INPV under two manufacturer markup scenarios: the Preservation of Gross Margin scenario, which is the manufacturer markup scenario used in the calculation of Consumer Operating Cost Savings in this table; and the Preservation of Operating Profit scenario, where DOE assumed manufacturers would not be able to increase per-unit operating profit in proportion to increases in manufacturer production costs. DOE includes the range of estimated INPV in the above table, drawing on the MIA explained further in section IV.J of this document to provide additional context for assessing the estimated impacts of this direct final rule to society, including potential changes in production and consumption, which is consistent with OMB's Circular A-4 and E.O. 12866. If DOE were to include the INPV into the net benefit calculation for this direct final rule, the net benefits would range from $1.~~48~~62 billion to $1.~~51~~65 billion at 3-percent discount rate and would range from $0.~~58~~64 billion to $0.~~61~~67 billion at 7-percent discount rate. Parentheses indicate negative (-) values.

The benefits and costs of the adopted standards can also be expressed in terms of annualized values. The monetary values for the total annualized net benefits are (1) the reduced consumer operating costs, minus (2) the increase in product purchase prices and installation costs, plus (3) the value of climate and health benefits of emission reductions, all annualized.[14]

The national operating cost savings are domestic private U.S. consumer monetary savings that occur as a result of purchasing the covered products and are measured for the lifetime of MREFs shipped during the period 2029−2058. The benefits associated with reduced emissions achieved as a result of the adopted standards are also calculated based on the lifetime of MREFs shipped during the period 2029–2058. Total benefits for both the 3-percent and 7-percent cases are presented using the average GHG social costs with

[14] To convert the time-series of costs and benefits into annualized values, DOE calculated a present value in 2022, 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.*, 2030), and then discounted the present value from each year to 2022. 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.

3-percent discount rate. Estimates of SC-GHG values are presented for all four discount rates in section IV.L of this document.

Table I.4 presents the total estimated monetized benefits and costs associated with the standards adopted in this direct final rule, expressed in terms of annualized values. The results under the primary estimate are as follows.

Using a 7-percent discount rate for consumer benefits and costs and health benefits from reduced NOx and SO_2 emissions, and the 3-percent discount rate case for climate benefits from reduced GHG emissions, the estimated cost of the standards adopted in this direct final rule is $~~78.8~~72.7 million per year in increased equipment costs, while the estimated annual benefits are $90.6 million in reduced equipment operating costs, $18.3 million in climate benefits, and $25.6 million in health benefits. In this case, the net benefit would amount to $~~55.6~~61.7 million per year.

Using a 3-percent discount rate for all benefits and costs, the estimated cost of the standards is $~~78.5~~70.8 million per year in increased equipment costs, while the estimated annual benefits are $115 million in reduced operating costs, $18.3 million in climate benefits, and $35.6 million in health benefits. In this case, the net benefit amounts to $~~90.3~~98.0 million per year.

Table I.4 Annualized Benefits and Costs of Adopted Standards for MREFs Shipped 2028 to 2057 (TSL 4, the Recommended TSL)

	Million 2022$/year		
	Primary Estimate	Low-Net-Benefits Estimate	High-Net-Benefits Estimate
3% discount rate			
Consumer Operating Cost Savings	115.0	111.5	116.3
Climate Benefits*	18.3	17.7	18.5
Health Benefits**	35.6	34.5	36.0
Total Monetized Benefits†	168.9	163.7	170.7
Consumer Incremental Product Costs‡	~~78.5~~70.8	74.9	68.7
Monetized Net Benefits	~~90.3~~98.0	88.8	102.0
Change in Producer Cashflow (INPV)‡‡	(7.7) - (5.0)		
7% discount rate			
Consumer Operating Cost Savings	90.6	88.1	91.5
Climate Benefits* (3% discount rate)	18.3	17.7	18.5
Health Benefits**	25.6	24.9	25.8
Total Benefits†	134.4	130.7	135.7
Consumer Incremental Product Costs‡	~~78.8~~72.7	75.8	70.9
Net Benefits	~~55.6~~61.7	54.9	64.8
Change in Producer Cashflow (INPV)‡‡	(7.7) - (5.0)		

Note: This table presents the costs and benefits associated with MREFs shipped during the period 2029−2058. These results include consumer, climate, and health benefits that accrue after 2058 from the products shipped in 2029−2058. The Primary, Low Net Benefits, and High Net Benefits Estimates utilize projections of energy prices from the *AEO2023* Reference case, Low Economic Growth case, and High Economic Growth case, respectively. In addition, incremental equipment costs reflect a medium decline rate in the Primary Estimate, a low decline rate in the Low Net Benefits Estimate, and a high decline rate in the High Net Benefits Estimate. The methods used to derive projected price trends are explained in section IV.H.3 of this document. Note that the Benefits and Costs may not sum to the Net Benefits due to rounding.
* Climate benefits are calculated using four different estimates of the global SC-GHG (see section IV.L of this document). For presentational purposes of this table, the climate benefits associated with the average SC-GHG at a 3 percent discount rate are shown, but DOE does not have a single central SC-GHG point estimate, and it emphasizes the importance and value of considering the benefits calculated using all four sets of SC-GHG estimates. To monetize the benefits of reducing GHG emissions, this analysis uses the interim estimates presented in the *Technical Support Document: Social Cost of Carbon, Methane, and Nitrous Oxide Interim Estimates Under Executive Order 13990* published in February 2021 by the IWG.
** Health benefits are calculated using benefit-per-ton values for NO_X and SO_2. DOE is currently only monetizing (for SO_2 and NO_X) $PM_{2.5}$ precursor health benefits and (for NO_X) ozone precursor health benefits but will continue to assess the ability to monetize other effects such as health benefits from reductions in direct $PM_{2.5}$ emissions. See section IV.L of this document for more details.
† Total benefits for both the 3-percent and 7-percent cases are presented using the average SC-GHG with 3-percent discount rate, but DOE does not have a single central SC-GHG point estimate.
‡ Costs include incremental equipment costs.

‡‡Operating Cost Savings are calculated based on the life cycle costs analysis and national impact analysis as discussed in detail below. See sections IV.F and IV.H of this document. DOE's national impacts analysis includes all impacts (both costs and benefits) along the distribution chain beginning with the increased costs to the manufacturer to manufacture the product and ending with the increase in price experienced by the consumer. DOE also separately conducts a detailed analysis on the impacts on manufacturers (*i.e.*, manufacturer impact analysis, or "MIA"). See section IV.J of this document. In the detailed MIA, DOE models manufacturers' pricing decisions based on assumptions regarding investments, conversion costs, cashflow, and margins. The MIA produces a range of impacts, which is the rule's expected impact on the INPV. The change in INPV is the present value of all changes in industry cash flow, including changes in production costs, capital expenditures, and manufacturer profit margins. The annualized change in INPV is calculated using the industry weighted average cost of capital value of 7.7 percent that is estimated in the MIA (see chapter 12 of the direct final rule technical support document for a complete description of the industry weighted average cost of capital). For MREFs, the annualized change in INPV ranges from $7.7 million to $5.0 million. DOE accounts for that range of likely impacts in analyzing whether a trial standard level is economically justified. See section V.C of this document. DOE is presenting the range of impacts to the INPV under two manufacturer markup scenarios: the Preservation of Gross Margin scenario, which is the manufacturer markup scenario used in the calculation of Consumer Operating Cost Savings in this table; and the Preservation of Operating Profit scenario, where DOE assumed manufacturers would not be able to increase per-unit operating profit in proportion to increases in manufacturer production costs. DOE includes the range of estimated annual change in INPV in the above table, drawing on the MIA explained further in section IV.J of this document to provide additional context for assessing the estimated impacts of this direct final rule to society, including potential changes in production and consumption, which is consistent with OMB's Circular A-4 and E.O. 12866. If DOE were to include the INPV into the annualized net benefit calculation for this direct final rule, the annualized net benefits would range from $~~82.6 million to $85~~90.3 million to $93.0 million at 3-percent discount rate and would range from $~~47.9~~54.0 million to $~~50.6~~56.7 million at 7-percent discount rate. Parentheses indicate negative (-) values.

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

DOE has determined that the Joint Agreement was submitted jointly by interested persons that are fairly representative of relevant points of view, in accordance with 42 U.S.C. 6295(p)(4)(A). After considering the analysis and weighing the benefits and burdens, DOE has determined that the recommended standards are in accordance with 42 U.S.C. 6295(o), which contains the criteria for prescribing new or amended standards. Specifically, the Secretary has determined that the adoption of the recommended standards would result in the significant conservation of energy and is technologically feasible and economically justified. In determining whether the recommended standards are economically justified, the Secretary has determined that the benefits of the recommended standards exceed the burdens. The Secretary has concluded that the recommended standards, when considering 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 yield benefits outweighing the negative impacts on some consumers and on manufacturers, including the conversion costs that could result in a reduction in INPV for manufacturers.

Using a 7-percent discount rate for consumer benefits and costs and NOx and SO_2 reduction benefits, and a 3-percent discount rate case for GHG social costs, the estimated cost of the standards for MREFs is \$~~78.8~~72.7 million per year in increased product costs, while the estimated annual benefits are \$90.6 million in reduced product operating costs, \$18.3 million in climate benefits, and \$25.6 million in health benefits. The net benefit amounts to \$~~55.6~~61.7 million per year. DOE notes that the net benefits are substantial even in the absence of the climate benefits,[15] and DOE would adopt the same standards in the absence of such benefits.

The significance of energy savings offered by a new or amended energy conservation standard cannot be determined without knowledge of the specific circumstances surrounding a given rulemaking.[16] For example, some covered products and equipment have most of their energy consumption occur during periods of peak energy demand. The impacts of these products on the energy infrastructure can be more pronounced than products with relatively constant demand. Accordingly, DOE evaluates the significance of energy savings on a case-by-case basis.

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[15] The information on climate benefits is provided in compliance with Executive Order 12866.
[16] Procedures, Interpretations, and Policies for Consideration in New or Revised Energy Conservation Standards and Test Procedures for Consumer Products and Commercial/Industrial Equipment, 86 FR 70892, 70901 (Dec. 13, 2021).

As previously mentioned, the standards are projected to result in estimated national energy savings of 0.32 quads full-fuel-cycle ("FFC"), the equivalent of the primary annual energy use of 2.1 million homes. In addition, they are projected to reduce cumulative CO_2 emissions by 5.85 million metric tons. Based on these findings, DOE has determined the energy savings from the standard levels adopted in this direct final rule are "significant" within the meaning of 42 U.S.C. 6295(o)(3)(B). A more detailed discussion of the basis for these conclusions is contained in the remainder of this document and the accompanying technical support document ("TSD"). [17]

Under the authority provided by 42 U.S.C. 6295(p)(4), DOE is issuing this direct final rule amending the energy conservation standards for MREFs. Consistent with this authority, DOE is also simultaneously publishing elsewhere in this issue of the *Federal Register* a NOPR proposing standards that are identical to those contained in this direct final rule. *See* 42 U.S.C. 6295(p)(4)(A)(i).

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

EPCA authorizes DOE to regulate the energy efficiency of a number of consumer products and certain industrial equipment. Title III, Part B of EPCA[18] established the

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[17] The direct final rule TSD is available in the docket for this rulemaking at *www.regulations.gov/docket/EERE-2020-BT-STD-0039/document.*

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

Energy Conservation Program for Consumer Products Other Than Automobiles, which, in addition to identifying particular consumer products and commercial equipment as covered under the statute, permits the Secretary of Energy to classify additional types of consumer products as covered products. (42 U.S.C. 6292(a)(20)) DOE added MREFs as covered products through a final determination of coverage published in the *Federal Register* on July 18, 2016 (the "July 2016 Final Coverage Determination"). 81 FR 46768. MREFs are consumer refrigeration products other than refrigerators, refrigerator-freezers, or freezers, which include coolers and combination cooler refrigeration products. 10 CFR 430.2. MREFs include refrigeration products such as coolers (*e.g.,* wine chillers and other specialty products) and combination cooler refrigeration products (*e.g.,* wine chillers and other specialty compartments combined with a refrigerator, refrigerator-freezers, or freezers). EPCA further provides that, not later than 6 years after the issuance of any final rule establishing or amending a standard, DOE must publish either a notice of determination that standards for the product do not need to be amended, or a NOPR including new proposed energy conservation standards (proceeding to a final rule, as appropriate). (42 U.S.C. 6295(m)(1)) Not later than ~~three~~3 years after issuance of a final determination not to amend standards, DOE must publish either a notice of determination that standards for the product do not need to be amended, or a NOPR including new proposed energy conservation standards (proceeding to a final rule, as appropriate). (42 U.S.C. 6295(m)(3)(B))

The energy conservation program under EPCA, consists essentially of four parts: (1) testing, (2) labeling, (3) the establishment of Federal energy conservation standards, and (4) certification and enforcement procedures. Relevant provisions of the EPCA specifically include definitions (42 U.S.C. 6291), test procedures (42 U.S.C. 6293), labeling provisions (42 U.S.C. 6294), energy conservation standards (42 U.S.C. 6295), and the authority to require information and reports from manufacturers (42 U.S.C. 6296).

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

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 42 U.S.C. 6295(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 appears at appendix A (*Uniform Test Method for Measuring the Energy Consumption of Refrigerators, Refrigerator-Freezers, and Miscellaneous Refrigeration Products*).

DOE must follow specific statutory criteria for prescribing new or amended standards for covered products, including MREFs. Any new or amended standard for a covered product must be designed to achieve the maximum improvement in energy efficiency that the Secretary of Energy determines is technologically feasible and economically justified. (42 U.S.C. 6295(o)(2)(A) and 42 U.S.C. 6295(o)(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 standard is not technologically feasible or economically justified. (42 U.S.C. 6295(o)(3)(A)–(B)) In deciding whether a proposed standard is economically justified, DOE must determine whether the benefits of the standard exceed its burdens. (42 U.S.C. 6295(o)(2)(B)(i)) DOE must make this determination after receiving comments on the proposed standard, and by considering, to the greatest extent practicable, the following seven statutory factors:

(1) The economic impact of the standard on manufacturers and consumers of the 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 standard;

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

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

(5) The impact of any lessening of competition, as determined in writing by the Attorney General, that is likely to result from the standard;

(6) The need for national energy and water conservation; and

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

(42 U.S.C. 6295(o)(2)(B)(i)(I)–(VII))

Further, EPCA, as codified, establishes a rebuttable presumption that a standard is economically justified if the Secretary finds that the additional cost to the consumer of purchasing a 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, as codified, also contains what is known as an "anti-backsliding" provision, which prevents the Secretary from prescribing any amended standard that either increases the maximum allowable energy use or decreases the minimum required energy efficiency of a covered 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))

EPCA specifies requirements when promulgating an energy conservation standard for a covered product that has two or more subcategories. A rule prescribing an energy conservation standard for a type (or class) of product 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 considers 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))

Additionally, pursuant to the amendments contained in the Energy Independence and Security Act of 2007 ("EISA 2007"), Public Law 110-140, final rules for new or amended energy conservation standards promulgated after July 1, 2010, are 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 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 current test procedure for MREFs addresses standby mode and off mode energy use, as do the amended standards adopted in this direct final rule.

Finally, EISA 2007 amended EPCA, in relevant part, to grant DOE authority to issue a final rule (*i.e.*, a "direct final rule") establishing an energy conservation standard upon receipt of a statement 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, that contains recommendations with respect to an energy or water conservation standard. (42 U.S.C. 6295(p)(4)) Pursuant to 42 U.S.C. 6295(p)(4), the Secretary must also determine whether a jointly-submitted recommendation for an energy or water conservation standard satisfies 42 U.S.C. 6295(o) or 42 U.S.C. 6313(a)(6)(B), as applicable.

The direct final rule must be published simultaneously with a NOPR that proposes an energy or water conservation standard that is identical to the standard established in the direct final rule, and DOE must provide a public comment period of at least 110 days on this proposal. (42 U.S.C. 6295(p)(4)(A)–(B)) While DOE typically provides a comment period of 60 days on proposed standards, for a NOPR accompanying a direct final rule, DOE provides a comment period of the same length as the comment period on the direct final rule—*i.e.*, 110 days. Based on the comments received during this period, the direct final rule will either become effective, or DOE will withdraw it not later than 120 days after its issuance 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, may provide a reasonable basis for withdrawal of the direct final rule under 42 U.S.C. 6295(o). (42 U.S.C. 6295(p)(4)(C)) Receipt of an alternative joint recommendation may also trigger a DOE withdrawal of the direct final rule in the same manner. (*Id.*)

DOE has previously explained its interpretation of its direct final rule authority. In a final rule amending the Department's "Procedures, Interpretations and Policies for Consideration of New or Revised Energy Conservation Standards for Consumer Products" at 10 CFR part 430, subpart C, appendix A ("Process Rule"), DOE noted that it may issue standards recommended by interested persons that are fairly representative of relative points of view as a direct final rule when the recommended standards are in accordance with 42 U.S.C. 6295(o) or 42 U.S.C. 6313(a)(6)(B), as applicable. 86 FR 70892, 70912 (Dec. 13, 2021). But the direct final rule provision in EPCA does not impose additional requirements applicable to other standards rulemakings, which is consistent with the unique circumstances of rules issued as consensus agreements under DOE's direct final rule authority. *Id.* DOE's discretion remains bounded by its statutory mandate to adopt a standard that results in the maximum improvement in energy efficiency that is technologically feasible and economically justified—a requirement found in 42 U.S.C. 6295(o). *Id.* As such, DOE's review and analysis of the Joint Agreement is limited to whether the recommended standards satisfy the criteria in 42 U.S.C. 6295(o).

B. Background

1. Current Standards

In a direct final rule published on October 28, 2016 ("October 2016 Final Rule"), DOE prescribed the current energy conservation standards for MREFs manufactured on and after October 28, 2019. 81 FR 75194. These standards are set forth in DOE's regulations at 10 CFR 430.32(aa)(1)-(2). These standards are consistent with a negotiated term sheet submitted to DOE by interested parties representing manufacturers, energy and environmental advocates, and consumer groups.[19]

2. Current Test Procedures

On October 12, 2021, DOE published a test procedure final rule ("October 2021 TP Final Rule") amending the test procedure for MREFs, at appendix A. 86 FR 56790. The test procedure amendments included adopting the latest version of the relevant industry standard published by the Association of Home Appliance Manufacturers ("AHAM"), updated in 2019, AHAM Standard HRF-1, "Energy and Internal Volume of Refrigerating Appliances" ("HRF-1-2019"). 10 CFR 430.3(i)(4). The standard levels adopted in this direct final rule are based on the annual energy use ("AEU") metrics as measured according to appendix A.

3. History of Standards Rulemaking for MREFs

On April 1, 2015, DOE published a notice announcing its intention to establish a negotiated rulemaking working group under the Appliance Standards Rulemaking Advisory Committee ("ASRAC") to negotiate energy conservation standards for refrigeration products such as wine chillers. 80 FR 17355. DOE then created a working group of interested parties to develop a series of recommended energy conservation standards for MREFs. On July 18, 2016, DOE published the July 2016 Final Coverage Determination that added MREFs as covered products. 81 FR 46768. In that determination, DOE noted that MREFs, on average, consume more than 150 kilowatt hours per year ("kWh/yr") and that the aggregate annual national energy use of these products exceeds 4.2 terawatt hours ("TWh"). 81 FR 46768, 46775. In addition to establishing coverage, the July 2016 Final Coverage Determination established

[19] The negotiated term sheets are available in docket ID EERE–2011–BT–STD–0043 on *www.regulations.gov*.

definitions for "miscellaneous refrigeration products," "coolers," and "combination cooler refrigeration products" in 10 CFR 430.2. 81 FR 46768, 46791-46792.

On October 28, 2016, a negotiated term sheet containing a series of recommended standards and other related recommendations were submitted to ASRAC for approval and, subsequently, DOE published the October 2016 Direct Final Rule adopting energy conservation standards consistent with the recommendations contained in the term sheet. 81 FR 75194. Concurrent with the October 2016 Direct Final Rule, DOE published a NOPR in which it proposed and requested comments on the standards set forth in the direct final rule. 81 FR 74950. On May 26, 2017, DOE published a notice in the *Federal Register* in which it determined that the comments received in response to the October 2016 Direct Final Rule did not provide a reasonable basis for withdrawing the rule and, therefore, confirmed the adoption of the energy conservation standards established in that direct final rule. 82 FR 24214.

4. The Joint Agreement

On September 25, 2023, DOE received a joint statement of recommended standards (*i.e.*, the Joint Agreement) for various consumer products, including MREFs, submitted jointly by groups representing manufacturers, energy and environmental advocates, consumer groups, and a utility.[20] In addition to the recommended standards for MREFs, the Joint Agreement also included separate recommendations for several

[20] The signatories to the Joint Agreement include AHAM, American Council for an Energy-Efficient Economy, Alliance for Water Efficiency, Appliance Standards Awareness Project, Consumer Federation of America, Consumer Reports, Earthjustice, National Consumer Law Center, Natural Resources Defense Council, Northwest Energy Efficiency Alliance, and Pacific Gas and Electric Company. Members of AHAM's Major Appliance Division that manufacture the affected products include: Alliance Laundry Systems, LLC; Asko Appliances AB; Beko US Inc.; Brown Stove Works, Inc.; BSH; Danby Products, Ltd.; Electrolux Home Products, Inc.; Elicamex S.A. de C.V.; Faber; Fotile America; GEA, a Haier Company; L'Atelier Paris Haute Design LLG; LGEUSA; Liebherr USA, Co.; Midea America Corp.; Miele, Inc.; Panasonic Appliances Refrigeration Systems (PAPRSA) Corporation of America; Perlick Corporation; Samsung; Sharp Electronics Corporation; Smeg S.p.A; Sub-Zero Group, Inc.; The Middleby Corporation; U-Line Corporation; Viking Range, LLC; and Whirlpool.

other covered products.[21] And, while acknowledging that DOE may implement these recommendations in separate rulemakings, the Joint Agreement also stated that the recommendations were recommended as a complete package and each recommendation is contingent upon the other parts being implemented. DOE understands this to mean that the Joint Agreement is contingent upon DOE initiating rulemaking processes to adopt all of the recommended standards in the agreement. That is distinguished from an agreement where issuance of an amended energy conservation standard for a covered product is contingent on issuance of amended energy conservation standards for the other covered products. If the Joint Agreement were so construed, it would conflict with the anti-backsliding provision in 42 U.S.C. 6295(o)(1), because it would imply the possibility that, if DOE were unable to issue an amended standard for a certain product, it would have to withdraw a previously issued standard for one of the other products. The anti-backsliding provision, however, prevents DOE from withdrawing or amending an energy conservation standard to be less stringent. As a result, DOE will be proceeding with individual rulemakings that will evaluate each of the recommended standards separately under the applicable statutory criteria. The Joint Agreement recommends amended standard levels for MREFs as presented in Table II.3. (Joint Agreement, No. 34 at p. 4) Details of the Joint Agreement recommendations for other products are provided in the Joint Agreement posted in the docket.[22]

Table II.1 Recommended Amended Energy Conservation Standards for Miscellaneous Refrigeration Products

Product Class	Level (Based on AV (ft^3))	Compliance Date
1. Freestanding Compact Coolers (FCC)	5.52AV +109.1	January 31, 2029
2. Freestanding Coolers (FC)	5.52AV +109.1	January 31, 2029
3. Built-in Compact Coolers (BICC)	5.52AV +109.1	January 31, 2029
4. Built-in Coolers (BIC)	6.30AV + 124.6	January 31, 2029

[21] The Joint Agreement contained recommendations for 6 covered products: refrigerators, refrigerator-freezers, and freezers; clothes washers; clothes dryers; dishwashers; cooking products; and miscellaneous refrigeration products.
[22] The term sheet is available in the docket at: *www.regulations.gov/document/EERE-2020-BT-STD-0039-0034*.

C-3A. Cooler with all-refrigerator – automatic defrost	4.11AV + 117.4	January 31, 2029
C-3A-BI. Built-in cooler with all-refrigerator – automatic defrost	4.67AV + 133.0	January 31, 2029
C-5-BI. NEW PRODUCT CLASS: Built-in cooler with refrigerator-freezer – automatic defrost with bottom-mounted freezer	5.47AV + 196.2 +28I	January 31, 2029
C-9. Cooler with upright freezer with automatic defrost without an automatic icemaker	5.58AV + 147.7 + 28I	January 31, 2029
C-9-BI. Built-in cooler with upright freezer with automatic defrost without an automatic icemaker	6.38AV + 168.8 + 28I	January 31, 2029
C-13A. Compact cooler with all-refrigerator – automatic defrost	4.74AV + 155.0	January 31, 2029
C-13A-BI. Built-in compact cooler with all-refrigerator – automatic defrost	5.22AV + 170.5	January 31, 2029
AV = Total adjusted volume, expressed in ft^3, as determined in appendices A and B of subpart B of 10 CFR part 430. I = 1 for a product with an automatic icemaker and = 0 for a product without an automatic icemaker.		

When the Joint Agreement was submitted, DOE was conducting a rulemaking to consider amending the standards for MREFs. As part of that process, DOE published a NOPR and announced a public meeting on March 31, 2023 ("March 2023 NOPR") seeking comment on its proposed amended standards to inform its decision consistent with its obligations under EPCA and the Administrative Procedure Act ("APA"). 88 FR 19382. DOE held a public webinar on May 2, 2023, to discuss and receive comments on the March 2023 NOPR and NOPR TSD ("May 2, 2023, public meeting"). The NOPR TSD is available at: *www.regulations.gov/document/EERE-2020-BT-STD-0039-0026*. The March 2023 NOPR proposed amended standards defined in terms of the AEU metrics as measured according to appendix A. *Id*. at 88 FR 19383-19384.

Although DOE is adopting the Joint Agreement as a direct final rule and no longer proceeding with its prior rulemaking, DOE did consider relevant comments, data, and information obtained during that rulemaking process in determining whether the recommended standards from the Joint Agreement are in accordance with 42 U.S.C. 6295(o). Any discussion of comments, data, or information in this direct final rule that were obtained during DOE's prior rulemaking will include a parenthetical reference that provides the location of the item in the public record.[23]

III. General Discussion

DOE is issuing this direct final rule after determining that the recommended standards submitted in the Joint Agreement meet the requirements in 42 U.S.C. 6295(p)(4). More specifically, DOE has determined that the recommended standards were submitted by interested persons that are fairly representative of relevant points of view and the recommended standards satisfy the criteria in 42 U.S.C. 6295(o).

A. Scope of Coverage

This direct final rule covers those consumer products that meet the definition of "miscellaneous refrigeration product~~" as codified at 10 CFR 430.2,~~" as codified at 10 CFR 430.2, which states that it is a consumer refrigeration product other than a refrigerator, refrigerator-freezer, or freezer, which includes coolers and combination cooler refrigeration products.

The differences between miscellaneous refrigeration products and other consumer refrigeration products, which were addressed in a separate rulemaking for refrigerators, refrigerator-freezers, and freezers, are largely in compartment temperature capability. Refrigerators are broadly defined as a cabinet capable of maintaining a compartment temperature above 32 °F and below 39 °F. Freezers are broadly defined as a

[23] The parenthetical reference provides a reference for information located in the docket of DOE's rulemaking to develop energy conservation standards for MREFs. (Docket No. EERE-2020-BT-STD-0039, which is maintained at *www.regulations.gov*). The references are arranged as follows: (commenter name, comment docket ID number, page of that document).

cabinet capable of maintaining compartment temperature of 0 °F or below. Refrigerator-freezers have two or more compartments, with one capable of maintaining compartment temperatures above 32° F and below 39 °F (*i.e.,* a fresh food or refrigerator compartment), and the other capable of maintaining a compartment temperature of 8 °F with adjustability down to 0 °F or below (*i.e.,* a frozen food or freezer compartment). Miscellaneous refrigeration products generally include a cooler compartment that is incapable of maintaining the low temperatures achieved by refrigerators, refrigerator-freezers, and freezers. Coolers (and cooler compartments) have temperature ranges that either extend no lower than 39 °F, or no lower than 37 °F but at least as high as 60 °F. Combination-coolers contain a fresh food and/or frozen food compartment in addition to one or more cooler compartments. *See* 10 CFR 430.2 for more information regarding consumer refrigeration products definitions.

When evaluating and establishing energy conservation standards, DOE divides covered products into product classes by the type of energy used, or by capacity, or based upon performance-related features that justify a higher or lower standard. (42 U.S.C. 6295(q)) 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. (*Id.*)

The Joint Agreement proposed approach for MREF product classes embeds within the energy use equations the difference between classes for MREFs that are otherwise identical except for presence of an icemaker, using a logical variable I (equal to 1 for a product with an icemaker and equal to 0 for a product without an icemaker) multiplied by the constant icemaker energy use adder.

The product class representation simplification in the Joint Agreement is consistent with what was proposed by DOE in the March 2023 NOPR. Based on the comments received in response to the March 2023 NOPR and DOE's evaluation of the Joint Agreement, this direct final rule adopts this change. See section IV.A.1 of this document for further detail and discussion regarding the product classes analyzed in this direct final rule.

B. Fairly Representative of Relevant Point of View

Under the direct final rule provision in EPCA, recommended energy conservation standards must be submitted 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 DOE. (42 U.S.C. 6295(p)(4)(A)) With respect to this requirement, DOE notes that the Joint Agreement included a trade association, AHAM, which represents 15 manufacturers of MREFs.[24] The Joint Agreement also included environmental and energy-efficiency advocacy organizations, consumer advocacy organizations, and a gas and electric utility company. As a result, DOE has determined that the Joint Agreement was submitted by interested persons who are fairly representative of relevant points of view. Additionally, DOE received a letter in support of the Joint Agreement from the States of New York, California, and Massachusetts. (See NYSERDA, et. al., No. 35 at p. 2) DOE also received a letter in support of the Joint Agreement from the gas and electric utility, SDG&E, and the electric utility, SCE (See SDG&E, et al., No. 36 at p. 1).

[24] Manufacturers listed in the Joint Agreement include: Asko Appliances AB, BSH Home Appliances Corporation, Danby Products, Ltd., Electrolux Home Products, Inc, GE Appliances, a Haier Company, Liebherr USA, Co., Electronics America Inc., LG Electronics, Midea America Corp., Miele, Inc., Panasonic Appliances Refrigeration Systems (PAPRSA) Corporation of America, Smeg S.p.A, Sub-Zero Group, Inc., The Middleby Corporation (listed with subsidiaries U-Line Corporation and Viking Range, LLC).

C. Technological Feasibility

1. General

In each energy conservation standards rulemaking, DOE conducts a screening analysis based on information gathered on all current technology options and prototype designs that could improve the efficiency of the products or equipment that are the subject of the rulemaking. As the first step in such an analysis, DOE develops a list of technology options for consideration in consultation with manufacturers, design engineers, and other interested parties. DOE then determines which of those means for improving efficiency are technologically feasible. DOE considers technologies incorporated in commercially available products or in working prototypes to be technologically feasible. Sections 6(b)(3)(i) and 7(b)(1) of appendix A to 10 CFR part 430, subpart C ("Process Rule").

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; (3) adverse impacts on health or safety and (4) unique-pathway proprietary technologies. Sections 7(b)(2)-(5) of the Process Rule. Section IV.B of this document 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 or amended 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(o)(2)(A)) 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 document and in chapter 5 of the direct final rule TSD.

D. Energy Savings

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 the amended standards (2029–2058).[25] 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 amended energy conservation standards.

DOE used its national impact analysis ("NIA") spreadsheet models to estimate national energy savings ("NES") from potential amended standards for MREFs. The NIA spreadsheet model (described in section IV.H of this document) calculates energy savings in terms of site energy, which is the energy directly consumed by products at the locations where they are used. For electricity, DOE reports national energy savings in terms of primary energy savings, which is the savings in the energy that is used to

[25] DOE also presents a sensitivity analysis that considers impacts for products shipped in a 9-year period.

generate and transmit the site electricity. For natural gas, the primary energy savings are considered to be equal to the site energy savings. DOE also calculates NES in terms of 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.[26] 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.

2. Significance of Savings

To adopt any new or amended 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))

The significance of energy savings offered by a new or amended energy conservation standard cannot be determined without knowledge of the specific circumstances surrounding a given rulemaking. For example, some covered products and equipment have most of their energy consumption occur during periods of peak energy demand. The impacts of these products on the energy infrastructure can be more pronounced than products with relatively constant demand. Accordingly, DOE evaluates the significance of energy savings on a case-by-case basis, taking into account the significance of cumulative FFC national energy savings, the cumulative FFC emissions reductions, and the need to confront the global climate crisis, among other factors.

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

As stated, the standard levels adopted in this direct final rule are projected to result in national energy savings of 0.32 quads (FFC), the equivalent of the primary annual energy use of 2.1 million homes. Based on the amount of FFC savings, the corresponding reduction in emissions, and need to confront the global climate crisis, DOE has determined the energy savings from the standard levels adopted in this direct final rule are "significant" within the meaning of 42 U.S.C. 6295(o)(3)(B).

E. Economic Justification

1. Specific Criteria

As noted previously, 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 amended standards on manufacturers, DOE conducts an MIA, as discussed in section IV.J of this document. DOE first uses an annual cash-flow approach to determine the quantitative impacts. This step includes both a short-term assessment—based on the cost and capital requirements during the period between when a regulation is issued and when entities must comply with the regulation—and a long-term assessment over a 30-year period. The industry-wide impacts analyzed include (1) 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 or amended standards. These measures are discussed further in the following section. For consumers in the aggregate, DOE also calculates the national net present value of the consumer costs and benefits expected to result from particular standards. DOE also evaluates the impacts of potential standards on identifiable subgroups of consumers that may be affected disproportionately by a standard.

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

EPCA requires DOE to consider the savings in operating costs throughout the estimated average life of the covered 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 or amended standards. The LCC savings for the considered efficiency levels are calculated relative to the case that reflects projected market trends in the absence of new or amended standards. 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 document 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 standard. (42 U.S.C. 6295(o)(2)(B)(i)(V)) It also directs the Attorney General to determine the impact, if any, of any lessening of competition likely to result from a standard and to transmit such determination to the Secretary within 60 days of the publication of a proposed rule, together with an analysis of the nature and extent of the impact. (42 U.S.C. 6295(o)(2)(B)(ii)) DOE will transmit a copy of this direct final rule to the Attorney General with a request that the Department of Justice ("DOJ") provide its determination on this issue. DOE will consider DOJ's comments on the rule in determining whether to withdraw the direct final rule. 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 and water conservation in determining whether a new or amended standard is economically justified. (42 U.S.C. 6295(o)(2)(B)(i)(VI)) The energy savings from the adopted standards are likely to provide improvements to the security and reliability of the Nation's energy system. Reductions in the demand for electricity also may result in reduced costs for maintaining the reliability of the Nation's electricity system. DOE conducts a utility impact analysis to estimate how standards may affect the Nation's needed power generation capacity, as discussed in section IV.M of this document.

DOE ~~maintains~~finds that environmental and public health benefits associated with the more efficient use of energy are important to take into account when considering the need for national energy conservation. The adopted standards are likely to result in environmental benefits in the form of reduced emissions of air pollutants and greenhouse gases ("GHGs") 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 estimated 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 an energy conservation standard is economically justified, DOE may consider any other factors that the Secretary deems to be relevant. (42 U.S.C. 6295(o)(2)(B)(i)(VII)) To the extent DOE identifies any relevant information regarding economic justification that does not fit into the other categories described previously, DOE could consider such information under "other factors."

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 amended 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 document.

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, including relevant comments DOE received in its separate rulemaking to amend the energy conservation standards for MREFs prior to receiving the Joint Agreement.

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 energy conservation standards. The national impacts analysis uses a second spreadsheet set that provides shipments projections 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: *www.regulations.gov/docket/EERE-2020-BT-STD-0039*. Additionally, DOE used output from the latest version of the Energy Information Administration's ("EIA's") *Annual Energy Outlook* ("*AEO*") for the emissions and utility impact analyses.

A. Market and Technology Assessment

DOE develops information in the market and technology assessment that provides an overall picture of the market for the 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 in the following sections. See chapter 3 of the direct final rule TSD for further discussion of the market and technology assessment.

1. Product Classes

The Joint Agreement specifies 11 product classes for MREFs. (Joint Agreement, No. 34 at p. 7) In particular, the Joint Agreement recommends a consolidated product class representation, which incorporates icemaker energy adders and door allowances into the energy use equations for product classes in which they are applicable. As discussed further in section IV.A.1.a of this document, DOE notes, that the consolidation of product class representation in the Joint Agreement does not combine the product classes, but rather serves to simplify the list of classes, in particular for those product classes with and without icemakers, and facilitates the implementation of a single equation for representation of their maximum allowable energy use. In this direct final rule, DOE is adopting the product classes from the Joint Agreement, as listed in Table IV.1.

Table IV.1 Recommended Product Classes for Miscellaneous Refrigeration Products

Product Class
1. Freestanding Compact Coolers (FCC)
2. Freestanding Coolers (FC)
3. Built-in Compact Coolers (BICC)
4. Built-in Coolers (BIC)
C-3A. Cooler with all-refrigerator – automatic defrost
C-3A-BI. Built-in cooler with all-refrigerator – automatic defrost
C-5-BI. Built-in cooler with all-refrigerator
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-13A. Compact cooler with all-refrigerator – automatic defrost
C-13A-BI. Built-in compact cooler with all-refrigerator – automatic defrost

DOE further notes that product classes established through EPCA's direct final rule authority are not subject to the criteria specified at 42 U.S.C. 6295(q)(1) for establishing product classes. Nevertheless, in accordance with 42 U.S.C. 6295(o)(4)—which is applicable to direct final rules—DOE has concluded that the standards adopted in this direct final rule will not result in the unavailability in any covered product type (or class) of performance characteristics, features, sizes, capacities, and volumes that are substantially the same as those generally available in the United States currently.[27] DOE's findings in this regard are discussed in detail in section V.B.4 of this document.

a. Product Classes with Automatic Icemakers

The Joint Agreement includes a proposed simplification of maximum allowable energy and expresses the maximum allowable energy use for both icemaking and non-icemaking classes in the same equation, thus consolidating the presentation of classes and

[27] EPCA specifies that DOE may not prescribe an amended or new standard if the Secretary finds (and publishes such finding) that 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 at the time of the Secretary's finding. (42 U.S.C. 6295(o)(4))

their energy conservation standards. The energy use equations will, for those classes that may or may not have an icemaker, include a term equal to the icemaking energy use adder multiplied by a factor that is defined to equal 1 for products with icemakers and to equal 0 for products without icemakers. This approach does not combine classes that are the same other than the presence of an icemaker but does simplify the list of classes and representation of their maximum allowable energy use, providing for each set of classes with and without ice makers a single equation for maximum energy use. This simplification is consistent with the approach proposed in the March 2023 NOPR. *See* 88 FR 19382, 19395.

In this direct final rule, DOE is adopting the Joint Agreement proposal to express the maximum allowable energy use for any set of classes differing only in whether the class includes an icemaker or not within a single equation. The single equation does this by including the icemaker energy use adder multiplied by logical variable I that is set equal to 1 for a product with an icemaker present and 0 for a product without an icemaker.

b. Addition of Product Class C-5-BI

The Joint Agreement recommends the addition of a new product class C-5-BI (*i.e.,* built-in combination cooler-refrigerator-freezers with bottom-mounted freezers and automatic icemakers) and specific energy efficiency standards for the new product class ("PC"). (Joint Agreement, No. 34 at p. 7) The current energy conservation standards for MREFs do not include a separate product class for products of this configuration. However, DOE has previously proposed establishing a separate product class for C-5-BI configurations in the March 2023 NOPR, with a baseline level of 6.08AV + 246 kWh/yr, based in part on input from commenters, and considered increased efficiency levels using PC C-3A-BI as a proxy. 88 FR 19382, 19395.

The Joint Agreement recommends a standard equation of 5.47AV + 196.2 + 28I kWh/yr for product class C-5-BI. DOE notes that this recommended level is consistent with the level proposed in the March 2023 NOPR for product class C-5-BI, which represents a 10 percent more stringent level than the baseline level identified in the March 2023 NOPR.

Considering that the recommendation is consistent with the proposed level in the March 2023 NOPR and carries support from a broad cross-section of interests, including trade associations representing these manufactures, environmental and energy-efficiency advocacy organizations, consumer advocates, and electric utility providers a well as the support of several States, DOE believes it appropriate to adopt this new product class, C-5-BI, and the recommended standard equation. DOE's direct rulemaking authority under 42 U.S.C. 6295(p)(4) is constrained only by the requirements of 42 U.S.C. 6295(o), which does not include the product class requirements in 42 U.S.C. 6295(q). However, DOE notes that the addition of a PC C-5-BI is warranted as the application of bottom-mounted freezer and icemaker on a built-in cooler with refrigerator-freezer provides consumers the utility of storage compartments at freezing, fresh food, and cooler temperature levels, whereas the current classes combine a cooler compartment with either a freezer or fresh food compartment, but not both. In addition, establishing separate classes of this configuration both with and without automatic icemaking addresses the unique utility of icemaking that may be included as part of the product. As a result of this additional utility, the application of a bottom-mounted freezer and icemaker constitutes a performance related feature.

Given the indication from the Joint Agreement that such a product class standard would be beneficial in its implementation, the classification of a bottom-mounted freezer and icemaker as performance related features, and the recommendation's consistency with the other adopted standards, DOE is adopting a PC C-5-BI standard in this direct final rule.

See section V of this document for more information regarding the TSL configuration and discussion of the adopted level for this product class. See chapter 5 of the direct final rule TSD for more discussion regarding the addition of this product class.

2. Technology Options

In the preliminary market analysis and technology assessment, DOE identified 36 technology options initially determined to improve the efficiency of MREFs, as measured by the DOE test procedure. In this direct final rule, DOE considered the technology options listed in Table IV.2, consistent with the table of technology options presented in the March 2023 NOPR. 88 FR 19382, 19395-19396. Chapter 3 of the direct final rule TSD includes a detailed list and descriptions of all technology options identified for MREFs.

Table IV.2 Technology Options Identified for MREFs

Insulation
1. Improved resistivity of insulation (insulation type)
2. Increased insulation thickness
3. Vacuum-insulated panels
4. Gas-filled insulation panels
Gaskets and Anti-Sweat Heat
5. Improved gaskets
6. Double door gaskets
7. Anti-sweat heat
Doors
8. Low-E coatings
9. Inert gas fill
10. Vacuum-insulated glass

11. Additional panes
12. Frame design
13. Solid door
Compressor
14. Improved compressor efficiency
15. Variable-speed compressors
16. Linear compressors
Evaporator
17. Increased surface area
18. Forced-convection evaporator
19. Tube and fin enhancements (including microchannel designs)
20. Multiple evaporators
Condenser
21. Increased surface area
22. Tube and fin enhancements (including microchannel designs)
23. Forced-convection condenser
Defrost System
24. Off-cycle defrost
25. Reduced energy for active defrost
26. Adaptive defrost
27. Condenser hot gas defrost
Control System
28. Electronic temperature control
29. Air-distribution control
Other Technologies
30. Fan and fan motor improvements
31. Improved expansion valve
32. Fluid control or solenoid off-cycle valve
33. Alternative refrigerants
34. Improved refrigerant piping
35. Component location
36. Alternative refrigeration systems

B. Screening Analysis

DOE uses the following five 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 commercially viable, existing prototypes will not be considered further.

(2) *Practicability to manufacture, install, and service.* If it is determined that mass production of a technology in commercial products and reliable installation and servicing of the technology 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.* If a technology is determined to have a significant adverse impact on the utility of the product to subgroups of consumers, or 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) *Safety of technologies.* If it is determined that a technology would have significant adverse impacts on health or safety, it will not be considered further.

(5) *Unique-pathway proprietary technologies.* If a technology has proprietary protection and represents a unique pathway to achieving a given efficiency level, it will not be considered further, due to the potential for monopolistic concerns.

10 CFR part 430, subpart C, appendix A, sections 6(b)(3) and 7(b).

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

The subsequent sections include DOE's evaluation of each technology option against the screening analysis criteria and whether DOE determined that a technology option should be excluded ("screened out") based on the screening criteria.

1. Screened-Out Technologies

In this direct final rule, DOE screened out the technologies presented in Table IV.3 on the basis of technological feasibility, practicability to manufacture, install, and service, adverse impacts on utility or availability, adverse impacts on health and safety, and/or unique-pathway proprietary technologies. Chapter 4 of the direct final rule TSD includes a detailed description of the screening analysis for each of these technology options.

Table IV.3 Technologies Screened Out in the Direct Final Rule

Solid doors
Ultra-low-E (reflective) glass doors
Vacuum-insulated glass
Improved gaskets and double gaskets
Linear compressors
Fluid control or solenoid off-cycle valves
Evaporator tube and fin enhancements
Condenser tube and fin enhancements (except microchannel condensers)
Condenser hot gas defrost
Improved refrigerant piping
Component location
Alternative refrigeration systems
Improved VIPs

2. Remaining Technologies

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

Table IV.4 Technologies Remaining in the Direct Final Rule

Insulation
1. Improved resistivity of insulation (insulation type)
2. Increased insulation thickness
3. Gas-filled insulation panels
4. Vacuum-insulated panels
Gasket and Anti-Sweat Heat
5. Anti-sweat heat
Doors
6. Low-E coatings
7. Inert gas fill
8. Additional panes
9. Frame design
Compressor
10. Improved compressor efficiency
11. Variable-speed compressors
Evaporator
12. Forced-convection evaporator
13. Increased surface area
14. Multiple evaporators
Condenser
15. Increased surface area
16. Microchannel designs
17. Forced-convection condenser
Defrost System
18. Reduced energy for automatic defrost
19. Adaptive defrost
20. Off-cycle defrost
Control System
21. Electronic Temperature control
22. Air-distribution control
Other Technologies
23. Fan and fan motor improvements
24. Improved expansion valve
25. Alternative Refrigerants

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 finds that all of the remaining technology options meet the other screening criteria (*i.e.*, practicable to manufacture, install, and service and do not result in adverse impacts on consumer utility, product availability, health, or safety). For additional details, see chapter 4 of the direct final rule TSD.

C. Engineering Analysis

The purpose of the engineering analysis is to establish the relationship between the efficiency and cost of MREFs. There are two elements to consider in the engineering analysis; the selection of efficiency levels to analyze (*i.e.*, the "efficiency analysis") and the determination of product cost at each efficiency level (*i.e.*, the "cost analysis"). In determining the performance of higher-efficiency products, DOE considers technologies and design option combinations not eliminated by the screening analysis. For each product class, DOE estimates the baseline cost, as well as the incremental cost for the product/equipment at efficiency levels above the baseline. The output of the engineering analysis is a set of cost-efficiency "curves" that are used in downstream analyses (*i.e.*, the LCC and PBP analyses and the NIA).

1. Efficiency Analysis

DOE typically uses one of two approaches to develop energy efficiency levels for the engineering analysis: (1) relying on observed efficiency levels in the market (*i.e.*, the efficiency-level approach), or (2) determining the incremental efficiency improvements associated with incorporating specific design options to a baseline model (*i.e.*, the design-option approach). Using the efficiency-level approach, the efficiency levels established for the analysis are determined based on the market distribution of existing products (in other words, based on the range of efficiencies and efficiency level "clusters" that already exist on the market). Using the design option approach, the efficiency levels established for the analysis are determined through detailed engineering calculations and/or computer simulations of the efficiency improvements from implementing specific design options that have been identified in the technology assessment. DOE may also rely on a combination of these two approaches. For example, the efficiency-level approach (based on actual products on the market) may be extended using the design option approach to interpolate to define "gap fill" levels (to bridge large gaps between other identified efficiency levels) and/or to extrapolate to the "max-tech" level (particularly in cases where the "max-tech" level exceeds the maximum efficiency level currently available on the market).

~~In defining the efficiency levels for this direct final rule, DOE considered comments it had received in response to the efficiency levels proposed in the March 2023 NOPR.~~ The approach used for this direct final rule to define the efficiency levels for analysis is largely the same as the approach DOE had used for the March 2023 NOPR analysis.

For its analysis in this direct final rule, DOE used a combined efficiency level and design option approach~~.~~ to directly analyze five products classes: freestanding compact coolers, freestanding coolers, and combination cooler classes C-13A, C-3A, and C-9. First, an efficiency-level approach was used to establish an analysis tied to existing products on the market. Several products from the cooler class (compact and standard size) and one product from the combination cooler class (C-13A) were used in physical teardowns. Additional analyses were conducted on classes C-3A and C-9; however, a lack of physical teardown products for these classes led DOE to rely heavily on adjusted analyses from the consumer refrigerator, refrigerator-freezer, and freezers ("RF") classes 3 and 9, respectively. Then, a design option approach was used to extend the analysis through "built-down" efficiency levels and "built-up" efficiency levels where there were gaps in the range of efficiencies of products that were reverse engineered. As discussed in the section that follows, DOE applied its direct analyses of freestanding products to the corresponding built-in product classes. DOE's direct analysis informed the adopted standards for those product classes that were not directly analyzed. See section 5.4.1 of the direct final rule TSD for more discussion on DOE's efficiency analysis.

a. Built-in Classes

In this direct final rule analysis, DOE used the freestanding MREF classes as proxies for built-in classes. DOE conducted analysis of the current market for miscellaneous refrigeration products and found that built-in and freestanding products occupy the same range of efficiencies, and DOE did not identify any unique characteristic that would inhibit efficiency improvements for built-in products relative to freestanding products based on a review on the market. As a result, DOE chose to apply its freestanding products analyses to built-in classes.

In response to the March 2023 NOPR, AHAM and Sub-zero Group Inc. ("Sub-zero") ~~commented~~argued that freestanding product classes are not a proxy for built-in product classes and DOE should evaluate them separately. (AHAM, No. 31 at p. 6; Sub-zero, No. 30 at p. 1) AHAM and Sub-zero stated that built-in products have constraints, such as incorporation into kitchen designs and needing to be flush with cabinetry, that affect that the technology options for achieving higher efficiency levels. (AHAM, No. 31 at pp. 6-7; Sub-zero, No. 30 at p. 2) AHAM and Sub-Zero also stated that different testing requirements for built-ins (*e.g.,* two inches or less of rear clearance for freestanding products as opposed to no rear clearance for built-in products) creates inherent design differences between the freestanding and built-in products. *Id.* AHAM and Sub-zero ~~encourage~~encouraged DOE to revise its analysis to ~~analyze~~ separately analyze freestanding and built-in products~~ in recognition~~, contending that these products are fundamentally different. (AHAM, No. 31 at p. 7; Sub-zero, No. 30 at p. 2)

With regards to the comments from AHAM and Sub-zero, DOE notes that, in its review of the MREF market, many products certified as freestanding have installation instructions that provide requirements for both freestanding and built-in installation and are advertised for both installations. DOE found that for such products, the majority of high-efficiency models are advertised as capable of both freestanding and built-in installations. For coolers between 2 and 6 cubic feet, DOE found that all the most efficient products reviewed (roughly 37 percent better than baseline or more) were capable of both configurations, whereas some of the products that were less efficient in that adjusted volume range were advertised as freestanding only. This suggests that built-in products are not inhibited in their ability to achieve high efficiencies. For larger coolers between 14 and 16 cubic feet in adjusted volume, DOE found products up to 15 percent greater than the baseline level that were configurable in both, based on manufacturer instructions. There were a few large cooler products that reached the highest available efficiency reviewed, up to roughly 30 percent better than baseline, that are advertised as only capable of a freestanding configuration.

DOE also reviewed the depth of the various models considered to determine if models advertised for built-in installation have any clear dimensional limitation that might make achieving high efficiency levels more difficult. DOE was unable to determine a clear correlation between depth and energy use for any of the models or capacity ranges considered, nor between depth and instructions or advertising for built-in installation. In fact, DOE found that the most efficient freestanding-only model in the large cubic volume range had the smallest depth of all the other models reviewed, suggesting that dimensional restriction on depth was not a key factor relative to the overall unit efficiency.

~~DOE also observed that the highest efficiency levels for coolers of the built-in class and efficiency levels for freestanding coolers having installation instructions or advertising for both freestanding and built-in installation were at or close to the maximum technology efficiency levels analyzed by DOE. DOE has not been provided evidence that manufacturers are using design options in built-ins other than those that have passed screening for this analysis nor was evidenced provided to suggest other design options have been used to achieve max-tech efficiency levels in built-in products. Hence, DOE concludes built-ins are using the same set of design options as analyzed at max-tech for freestanding classes. Consequently, DOE did not conduct separate analysis for built-in classes for this direct final rule.~~

As discussed in section IV.C.1.c of this document, the efficiency levels analyzed for this direct final rule represent a percentage reduction in energy use below the currently applicable standard for each product class. DOE's analysis of the freestanding product classes as a proxy for the built-in product classes does not presume that the two product types have the same nominal costs at each higher efficiency level, but rather reflects that *incremental* design changes associated with reducing energy use on a percentage basis—relative to the currently applicable standard for each respective product type—are substantially similar between freestanding and built-in products. To reflect the inherent design differences between built-in products compared to free-standing products, as described by commenters, DOE applied a $30, $50, or $150 adder (depending on product size) to the baseline costs for the built-in product classes compared to their freestanding counterparts. *See* chapter 5 of the direct final rule TSD for further details regarding the engineering analysis conducted for each product class.

b. Baseline Efficiency/Energy Use

For each product class, DOE generally selects a baseline model as a reference point for each class, and measures changes resulting from potential energy conservation standards against the baseline. The baseline model in each product class represents the characteristics of a product/equipment typical of that class (*e.g.*, capacity, physical size). Generally, a baseline model is one that just meets current energy conservation standards, or, if no standards are in place, the baseline is typically the most common or least efficient unit on the market. When selecting units for the analysis, DOE selects units at baseline from various manufacturers for each directly analyzed product class.

For this direct final rule, DOE chose baseline efficiency levels represented by the current Federal energy conservation standards, expressed as maximum annual energy consumption as a function of the product's adjusted volume. The baseline levels differ for coolers and combination coolers to account for design differences; all coolers share the same baseline level, *i.e.*, the baseline is the same function of adjusted volume for both freestanding and built-in models, for both compact and standard-size models. The current standards incorporate an allowance of a constant 84 kWh/yr icemaker adder for product classes with automatic icemakers, consistent with the current test procedure, which requires adding this amount of annual energy use to the products tested performance if the product has an automatic icemaker. DOE adjusted the baseline energy usage levels for each class to account for the planned revision in the test procedure to reduce the icemaker energy use adder to 28 kWh/yr. [28]

DOE directly analyzed a sample of market representative models from within five product classes from multiple manufacturers. Directly analyzed classes include three

[28] See the October 12, 2021 test procedure final rule for refrigeration products for more information regarding the adoption of the 28 kWh/yr icemaker adder. 86 FR 56790.

different AV coolers (AVs of 3 ft^3, 5 ft^3, and 15 ft^3) and three combination cooler classes (C-13A, C-9 and C-3A). In conducting these analyses, eight teardown units were used in construction of cost curves, and their characteristics were determined in large part by testing and reverse-engineering. Further information on the design characteristics of specific analyzed baseline models is summarized in section 5.4.1 of the direct final rule TSD.

c. Higher Efficiency Levels

As part of DOE's analysis, the maximum available efficiency level is the highest efficiency unit currently available on the market. DOE also defines a "max-tech" efficiency level to represent the maximum possible efficiency for a given product.

For this direct final rule, DOE analyzed up to five incremental efficiency levels beyond the baseline for each of the analyzed product classes. The efficiency levels begin at EL 1, which was 10 percent more efficient than the current MREF energy conservation standards. For the compact coolers analysis, DOE extended the efficiency levels in steps of 10 percent of the current energy conservation standard up to EL 4 at 40 percent; for full-size coolers, EL 4 is analyzed at 35 percent. For combination coolers (excluding C-9) efficiency levels above EL 1 are in steps of roughly 5 percent up to EL 4. Finally, EL 5 represents maximum technology ("max-tech"), which uses design option analysis to extend the analysis beyond EL 4 by using all applicable design options, including max efficiency variable-speed compressors and maximum practical use of vacuum-insulated panels ("VIPs"). For compact coolers, max tech stands at either 59 percent or 50 percent for the two directly analyzed AVs – 3.1 ft^3 and 5.1 ft^3 respectively; full-size coolers max-tech stands at 38 percent. For combination coolers C-13A and C-3A, max tech stands at 28 percent and 24 percent, respectively.

DOE conducted analysis for product class C-9 starting with analysis for a class 9 upright freezer with comparable total refrigerated volume. In its analysis, DOE concluded that application of all of the design options being considered at max-tech would be required for the product to be compliant with the current energy conservation standards. Currently, the Compliance Certification Database ("CCD") includes only one product that is certified as C-9 – an LG product certified with energy use 17 percent below the standard. DOE did not purchase, test, and reverse-engineer this product, in-part because of the limited product offering and expected insignificant potential for energy savings for the class. Thus, DOE is relying primarily on its analysis of the RF product class 9 freezer, to suggest that opportunities for energy savings are likely limited and likely not cost-effective, even if improved efficiency is technically feasible. DOE has not analyzed efficiency levels beyond baseline for this product class in this direct final rule but has taken into consideration all design options applied at max-tech in its analysis.

DOE notes the current Energy Star specifications correspond to EL 1 for freestanding full-size coolers (10 percent), EL 2 for freestanding compact coolers (20 percent), and EL 3 for both classes of built-in coolers (30 percent).[29]

The efficiency levels analyzed beyond the baseline are shown in Table IV.5 as follows.

Table IV.5 Incremental Efficiency Levels for Analyzed Products (% Energy Use Less than Baseline)

	Coolers			Combination Coolers	
Product Class (AV, cu.ft.)	FCC (3.1)	FCC (5.1)	FC (15.3)	C-13A (5)	C-3A (21)

[29] See EnergyStar, "Refrigerators & Freezers Key Product Criteria," Available at *www.energystar.gov/products/appliances/refrigerators/key_product_criteria* (last accessed July 14, 2023)

EL 1	10%	10%	10%*	10%	10%
EL 2	20%*	20%*	20%	16%	15%
EL 3	30%	30%	30%	20%	20%
EL 4	40%	40%	35%	25%	24%
EL 5	59%	50%	38%	28%	[redacted]

* Efficiencies at or slightly better than the ENERGY STAR® efficiency

d. Variable-Speed Compressor Supply Chain

In response to the March 2023 NOPR, AHAM suggested that DOE evaluate the robustness of the supply chains for variable-speed compressors ("~~VSC~~VSCs") while considering the growing demand given more stringent standards for cooling appliances, including both air conditioning and refrigeration. (AHAM, No. 31 at p. 5)

In considering this comment and comments provided in response to the RF rulemaking, DOE interviewed relevant compressor manufacturers to gather information regarding the level of VSC implementation that would be required at the efficiency levels analyzed in this direct final rule, the current and predicted supply of VSCs into the U.S. market, the predicted time to ramp up production of VSCs, and pricing of VSCs and components. ~~See section IV.C.e of the RF direct final rule for in-depth discussion on DOE's VSC supply chain research and analysis. 89 3049-3050 (Jan. 17, 2024) ("January 2024 RF DFR")~~None of the compressor manufacturers interviewed expressed any concerns regarding the ability to ramp-up VSC capacity in response to more stringent MREF standards. Compressor manufacturers additionally noted that any previous bottlenecks in the VSC supply chain are no longer a factor at this time, and that they have been modifying sourcing strategies to ensure a reliable supply of VSCs going forward. DOE concluded from these interviews that compressor manufacturers will be able to readily meet any increased demand for VSCs as a result of the adopted standards within the 5-year timeframe between publication of this direct final rule and the compliance date. DOE further notes that the amended standards adopted in this final rule reflect the recommendations of the Joint Agreement, of which AHAM was a signatory.

DOE notes that the VSCs focused on in the supply chain analysis conducted in the RF direct final rule differ from those utilized in air conditioners and other non-related cooling appliances that are mentioned in the comment from AHAM. VSCs utilized in refrigeration applications are generally different designs, are manufactured in different factories, and are generally produced by different manufacturers.

In addition to the analysis conducted for the January 2024 RF DFR, DOE notes that RF and MREF compressors are similar in design and may be the same for some configurations, depending on the required compressor capacity. Given the similarities and applicability of these compressors design for refrigeration equipment, DOE anticipates that the uptick in VSC production resulting from amended standards for RFs would naturally satisfy the additional demand for MREF VSC compressors resulting from the adoption of amended standards in this direct final rule.

Furthermore, DOE estimates that total MREF shipments for 2022 are approximately 1.6 million units, , which is relatively insignificant when compared to the estimated 12 million and 2 million standard and compact RFs shipped in 2020, respectively, and thus the impact of additional VSC demand due to more stringent MREF standards is far less of an issue. DOE therefore expects that compressor manufacturers could readily meet any increased demand for MREF VSCs within the 5-year timeframe between publication of this direct final rule and the compliance date.

In considering all of the information provided by relevant manufacturers of VSCs, DOE believes that increases in VSCs in the U.S. market aligned with the adopted standard levels are well within the production capacity of the compressor industry.

2. Cost Analysis

The cost analysis portion of the engineering analysis is conducted using one or a combination of cost approaches. The selection of cost approach depends on a suite of factors, including the availability and reliability of public information, characteristics of the regulated product, the availability and timeliness of purchasing the product on the market. The cost approaches are summarized as follows:

- *Physical teardowns:* Under this approach, DOE physically dismantles a commercially available product, component-by-component, to develop a detailed bill of materials for the product.
- *Catalog teardowns:* In lieu of physically deconstructing a product, DOE identifies each component using parts diagrams (available from manufacturer websites or appliance repair websites, for example) to develop the bill of materials for the product.
- *Price surveys*: If neither a physical nor catalog teardown is feasible (for example, for tightly integrated products such as fluorescent lamps, which are infeasible to disassemble and for which parts diagrams are unavailable) or cost-prohibitive and otherwise impractical (*e.g.*, large commercial boilers), DOE conducts price surveys using publicly available pricing data published on major online retailer websites and/or by soliciting prices from distributors and other commercial channels.

In the present case, DOE conducted the analysis using primarily physical teardowns. Where possible, physical teardowns were used to provide a baseline of technology options and pricing for a specific product class at a specific EL. Then with technology option information, DOE estimated the cost of various design options including compressors, VIPs, and insulation, by extrapolating the costs from price surveys. With specific costs for technology options, DOE was then able to "build-up" or "build-down" from the various teardown models to finish the cost-efficiency curves. DOE used this approach to calibrate the analysis to certified or measured energy use of specific available models where possible, while allowing a broader range of potential efficiency levels to be considered.

The resulting bill of materials provides the basis for the manufacturer production cost ("MPC") estimates.

To account for manufacturers' non-production costs and profit margin, DOE applies a multiplier (the manufacturer markup) to the MPC. The resulting manufacturer selling price ("MSP") is the price at which the manufacturer distributes a unit into commerce. DOE developed an average manufacturer markup by examining corporate annual reports and Securities and Exchange Commission ("SEC") 10-K reports[30] filed by publicly traded manufacturers in primarily engaged in appliance manufacturing and whose combined product range includes MREFs. DOE then compared the manufacturer markups derived from the financials to the manufacturer markups estimated in the October 2016 Direct Final Rule. 81 FR 75194, 75224-75225. See chapter 12 of the direct final rule TSD for additional detail on the manufacturer markup.

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[30] U.S. Securities and Exchange Commission, Electronic Data Gathering, Analysis, and Retrieval (EDGAR) system. Available at *www.sec.gov/edgar/search/* (last accessed January 30, 2024).

3. Cost-Efficiency Results

The results of the engineering analysis are reported as cost-efficiency data (or "curves") in the form of AEU (in kWh) versus MPC (in dollars), which form the basis for subsequent analyses.

DOE developed estimates of MPCs for each unit in the teardown sample, and also performed additional modeling for each of the teardown samples, to extend the analysis to cover the range of efficiency levels appropriate for a representative product. To estimate the MPCs necessary to achieve higher efficiency levels, in particular those beyond the highest-efficiency products in the test sample, DOE considered design options that were most likely to be considered and implemented by manufacturers to achieve the higher efficiency levels. Based on input from manufacturers and an understanding of the markets, DOE then estimated the costs associated with those design ~~option~~options to determine the MPCs at each of the analyzed efficiency levels.

The resulting weighted average incremental design option by efficiency level and cost curves for each directly analyzed product class are (*i.e.,* the additional costs manufacturers would likely incur by producing miscellaneous refrigeration products at each efficiency level compared to the baseline) are provided in Tables IV.6 and IV.7 as follows. See chapter 5 of the direct final rule TSD for additional detail on the engineering analysis and formulation of cost curves.

Table IV.6 Incremental Design Options* by Efficiency Level and Product Class

Product Class (AV*)**		**EL1**	**EL2**	**EL3**	**EL4**	**EL5**
FCC (3.1)	EL Percent	10%	20%	30%	40%	59%

	Design Options Added	Higher EER Compressor; Argon Filled Glass	Tube and Fin Condenser; Brushless DC Evaporator Fan	Higher-EER Compressor; Tube and Fin Evaporator; Brushless DC Condenser Fan	Variable-Speed Compressor; Higher EER Compressor; Roll Bond Evaporator; Increased Insulation Thickness	Partial VIP Coverage; Triple Pane Glass**; Tube and Fin Bond Evaporator
FCC (5.1)	EL Percent	10%	20%	30%	40%	50%
	Design Options Added	Argon Filled Glass; Higher-EER Compressor	Higher-EER Compressor	Higher-EER Compressor; Hot Wall + Tube and Fin Condenser	Higher-EER Compressor; Tube and Fin Evaporator; Increased Insulation Thickness	Variable-Speed Compressor; Partial VIP Coverage; Triple Pane Glass**
FC (15.3)	EL Percent	10%	20%	30%	35%	38%
	Design Options Added	Higher-EER Compressor; Hot Wall + Tube and Fin Condenser	Higher-EER Compressor	Variable-Speed Compressor; Variable Defrost; 3x Tube and Fin Evaporator; Increased Insulation Thickness	Triple Pane Glass**	Partial VIP Coverage
C-13A (5)	EL Percent	10%	16%	20%	25%	28%
	Design Options Added	Higher-EER Compressor	Higher-EER Compressor	Variable-Speed Compressor	Triple Pane Glass**	Partial VIP Coverage
C-3A (20.6)	EL Percent	10%	15%	20%	24%	
	Design Options Added	Higher-EER Compressor	Variable-Speed Compressor; Variable (off-cycle) Defrost	Triple Pane Glass**; Timed (off-cycle) Defrost; Higher-EER Variable Speed Compressor	Partial VIP Coverage; Variable (off-cycle) Defrost	

*Design options are cumulative between efficiency levels (except for component replacements)
** Triple-pane glass pack consists of soft-coated low-E glass and argon gas fill (with a reduced gap size to maintain door thickness)
*** AV represented in ft^3

Table IV.7 Cost-Efficiency Curves for Miscellaneous Refrigeration Products

Product Class (AV*)		**EL0**	**EL1**	**EL2**	**EL3**	**EL4**	**EL5**
FCC (3.1)	EL Percent	0%	10%	20%	30%	40%	59%
	MPC	$298.10	$301.43	$317.16	$334.32	$367.99	$425.94
	Incremental MPC	$0.00	$3.33	$19.06	$36.22	$69.88	$127.83
FCC (5.1)	EL Percent	0%	10%	20%	30%	40%	50%
	MPC	$337.79	$340.92	$343.33	$359.55	$386.02	$477.10
	Incremental MPC	$0.00	$3.13	$5.53	$21.76	$48.23	$139.31
FC (15.3)	EL Percent	0%	10%	20%	30%	35%	38%
	MPC	$699.52	$714.82	$718.24	$762.98	$921.40	$957.10
	Incremental MPC	$0.00	$15.30	$18.72	$63.46	$221.87	$257.57
C-13A (5)	EL Percent	0%	10%	16%	20%	25%	28%
	MPC	$571.07	$573.07	$574.83	$603.56	$651.33	$677.23
	Incremental MPC	$0.00	$2.00	$3.76	$32.48	$80.26	$106.16
C-3A (20.6)	EL Percent	0%	10%	15%	20%	24%	
	MPC	$540.00	$543.17	$578.47	$698.50	$742.55	
	Incremental MPC	$0.00	$3.17	$38.47	$158.50	$202.55	
C-9 (20)**	EL Percent	0%					
	MPC	$800					
	Incremental MPC	$0.00					

* Adjusted volumes provided in ft^3
** Only considered at baseline

D. Markups Analysis

The markups analysis develops appropriate markups (*e.g.*, retailer markups, distributor markups, contractor markups) in the distribution chain and sales taxes to convert the MSP estimates derived in the engineering analysis to consumer prices, which are then used in the LCC and PBP 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, DOE identified two distribution channels: (1) manufacturers to retailers to consumers, and (2) manufacturers to wholesalers to dealers/retailers to consumers. The parties involved in the distribution channel are retailers, wholesalers, and dealers.

DOE developed baseline and incremental markups for each actor in the distribution chain. Baseline markups are applied to the price of products with baseline efficiency, while incremental markups are applied to the difference in price between baseline and higher-efficiency models (the incremental cost increase). The incremental markup is typically less than the baseline markup and is designed to maintain similar per-unit operating profit before and after new or amended standards.[31]

DOE relied on economic data from the U.S. Census Bureau to estimate average baseline and incremental markups. Specifically, DOE used the 2017 Annual Retail Trade Survey for the "electronics and appliance stores" sector to develop retailer markups,[32]and the 2017 Annual Wholesaler Trade Survey for the "household appliances, and electrical and electronics goods merchant wholesalers" sector to estimate wholesaler markups.[33] For the wholesaler to dealer/retailer channel, DOE assumed that the dealer markups are half of the retailer markups in the retailer channel.

For this direct final rule, DOE considered comments it had received regarding the markups analysis conducted for the March 2023 NOPR. The approach used for this direct final rule is largely the same as the approach DOE had used for the March 2023 NOPR analysis.

In response to the March 2023 NOPR, AHAM commented on DOE's reliance on the concept of incremental markups, stating that it is based on discredited theory, and it is

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[31] Because the projected price of standards-compliant products is typically higher than the price of baseline products, using the same markup for the incremental cost and the baseline cost would result in higher per-unit operating profit. While such an outcome is possible, DOE maintains that in markets that are reasonably competitive it is unlikely that standards would lead to a sustainable increase in profitability in the long run.

[32] U.S. Census Bureau, *Annual Retail Trade Survey.* 2017. Available at *www.census.gov/programs-surveys/arts.html.*

[33] U.S. Census Bureau, *Annual Wholesale Trade Survey.* 2017. Available at *www.census.gov/awts.*

in contradiction to empirical evidence provided by AHAM during a 2014 proposed rulemaking for energy conservation standards for residential dishwashers. (AHAM, No. 31 at p. 9)

DOE's incremental markup approach assumes that an increase in profitability, which is implied by keeping a fixed markup when the product price goes up due to higher efficiency standards, is unlikely to be viable over time in a reasonably competitive market like household appliance retailers. The Herfindahl-Hirschman Index ("HHI") reported by the 2017 Economic Census indicates that the household appliance stores sector (NAICS 443141) is a highly competitive marketplace.[34] DOE recognizes that actors in the distribution chains are likely to seek to maintain the same markup on appliances in response to changes in manufacturer selling prices after an amendment to energy conservation standards. However, DOE believes that retail pricing is likely to adjust over time as those actors are forced to readjust their markups to reach a medium-term equilibrium in which per-unit profit is relatively unchanged before and after standards are implemented.

DOE acknowledges that markup practices in response to amended standards are complex and ~~varying~~vary with business conditions. However, DOE's analysis necessarily only considers changes in appliance offerings that occur in response to amended standards and isolate the effect of amended standards from other factors. Obtaining data on markup practices in the situation described ~~above~~previously is very

[34] 2017 Economic Census, Selected sectors: Concentration of largest firms for the U.S. Available at *www.census.gov/data/tables/2017/econ/economic-census/naics-sector-44-45.html.* The Herfindahl-Hirschman Index value can be found by navigating to the "Concentration of largest firms for the U.S." table and then filtering the industry code to NAICS 443141.The Herfindahl-Hirschman Index reported for the largest 50 firms in household appliance stores sector, is 123.8. Generally, a market with an HHI value of under 1,000 is considered to be competitive.

challenging. Hence, DOE continues to maintain that its assumption that standards do not facilitate a sustainable increase in profitability is reasonable.

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

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 performed, particularly assessments of the energy savings and the savings in consumer operating costs that could result from adoption of amended or new standards.

DOE determined a range of annual energy use of MREFs as a function of unit volume. As shown in Table IV.8, DOE developed distributions of adjusted volume of product classes with more than one representative unit base on the capacity distributions reported in the TraQline® wine chiller data spanning from 2020 Q1 to 2022 Q1.[35] DOE also developed a sample of households that use MREFs based on the TraQline wine chiller data (see section IV.F of this document for details). For each volume and considered efficiency level, DOE derived the energy consumption as measured by the DOE MREF test procedure at appendix A.

[35] TraQline is a market research company that specialized in tracking consumer purchasing behavior across a wide range of products using quarterly online surveys.

Table IV.8 Distribution of Adjusted Interior volumes by Product Class

Adjusted Volume (ft^3)	Percentage
Cooler-FC	
3.1	83.4
5.1	16.6
Cooler-BIC	
3.1	81.3
5.1	18.7
Cooler-F and Cooler-BI	
15.3	100.0
C-3A	
21	100.0
C-9	
20	100.0
C-13A	
5	100.0

For this direct final rule, DOE considered comments it had received regarding the energy use analysis conducted for the March 2023 NOPR. The approach used for this direct final rule is largely the same as the approach DOE had used for the March 2023 NOPR analysis.

In response to the March 2023 NOPR, AHAM commented that DOE relies heavily on the EIA's Residential Energy Consumption Survey (''RECS'') data for estimating energy use and how consumption varies at the household level. Specifically, AHAM expressed concern that the use of RECS data to estimate energy consumption at the household level may introduce ''outlier values,'' resulting in uncertainty and inaccuracies (AHAM, No. 31 at p. 11) In this direct final rule, as well as in the March 2023 NOPR, DOE did not tie the energy consumption of MREFs to RECS survey data. 87 FR 35678. No household or demographic information from RECS ~~affects~~was used in the energy ~~consumption of a particular household~~use analysis for MREFs. Instead, as mentioned above, DOE used the TraQline wine chiller data to develop a sample of households representing MREF purchasers and derived the energy consumption of

MREFs as measured by the DOE MREF test procedure. DOE further notes that AHAM is a party to the Joint Agreement and is supportive of the recommended standards adopted in this direct final rule.

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 is the total consumer expense of an appliance or product over the life of that product, consisting of total installed cost (manufacturer selling price, 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.

- 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 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 or amended energy conservation standards. In contrast, the PBP for a given efficiency level is measured relative to the baseline product.

For this direct final rule, DOE considered comments it had received regarding the LCC analysis conducted for the March 2023 NOPR. The LCC approach used for this direct final rule is largely the same as the approach DOE had used for the March 2023 NOPR analysis.

During the May 2, 2023, public meeting, Edison Electric Institute ("EEI") questioned the cost-effectiveness of the proposed TSL (TSL 4), due to the high percentage of consumers experiencing a net LCC cost and the simple payback period results ranging from 6.8 to ~~eight~~8 years, and urged DOE to consider selecting another TSL that may be more cost-effective for consumers. (May 2, 2023, Public Meeting Transcript, No. 33 at pp. 5-6). In response, DOE notes that when deciding whether a proposed standard is economically justified, DOE determines whether the benefits of the standard exceed its burdens by considering the seven statutory factors discussed in section II.A of this document. DOE considered the seven statutory factors when evaluating the Recommended TSL in the Joint Agreement. ~~DOE provides a~~As discussed in section V.C.1 of this document, overall, the LCC savings would be positive for all MREF product classes, and, while 43.7 percent of MREF consumers would experience a net cost, slightly more than half of MREF consumers would experience a net benefit (52.9 percent). DOE provides a detailed comparative discussion and rigorous justification on the adopted TSL (the Recommended TSL) in section V.C.1 of this document.

For each considered efficiency level in each product class, DOE calculated the LCC and PBP for a nationally representative set of MREF purchasers. As stated previously, DOE developed purchaser samples based on TraQline wine chiller survey data. The survey panel is weighted against the U.S. Census based on their demographic characteristics to make the sample representative of the U.S. population. The wine chiller survey asked respondents about the product features of the wine chillers they recently purchased, as well as the purchasing channel of the products. To account for the more recent MREF consumers, DOE used the latest twolast 2 years of survey data (2020 Q1 to 2022 Q1) to construct the household sample used in this direct final rule.

For each sample purchaser, DOE determined the energy consumption for the MREFs and the appropriate energy price. By developing a representative sample of purchasers, 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 lifetime, 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 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 for products at each efficiency level for 10,000 MREF purchasers per simulation run. The analytical results include a distribution of 10,000 data points showing the range of LCC savings for a given efficiency level relative to the no-new-standards case efficiency distribution. In performing an iteration of the Monte Carlo simulation for a given consumer, product efficiency is chosen based on its probability. If the chosen product efficiency is greater than or equal to the efficiency of the standard level under consideration, the LCC calculation reveals that a consumer is not impacted by the standard level. By accounting for consumers who already purchase more-efficient products, DOE avoids overstating the potential benefits from increasing product efficiency.

DOE calculated the LCC for consumers of MREFs as if each were to purchase a new product in the first year of required compliance with amended standards. As discussed earlier in this document, the compliance date of amended standards is January 31, 2029, for TSL 4 (the Recommended TSL detailed in the Joint Agreement). For all other TSLs considered in this direct final rule, standards apply to MREFs manufactured 5 years after the date on which any amended standard is published. (42 U.S.C. 6295(l)(2)) Therefore, DOE used 2029 as the first year of compliance with any amended standards for MREFs for all TSLs.

Table IV.9 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.9 Summary of Inputs and Methods 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. Used historical data to derive a price scaling index to project product costs.
Installation Costs	Assumed no change with efficiency level. Not considered in the analysis.
Annual Energy Use	Derived from engineering inputs (see chapter 5 of the direct final rule TSD). Variability: Based on the product class and rep unit volume, where applicable.
Energy Prices	Electricity: Based on 2022 average and marginal electricity price data from the Edison Electric Institute. Variability: Electricity prices vary by region.
Energy Price Trends	Based on *AEO2023* price projections.
Repair and Maintenance Costs	Assumed no change with efficiency level. Not considered in the analysis.
Product Lifetime	Sample weighted average: 12.6 years
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	2029

* Not used for PBP calculation. References for the data sources mentioned in this table are provided in the sections following the table or in chapter 8 of the direct final rule TSD.

In response to the March 2023 NOPR, AHAM commented that ~~DOE~~ should be conducting a purchase decision analysis in its LCC model to reflect the actual conditions and expectations of the purchaser rather than relying on an outcome modeling approach. (AHAM, No. 31 at ~~p. 15~~pp. 8-9) In the current setup of LCC analysis, DOE is not explicitly modeling the purchase decision made by purchasers when the standard becomes effective. DOE's analysis is intended to model the range of individual outcomes likely to result from a hypothetical amended energy conservation standard at various levels of efficiency. DOE does not discount the consumer decision theory established in the broad behavioral economics field but rather notes that its methodological decision was made after considering the existence of various systematic market failures and their implication in rational versus actual purchase behavior. Furthermore, the outcome of the LCC is not considered in isolation, but in the context of the broader set of analyses, including the NIA. Moreover, the type of data required to facilitate a robust consumer choice modeling of a specific household appliance at the individual household level is currently lacking and AHAM did not provide much data.

DOE further notes that AHAM is a party to the Joint Agreement and is supportive of the recommended standard adopted in this direct final rule.

1. Product Cost

To calculate consumer product costs, DOE multiplied the MPCs developed in the engineering analysis by the markups described previously (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.

Economic literature and historical data suggest that the real costs of many products may trend downward over time according to "learning" or "experience" curves. Experience curve analysis implicitly includes factors such as efficiencies in labor, capital investment, automation, materials prices, distribution, and economies of scale at an industry-wide level.[36] In the experience curve method, the real cost of production is related to the cumulative production or "experience" with a manufactured product. As MREFs use similar technologies to RF, DOE applied the same experience curve developed for RF to MREFs. DOE used inflation-adjusted historical Producer Price Index ("PPI") data for "household refrigerator and home freezer manufacturing" from the Bureau of Labor Statistics' ("BLS") spanning the time period between 1981 and 2022,[37] along with the cumulative production of RF to derive the experience curve. The

[36] Taylor, M. and Fujita, K.S. Accounting for Technological Change in Regulatory Impact Analyses: *The Learning Curve Technique*. LBNL-6195E. Lawrence Berkeley National Laboratory, Berkeley, CA. April 2013. Available at *escholarship.org/uc/item/3c8709p4#page-1*.
[37] Household refrigerator and home freezer manufacturing PPI series ID: PCU3352203352202. Available at *www.bls.gov/ppi/*.

estimated learning rate (defined as the fractional reduction in price expected from each doubling of cumulative production) is 39.4 ± 1.9 percent.

DOE included variable-speed compressors as a technology option for higher efficiency levels. To develop future prices specific for that technology, DOE applied a different price trend to the controls portion of the variable-speed compressor, which represents part of the price increment when moving from an efficiency level achieved with the highest efficiency single-speed compressor to an efficiency level with variable-speed compressor. DOE used PPI data on "semiconductors and related device manufacturing" between 1967 and 2022 to estimate the historic price trend of electronic components in the control.[38] The regression, performed as an exponential trend line fit, results in an R-square of 0.99, with an annual price decline rate of 6.3 percent. See chapter 8 of the TSD for further details on this topic.

In response to the March 2023 NOPR, AHAM commented that there is no theoretical underpinning for the implementation of an experience or learning curve and the functional form it should take. In addition, AHAM stated that the data that DOE used merely represents an empirical relationship, and a clear connection between the actual products in question and the data used needs to be made. AHAM noted that there is little reason to support the concept that price learning through manufacturing efficiencies should extend beyond the labor and materials in the product itself, and that such a relationship should not hold for other cost components. (AHAM, No. 31 at p. 10)

DOE notes that there is considerable empirical evidence of consistent price declines for appliances in the past few decades. Several studies examined retail prices of

[38] Semiconductors and related device manufacturing PPI series ID: PCU334413334413. Available at *www.bls.gov/ppi/*.

a wide range of household appliances during different periods of time and showed that prices had been steadily falling while efficiency had been increasing, for example Dale, *et al*. (2009)[39] and Taylor, *et al*. (2015).[40] As mentioned in Taylor and Fujita (2013),[41] Federal agencies have adopted different approaches to account for "the changing future compliance costs that might result from technological innovation or anticipated behavioral changes." Given the limited data availability on historical manufacturing costs broken by different components, DOE utilized the PPI published by the BLS as a proxy for manufacturing costs to represent the analyzed product as a whole.[42] While products may experience varying degrees of price learning during different product stages, given that MREFs share similar cooling technologies with RF, DOE applied the same learning rate developed for RF to MREFs. DOE modeled the average learning rate based on the full historical PPI series for "household refrigerator and home freezer manufacturing" to capture the overall price evolution in relation to the cumulative shipments. DOE also conducted sensitivity analyses that are based on a particular segment of the PPI data to investigate the impact of alternative product price projections (low price learning and high price learning) in the NIA of this direct final rule. DOE further notes that AHAM is a party to the Joint Agreement and is supportive of the recommended standard adopted in this direct final rule.

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[39] Dale, L., C. Antinori, M. McNeil, James E. McMahon, and K. S. Fujita. Retrospective evaluation of appliance price trends. Energy Policy. 2009. 37 pp. 597–605.

[40] Taylor, M., C. A. Spurlock, and H.-C. Yang. Confronting Regulatory Cost and Quality Expectations. An Exploration of Technical Change in Minimum Efficiency Performance Standards. 2015. Lawrence Berkeley National Lab. (LBNL), Berkeley, CA (United States). Report No. LBNL-1000576. (last accessed June 30, 2023.) Available at *www.osti.gov/biblio/1235570/* (last accessed June 30, 2023).

[41] Taylor, M. and K. S. Fujita. Accounting for Technological Change in Regulatory Impact Analyses: The Learning Curve Technique. 2013. Lawrence Berkeley National Lab (LBNL), Berkeley, CA (United States). Report No. LBNL-6195E. Available at ~~*http*~~*https://escholarship.org/uc/item/3c8709p4* (last accessed ~~July 20, 2023~~March 24, 2024).

[42] PPI is a proxy for manufacturing costs as certain effects (such as market structure and competitive effects) could influence PPI in a way that would not be reflected in manufacturing costs.

[1] Dale, L., C. Antinori, M. McNeil, James E. McMahon, and K. S. Fujita. Retrospective evaluation of appliance price trends. Energy Policy. 2009. 37 pp. 597–605.
[2] Taylor, M., C. A. Spurlock, and H.-C. Yang. Confronting Regulatory Cost and Quality Expectations. An Exploration of Technical Change in Minimum Efficiency Performance Standards. 2015. Lawrence Berkeley National Lab. (
), Berkeley, CA (United States). Report No. LBNL-1000576. (Last accessed June 30, 2023.) Available at *www.osti.gov/biblio/1235570/* (last accessed June 30, 2023).
[3] Taylor, M. and K. S. Fujita. Accounting for Technological Change in Regulatory Impact Analyses: The Learning Curve Technique. 2013. Lawrence Berkeley National Lab (LBNL), Berkeley, CA (United States). Report No. LBNL-6195E. Available at *escholarship.org/uc/3c8709p4* (last accessed July 20, 2023).

2. Installation Cost

Installation cost includes labor, overhead, and any miscellaneous materials and parts needed to install the product. DOE is not aware of any data that suggest the cost of installation changes as a function of efficiency for MREFs. DOE therefore assumed that installation costs are the same regardless of EL and do not impact the LCC or PBP. As a result, DOE did not include installation costs in the LCC and PBP analysis.

3. Annual Energy Consumption

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

4. Energy Prices

Because marginal electricity price more accurately captures the incremental savings associated with a change in energy use from higher efficiency, it provides a better representation of incremental change in consumer costs than average electricity prices. Therefore, DOE applied average electricity prices for the energy use of the product purchased in the no-new-standards case, and marginal electricity prices for the incremental change in energy use associated with the other efficiency levels considered.

DOE derived electricity prices in 2022 using data from EEI Typical Bills and Average Rates reports. Based upon comprehensive, industry-wide surveys, this semi-annual report presents typical monthly electric bills and average kilowatt-hour costs to the customer as charged by investor-owned utilities. For the residential sector, DOE calculated electricity prices using the methodology described in Coughlin and Beraki (2018).[43]

DOE's methodology allows electricity prices to vary by sector, region, and season. In the analysis, variability in electricity prices is chosen to be consistent with the way the consumer economic and energy use characteristics are defined in the LCC analysis. See chapter 8 of the direct final rule TSD for details.

To estimate energy prices in future years, DOE multiplied the 2022 energy prices by the projection of annual average price changes from the Reference case in *AEO2023*, which has an end year of 2050.[44] To estimate price trends after 2050, the 2046–2050 average was used for all years.

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. Typically, small incremental increases in product efficiency

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[43] Coughlin, K. and B. Beraki.2018. Residential Electricity Prices: A Review of Data Sources and Estimation Methods. Lawrence Berkeley National Lab. Berkeley, CA. Report No. LBNL-2001169. Available at *https://ees.lbl.gov/publications/residential-electricity-prices-review*.

[44] EIA. Annual Energy Outlook 2023. Available at *www.eia.gov/outlooks/aeo/* (last accessed November 29, 2023).

entail no, or only minor, changes in repair and maintenance costs compared to baseline efficiency products. DOE is not aware of any data that suggest the cost of repair or maintenance for MREFs changes as a function of efficiency. DOE therefore assumed that these costs are the same regardless of EL and do not impact the LCC or PBP. As a result, DOE did not include maintenance and repair costs in the LCC and PBP analysis.

6. Product Lifetime

For MREFs, DOE used lifetime estimates from products that operate using the same refrigeration technology: covered refrigerators and refrigerator-freezers~~. DOE assumed~~, based on the Refrigerators, Refrigerator-Freezers, and Freezers direct final rule analysis. 89 FR 3026 (January 17, 2024). DOE estimated a maximum lifetime of 40 years for all product classes and an average lifetime of 10.6 years for compact coolers and 14.6 years for full-size coolers. The weighted average lifetime over the sample population, considering the market distribution, was 12.6 years. DOE also assumed that the probability function for the annual survival of MREFs would take the form of a Weibull distribution. See chapter 8 of the direct final rule TSD for a more detailed discussion.

7. Discount Rates

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

DOE applies weighted average discount rates calculated from consumer debt and asset data, rather than marginal or implicit discount rates.[45] The LCC analysis estimates net present value over the lifetime of the product, so the appropriate discount rate will reflect the general opportunity cost of household funds, taking this time scale into account. Given the long-time horizon modeled in the LCC, the application of a marginal interest rate associated with an initial source of funds is inaccurate. Regardless of the method of purchase, consumers are expected to continue to rebalance their debt and asset holdings over the LCC analysis period, based on the restrictions consumers face in their debt payment requirements and the relative size of the interest rates available on debts and assets. DOE estimates the aggregate impact of this rebalancing using the historical distribution of debts and assets.

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 triennial Survey of Consumer Finances[46] ("SCF") starting in 1995 and ending in 2019. 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 amended standards would take effect. DOE assigned each sample household a specific discount rate drawn from one of

[45] The implicit discount rate is inferred from a consumer purchase decision between two otherwise identical goods with different first cost and operating cost. It is the interest rate that equates the increment of first cost to the difference in net present value of lifetime operating cost, incorporating the influence of several factors: transaction costs; risk premiums and response to uncertainty; time preferences; interest rates at which a consumer is able to borrow or lend. The implicit discount rate is not appropriate for the LCC analysis because it reflects a range of factors that influence consumer purchase decisions, rather than the opportunity cost of the funds that are used in purchases.

[46] U.S. Board of Governors of the Federal Reserve System. Survey of Consumer Finances. 1995, 1998, 2001, 2004, 2007, 2010, 2013, 2016, and 2019. Available at *https://www.federalreserve.gov/econresdata/scf/scfindex.htm* (last accessed November 29, 2023).

the distributions. The average rate across all types of household debt and equity and income groups, weighted by the shares of each type, is 4.2 percent. See chapter 8 of the direct final rule TSD for further details on the development of consumer discount rates.

8. Energy 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 under the no-new-standards case (*i.e.*, the case without amended or new energy conservation standards).

For this direct final rule, DOE is using the efficiency distribution by product class as provided by AHAM in response to a notice of public meeting and availability of the preliminary technical support document for MREFS. 87 FR 3229 (Jan. 21, 2022) (See AHAM, No. 18, pp. 2–5) DOE understands that this approach inherently assumes that the rest of the MREF market has a similar distribution of efficiencies. However, due to lack of efficiency data from non-AHAM members, DOE has no reason to question that assumption. DOE also assumed that the current distribution of product efficiencies would remain constant in 2029, and during the analysis period, in the no-new-standards case.

The estimated market shares for the no-new-standards case for MREFs are shown in Table IV.10. See chapter 8 of the direct final rule TSD for further information on the derivation of the efficiency distributions.

Table IV.10 Efficiency Distributions for the No-New-Standards Case in the Compliance Year

Product Class	Total Adjusted Volume (cu. ft.)	2029 Market Share (%)						
		EL 0	EL 1	EL 2	EL 3	EL 4	EL 5	Total*
Cooler-FC	3.1 5.1	79	18	3	0	0	0	100
Cooler-BIC	3.1 5.1	18	6	1	1	0	74	100
Cooler-F	15.3	42	58	0	0	0	0	100
Cooler-BI	15.3	72	8	20	0	0	0	100
C-13A	5	99	1	0	0	0	0	100
C-3A	21	100	0	0	0	0		100

* The total may not sum to 100% due to rounding.

The LCC Monte Carlo simulations draw from the efficiency distributions and randomly assign an efficiency to the MREF purchased by each sample household in the no-new-standards case. The resulting percent shares within the sample match the market shares in the efficiency distributions.

9. Payback Period Analysis

The payback period is the amount of time (expressed in years) it takes the consumer to recover the additional installed cost of more-efficient products, compared to baseline products, through energy cost savings. Payback periods 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. DOE refers to this as a "simple PBP" because it does not consider changes over time in operating cost savings. The PBP calculation uses the same inputs as the LCC analysis when deriving first-year operating costs.

As noted previously, EPCA 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 projection for the year in which compliance with the amended standards would be required.

G. Shipments Analysis

DOE uses projections of annual product shipments to calculate the national impacts of potential amended or new energy conservation standards on energy use, NPV, and future manufacturer cash flows.[47] 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.

DOE defined two broad MREF product categories (coolers and combination cooler refrigeration products) and developed models to estimate shipments for each category. DOE used various data and assumptions to develop the shipments for each product class considered in this rulemaking.

[47] DOE uses 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.

Given the limited available data sources on historical shipments of coolers, DOE assumed a constant penetration rate of 13.3 percent in the U.S. households throughout the analysis period based on online surveys[48] to estimate the annual shipments starting from 2016.[49,50] DOE multiplied the estimated penetration by the total number of households from the *AEO2023*, and then determined the number of new shipments by dividing the total stock by the mean product lifetime. DOE projected the annual shipments by incorporating the lifetime distributions by product class and assuming that the growth of new sales is consistent with the housing projections from *AEO2023*. To estimate shipments prior to 2016, DOE assumed a flat historical shipment trend at the 2016 level. With even more limited available data sources on historical shipments of combination cooler refrigeration products, DOE estimated total shipments of combination cooler refrigeration products in 2014 to be 36,000 units, based on feedback from manufacturers from the October 2016 Direct Final Rule. DOE assumed sales would increase in line with the increase in the number of households in *AEO2023*. Finally, DOE incorporated the 2021 shipment data provided by AHAM (see AHAM, No. 18 at pp. 3, 5)[51] to re-calibrate total shipments for each product class considered in this rulemaking.

[48] DOE also reviewed the recent release of the EIA 2020 RECS ("RECS 2020"), which identified wine chillers in representative U.S. households. DOE found that the penetration rate of wine chillers in RECS 2020 is significantly lower compared to that estimated by DOE for MREFs based on previous market surveys. Due to the uncertainty on the breakdown of MREFs between wine chillers and other miscellaneous refrigeration applications in the U.S. market, DOE continued to use the 13.3 percent penetration rate for MREFs in this direct final rule. However, DOE also modeled an alternative shipments scenario based on the lower penetration rate of MREFs in American homes derived from the RECS 2020 data. For more details on this alternative scenario and the resulting NES and NPV results, see chapter 9 and appendix 10C of the direct final rule TSD, respectively.
[49] Greenblatt, J. B., S. J. Young, H.-C. Yang, T. Long, B. Beraki, S. K. Price, S. Pratt, H. Willem, L.-B. Desroches, and S. M. Donovan. U.S. Residential Miscellaneous Refrigeration Products: Results from Amazon Mechanical Turk Surveys. 2014. Lawrence Berkeley National Laboratory: Berkeley, CA. Report No. LBNL-6537E.
[50] Donovan, S. M., S. J. Young, and J. B. Greenblatt. Ice-Making in the U.S.: Results from an Amazon Mechanical Turk Survey. Lawrence Berkeley National Laboratory. Report No. LBNL-183899.
[51] This shipments information was provided by AHAM in a confidential document. The reference points to the public version of this document, where confidential business information is redacted.

DOE used the efficiency distributions by product class to match the data submitted by AHAM. DOE also assumed that the market share of each product class (in relation to the total MREF shipments) matched the market shares provided by AHAM. To estimate total MREF shipments, DOE utilized the AHAM shipments data and AHAM-member information and reviewed the TraQline data from 2020 Q1 to 2022 Q1 to estimate non-AHAM-member shipments.[52] Based on this approach, DOE's estimate of the MREF shipments for the whole market was consistent with the total number of shipments estimated using DOE's approach discussed earlier and used in the March 2023 NOPR. Hence, DOE continued using the same approach to develop the total MREF shipments in this direct final rule but incorporated the product class breakdown provided by AHAM to re-distribute the total shipments by product class.

H. National Impact Analysis

The NIA assesses the NES and the NPV from a national perspective of total consumer costs and savings that would be expected to result from new or amended standards at specific efficiency levels.[53] ("Consumer" in this context refers to consumers of the product being regulated.) DOE calculates the NES and NPV for the potential standard levels considered 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 the present analysis, DOE projected the energy savings, operating cost savings, product costs, and NPV of consumer benefits over the lifetime of MREFs sold from 2029 through 2058.

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[52] DOE also collected and reviewed manufacturer interview data but was unable to collect a representative sample that would allow it to estimate non-AHAM-member shipments data.
[53] The NIA accounts for impacts in the United States and U.S. territories.

DOE evaluates the impacts of new or amended standards by comparing a case without such standards with standards-case projections. The no-new-standards case 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.11 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.11 Summary of Inputs and Methods for the National Impact Analysis

Inputs	Method
Shipments	Annual shipments from shipments model.
Compliance Date of Standard	2029
Efficiency Trends	No trend assumed.
Annual Energy Consumption per Unit	Calculated for each efficiency level based on inputs from energy use analysis.
Total Installed Cost per Unit	Calculated for each efficiency level based on inputs from energy use analysis.
Annual Energy Cost per Unit	Calculated for each efficiency level using the energy use per unit, and electricity prices and trends.
Repair and Maintenance Cost per Unit	Annual values do not change with efficiency level.
Energy Price Trends	*AEO2023* projections (to 2050) and fixed at 2050 prices thereafter.
Energy Site-to-Primary and FFC Conversion	A time-series conversion factor based on *AEO2023*.
Discount Rate	Three and seven percent.
Present Year	2024

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. Section IV.F.8 of this document describes how DOE developed an energy efficiency distribution for the no-new-standards case (which yields a shipment-weighted average efficiency) for each of the considered product classes for the year of anticipated compliance with an amended standard.

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 (2029). In this scenario, the market shares 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.

In the absence of data on trends in efficiency, DOE assumed no efficiency trend over the analysis period for both the no-new-standards and standards cases. For a given case, market shares by efficiency level were held fixed to their 2029 distribution.

2. National Energy Savings

The NES analysis involves a comparison of national energy consumption of the considered products between each potential standards case ("TSL") and 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 conversion factors derived from *AEO2023*. Cumulative energy savings are the sum of the NES for each year over the timeframe of the analysis.

Use of higher-efficiency products is sometimes associated with a direct rebound effect, which refers to an increase in utilization of the product due to the increase in efficiency. DOE did not find any data on the rebound effect specific to MREFs that would indicate that consumers would alter their utilization of their product due to an increase in efficiency. MREFs are typically plugged in and operate continuously; therefore, DOE assumed a rebound rate of 0. DOE did not receive any comments regarding this assumption in response to the March 2023 NOPR.

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 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 (Aug. 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 (Aug. 17, 2012). NEMS is a public domain, multi-sector, partial equilibrium model of the U.S. energy sector[54] that EIA uses to prepare its *Annual Energy Outlook.* The FFC factors incorporate losses in production and delivery in the case of natural gas (including fugitive emissions) and additional energy used to produce and deliver the various fuels used by power plants. 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 (energy costs and repair and maintenance 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 projection period.

As discussed in section IV.F.1 of this document, DOE developed MREF price trends based on an experience curve calculated using historical PPI data. DOE applied the same trends to project prices for each product class at each considered efficiency

[54] For more information on NEMS, refer to *The National Energy Modeling System: An Overview 2009*, DOE/EIA-0581(2009), October 2009. Available at *www.eia.gov/analysis/pdfpages/0581(2009)index.php* (last accessed November 29, 2023).

level~~,~~ including baseline. By 2058, which is the end date of the projection period, the average price of single-speed compressor MREFs is projected to drop 33.2 percent and the average price of MREFs with a variable-speed compressor is projected to drop about 33.8 percent relative to 2029.

To evaluate the effect of uncertainty regarding the price trend estimates, DOE investigated the impact of different product price projections on the consumer NPV for the considered TSLs for MREFs. In addition to the default price trend, DOE considered high and low-price-decline sensitivity cases. For the single-speed compressor MREFs and the non-variable- speed controls portion of MREFs, DOE estimated the high- price-decline and the low- price- decline scenarios based on household refrigerator and home freezer PPI data limited to the period between the period 1981–2008 and 2009-2022, respectively. For the variable-speed controls portion of MREFs, DOE estimated the high price decline and the low- price- decline scenarios based on an exponential trend line fit of the semiconductor PPI between the period 1994-2022 and 1967-1993, respectively. The derivation of these price trends is described in Chapter 8 and the results of these sensitivity cases are ~~described~~given in appendix 10C of the direct final rule TSD.

The energy cost savings are calculated using the estimated energy savings in each year and the projected price of the appropriate form of energy. To estimate energy prices in future years, DOE multiplied the average regional energy prices by the projection of annual national-average residential energy price changes in the Reference case from *AEO2023*, which has an end year of 2050. To estimate price trends after 2050, the 2046-2050 average was used for all years. As part of the NIA, DOE also analyzed scenarios that used inputs from variants of the *AEO2023* Reference case that have lower and higher economic growth. Those cases have lower and higher 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.The resulting consumer NPV for the low-economic growth scenario, combined with the low-price-decline scenario is up to 24% lower compared to the Reference case scenario, while the consumer NPV for the high-economic growth scenario combined with the high-price-decline scenario is up to 12% higher compared to the Reference case. See appendix 10C of the direct final rule TSD for more details.

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 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.[55] 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 energy conservation standards on consumers, DOE evaluates the impact on identifiable subgroups of consumers that may be disproportionately affected by a new or amended national standard. The purpose of a subgroup analysis is to determine the extent of any such

[55] United States Office of Management and Budget. *Circular A-4: Regulatory Analysis*. September 17, 2003. Section E. Available at *georgewbush-https://www.*whitehouse.*archives.*gov/*wp-content/uploads/legacy_drupal_files/omb/memoranda/m03-21.htmlcirculars/A4/a-4.pdf* (last accessed November 10, 2023).

disproportional impacts. DOE evaluates impacts on particular subgroups of consumers by analyzing the LCC impacts and PBP for those particular consumers from alternative standard levels. For this direct final rule, DOE analyzed the impacts of the considered standard levels on senior-only households. Low-income consumers were not considered in the subgroup analysis, as MREFs are not products generally used by this subgroup. Based on the TraQline wine chiller data, less than 4 percent of MREF owners are below the Federal household income threshold for poverty. The analysis used a subset of the TraQline consumer sample composed of households that meet the criteria for this subgroup. DOE used the LCC and PBP computer model to estimate the impacts of the considered efficiency levels on senior-only households. Chapter 11 in the direct final rule TSD describes the consumer subgroup analysis.

J. Manufacturer Impact Analysis

1. Overview

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

The quantitative part of the MIA primarily relies on the 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~~on 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 standards cases (*i.e.*, "TSLs"). To capture the uncertainty relating to manufacturer pricing strategies following amended standards, the GRIM estimates a range of possible impacts under different manufacturer markup scenarios.

The qualitative part of the MIA addresses manufacturer characteristics and market trends. Specifically, the MIA considers such factors as a potential standard's impact on 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 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 also used public sources of information to further calibrate its initial characterization of the MREF manufacturing industry, including corporate annual reports filed by publicly traded manufacturers in primarily home appliance manufacturing and MREFs, the U.S. Census Bureau's *Annual Survey of Manufactures* ("*ASM*"),[56] and reports from D&B Hoovers.[57]

In Phase 2 of the MIA, DOE prepared a framework industry cash-flow analysis to quantify the potential impacts of amended energy conservation standards. The GRIM uses several factors to determine a series of annual cash flows starting with the announcement of the standard and extending over a 30-year period following the 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) creating a need for increased investment, (2) raising production costs per unit, and (3) altering revenue due to higher per-unit prices and changes in sales volumes.

In addition, during Phase 2, DOE developed interview guides to distribute to manufacturers of 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.

In Phase 3 of the MIA, DOE conducted structured, detailed interviews with representative manufacturers. During these interviews, DOE discussed engineering, manufacturing, procurement, and financial topics to validate assumptions used in the

[56] U.S. Census Bureau, *Annual Survey of Manufactures*. "Summary Statistics for Industry Groups and Industries in the U.S (2021)." Available at *www.census.gov/programs-surveys/asm/data.html* (last accessed July 5, 2023).
[57] The D&B Hoovers login is available at *app.dnbhoovers.com* (last accessed November 29, 2023).

GRIM and to identify key issues or concerns. As part of Phase 3, DOE also evaluated subgroups of manufacturers that may be disproportionately impacted by amended standards or that may not be accurately represented by the average cost assumptions used to develop the industry cash flow analysis. Such manufacturer subgroups may include small business manufacturers, low-volume manufacturers, niche players, and/or manufacturers exhibiting a cost structure that largely differs from the industry average. DOE identified one subgroup for a separate impact analysis: small business manufacturers. The small business subgroup is discussed in chapter 12 of the direct final rule TSD.

2. Government Regulatory Impact Model and Key Inputs

DOE uses the GRIM to quantify the changes in cash flow due to new or amended standards that result in a higher or lower industry value. The GRIM uses a standard, annual discounted cash-flow analysis that incorporates manufacturer costs, markups, shipments, and industry financial information as inputs. The GRIM models changes in costs, distribution of shipments, investments, and manufacturer margins that could result from an amended energy conservation standard. The GRIM spreadsheet uses the inputs to arrive at a series of annual cash flows, beginning in 2024 (the base year of the analysis) and continuing to 2058. DOE calculated INPVs by summing the stream of annual discounted cash flows during this period. For manufacturers of MREFs, DOE used a real discount rate of 7.7 percent, which was derived from industry financials and then modified according to feedback received during manufacturer interviews.

The GRIM calculates cash flows using standard accounting principles and compares changes in INPV between 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 or amended energy conservation standard on manufacturers. As discussed previously, DOE developed critical GRIM inputs using a number of sources, including publicly available data, results of the engineering analysis, results of the shipments analysis, and information gathered from industry stakeholders during the course of manufacturer interviews. The GRIM results are presented in section 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. Manufacturer Production Costs

Manufacturing more efficient products is typically more expensive than manufacturing baseline products due to the use of more complex components, which are typically more costly than baseline components. The changes in the MPCs of covered products can affect the revenues, gross margins, and cash flow of the industry. For its analysis in this direct final rule, DOE used a combined efficiency level and design option approach. First, an efficiency-level approach was used to establish an analysis tied to existing products on the market. A design option approach was then used to extend the analysis through "built-down" efficiency levels and "built-up" efficiency levels where there were gaps in the range of efficiencies of products that were reverse engineered.

For a complete description of the MPCs, see section IV.C of this document and chapter 5 of the direct final rule TSD.

b. Shipments Projections

The GRIM estimates manufacturer revenues based on total unit shipment projections and the distribution of those shipments by efficiency level. Changes in sales volumes and efficiency mix over time can significantly affect manufacturer finances. For this analysis, the GRIM uses the NIA's annual shipment projections derived from the shipments analysis from 2024 (the base year) to 2058 (the end year of the analysis period). See section IV.G of this document and chapter 9 of the direct final rule TSD for additional details.

c. Product and Capital Conversion Costs

New or amended energy conservation standards could cause manufacturers to incur 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 investments in research, development, testing, marketing, and other non-capitalized costs necessary to make product designs comply with new or amended energy conservation standards. Capital conversion costs are investments in property, plant, and equipment necessary to adapt or change existing production facilities such that new compliant product designs can be fabricated and assembled.

Product Conversion Costs

DOE based its estimates of the product conversion costs necessary to meet the varying efficiency levels on information from manufacturer interviews, the design paths analyzed in the engineering analysis, the prior MREF rulemaking analysis (*see* 81 FR 75194), and market share and model count information. Generally, manufacturers indicated a preference to meet amended standards with design options that were direct and relatively straightforward component swaps. However, at higher efficiency levels, manufacturers anticipated the need for platform redesigns. Efficiency levels that significantly altered cabinet construction would require very large investments to update designs. Manufacturers noted that increasing foam thickness would require complete redesign of the cabinet, liner, and shelving due to loss of interior volume. Additionally, extensive use of VIPs would require redesign of the cabinet to maximize the benefits of VIPs.

Capital Conversion Costs

DOE relied on information from manufacturer interviews and the engineering analysis to evaluate the level of capital conversion costs would likely incur at the considered standard levels. During interviews, manufacturers provided estimates and descriptions of the required tooling changes that would be necessary to upgrade product lines to meet the various efficiency levels. Based on these inputs, DOE modeled incremental capital conversion costs for efficiency levels that could be reached with individual components swaps. However, based on feedback, DOE modeled higher capital conversion costs when manufacturers would have to redesign their existing product platforms. DOE used information from manufacturer interviews to determine the cost of the manufacturing equipment and tooling necessary to implement complete redesigns.

Increases in foam thickness require either reductions to interior volume or increases to exterior volume. Many MREFs are sized to fit standard widths, meaning any increase in foam thickness would likely result in the loss of interior volume. Additionally, many MREFs are sized to maximize storage of specific products (*e.g.*, canned beverages or wine bottles) and small changes in wall thickness could dramatically decrease the unit storage capacity for those products. The reduction of interior volume has significant consequences for manufacturing. Redesigning the cabinet to increase the effectiveness of insulation likely requires manufacturers to update designs and tooling associated with the interior of the product. This could require investing in new tooling to accommodate changes to the liner, shelving, drawers, and doors.

To minimize reductions to interior volume, manufacturers may choose to adopt VIP technology. Extensive incorporation of VIPs into designs ~~require~~requires significant upfront capital due to differences in the handling, storing, and manufacturing of VIPs as compared to typical polyurethane foams. VIPs are relatively fragile and must be protected from punctures and rough handling. If VIPs have leaks of any size, the panel will eventually lose much of its thermal insulative properties and structural strength. If already installed within a cabinet wall, a punctured VIP may significantly reduce the structural strength of the MREF cabinet. As a result, VIPs require careful handling and installation. Manufacturers noted the need to allocate special warehouse space to ensure the VIPs are not jostled or roughly handled in the manufacturing environment. VIPs require significantly more warehouse space than polyurethane foams. The application of VIPs can be difficult and may require investment in hard-tooling or robotic systems to ensure the panels are positioned properly within the cabinet or door. Manufacturers noted that producing cabinets with VIPs are much more labor and time intensive than producing cabinets with typical polyurethane foams and the increase in labor can affect total production capacity.

To develop industry conversion cost estimates, DOE estimated the number of product platforms in DOE's CCD[58] and California Energy Commission's Modernized

[58] U.S. Department of Energy's Compliance Certification Database is available at *www.regulations.doe.gov/certification-data/#q=Product_Group_s%3A** (last accessed August 17, 2023).

Appliance Efficiency Database System ("MAEDbS")[59] and scaled up the product and capital conversion costs associated with the number of product platforms that would require updating at each efficiency level. DOE adjusted the conversion cost estimates developed in support of the March 2023 NOPR to 2022$ for this analysis.

DOE acknowledges that manufacturers may follow different design paths to reach the various efficiency levels analyzed. An individual manufacturer's investments depend on a range of factors, including the company's current product offerings and product platforms, existing production facilities and infrastructure, and make vs. buy decisions for components. DOE's conversion cost methodology incorporated feedback from all manufacturers that took part in interviews and extrapolated industry values. While industry average values may not represent any single manufacturer, DOE's model provides reasonable estimates of industry-level investments.

In general, DOE assumes all conversion-related investments occur between the year of publication of the direct 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 of this document. For additional information on the estimated product and capital conversion costs, see chapter 12 of the direct final rule TSD.

d. Manufacturer Markup Scenarios

MSPs include direct manufacturing production costs (*i.e.*, labor, materials, and overhead estimated in DOE's MPCs) and all non-production costs (*i.e.*, SG&A, R&D, and interest), along with profit. To calculate the MSPs in the GRIM, DOE applied

[59] California Energy Commission's Modernized Appliance Efficiency Database System is available at *cacertappliances.energy.ca.gov/Pages/ApplianceSearch.aspx* (last accessed August 17, 2023). DOE used this database to gather product information not provided in DOE's CCD *(e.g.,* manufacturer names).

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 impacts on manufacturers. For the MIA, DOE modeled two standards case scenarios to represent uncertainty regarding the potential impacts on prices and profitability for manufacturers following the implementation of amended energy conservation standards: (1) a preservation-of-gross-margin-percentage scenario; and (2) a preservation-of-operating-profit scenario. These scenarios lead to different manufacturer markup values that, when applied to the MPCs, result in varying revenue and cash flow impacts.

Under the preservation-of-gross-margin-percentage scenario, DOE applied a single uniform "gross margin percentage" markup across all efficiency levels, 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 manufacturer production costs increase with efficiency, this scenario implies that the per-unit dollar profit will increase. DOE assumed a gross margin percentage of 20 percent for FCC and 28 percent for all other product classes.[60] Manufacturers tend to believe it is optimistic to assume that they would be able to maintain the same gross margin percentage as their production costs increase, particularly for minimally efficient products. Therefore, this scenario represents a high bound of industry profitability under an amended energy conservation standard.

In the preservation-of-operating-profit scenario, as the cost of production goes up under a standards case, manufacturers are generally required to reduce their manufacturer markups to a level that maintains base-case operating profit. DOE implemented this

[60] The gross margin percentages of 20 percent and 28 percent are based on manufacturer markups of 1.25 and 1.38 percent, respectively.

scenario in the GRIM by lowering the manufacturer markups at each TSL to yield approximately the same earnings before interest and taxes in the standards case as in the no-new-standards case in the year after the expected compliance date of the amended standards. The implicit assumption behind this scenario is that the industry can only maintain its operating profit in absolute dollars after the standard takes effect.

A comparison of industry financial impacts under the two manufacturer markup scenarios is presented in section V.B.2.a of this document.

3. Discussion of MIA Comments

For this direct final rule, DOE considered comments it had received regarding its MIA presented in the March 2023 NOPR. The approach used for this direct final rule is largely the same approach DOE had used for the March 2023 NOPR analysis.

In response to the March 2023 NOPR, AHAM stated that it cannot comment on the accuracy of DOE's approach for including how manufacturers might or might not recover potential investments (*i.e.*, the accuracy of DOE's manufacturer markup scenarios) but that AHAM supports DOE's intent in the microwave ovens supplemental notice of proposed rulemaking ("SNOPR") ("August 2022 SNOPR") energy conservation standards rulemaking to include those costs and investments in the actual costs of products and retail prices. (AHAM, No. 31 at p. 12) AHAM urged DOE to apply the same conceptual approach used in the August 2022 SNOPR in the MREF rulemaking and all future rulemakings (*i.e.*, to analyze a conversion-cost-recovery manufacturer markup scenario). (*Id.*)

As discussed in section IV.J.2.d of this document, DOE modeled two standards-case manufacturer markup scenarios to represent the uncertainty regarding the potential impacts on prices and profitability for manufacturers following the implementation of amended energy conservation standards. For the March 2023 NOPR, DOE applied the preservation-of-gross-margin-percentage scenario to reflect an upper bound of industry profitability and a preservation-of-operating-profit scenario to reflect a lower bound of industry profitability under amended standards. DOE used these scenarios to reflect the range of realistic profitability impacts under more stringent standards. Manufacturing more efficient MREFs is generally more expensive than manufacturing baseline MREFs, as reflected by the MPCs estimated in the engineering analysis. Under the preservation-of-gross-margin scenario for MREFs, incremental increases in MPCs at higher efficiency levels result in an increase in per-unit dollar profit per unit sold. In interviews, manufacturers stated the industry relies on competitive pricing, so they would likely not increase their manufacturer markups that would allow them to recover their full investments. The preservation-of-gross-margin-scenario reflects an upper bound of industry profitability in which manufacturers would be able to maintain the same amount of profit as a percentage of revenues at all efficiency levels within a product class. Applying the approach used in the August 2022 SNOPR (*i.e.*, a conversion-cost-recovery scenario) would result in the MREF industry increasing manufacturer markups under amended standards. Based on information gathered during confidential interviews in support of the March 2023 NOPR, DOE does not expect that the MREF industry would increase manufacturer markups under an amended standard. Furthermore, in response to the March 2023 NOPR, DOE did not receive any public or confidential data indicating that industry would increase manufacturer markups in response to more stringent standards. Therefore, DOE used the same manufacturer markup scenarios from the March 2023 NOPR for this direct final rule analysis.

In response to the March 2023 NOPR, AHAM commented the cumulative regulatory burden is significant for home appliance manufacturers when needing to redesign products and product lines for the proposed levels for MREFs, for consumer clothes dryers, residential clothes washers, consumer conventional cooking products, dishwashers, RF, and the finalized levels for room air conditioners and microwave ovens. (*Id*. at p. 13). AHAM asserted that engineers will therefore need to spend all their time redesigning products to meet more stringent energy efficiency standards, pulling resources from other development efforts and business priorities. AHAM suggested that DOE could reduce cumulative regulatory burden by spacing out the timing of final rules, allowing more lead time by delaying the publication of final rules in the *Federal Register* after they have been issued, and reducing the stringency of standards such that fewer products would require redesign. (*Id*. at p. 14)

DOE analyzes cumulative regulatory burden in accordance with section 13(g) of the Process Rule. DOE details the rulemakings and expected conversion expenses of Federal energy conservation standards that could impact MREF original equipment manufacturers ("OEMs") that take effect approximately 3 years before and after the 2029 compliance date in section V.B.2.e of this document. As shown in Table V.23 in section V.B.2.e of this document, DOE considers the potential cumulative regulatory burden from other DOE energy conservation standard rulemakings for consumer clothes dryers, residential clothes washers, consumer conventional cooking products, dishwashers, RF, room air conditioners, and microwave ovens in this direct final rule analysis.

Regarding AHAM's suggestion about spacing out the timing of final rules for home appliance rulemakings, DOE has statutory requirements under EPCA on the timing of rulemakings. For consumer clothes dryers, residential clothes washers, consumer conventional cooking products, dishwashers, RF, room air conditioners, and microwave ovens, amended standards apply to covered products manufactured ~~three~~3 years after the date on which any new or amended standards are published. (42 U.S.C. 6295(m)(4)(A)(i)) For MREFs, amended standards apply 5 years after the date on which any new or amended standard is published. (42 U.S.C. 6295(l)(2)) And the multi-product Joint Agreement, where stakeholders can recommend ~~difference~~different compliance dates under DOE's direct final rule authority, stated "jointly recommended compliance dates will achieve the overall energy and economic benefits of this agreement while allowing necessary lead-times for manufacturers to redesign products and retool manufacturing plants to meet the recommended standards across product categories." (Joint Agreement, No. 34 at p. 2) The staggered compliance dates between the statutorily-required dates and the dates recommended in the Joint Agreement help mitigate manufacturers' concerns resource allocation and concurrent amended standards. See section II.B.4 of this document for compliance dates of rulemakings recommended in the Joint Agreement.

In response to the March 2023 NOPR, the Appliance Standards Awareness Project ("ASAP") *et al*.[61] commented that DOE may have overestimated the decrease in INPV, and described some perceived inconsistencies. ASAP *et al.* pointed out that although DOE estimated a 10 percent reduction in shipments based on a 10 percent increase in production cost, ignoring the efficiency elasticity, the shipments decline should be no more than 4.5 percent at the compliance year. (ASAP *et al*., No. 32 at pp. 1-2) In response to this comment, DOE re-evaluated its base assumptions and corrected its shipments estimates. The reduction in shipments ~~at~~in the projected compliance year

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[61] "ASAP *et al.*" refers to a joint comment from Appliance Standards Awareness Project, American Council for an Energy-Efficient Economy, National Consumer Law Center, New York State Energy Research and Development Authority, and Northwest Energy Efficiency Alliance.

for the Recommended TSL (*i.e.*, TSL 4) is now estimated to be 3.4 percent. For more details, see chapter 9 of the direct final rule TSD.

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 in emissions of other gases due to "upstream" activities in the fuel production chain. These upstream activities comprise extraction, processing, and transporting fuels to the site of combustion.

The analysis of electric power sector emissions of CO_2, NO_X, SO_2, and Hg uses emissions intended to represent the marginal impacts of the change in electricity consumption associated with amended or new standards. The methodology is based on results published for the *AEO*, including a set of side cases that implement a variety of efficiency-related policies. The methodology is described in appendix 13A in the direct final rule TSD. The analysis presented in this document uses projections from *AEO2023*. Power sector emissions of CH_4 and N_2O from fuel combustion are estimated using Emission Factors for Greenhouse Gas Inventories published by the EPA.[62]

FFC upstream emissions, which include emissions from fuel combustion during extraction, processing, and transportation of fuels, and "fugitive" emissions (direct

[62] Available at *www.epa.gov/sites/production/files/2021-04/documents/emission-factors_apr2021.pdf* (last accessed November 12, 2023).

leakage to the atmosphere) of CH_4 and CO_2, are estimated based on the methodology described in chapter 15 of the direct final rule TSD.

The emissions intensity factors are expressed in terms of physical units per MWh or MMBtu of site energy savings. For power sector emissions, specific emissions intensity factors are calculated by sector and end use. Total emissions reductions are estimated using the energy savings calculated in the national impact analysis.

1. Air Quality Regulations Incorporated in DOE's Analysis

DOE's no-new-standards case for the electric power sector reflects the *AEO*, which incorporates the projected impacts of existing air quality regulations on emissions. *AEO2023* reflects, to the extent possible, laws and regulations adopted through mid-November 2022, including the emissions control programs discussed in the following paragraphs, and the Inflation Reduction Act.[63] 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 numerous States in the eastern half of the United States are also limited under the Cross-State Air Pollution Rule ("CSAPR"). 76 FR 48208 (Aug. 8, 2011). CSAPR requires these States to reduce certain emissions, including annual SO_2 emissions, and went into effect as of January 1, 2015.[64] The *AEO*

[63] For further information, see the Assumptions to *AEO2023* report that sets forth the major assumptions used to generate the projections in the Annual Energy Outlook. Available at *www.eia.gov/outlooks/aeo/assumptions/* (last accessed Nov. 22, 2023).

[64] CSAPR requires states to address annual emissions of SO_2 and NO_X, precursors to the formation of fine particulate matter ("$PM_{2.5}$") pollution, in order to address the interstate transport of pollution with respect to the 1997 and 2006 $PM_{2.5}$ National Ambient Air Quality Standards ("NAAQS"). CSAPR also requires certain states to address the ozone season (May-September) emissions of NO_X, a precursor to the formation of ozone pollution, in order to address the interstate transport of ozone pollution with respect to the 1997 ozone NAAQS. 76 FR 48208 (Aug. 8, 2011). EPA subsequently issued a supplemental rule that included an additional five states in the CSAPR ozone season program; 76 FR 80760 (Dec. 27, 2011) (Supplemental Rule), and EPA issued the CSAPR Update for the 2008 ozone NAAQS. 81 FR 74504 (Oct. 26, 2016).

incorporates implementation of CSAPR, including the update to the CSAPR ozone season program emission budgets and target dates issued in 2016. 81 FR 74504 (Oct. 26, 2016). Compliance with CSAPR is flexible among EGUs and is enforced through the use of tradable emissions allowances. Under existing EPA regulations, for states subject to SO_2 emissions limits under CSAPR, 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 another regulated EGU.

However, beginning in 2016, SO_2 emissions began to fall as a result of the Mercury and Air Toxics Standards ("MATS") for power plants.[65] 77 FR 9304 (Feb. 16, 2012). The final rule establishes power plant emission standards for mercury, acid gases, and non-mercury metallic toxic pollutants. Because of the emissions reductions under the MATS, 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 another regulated EGU. Therefore, energy conservation standards that decrease electricity generation will generally reduce SO_2 emissions. DOE estimated SO_2 emissions reduction using emissions factors based on *AEO2023*.

CSAPR also established limits on NO_X emissions for numerous States in the eastern half of the United States. Energy conservation standards would have little effect on NO_X emissions in those States covered by CSAPR emissions limits if excess NO_X emissions allowances resulting from the lower electricity demand could be used to permit offsetting increases in NO_X emissions from other EGUs. In such case, NOx emissions would remain near the limit even if electricity generation goes down. Depending on the

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[65] In order to continue operating, coal power plants must have either flue gas desulfurization or dry sorbent injection systems installed. Both technologies, which are used to reduce acid gas emissions, also reduce SO_2 emissions.

configuration of the power sector in the different regions and the need for allowances, however, NO_X emissions might not remain at the limit in the case of lower electricity demand. That would mean that standards might reduce NO_x emissions in covered States. Despite this possibility, DOE has chosen to be conservative in its analysis and has maintained the assumption that standards will not reduce NO_X emissions in States covered by CSAPR. Standards would be expected to reduce NO_X emissions in the States not covered by CSAPR. DOE used *AEO2023* data to derive NO_X emissions factors for the group of States not covered by CSAPR.

The MATS limit mercury emissions from power plants, but they do not include emissions caps and, as such, DOE's energy conservation standards would be expected to slightly reduce Hg emissions. DOE estimated mercury emissions reduction using emissions factors based on *AEO2023*, which incorporates the MATS.

L. Monetizing Emissions Impacts

As part of the development of this direct final rule, for the purpose of complying with the requirements of Executive Order 12866, DOE considered the estimated monetary benefits from the reduced emissions of CO_2, CH_4, N_2O, NO_X, and SO_2 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 projection period for each TSL. This section summarizes the basis for the values used for monetizing the emissions benefits and presents the values considered in this direct final rule.

To monetize the benefits of reducing GHG emissions, this analysis uses the interim estimates presented in the *Technical Support Document: Social Cost of Carbon, Methane, and Nitrous Oxide Interim Estimates Under Executive Order 13990* published in February 2021 by the IWG ("February 2021 SC-GHG TSD").

1. Monetization of Greenhouse Gas Emissions

DOE estimates the monetized benefits of the reductions in emissions of CO_2, CH_4, and N_2O by using a measure of the SC of each pollutant (*e.g.*, SC-CO_2). These estimates represent the monetary value of the net harm to society associated with a marginal increase in emissions of these pollutants in a given year, or the benefit of avoiding that increase. These estimates are intended to include (but are not limited to) climate-change-related changes in net agricultural productivity, human health, property damages from increased flood risk, disruption of energy systems, risk of conflict, environmental migration, and the value of ecosystem services.

~~For this direct final rule, DOE considered comments it had received regarding its approach for monetizing greenhouse gas emissions in the March 2023 NOPR. The approach used for this direct final rule is largely the same approach DOE had used for the March 2023 NOPR analysis.~~

~~In response to the March 2023 NOPR, AHAM objected to DOE using the social cost of carbon and other monetization of emissions reductions benefits in its analysis of the factors EPCA requires DOE to balance in determining the appropriate standard. AHAM stated that while it may be acceptable for DOE to continue its current practice of examining the SCC and monetization of other emissions reductions benefits as informational so long as the underlying interagency analysis is transparent and vigorous,~~

~~the monetization analysis should not impact the TSLs DOE selects as a new or amended standard. (AHAM, No. 31 at pp. 1516)~~

~~As stated in section E.1.f of this document, DOE accounts for the environmental and public health benefits associated with the more efficient use of energy, including those connected to global climate change, as they are important to take into account when considering the need for national energy conservation. (See 42 U.S.C. 6295(o)(2)(B)(i)(IV)) In addition, Executive Order 13563, which was re- affirmed on January 21, 2021, stated that each agency must, among other things: ''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).'' For these reasons, DOE includes the monetized value of emissions reductions in its evaluation of potential standard levels. While the benefits associated with reduction of GHG emissions inform DOE's evaluation of potential standards, the action of proposing or adopting specific standards is not ''based on'' the SC- GHG values, as DOE would reach the same conclusion regarding the economic justification of standards presented in this direct final rule without considering the social cost of greenhouse gases.~~

DOE exercises its own judgment in presenting monetized climate benefits as recommended by applicable Executive orders, and DOE would reach the same conclusion presented in this ~~direct final rule~~proposed rulemaking in the absence of the ~~social cost of greenhouse gases.~~ estimated benefits from reductions in GHG emissions. That is, the social costs of greenhouse gases, whether measured using the February 2021 interim estimates presented by the Interagency Working Group on the Social Cost of

Greenhouse Gases or by another means, did not affect the rule ultimately ~~finalized~~proposed by DOE.

DOE estimated the global social benefits of CO_2, CH_4, and N_2O reductions using SC-GHG values that were based on the interim values presented in the ~~February 2021 SC-GHG TSD by the IWG.~~ *Technical Support Document: Social Cost of Carbon, Methane, and Nitrous Oxide Interim Estimates under Executive Order 13990*, published in February 2021 by the IWG ("February 2021 SC-GHG TSD"). The SC-GHG is the monetary value of the net harm to society associated with a marginal increase in emissions in a given year, or the benefit of avoiding that increase. In principle, the SC-GHG includes the value of all climate change impacts, including (but not limited to) changes in net agricultural productivity, human health effects, property damage from increased flood risk and natural disasters, disruption of energy systems, risk of conflict, environmental migration, and the value of ecosystem services. The SC-GHG therefore, reflects the societal value of reducing emissions of the gas in question by one metric ton. The SC-GHG is the theoretically appropriate value to use in conducting benefit-cost analyses of policies that affect CO_2, N_2O and CH_4 emissions. As a member of the IWG involved in the development of the February 2021 SC-GHG TSD, DOE ~~agrees~~agreed that the interim SC-GHG estimates represent the most appropriate estimate of the SC-GHG ~~for this rule, which was~~until revised estimates were developed ~~using~~reflecting the ~~interim estimates. DOE continues to evaluate recent developments in~~latest, peer-reviewed science. *See* 87 FR 78382, 78406-78408 for discussion of the ~~scientific literature, including~~development and details of the ~~December 2023~~IWG SC-GHG estimates.

~~The SC-GHG estimates presented here were developed over many years, using transparent process, peer-reviewed methodologies, the best science available at the time~~

of that process, and with input from the public. Specifically, in 2009, the IWG, that included the DOE and other executive branch agencies and offices was established to ensure that agencies were using the best available science and to promote consistency in the social cost of carbon (SC-CO_2) values used across agencies. The IWG published SC-CO_2 estimates in 2010 that were developed from an ensemble of three widely cited integrated assessment models ("IAMs") that estimate global climate damages using highly aggregated representations of climate processes and the global economy combined into a single modeling framework. The three IAMs were run using a common set of input assumptions in each model for future population, economic, and CO_2 emissions growth, as well as equilibrium climate sensitivity – a measure of the globally averaged temperature response to increased atmospheric CO_2 concentrations. These estimates were updated in 2013 based on new versions of each IAM. In August 2016 the IWG published estimates of the social cost of methane (SC-CH_4) and nitrous oxide (SC-N_2O) using methodologies that are consistent with the methodology underlying the SC-CO_2 estimates. The modeling approach that extends the IWG SC-CO_2 methodology to non-CO_2 GHGs has undergone multiple stages of peer review. The SC-CH_4 and SC-N_2O estimates were developed by Marten *et al.*[66] and underwent a standard double-blind peer review process prior to journal publication. In 2015, as part of the response to public comments received to a 2013 solicitation for comments on the SC-CO_2 estimates, the IWG announced a National Academies of Sciences, Engineering, and Medicine review of the SC-CO_2 estimates to offer advice on how to approach future updates to ensure that the estimates continue to reflect the best available science and methodologies. In January 2017, the National Academies released their final report, *Valuing Climate Damages: Updating Estimation of the Social Cost of Carbon Dioxide*, and recommended specific

[66] Marten, A. L., E. A. Kopits, C. W. Griffiths, S. C. Newbold, and A. Wolverton. Incremental CH4 and N2O mitigation benefits consistent with the US Government's SC-CO2 estimates. *Climate Policy*. 2015. 15(2): pp. 272–298.

criteria for future updates to the SC-CO_2 estimates, a modeling framework to satisfy the specified criteria, and both near-term updates and longer-term research needs pertaining to various components of the estimation process.[67] Shortly thereafter, in March 2017, President Trump issued Executive Order 13783, which disbanded the IWG, withdrew the previous TSDs, and directed agencies to ensure SC-CO_2 estimates used in regulatory analyses are consistent with the guidance contained in OMB's Circular A-4, "including with respect to the consideration of domestic versus international impacts and the consideration of appropriate discount rates" (E.O. 13783, Section 5(c)). Benefit-cost analyses following E.O. 13783 used SC-GHG estimates that attempted to focus on the U.S.-specific share of climate change damages as estimated by the models and were calculated using two discount rates recommended by Circular A-4, 3 percent and 7 percent. All other methodological decisions and model versions used in SC-GHG calculations remained the same as those used by the IWG in 2010 and 2013, respectively.

On January 20, 2021, President Biden issued Executive Order 13990, which re-established the IWG and directed it to ensure that the U.S. Government's estimates of the social cost of carbon and other greenhouse gases reflect the best available science and the recommendations in the National Academies 2017 report. The IWG was tasked with first reviewing the SC-GHG estimates currently used in Federal analyses and publishing interim estimates within 30 days of the E.O. that reflect the full impact of GHG emissions, including by taking global damages into account. The interim SC-GHG estimates published in February 2021 are used here to estimate the climate benefits for this direct final rule. The E.O. instructs the IWG to undertake a fuller update of the SC-GHG estimates that takes into consideration the advice in the National Academies 2017

[67] National Academies of Sciences, Engineering, and Medicine. Valuing Climate Damages: Updating Estimation of the Social Cost of Carbon Dioxide. 2017. The National Academies Press: Washington, DC. Available at *nap.nationalacademies.org/catalog/24651/valuing-climate-damages-updating-estimation-of-the-social-cost-of.*

report and other recent scientific literature. The February 2021 SC-GHG TSD provides a complete discussion of the IWG's initial review conducted under E.O.13990. In particular, the IWG found that the SC-GHG estimates used under E.O. 13783 fail to reflect the full impact of GHG emissions in multiple ways.

First, the IWG found that the SC-GHG estimates used under E.O. 13783 fail to fully capture many climate impacts that affect the welfare of U.S. citizens and residents, and those impacts are better reflected by global measures of the SC-GHG. Examples of omitted effects from the E.O. 13783 estimates include direct effects on U.S. citizens, assets, and investments located abroad, supply chains, U.S. military assets and interests abroad, and tourism, and spillover pathways such as economic and political destabilization and global migration that can lead to adverse impacts on U.S. national security, public health, and humanitarian concerns. In addition, assessing the benefits of U.S. GHG mitigation activities requires consideration of how those actions may affect mitigation activities by other countries, as those international mitigation actions will provide a benefit to U.S. citizens and residents by mitigating climate impacts that affect U.S. citizens and residents. A wide range of scientific and economic experts have emphasized the issue of reciprocity as support for considering global damages of GHG emissions. If the United States does not consider impacts on other countries, it is difficult to convince other countries to consider the impacts of their emissions on the United States. The only way to achieve an efficient allocation of resources for emissions reduction on a global basis—and so benefit the U.S. and its citizens—is for all countries to base their policies on global estimates of damages. As a member of the IWG involved in the development of the February 2021 SC-GHG TSD, DOE agrees with this assessment and, therefore, in this direct final rule DOE centers attention on a global measure of SC-GHG. This approach is the same as that taken in DOE regulatory analyses from 2012 through 2016. A robust estimate of climate damages that accrue only to U.S. citizens and residents does not currently exist in the literature. As explained in the February 2021 TSD, existing estimates are both incomplete and an underestimate of total damages that accrue to the citizens and residents of the U.S. because they do not fully capture the regional interactions and spillovers discussed above, nor do they include all of the important physical, ecological, and economic impacts of climate change recognized in the climate change literature. As noted in the February 2021 SC- GHG TSD, the IWG will continue to review developments in the literature, including more robust methodologies for estimating a U.S.-specific SC- GHG value, and explore ways to better inform the public of the full range of carbon impacts. As a member of the IWG, DOE will continue to follow developments in the literature pertaining to this issue.

Second, the IWG found that the use of the social rate of return on capital (7 percent under current OMB Circular A-4 guidance) to discount the future benefits of reducing GHG emissions inappropriately underestimates the impacts of climate change for the purposes of estimating the SC-GHG. Consistent with the findings of the National Academies and the economic literature, the IWG continued to conclude that the consumption rate of interest is the theoretically appropriate discount rate in an intergenerational context,[68] and recommended that discount rate uncertainty and relevant

[68] Interagency Working Group on Social Cost of Carbon. *Social Cost of Carbon for Regulatory Impact Analysis under Executive Order 12866*. 2010. United States Government. Available at *www.epa.gov/sites/default/files/2016-12/documents/scc_tsd_2010.pdf* (last accessed April 15, 2022); Interagency Working Group on Social Cost of Carbon. *Technical Update of the Social Cost of Carbon for Regulatory Impact Analysis Under Executive Order 12866*. 2013. Available at *www.federalregister.gov/documents/2013/11/26/2013-28242/technical-support-document-technical-update-of-the-social-cost-of-carbon-for-regulatory-impact* (last accessed Nov 15, 2023.); Interagency Working Group on Social Cost of Greenhouse Gases, United States Government. Technical Support Document: Technical Update on the Social Cost of Carbon for Regulatory Impact Analysis-Under Executive Order 12866. August 2016. Available at *www.epa.gov/sites/default/files/2016-12/documents/sc_co2_tsd_august_2016.pdf* (last accessed November 18, 2023.); Interagency Working Group on Social Cost of Greenhouse Gases, United States Government. Addendum to Technical Support Document on Social Cost of Carbon for Regulatory Impact Analysis under Executive Order 12866: Application of the Methodology to Estimate the Social Cost of Methane and the Social Cost of Nitrous

aspects of intergenerational ethical considerations be accounted for in selecting future discount rates.

Furthermore, the damage estimates developed for use in the SC-GHG are estimated in consumption-equivalent terms, and so an application of OMB Circular A-4's guidance for regulatory analysis would then use the consumption discount rate to calculate the SC-GHG. DOE agrees with this assessment and will continue to follow developments in the literature pertaining to this issue. DOE also notes that while OMB Circular A-4, as published in 2003, recommends using 3% and 7% discount rates as "default" values, Circular A-4 also reminds agencies that "different regulations may call for different emphases in the analysis, depending on the nature and complexity of the regulatory issues and the sensitivity of the benefit and cost estimates to the key assumptions." On discounting, Circular A-4 recognizes that "special ethical considerations arise when comparing benefits and costs across generations," and Circular A-4 acknowledges that analyses may appropriately "discount future costs and consumption benefits…at a lower rate than for intragenerational analysis." In the 2015 Response to Comments on the Social Cost of Carbon for Regulatory Impact Analysis, OMB, DOE, and the other IWG members recognized that "Circular A-4 is a living document" and "the use of 7 percent is not considered appropriate for intergenerational discounting. There is wide support for this view in the academic literature, and it is recognized in Circular A-4 itself." Thus, DOE concludes that a 7% discount rate is not appropriate to apply to value the social cost of greenhouse gases in the analysis presented in this direct final rule.

Oxide. August 2016. Available at *www.epa.gov/sites/default/files/2016-12/documents/addendum_to_sc-ghg_tsd_august_2016.pdf* (last accessed November 29, 2023).

To calculate the present and annualized values of climate benefits, DOE uses the same discount rate as the rate used to discount the value of damages from future GHG emissions, for internal consistency. That approach to discounting follows the same approach that the February 2021 TSD recommends "to ensure internal consistency—i.e., future damages from climate change using the SC-GHG at 2.5 percent should be discounted to the base year of the analysis using the same 2.5 percent rate." DOE has also consulted the National Academies' 2017 recommendations on how SC-GHG estimates can "be combined in RIAs with other cost and benefits estimates that may use different discount rates." The National Academies reviewed several options, including "presenting all discount rate combinations of other costs and benefits with [SC-GHG] estimates."

As a member of the IWG involved in the development of the February 2021 SC-GHG TSD, DOE agrees with the above assessment and will continue to follow developments in the literature pertaining to this issue. While the IWG works to assess how best to incorporate the latest, peer reviewed science to develop an updated set of SC-GHG estimates, it set the interim estimates to be the most recent estimates developed by the IWG prior to the group being disbanded in 2017. The estimates rely on the same models and harmonized inputs and are calculated using a range of discount rates. As explained in the February 2021 SC-GHG TSD, the IWG has recommended that agencies revert to the same set of four values drawn from the SC-GHG distributions based on three discount rates as were used in regulatory analyses between 2010 and 2016 and were subject to public comment. For each discount rate, the IWG combined the distributions across models and socioeconomic emissions scenarios (applying equal weight to each) and then selected a set of four values recommended for use in benefit-cost analyses: an average value resulting from the model runs for each of three discount rates (2.5 percent, 3 percent, and 5 percent), plus a fourth value, selected as the 95th percentile of estimates based on a 3 percent discount rate. The fourth value was included to provide information on potentially higher-than-expected economic impacts from climate change. As explained in the February 2021 SC-GHG TSD, and DOE agrees, this update reflects the immediate need to have an operational SC-GHG for use in regulatory benefit-cost analyses and other applications that was developed using a transparent process, peer-reviewed methodologies, and the science available at the time of that process. Those estimates were subject to public comment in the context of dozens of proposed rulemakings as well as in a dedicated public comment period in 2013.

There are a number of limitations and uncertainties associated with the SC-GHG estimates. First, the current scientific and economic understanding of discounting approaches suggests discount rates appropriate for intergenerational analysis in the context of climate change are likely to be less than 3 percent, near 2 percent or lower.[69] Second, the IAMs used to produce these interim estimates do not include all of the important physical, ecological, and economic impacts of climate change recognized in the climate change literature and the science underlying their "damage functions" – *i.e.*, the core parts of the IAMs that map global mean temperature changes and other physical impacts of climate change into economic (both market and nonmarket) damages – lags behind the most recent research. For example, limitations include the incomplete treatment of catastrophic and non-catastrophic impacts in the integrated assessment models, their incomplete treatment of adaptation and technological change, the incomplete way in which inter-regional and intersectoral linkages are modeled,

[69] Interagency Working Group on Social Cost of Greenhouse Gases (IWG).. 2021. Technical Support Document: Social Cost of Carbon, Methane, and Nitrous Oxide Interim Estimates under Executive Order 13990. February. United States Government. Available at: *www.whitehouse.gov/briefing-room/blog/2021/02/26/a-return-to-science-evidence-based-estimates-of-the-benefits-of-reducing-climate-pollution*/ (last accessed November 29, 2023.)/.

uncertainty in the extrapolation of damages to high temperatures, and inadequate representation of the relationship between the discount rate and uncertainty in economic growth over long time horizons. Likewise, the socioeconomic and emissions scenarios used as inputs to the models do not reflect new information from the last decade of scenario generation or the full range of projections. The modeling limitations do not all work in the same direction in terms of their influence on the $SC\text{-}CO_2$ estimates. However, as discussed in the February 2021 SC-GHG TSD, the IWG has recommended that, taken together, the limitations suggest that the interim SC-GHG estimates used in this direct final rule likely underestimate the damages from GHG emissions. DOE concurs with this assessment.

In the February 2021 SC-GHG TSD, the IWG stated that the models used to produce the interim estimates do not include all of the important physical, ecological, and economic impacts of climate change recognized in the climate change literature. For these same impacts, the science underlying their "damage functions" lags behind the most recent research. In the judgment of the IWG, these and other limitations suggest that the range of four interim SC-GHG estimates presented in the TSD likely underestimate societal damages from GHG emissions. The IWG is in the process of assessing how best to incorporate the latest peer-reviewed science and the recommendations of the National Academies to develop an updated set of SC-GHG estimates, and DOE remains engaged in that process.

DOE is aware that in December 2023, EPA issued a new set of SC-GHG estimates in connection with a final rulemaking under the Clean Air Act.[70] As DOE had used the IWG interim values in proposing this rule and is currently reviewing the updated

[70] See *www.epa.gov/environmental-economics/scghg.*

2023 SC-GHG values, for this final rule, DOE used these updated 2023 SC-GHG values to conduct a sensitivity analysis of the value of GHG emissions reductions. DOE notes that because EPA's estimates are considerably higher than the IWG's interim SC-GHG values applied for this direct final rule, an analysis that uses the EPA's estimates results in significantly greater climate-related benefits. However, such results would not affect DOE's decision in this direct final rule. As stated elsewhere in this document, DOE would reach the same conclusion regarding the economic justification of the standards presented in this direct final rule without considering the IWG's interim SC-GHG values, which DOE agrees are conservative estimates. For the same reason, if DOE were to use EPA's higher SC-GHG estimates, they would not change DOE's conclusion that the standards are economically justified.

DOE's derivations of the SC-CO_2, SC-N_2O, and SC-CH_4 values used for this NOPR are discussed in the following sections, and the results of DOE's analyses estimating the benefits of the reductions in emissions of these GHGs are presented in section V.B.6 of this document.

a. Social Cost of Carbon

The SC-CO_2 values used for this final rule were based on the values developed for the February 2021 SC-GHG TSD, which are shown in ~~Table IV.10 in five~~Table IV.12 in 5-year increments from 2020 to 2050. The set of annual values that DOE used, which was adapted from estimates published by EPA,[71] is presented in appendix 14A of the direct final rule TSD. These estimates are based on methods, assumptions, and parameters identical to the estimates published by the IWG (which were based on EPA modeling), and include values for 2051 to 2070. DOE expects additional climate benefits

[71] *See* EPA, Revised 2023 and Later Model Year Light-Duty Vehicle GHG Emissions Standards: Regulatory Impact Analysis, Washington, D.C., December 2021. Available at *nepis.epa.gov/Exe/ZyPDF.cgi?Dockey=P1013ORN.pdf* (last accessed November 21, 2023).

to accrue for products still operating after 2070, but a lack of available SC-CO_2 estimates for emissions years beyond 2070 prevents DOE from monetizing these potential benefits in this analysis.

Table IV.12. Annual SC-CO_2 Values from 2021 Interagency Update, 2020–2050 (2020$ per Metric Ton CO_2)

Year	Discount Rate and Statistic			
	5%	3%	2.5%	3%
	Average	Average	Average	95th percentile
2020	14	51	76	152
2025	17	56	83	169
2030	19	62	89	187
2035	22	67	96	206
2040	25	73	103	225
2045	28	79	110	242
2050	32	85	116	260

DOE multiplied the CO_2 emissions reduction estimated for each year by the SC-CO_2 value for that year in each of the four cases. DOE adjusted the values to 2022$ using the implicit price deflator for gross domestic product ("GDP") from the Bureau of Economic Analysis. 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 SC-CO_2 values in each case.

b. Social Cost of Methane and Nitrous Oxide

The SC-CH_4 and SC-N_2O values used for this direct final rule were based on the values developed for the February 2021 SC-GHG TSD. Table IV.13 shows the updated sets of SC-CH_4 and SC- N_2O estimates from the latest interagency update in 5-year increments from 2020 to 2050. The full set of annual values used is presented in appendix 14-A of the direct final rule TSD. To capture the uncertainties involved in regulatory impact analysis, DOE has determined it is appropriate to include all four sets of SC-CH_4 and SC- N_2O values, as recommended by the IWG. DOE derived values after 2050 using the approach previously described above for the SC-CO_2.

Table IV.13. Annual SC-CH_4 and SC-N_2O Values from 2021 Interagency Update, 2020–2050 (2020$ per Metric Ton)

Year	SC-CH_4				SC-N_2O			
	Discount Rate and Statistic				Discount Rate and Statistic			
	5%	3%	2.5%	3%	5%	3%	2.5 %	3%
	Average	Average	Average	95th percentile	Average	Average	Average	95th percentile
2020	670	1500	2000	3900	5800	18000	27000	48000
2025	800	1700	2200	4500	6800	21000	30000	54000
2030	940	2000	2500	5200	7800	23000	33000	60000
2035	1100	2200	2800	6000	9000	25000	36000	67000
2040	1300	2500	3100	6700	10000	28000	39000	74000
2045	1500	2800	3500	7500	12000	30000	42000	81000
2050	1700	3100	3800	8200	13000	33000	45000	88000

DOE multiplied the CH_4 and N_2O emissions reduction estimated for each year by the SC-CH_4 and SC-N_2O estimates for that year in each of the cases. DOE adjusted the values to 2022$ using the implicit price deflator for GDP from the Bureau of Economic Analysis. To calculate a present value of the stream of monetary values, DOE discounted the values in each of the cases using the specific discount rate that had been used to obtain the SC-CH_4 and SC-N_2O estimates in each case.

c. Sensitivity Analysis Using Updated 2023 SC-GHG Estimates

In December 2023 EPA issued a new set of SC-GHG estimates (2023 SC-GHG) in connection with a final rulemaking under the Clean Air Act.[72] These estimates incorporate recent research addressingand address recommendations of the National Academies (2017), responses to public comments on an earlier sensitivity analysis using draft SC-GHG estimates,) and comments from a 2023 external peer review of the accompanying technical report. For this rulemaking, DOE used these newupdated 2023

[72] See *www.epa.gov/environmental-economics/scghg*.

SC-GHG values to conduct a sensitivity analysis of the value of GHG emissions reductions associated with alternative standards for ~~consumer conventional cooking products.~~ circulator pumps. This sensitivity analysis provides an expanded range of potential climate benefits associated with amended standards. The final year of ~~these~~EPA's new 2023 SC-GHG estimates is 2080; therefore, DOE did not monetize the climate benefits of GHG emissions reductions occurring after 2080.

~~The results of the sensitivity analysis are presented in appendix 14C of the Direct Final Rule TSD.~~ The overall climate benefits are ~~larger~~greater when using the higher, updated SC-GHG 2023 estimates, compared to the climate benefits using the older IWG SC-GHG estimates. ~~However, DOE's conclusion that the standards are economically justified remains the same regardless of which SC-GHG estimates are used~~The results of the sensitivity analysis are presented in appendix 14C of the direct final rule TSD.

2. Monetization of Other Emissions Impacts

For this direct final rule, DOE estimated the monetized value of NO_X and SO_2 emissions reductions from electricity generation using benefit per ton estimates for that sector from the EPA's Benefits Mapping and Analysis Program.[73] DOE used EPA's values for PM2.5-related benefits associated with NO_X and SO_2 and for ozone-related benefits associated with NO_X for 2025 and 2030, and 2040, calculated with discount rates of 3 percent and 7 percent. DOE used linear interpolation to define values for the years not given in the 2025 to 2040 range; for years beyond 2040 the values are held constant.

[73] U.S. Environmental Protection Agency. Estimating the Benefit per Ton of Reducing Directly-Emitted PM2.5, PM2.5 Precursors and Ozone Precursors from 21 Sectors. Available at *www.epa.gov/benmap/estimating-benefit-ton-reducing-directly-emitted-pm25-pm25-precursors-and-ozone-precursors* (last accessed December 4, 2023).

DOE combined the EPA regional benefit-per-ton estimates with regional information on electricity consumption and emissions from *AEO2023* to define weighted-average national values for NO_X and SO_2 (see appendix 14B of the direct final rule TSD).

DOE multiplied the site 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.

M. Utility Impact Analysis

The utility impact analysis estimates the changes in installed electrical capacity and generation projected to result for each considered TSL. The analysis is based on published output from the NEMS associated with *AEO2023*. 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. For the current analysis, impacts are quantified by comparing the levels of electricity sector generation, installed capacity, fuel consumption and emissions in the *AEO2023* 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 potential 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. 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 consumers on energy, (2) reduced spending on new energy supply by the utility industry, (3) increased consumer spending on the products to which the new standards apply and other goods and services, 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 BLS. BLS regularly publishes its estimates of the number of jobs per million dollars of economic activity in different sectors of the economy, as well as the jobs created elsewhere in the economy by this same economic activity. Data from BLS indicate that expenditures in the utility sector generally create fewer jobs (both directly and indirectly) than expenditures in other sectors of the economy.[74] 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

[74] *See* U.S. Department of Commerce–Bureau of Economic Analysis. *Regional Multipliers: A User Handbook for the Regional Input-Output Modeling System ("RIMS II")*. 1997. U.S. Government Printing Office: Washington, DC. Available at *https://apps.bea.gov/scb/pdf/regional/perinc/meth/rims2.pdf* (last accessed November 29, 2023).

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, the BLS data suggest that 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 called Impact of Sector Energy Technologies version 4 ("ImSET").[75] 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 that 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 direct final rule. Therefore, DOE used ImSET only to generate results

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[75] Livingston, O. V., S. R. Bender, M. J. Scott, and R. W. Schultz. *ImSET 4.0: Impact of Sector Energy Technologies Model Description and User's Guide*. 2015. Pacific Northwest National Laboratory: Richland, WA. PNNL-24563.

for near-term timeframes (2029–2033), where these uncertainties are reduced. For more details on the employment impact analysis, see chapter 16 of the direct final rule TSD.

O. Other Comments

As discussed previously, DOE considered relevant comments, data, and information obtained ~~during its own rulemaking~~through the 2023 NOPR public comment process in determining whether the recommended standards from the Joint Agreement are in accordance with 42 U.S.C. 6295(o). And while some of those comments were directed at specific aspects of DOE's analysis of the Joint Agreement under 42 U.S.C. 6295(o), others were more generally applicable to DOE's energy conservation standards rulemaking program as a whole. The ensuing discussion focuses on these general comments concerning energy conservation standards issued under EPCA.

The National Academies of Sciences, Engineering, and Medicine ("NAS") periodically appoint a committee to peer review the assumptions, models, and methodologies that DOE uses in setting energy conservation standards for covered products and equipment. The most recent such peer review was conducted in a series of meetings in 2020, and NAS issued the report[76] in 2021 detailing its findings and recommendations on how DOE can improve its analyses and align them with best practices for cost-benefit analysis.

In response to the March 2023 NOPR, AHAM stated that despite previous requests from AHAM and others, DOE has failed to review and incorporate the recommendations of the NAS report, instead indicating that it will conduct a separate

[76] National Academies of Sciences, Engineering, and Medicine. 2021. *Review of Methods Used by the U.S. Department of Energy in Setting Appliance and Equipment Standards*. Washington, DC: The National Academies Press. Available at *doi.org/10.17226/25992* (last accessed August 2, 2023).

rulemaking process without such a process having been initiated. (AHAM, No. 31 at p. 8) AHAM further stated that DOE seems to be ignoring the recommendations in the NAS Report and even conducting analysis that is opposite to the recommendations. AHAM commented that DOE cannot continue to perpetuate the errors in its analytical approach that have been pointed out by stakeholders and the NAS report as to do so will lead to arbitrary and capricious rules. (*Id*.)

As discussed, the rulemaking process for establishing new or amended standards for covered products and equipment are specified at appendix A to subpart C of 10 CFR part 430 (the Process Rule). DOE periodically examines and revises these provisions in separate rulemaking proceedings. The recommendations provided in the NAS Report, which pertain to the processes by which DOE analyzes energy conservation standards, will be considered by DOE in a separate, forthcoming rulemaking process.

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

A. Trial Standard Levels

In general, DOE typically evaluates potential new or amended standards for products and equipment by grouping individual efficiency levels for each class into TSLs. Use of TSLs allows DOE to identify and consider manufacturer cost interactions between the product classes, to the extent that there are such interactions, and price elasticity of consumer purchasing decisions that may change when different standard levels are set.

In the analysis conducted for this direct final rule, DOE analyzed the benefits and burdens of five TSLs for MREFs. DOE developed TSLs that combine efficiency levels for each analyzed product class. These TSLs were developed by combining specific efficiency levels for each of the MREF product classes analyzed by DOE. TSL 1 represents a 10 percent increase in efficiency, corresponding to the lowest analyzed efficiency level above the baseline for each analyzed product class. TSL 2 represents efficiency levels consistent with Energy Star requirements for coolers, which in most cases except freestanding coolers ("FC") represent an increase compared to TSL 1, and a modest increase in efficiency for certain combination cooler product classes. compared to TSL 1. TSL 3 increases the efficiency for freestanding ("FC") and built-in ("BIC") coolers FC by an additional 10 percent compared to TSL 1TSLs 1 and 2 and built-in coolers ("BIC") by an additional 10 percent compared to TSL 1[77], while maintaining the same efficiency levels as TSL 2 for combination coolers. TSL 4 (the recommended TSL) further increases the standard level adopted in this direct final rule for all product classes except built-in compact cooler ("BICC"), BIC, C-3A and C-3A-BI., which remain at the same level as in TSL 3. TSL 5 represents max-tech for each product class, which represents an increase from TSL 4 in all cases. 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.

[77] For BIC, the considered EL is lower at TSL 3 than TSL 2 due to the relatively high Energy Star level included in TSL 2.

Table V.1 presents the TSLs and the corresponding efficiency levels that DOE has identified for potential amended energy conservation standards for MREFs.

Table V.1 Trial Standard Levels for MREFs

	FCC	FC	BICC	BIC	C-13A	C-13A-BI	C-3A	C-3A-BI
TSL 1	~~EL 1~~EL1 (10%)	EL 1 (10%)	EL 1 (10%)	EL 1 (10%)	EL 1 (10%)	EL 1 (10%)	EL 1 (10%)	EL 1 (10%)
TSL 2	EL 2 (20%)	EL 1 (10%)	EL 3 (30%)	EL 3 (30%)	EL 2 (16%)	EL 2 (16%)	EL 1 (10%)	EL 1 (10%)
TSL 3	EL 2 (20%)	EL 2 (20%)	EL 3 (30%)	EL 2 (20%)	EL 2 (16%)	EL 2 (16%)	EL 1 (10%)	EL 1 (10%)
TSL 4	EL 3 (30%)	EL 3 (30%)	EL 3 (30%)	EL 2 (20%)	EL 3 (20%)	EL 3 (20%)	EL 1 (10%)	EL 1 (10%)
TSL 5	EL 5 (59%, 50%)*	EL 5 (38%)	EL 5 (59%, 50%)*	EL 5 (38%)	EL 5 (28%)	EL 5 (28%)	EL 4 (24%)	EL 4 (24%)

* Corresponding to 3.1 cu. ft. and 5.1 cu. ft. representative units, respectively.

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 amended standards at each TSL would have on the LCC and PBP. DOE also examined the impacts of potential standards on selected consumer subgroups. These analyses are discussed in the following sections.

a. Life-Cycle Cost and Payback Period

In general, higher-efficiency products affect consumers in two ways: (1) purchase price increases 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.

Tables V.2 through V.17 show the LCC and PBP results for the TSLs 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.8 of this document). Because some consumers purchase products with higher efficiency in the no-new-standards case, the average savings are less than the difference between the average LCC of the baseline product and the average LCC at each TSL. The savings refer only to consumers who are affected by a standard at a given TSL. Those who already purchase a product with efficiency at or above a given TSL are not affected. Consumers for whom the LCC increases at a given TSL experience a net cost.

Table V.2 Average LCC and PBP Results for BIC

TSL	Efficiency Level	Average Costs *2022$*				Simple Payback *Years*	Average Lifetime *years*
		Installed Cost	First Year's Operating Cost	Lifetime Operating Cost	LCC		
--	Baseline	1,877.84	39.78	469.37	2,347.21	-	14.5
1	1	1,905.01	35.86	423.09	2,328.10	6.9	14.5
3,4	2	1,911.08	32.27	380.67	2,291.75	4.4	14.5
2	3	1,980.25	28.39	334.88	2,315.12	9.0	14.5
--	4	2,261.59	26.58	313.49	2,575.08	29.1	14.5
5	5	2,325.00	25.68	302.80	2,627.79	31.7	14.5

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 baseline product.

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

TSL	Efficiency Level	Life-Cycle Cost Savings	
		Average LCC Savings* *2022$*	Percent of Consumers that Experience Net Cost
1	1	18.99	19.2
3,4	2	53.56	4.6
2	3	19.27	52.7
--	4	(240.68)	97.5
5	5	(293.40)	98.4

* The savings represent the average LCC for affected consumers.

Table V.4 Average LCC and PBP Results for BICC

TSL	Efficiency Level	Average Costs *2022$*				Simple Payback *Years*	Average Lifetime *years*
		Installed Cost	First Year's Operating Cost	Lifetime Operating Cost	LCC		
--	Baseline	749.12	26.35	239.64	988.76	-	10.6
1	1	754.97	23.88	217.17	972.14	2.4	10.6
--	2	778.61	21.30	193.67	972.27	5.8	10.6
2-4	3	808.77	18.95	172.20	980.97	8.1	10.6
--	4	857.81	16.47	149.60	1,007.41	11.0	10.6
5	5	969.53	12.06	109.45	1,078.98	15.4	10.6

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 baseline product.

Table V.5 Average LCC Savings Relative to the No-New-Standards Case for BICC

TSL	Efficiency Level	Life-Cycle Cost Savings	
		Average LCC Savings* *2022$*	Percent of Consumers that Experience Net Cost
1	1	16.08	0.9
--	2	11.21	10.0
2-4	3	1.53	15.1
--	4	(25.46)	20.0
5	5	(97.38)	23.7

* The savings represent the average LCC for affected consumers.

Table V.6 Average LCC and PBP Results for C-13A

TSL	Efficiency Level	Average Costs *2022$*				Simple Payback *Years*	Average Lifetime ~~*years*~~*Years*
		Installed Cost	First Year's Operating Cost	Lifetime Operating Cost	LCC		
--	Baseline	1,155.05	32.29	293.98	1,449.03	-	10.7
1	1	1,158.39	29.24	266.25	1,424.64	1.1	10.7
2,3	2	1,161.33	27.41	249.53	1,410.86	1.3	10.7
4	3	1,199.58	26.21	238.54	1,438.12	7.3	10.7
--	4	1,279.30	24.71	224.89	1,504.19	16.4	10.7
5	5	1,322.51	23.68	215.46	1,537.97	19.4	10.7

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 baseline product.

Table V.7 Average LCC Savings Relative to the No-New-Standards Case for C-13A

TSL	Efficiency Level	Life-Cycle Cost Savings	
		Average LCC Savings* *2022$*	Percent of Consumers that Experience Net Cost
1	1	24.36	0.2
2,3	2	37.86	0.6
4	3	10.60	47.2
--	4	(55.47)	89.1
5	5	(89.25)	93.9

* The savings represent the average LCC for affected consumers.

Table V.8 Average LCC and PBP Results for C-13A-BI

TSL	Efficiency Level	Average Costs *2022$*				Simple Payback *Years*	Average Lifetime *years*
		Installed Cost	First Year's Operating Cost	Lifetime Operating Cost	LCC		
--	Baseline	1,372.62	35.48	321.01	1,693.63	-	10.6
1	1	1,376.17	32.14	290.75	1,666.92	1.1	10.6
2,3	2	1,379.30	30.13	272.51	1,651.81	1.2	10.6
4	3	1,420.01	28.81	260.52	1,680.53	7.1	10.6
--	4	1,504.85	27.17	245.63	1,750.48	15.9	10.6
5	5	1,550.84	26.03	235.34	1,786.18	18.9	10.6

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 baseline product.

Table V.9 Average LCC Savings Relative to the No-New-Standards Case for C-13A-BI

TSL	Efficiency Level	Life-Cycle Cost Savings	
		Average LCC Savings* *2022$*	Percent of Consumers that Experience Net Cost
1	1	26.69	0.4
2,3	2	41.53	0.5
4	3	12.81	46.0
--	4	(57.14)	87.8
5	5	(92.83)	93.1

* The savings represent the average LCC for affected consumers.

Table V.10 Average LCC and PBP Results for C-3A

TSL	Efficiency Level	Average Costs *2022$*				Simple Payback *Years*	Average Lifetime *years*
		Installed Cost	First Year's Operating Cost	Lifetime Operating Cost	LCC		
--	Baseline	1,092.34	32.58	386.24	1,478.58	-	14.6
1-4	1	1,097.64	29.53	349.99	1,447.63	1.7	14.6
--	2	1,146.86	28.09	332.95	1,479.80	12.1	14.6
--	3	1,347.15	26.64	315.69	1,662.84	42.9	14.6
5	4	1,420.65	25.35	300.39	1,721.04	45.4	14.6

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 baseline product.

Table V.11 Average LCC Savings Relative to the No-New-Standards Case for C-3A

TSL	Efficiency Level	Life-Cycle Cost Savings	
		Average LCC Savings* *2022$*	Percent of Consumers that Experience Net Cost
1-4	1	30.95	0.0
--	2	(1.22)	64.0
--	3	(184.26)	99.4
5	4	(242.46)	99.6

* The savings represent the average LCC for affected consumers.

Table V.12 Average LCC and PBP Results for C-3A-BI

TSL	Efficiency Level	Average Costs *2022$*				Simple Payback *Years*	Average Lifetime *years*
		Installed Cost	First Year's Operating Cost	Lifetime Operating Cost	LCC		
--	Baseline	1,525.00	37.11	443.60	1,968.60	-	14.7
1-4	1	1,530.64	33.62	401.77	1,932.41	1.6	14.7
--	2	1,583.02	31.87	380.86	1,963.88	11.1	14.7
--	3	1,796.17	30.12	359.95	2,156.12	38.8	14.7
5	4	1,874.39	28.80	344.15	2,218.55	42.0	14.7

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 baseline product.

Table V.13 Average LCC Savings Relative to the No-New-Standards Case for C-3A-BI

TSL	Efficiency Level	Life-Cycle Cost Savings	
		Average LCC Savings* *2022$*	Percent of Consumers that Experience Net Cost
1-4	1	36.19	0.0
--	2	4.72	57.2
--	3	(187.52)	99.0
5	4	(249.95)	99.3

* The savings represent the average LCC for affected consumers.

Table V.14 Average LCC and PBP Results for FC

TSL	Efficiency Level	Average Costs *2022$*				Simple Payback *Years*	Average Lifetime *years*
		Installed Cost	First Year's Operating Cost	Lifetime Operating Cost	LCC		
--	Baseline	1,416.63	39.71	468.33	1,884.96	-	14.5
1,2	1	1,442.18	35.80	422.17	1,864.36	6.5	14.5
3	2	1,447.90	32.22	379.87	1,827.76	4.2	14.5
4	3	1,512.93	28.35	334.20	1,847.13	8.5	14.5
--	4	1,777.48	26.55	312.87	2,090.35	27.4	14.5
5	5	1,837.10	25.64	302.21	2,139.31	29.9	14.5

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 baseline product.

Table V.15 Average LCC Savings Relative to the No-New-Standards Case for FC

TSL	Efficiency Level	Life-Cycle Cost Savings	
		Average LCC Savings* *2022$*	Percent of Consumers that Experience Net Cost
1,2	1	21.06	10.0
3	2	45.59	1.8
4	3	26.22	44.0
--	4	(217.00)	97.5
5	5	(265.96)	98.2

* The savings represent the average LCC for affected consumers.

Table V.16 Average LCC and PBP Results for FCC

TSL	Efficiency Level	Average Costs *2022$*				Simple Payback *Years*	Average Lifetime *years*
		Installed Cost	First Year's Operating Cost	Lifetime Operating Cost	LCC		
--	Baseline	547.98	26.30	238.78	786.76	-	10.6
1	1	552.90	23.84	216.42	769.33	2.0	10.6
2,3	2	573.06	21.27	193.04	766.10	5.0	10.6
4	3	598.43	18.92	171.72	770.15	6.8	10.6
--	4	639.67	16.45	149.24	788.91	9.3	10.6
5	5	732.92	12.02	108.95	841.87	12.9	10.6

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 baseline product.

Table V.17 Average LCC Savings Relative to the No-New-Standards Case for FCC

TSL	Efficiency Level	Life-Cycle Cost Savings	
		Average LCC Savings* *2022$*	Percent of Consumers that Experience Net Cost
1	1	17.53	1.9
2,3	2	17.55	30.6
4	3	12.97	46.8
--	4	(5.79)	65.5
5	5	(58.75)	81.6

* The savings represent the average LCC for affected consumers.

b. Consumer Subgroup Analysis

In the consumer subgroup analysis, DOE estimated the impact of the considered TSLs on senior-only households, which account for 8.7% of the total MREF household sample. DOE did not consider low-income consumers in this direct final rule because MREFs are not products generally used by this subgroup, as they typically cost more than comparable compact refrigerators, which are able to maintain lower temperatures compared to MREFs, and therefore serve a wider range of applications. ~~Table V.18~~Based on the TraQline wine chiller data, less than 4 percent of MREF owners are below the federal household income threshold for poverty. Table V.18 compares the average LCC savings and PBP at each efficiency level for the senior-only consumer subgroup with similar metrics for the entire consumer sample for all product classes. In most cases, the average LCC savings and PBP for senior-only households at the considered efficiency levels are improved (*i.e.*, higher LCC savings and equal or lesser payback periods) from the average for all households. Chapter 11 of the direct final rule TSD presents the complete LCC and PBP results for the subgroup.

Table V.18 Comparison of LCC Savings and PBP for Senior-Only Consumer Subgroup and All Consumers

	Average LCC Savings* *2022$*		Simple Payback *years*	
TSL	**Senior-Only Households**	**All Households**	**Senior-Only Households**	**All Households**
FCC				
1	18.26	17.53	1.9	2.0
2,3	18.81	17.55	4.9	5.0
4	14.87	12.97	6.6	6.8
5	(54.77)	(58.75)	12.6	13.0
FC				
1,2	23.08	21.06	6.3	6.5
3	48.17	45.59	4.0	4.2
4	30.69	26.22	8.2	8.5
5	(260.04)	(265.96)	28.9	29.9
BICC				
1	16.95	16.08	2.3	2.4
2-4	4.12	1.53	7.8	8.1
5	(92.37)	(97.38)	15.0	15.4
BIC				
1	21.14	18.99	6.7	6.9
3,4	57.44	53.56	4.3	4.4
2	24.36	19.27	8.7	9.0
5	(286.98)	(293.40)	30.7	31.7
C-13A				
1	25.22	24.36	1.1	1.1
2,3	39.23	37.86	1.3	1.3
4	12.30	10.60	7.1	7.3
5	(86.88)	(89.25)	19.0	19.5
C-13A-BI				
1	27.67	26.69	1.0	1.1
2,3	43.09	41.53	1.2	1.3
4	14.75	12.81	6.9	7.1
5	(90.13)	(92.83)	18.4	18.9
C-3A				
1-4	32.33	30.95	1.7	1.7
5	(239.10)	(242.46)	44.0	45.4
C-3A-BI				
1-4	37.91	36.19	1.6	1.6
5	(245.98)	(249.95)	40.6	42.0

* The savings represent the average LCC for affected consumers.

c. Rebuttable Presumption Payback

As discussed in section IV.F.9 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. (42 U.S.C. 6295(o)(2)(B)(iii)) 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 procedure for MREFs. In contrast, the PBPs presented in section V.B.1.a of this document were calculated using distributions that reflect the range of energy use in the field.

Table V.19 presents the rebuttable-presumption payback periods for the considered TSLs for MREFs. While DOE examined the rebuttable-presumption criterion, it considered whether the standard levels considered 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), that 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.19 Rebuttable-Presumption Payback Periods

Efficiency Level	Rebuttable Payback Period *Years*							
	FCC	**FC**	**BICC**	**BIC**	**C-13A**	**C-13A-BI**	**C-3A**	**C-3A-BI**
1	1.8	5.9	2.1	6.2	1.0	1.0	1.6	1.5
2	4.5	3.7	5.3	4.0	1.2	1.1	11.0	10.0
3	6.2	7.6	7.3	8.1	6.6	6.4	38.7	35.2
4	8.4	24.6	9.9	26.2	14.9	14.4	41.0	38.1
5	11.7	26.8	13.9	28.5	17.6	17.1	--	--

2. Economic Impacts on Manufacturers

DOE performed an MIA to estimate the impact of amended energy conservation standards on manufacturers of MREFs. The next section describes the expected impacts on manufacturers at each considered TSL. Chapter 12 of the direct final rule TSD explains the analysis in further detail.

a. Industry Cash Flow Analysis Results

In this section, DOE provides GRIM results from the analysis, which examines changes in the industry that would result from a standard. The following tables summarize the estimated financial impacts (represented by changes in INPV) of potential amended energy conservation standards on manufacturers of MREFs, as well as the conversion costs that DOE estimates manufacturers of MREFs would incur at each TSL.

The impact of amended energy conservation standards was analyzed under two scenarios: (1) the preservation-of-gross-margin percentage; and (2) the preservation-of-operating-profit, as discussed in section IV.J.2.d of this document. The preservation-of-gross-margin percentages applies a “gross margin percentage” of 20 percent for FCC and 28 percent for all other product classes.[78] This scenario assumes that a manufacturer’s per-unit dollar profit would increase as MPCs increase in the standards cases and represents the upper-bound to industry profitability under potential new or amended energy conservation standards.

The preservation-of-operating-profit scenario reflects manufacturers’ concerns about their inability to maintain margins as MPCs increase to reach more stringent efficiency levels. In this scenario, while manufacturers make the necessary investments

[78] The gross margin percentages of 20 percent and 28 percent are based on manufacturer markups of 1.25 and 1.38 percent, respectively.

required to convert their facilities to produce compliant products, operating profit does not change in absolute dollars and decreases as a percentage of revenue. The preservation-of-operating-profit scenario results in the lower (or more severe) bound to impacts of potential amended standards on industry.

Each of the modeled scenarios results in a unique set of cash flows and corresponding INPV for each TSL. INPV is the sum of the discounted cash flows to the industry from the base year through the end of the analysis period. The "change in INPV" refers to the difference in industry value between the no-new-standards case and standards case at each TSL. To provide perspective on the short-run cash flow impact, DOE includes a comparison of free cash flow between the no-new-standards case and the standards case at each TSL in the year before amended standards would take effect. This figure provides an understanding of the magnitude of the required conversion costs relative to the cash flow generated by the industry in the no-new-standards case.

Conversion costs are one-time investments for manufacturers to bring their manufacturing facilities and product designs into compliance with potential amended standards. As described in section IV.J.2.c of this document, conversion cost investments occur between the year of publication of the direct final rule and the year by which manufacturers must comply with the amended standards. The conversion costs can have a significant impact on the short-term cash flow of the industry and generally result in lower free cash flow in the period between the publication of the direct final rule and the compliance date of potential amended standards. Conversion costs are independent of the manufacturer markup scenarios and are not presented as a range in this analysis.

Table V.20 Manufacturer Impact Analysis Results for Miscellaneous Refrigeration Products

	Unit	No-New-Standards Case	TSL 1	TSL 2	TSL 3	TSL 4	TSL 5
INPV	*2022$ Million*	807.7	773.7 to 777.2	758.7 to 770.6	761.9 to 772.1	715.6 to 747.4	386.7 to 524.5
Change in INPV*	*%*	-	(4.2) to (3.8)	(6.1) to (4.6)	(5.7) to (4.4)	(11.4) to (7.5)	(52.1) to (35.1)
Free Cash Flow (2028)	*2022$ Million*	60.4	41.5	34.3	35.8	13.2	(169.9)
Change in Free Cash Flow (2028)	*%*	-	(31.2)	(43.1)	(40.7)	(78.2)	(381.5)
Product Conversion Costs	*2022$ Million*	-	54.0	68.4	70.8	104.1	375.3
Capital Conversion Costs	*2022$ Million*	-	1.3	6.4	1.3	26.6	179.7
Total Conversion Costs	*2022$ Million*	-	55.3	74.8	72.1	130.7	555.1

*Parentheses denote negative (-) values.

The following cash flow discussion refers to product classes as defined in Table I.1 in section I of this document and the efficiency levels and design options as detailed in Table IV.4 in section IV.C.3 of this document.

At TSL 1, the standard represents a modest increase in efficiency, corresponding to the lowest analyzed efficiency level above baseline for all classes, except product classes C-9 and C-9-BI at baseline efficiency. The change in INPV is expected to range from -4.2 to -3.8 percent. At this level, the free cash flow is estimated to decrease by 41.5 percent compared to the no-new-standards case value of $60.4 million in the year 2028, the year before the standards year. Currently, 24.4 percent of MREF shipments meet the efficiencies required at TSL 1. See Table V.21 for the percentage of shipments that meet each TSL by product class.

DOE analyzed implementing various design options for the range of directly analyzed product classes. These design options could include implementing more efficient single-speed compressors, tube and fin evaporators and/or condensers, hot walls, and argon-filled glass. At TSL 1, capital conversion costs are minimal because most manufacturers can incorporate design options with component changes. Product conversion costs may be necessary for sourcing components, building prototypes, and testing new components. DOE estimates capital conversion costs of $1.3 million and product conversion costs of $54.0 million. Conversion costs total $55.3 million.

At TSL 1, the shipment-weighted average MPC for all MREFs is expected to increase by 0.7 percent relative to the no-new-standards case shipment-weighted average MPC for all MREFs in 2029. Given the relatively small increase in production costs, DOE does not project a notable drop in shipments in the year the standard takes effect. In the preservation-of-gross-margin percentage scenario, the minor increase in cashflow from the higher MSP is slightly outweighed by the $55.3 million in conversion costs, causing a small negative change in INPV at TSL 1 under this scenario. Under the preservation-of-operating-profit scenario, manufacturers earn the same per-unit operating profit as would be earned in the no-new-standards case, but manufacturers do not earn additional profit from their investments. In this scenario, the manufacturer markup decreases in 2030, the year after the analyzed 2029 compliance year. This reduction in the manufacturer markup and the $55.3 million in conversion costs incurred by manufacturers cause a slightly negative change in INPV at TSL 1 under the preservation-of-operating-profit scenario. See section IV.J.2.d of this document for details on the manufacturer markup scenarios.

TSL 2 represents efficiency levels consistent with ENERGY STAR requirements for coolers and a modest increase in efficiency for certain combination cooler product classes. The change in INPV is expected to range from -6.1 to -4.6 percent. At this level, the free cash flow is estimated to decrease by 43.1 percent compared to the no-new-standards case value of $60.4 million in the year 2028, the year before the standards year. Currently, 12.6 percent of MREF shipments meet the efficiencies required at TSL 2.

The design options DOE analyzed for most product classes include implementing similar design options as TSL 1, such as more efficient single-speed compressors. For FCC, C–13A, and C–13A-BI, TSL 2 corresponds to EL 2. For BICC and BIC, TSL 2 corresponds to EL 3. For the remaining product classes, the efficiencies required at TSL 2 are the same as TSL 1. The increase in conversion costs compared to TSL 1 are largely driven by the higher efficiencies required for BICs, which account for 3.5 percent of MREF shipments. For BIC products that do not meet this level, increasing insulation thickness would likely mean new cabinets, liners, and fixtures as well as new shelf designs. Implementing variable-speed compressors could require more advanced controls and electronics and new test stations. DOE estimates capital conversion costs of $6.4 million and product conversion costs of $68.4 million. Conversion costs total $74.8 million.

At TSL 2, the shipment-weighted average MPC for all MREFs is expected to increase by 3.4 percent relative to the no-new-standards case shipment-weighted average MPC for all MREFs in 2029. In the preservation-of-gross-margin percentage scenario, the minor increase in cashflow from the higher MSP is slightly outweighed by the $74.8 million in conversion costs, causing a small negative change in INPV at TSL 2 under this scenario. Under the preservation-of-operating-profit scenario, manufacturers earn the same per-unit operating profit as would be earned in the no-new-standards case, but manufacturers do not earn additional profit from their investments. In this scenario, the manufacturer markup decreases in 2030, the year after the analyzed compliance year.

This reduction in the manufacturer markup and the $74.8 million in conversion costs incurred by manufacturers cause a negative change in INPV at TSL 2 under the preservation-of-operating-profit scenario.

TSL 3 increases the efficiency for FCs by an additional 10 percent compared to TSL 2, and TSL 3 decreases the efficiency for BICs by 10 percent. Combination coolers are at the same efficiency levels as TSL 2. The change in INPV is expected to range from -5.7 to -4.4 percent. At this level, free cash flow is estimated to decrease by 40.7 percent compared to the no-new-standards case value of $60.4 million in the year 2028, the year before the standards year. Currently, approximately 5.8 percent of domestic MREF shipments meet the efficiencies required at TSL 3.

At this level, DOE analyzed similar design options as TSL 1 and TSL 2, such as implementing incrementally more efficient single-speed compressors. For all product classes except FC and BIC, the efficiencies required at TSL 3 are the same as TSL 2. For FC, TSL 3 corresponds to EL 2. For BIC, TSL 3 reflects a lower efficiency level (EL 2) as compared to TSL 2 (EL 3). Industry capital conversion costs decrease at TSL 3 as compared to TSL 2 due to the lower efficiency level required for BIC. As previously discussed, DOE expects manufacturers of BIC would likely need to increase insulation thickness at TSL 2 (EL 3) and incorporate variable-speed compressors. However, at TSL 3, DOE's engineering analysis and manufacturer feedback indicate that manufacturers could achieve EL 2 efficiencies for BIC with relatively straightforward component swaps versus a larger product redesign associated with increasing insulation. DOE estimates capital conversion costs of $1.3 million and product conversion costs of $70.8 million. Conversion costs total $72.1 million.

At TSL 3, the shipment-weighted average MPC for all MREFs is expected to increase by 3.2 percent relative to the no-new-standards case shipment-weighted average MPC for all MREFs in 2029. In the preservation-of-gross-margin-percentage scenario, the slight increase in cashflow from the higher MSP is outweighed by the $72.1 million in conversion costs, causing a slightly negative change in INPV at TSL 3 under this scenario. Under the preservation-of-operating-profit scenario, the manufacturer markup decreases in 2030, the year after the analyzed compliance year. This reduction in the manufacturer markup and the $72.1 million in conversion costs incurred by manufacturers cause a slightly negative change in INPV at TSL 3 under the preservation-of-operating-profit scenario.

At the Recommended TSL (*i.e.*, TSL 4), the standard reflects an increase in efficiency level for the product classes that make up the vast majority of MREF shipments (FCC, FC, C–13A). The Recommended TSL further increases the standard level adopted in this direct final rule for all product classes except BICC, BIC, C-3A, and C-3A-BI. The change in INPV is expected to range from -11.4 to -7.5 percent. At this level, free cash flow is estimated to decrease by 78.2 percent compared to the no-new-standards case value of $60.4 million in the year 2028, the year before the standards year. Currently, approximately 3.9 percent of domestic MREF shipments meet the efficiencies required at the Recommended TSL.

At the Recommended TSL, all product classes correspond to EL 3, except BIC, C-3A, C-3A-BI, C-9, and C-9-BI. For BIC, the Recommended TSL corresponds to EL 2. For C–3A, the efficiencies required at the Recommended TSL are the same as TSL 3 (EL 1). For C-3A-BI, the Recommended TSL corresponds to EL 1. Both C-9 and C-9-BI correspond to baseline efficiency. At this level, conversion costs are largely driven by the efficiencies required for FC, which accounts for approximately 11.8 percent of industry shipments. DOE's shipments analysis estimates that no FC shipments currently meet the efficiencies required at the Recommended TSL. All manufacturers would need to update their product platforms, which could include increasing insulation thickness and implementing variable-speed compressors. Increasing insulation thickness would likely result in the loss of interior volume or an increase in exterior product dimensions. A decrease of interior volume would require redesign of the cabinet as well as the designs and tooling associated with the interior of the product, such as the liner, shelving, racks, and drawers. DOE estimates capital conversion costs of $26.6 million and product conversion costs of $104.1 million. Conversion costs total $130.7 million.

At the Recommended TSL, the shipment-weighted average MPC for all MREFs is expected to increase by 8.1 percent relative to the no-new-standards case shipment-weighted average MPC for all MREFs in 2029. Given the projected increase in production costs, DOE expects an estimated 4 percent drop in shipments in the year the standard takes effect relative to the no-new-standards case. In the preservation-of-gross-margin-percentage scenario, the increase in cashflow from the higher MSP is outweighed by the $130.7 million in conversion costs and the drop in annual shipments, causing a negative change in INPV at the Recommended TSL under this scenario. Under the preservation-of-operating-profit scenario, the manufacturer markup decreases in 2030, the year after the analyzed compliance year. This reduction in the manufacturer markup, the $130.7 million in conversion costs incurred by manufacturers, and the drop in annual shipments cause a negative change in INPV at the Recommended TSL under the preservation-of-operating-profit scenario.

TSL 5 represents max-tech efficiency levels for all product classes. The change in INPV is expected to range from -52.1 to -35.1 percent. At this level, free cash flow is estimated to decrease by 381.5 percent compared to the no-new-standards case value of $60.4 million in the year 2028, the year before the standards year. Currently, approximately 2.9 percent of domestic MREF shipments meet the efficiencies required at TSL 5.

DOE's shipments analysis estimates that no shipments meet the efficiencies required across all product classes except for BICC, which account for only 4 percent of industry shipments. A max-tech standard would necessitate significant investment to redesign nearly all product platforms and incorporate design options such as the most efficient variable-speed compressors, triple-pane glass, increased foam insulation thickness, and VIP technology. Capital conversion costs may be necessary for new tooling for VIP placement as well as new testing stations for high-efficiency components. Increasing insulation thickness would likely result in the loss of interior volume or an increase in exterior product dimensions. Loss of interior volume would require redesign of the cabinet as well as the designs and tooling associated with the interior of the product, such as the liner, shelving, racks, and drawers. Product conversion costs at max-tech are significant as manufacturers work to completely redesign their product platforms. For products implementing VIPs, product conversion costs may be necessary for prototyping and testing for VIP placement, design, and sizing. Manufacturers implementing triple-pane glass may need to redesign the door frame and hinges to support the added thickness and weight. DOE estimates capital conversion costs of $179.7 million and product conversion costs of $375.3 million. Conversion costs total $555.1 million.

At TSL 5, the large conversion costs result in a free cash flow dropping below zero in the years before the standards year. The negative free cash flow calculation indicates manufacturers may need to access cash reserves or outside capital to finance conversion efforts.

At TSL 5, the shipment-weighted average MPC for all MREFs is expected to increase by 32.~~6~~7 percent relative to the no-new-standards case shipment-weighted average MPC for all MREFs in 2029. Given the projected increase in production costs, DOE expects an estimated 13 percent drop in shipments in the year the standard takes effect relative to the no-new-standards case. In the preservation-of-gross-margin-percentage scenario, the increase in cashflow from the higher MSP is outweighed by the $555.1 million in conversion costs and drop in annual shipments, causing a significant negative change in INPV at TSL 5 under this scenario. Under the preservation-of-operating-profit scenario, the manufacturer markup decreases in 2030, the year after the analyzed compliance year. This reduction in the manufacturer markup, the $555.1 million in conversion costs incurred by manufacturers, and the drop in annual shipments cause a significant decrease in INPV at TSL 5 under the preservation-of-operating-profit scenario.

Table V.21 Percentages of 2024 Shipments that Meet each TSL by Product Class

Product Class	TSL 1	TSL 2	TSL 3	TSL 4	TSL 5
FCC	21.0%	3.0%	3.0%	0.0%	0.0%
FC	58.0%	58.0%	0.0%	0.0%	0.0%
BICC	82.0%	75.0%	76.0%	76.0%	74.0%
BIC	28.0%	28.0%	28.0%	28.0%	0.0%
C-3A	0.0%	0.0%	0.0%	0.0%	0.0%
C-3A-BI	100.0%	100.0%	100.0%	100.0%	100.0%
C-9	100.0%	100.0%	100.0%	100.0%	100.0%
C-9-BI	0.0%	0.0%	0.0%	0.0%	0.0%
C-13A	1.0%	0.0%	0.0%	0.0%	0.0%
C-13A-BI	0.0%	0.0%	0.0%	0.0%	0.0%
Total	24.4%	12.6%	5.8%	3.9%	2.9%

b. Direct Impacts on Employment

To quantitatively assess the potential impacts of amended energy conservation standards on direct employment in the MREF industry, DOE used the GRIM to estimate the domestic labor expenditures and number of direct employees in the no-new-standards case and in each of the standards cases during the analysis period. For this direct final rule, DOE used the most up-to-date information available. DOE calculated these values using statistical data from the 2021 *ASM*,[79] BLS employee compensation data,[80] results from the engineering analysis, and manufacturer interviews conducted in support of the March 2023 NOPR.

Labor expenditures related to product manufacturing depend on 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 total MPCs by the labor percentage of MPCs. The total labor expenditures in the GRIM were then converted to total production employment levels by dividing production labor expenditures by the average fully burdened wage multiplied by the average number of hours worked per year per production worker. To do this, DOE relied on the *ASM* inputs: Production Workers Annual Wages, Production Workers Annual Hours, Production Workers for Pay Period, and Number of Employees. DOE also relied on the BLS employee compensation data to determine the fully burdened wage ratio. The fully

[79] U.S. Census Bureau, *Annual Survey of Manufactures*. "Summary Statistics for Industry Groups and Industries in the U.S (2021)." Available at *www.census.gov/programs-surveys/asm/data.html* (last accessed July 5, 2023).
[80] U.S. Bureau of Labor Statistics. *Employer Costs for Employee Compensation – June 2023*. September 12, 2023. Available at *www.bls.gov/news.release/pdf/ecec.pdf* (last accessed October 30, 2023).

burdened wage ratio factors in paid leave, supplemental pay, insurance, retirement and savings, and legally required benefits.

The number of production employees is then multiplied by the U.S. labor Percentage to convert total production employment to total domestic production employment. The U.S. labor percentage represents the industry fraction of domestic manufacturing production capacity for the covered product. This value is derived from manufacturer interviews, product database analysis, and publicly available information. Consistent with the March 2023 NOPR, DOE estimates that 7.8 percent of MREFs are produced domestically.

The domestic production employees estimate covers production line workers, including line supervisors, who are directly involved in fabricating and assembling products within the OEM facility. Workers performing services that are closely associated with production operations, such as materials-handling tasks using forklifts, are also included as production labor. DOE's estimates only account for production workers who manufacture the specific products covered by this rulemaking.

Non-production workers account for the remainder of the direct employment figure. The non-production employees estimate covers domestic workers who are not directly involved in the production process, such as sales, engineering, human resources, and management.[81] Using the amount of domestic production workers calculated above, non-production domestic employees are extrapolated by multiplying the ratio of non-

[81] The comprehensive description of production and non-production workers is available at "Definitions and Instructions for the Annual Survey of Manufacturers, MA-10000" (pp. 13–14) *www2.census.gov/programs-surveys/asm/technical-documentation/questionnaire/2021/instructions/MA_10000_Instructions.pdf* (last accessed September 9, 2023).

production workers in the industry compared to production employees. DOE assumes that this employee distribution ratio remains constant between the no-new-standards case and standards cases.

Using the GRIM, DOE estimates in the absence of amended energy conservation standards there would be 211 domestic production and non-production workers for MREFs in 2029. Table V.22 shows the range of the impacts of energy conservation standards on U.S. manufacturing employment in the MREF industry. The following discussion provides a qualitative evaluation of the range of potential impacts presented in Table V.22.

Table V.22 Domestic Direct Employment Impacts for MREF Manufacturers in 2029

	No-New-Standards Case	TSL 1	TSL 2	TSL 3	TSL 4	TSL 5
Direct Employment in 2029 (Production Workers + Non-Production Workers)	211	210	207	207	204	201
Potential Changes in Direct Employment Workers *	-	(188) to (1)	(188) to (3)	(188) to (3)	(188) to (6)	(188) to (9)

*DOE presents a range of potential employment impacts. Numbers in parentheses denote negative values.

The direct employment impacts shown in Table V.22 represent the potential domestic employment changes that could result following the compliance date for the MREF product classes in this direct final rule. The upper bound estimate corresponds to a change in the number of domestic workers that would result from amended energy conservation standards if manufacturers continue to produce the same scope of covered products within the United States after compliance takes effect. The lower bound estimate represents the maximum decrease in production workers if manufacturing moved to lower labor-cost countries. At lower TSLs, DOE believes the likelihood of changes in production location due to amended standards are low due to the relatively minor production line updates required. However, as amended standards increase in stringency and both the complexity and cost of production facility updates increases, manufacturers may reevaluate domestic production siting options. Specifically, implementing VIPs could necessitate additional labor content and significant capital investment. However, at the Recommended TSL (*i.e.,* TSL 4), none of the analyzed product classes would likely require VIPs to meet the recommended efficiency levels. Furthermore, DOE notes that of the six manufacturers with U.S. manufacturing facilities producing MREFs, five manufacturers are AHAM members, a key signatory of the Joint Agreement.

Additional detail on the analysis of direct employment can be found in chapter 12 of the direct final rule TSD. Additionally, the employment impacts discussed in this section are independent of the employment impacts from the broader U.S. economy, which are documented in chapter 16 of the direct final rule TSD.

c. Impacts on Manufacturing Capacity

In interviews, manufacturers noted that the majority of MREFs—namely FCC—are manufactured in Asia and rebranded by home appliance manufacturers. Manufacturers had few concerns about manufacturing constraints below the max-tech level and the implementation of VIPs. However, at max-tech, some manufacturers expressed technical uncertainty about industry's ability to meet the efficiencies required as few OEMs offer products at max-tech today. For example, DOE is not aware of any OEMs that currently offer FCC that meet TSL 5 efficiencies. DOE's shipments analysis estimates that except for BICC, which only accounts for 4 percent of MREF shipments, no shipments of other product classes meet the max-tech efficiencies.

Some low-volume domestic and European-based OEMs offer niche or high-end MREFs (*i.e.*, built-ins, combination coolers, FCCs that can be integrated into kitchen cabinetry). In interviews, these manufacturers stated that, due to their low volume and wide range of product offerings, they could face engineering resource constraints should amended standards necessitate a significant redesign, such as requiring insulation thickness changes for FCs at the Recommended TSL (*i.e.,* TSL 4) or requiring VIPs for all product classes at TSL 5. These manufacturers further stated that the extent of their resource constraints depend, in part, on the outcome of other ongoing DOE energy conservation standards rulemakings that impact related products, in particular, the energy conservation standards for RF. DOE notes that the January 2024 RF Direct Final Rule amending the energy conservation standards for RF was published in the *Federal Register* on January 17, 2024. 89 FR 3026. In that direct final rule, compliance with amended standards would be required in 2029 or 2030, depending on the product class, instead of 2027, as analyzed in the RF NOPR published in the *Federal Register* on February 27, 2023. *See* 88 FR 12452. Thus, manufacturers will have more time to redesign RF products to meet amended standards, compared to the EPCA-specified compliance period. Additionally, for OEMs that manufacture both MREFs and RFs, DOE expects that the alignment of the compliance dates for these covered products would help mitigate regulatory burden by reducing the number of times manufacturers would need to reorganize production lines.

d. Impacts on Subgroups of Manufacturers

Using average cost assumptions to develop industry cash-flow estimates may not capture the differential impacts among subgroups of manufacturers. Small manufacturers, niche players, or manufacturers exhibiting a cost structure that differs substantially from the industry average could be affected disproportionately. DOE investigated small businesses as a manufacturer subgroup that could be disproportionally impacted by energy conservation standards and could merit additional analysis.

DOE analyzes the impacts on small businesses in a separate analysis for the standards proposed in the NOPR published elsewhere in today'sthis issue of *Federal Register* and in chapter 12 of the direct final rule TSD. In summary, the SBA defines a "small business" as having 1,500 employees or less for NAICS 335220, "Major Household Appliance Manufacturing" or as having 1,250 employees of less for the secondary NAICS code of 333415: "Air-Conditioning and Warm Air Heating Equipment and Commercial and Industrial Refrigeration Equipment Manufacturing." Using the more conservative (*i.e.*, more inclusive) threshold of 1,500 employees, DOE identified twoone domestic OEMsOEM that qualifyqualifies as small businessesbusiness and is not foreign-owned and operated. For a discussion of the impacts on the small business manufacturer group, see chapter 12 of the direct final rule TSD.

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. 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.

For the cumulative regulatory burden analysis, DOE examines Federal, product-specific regulations that could affect MREF manufacturers that take effect approximately 3 years before and after 2029 the compliance date. This information is presented in Table V.23.

Table V.23 Compliance Dates and Expected Conversion Expenses of Federal Energy Conservation Standards Affecting Miscellaneous Refrigeration Products Original Equipment Manufacturers

Federal Energy Conservation Standard	Number of OEMs*	Number of OEMs Affected by ~~Today's~~This Rule**	Approx. Standards Compliance Year	Industry Conversion Costs *(Millions)*	Industry Conversion Costs / Equipment Revenue***
Automatic Commercial Ice Makers† 88 FR 30508 (May 11, 2023)	23	5	2027	$15.9 (2022$)	0.6%
Dishwashers† 88 FR 32514 (May 19, 2023)	21	12	2027	$125.6 (2021$)	2.1%
Refrigerated Bottled or Canned Beverage Vending Machines† 88 FR 33968 (May 25, 2023)	5	1	2028	$1.5 (2022$)	0.2%
Room Air Conditioners 88 FR 34298 (May 26, 2023)	8	4	2026	$24.8 (2021$)	0.4%
Microwave Ovens 88 FR 39912 (June 20, 2023)	18	8	2026	$46.1 (2021$)	0.7%
Consumer Water Heaters† 88 FR 49058 (July 27, 2023)	22	3	2030	$228.1 (2022$)	1.1%
Consumer Boilers† 88 FR 55128 (August 14, 2023)	24	1	2030	$98.0 (2022$)	3.6%
Commercial Water Heating Equipment 88 FR 69686 (October 6, 2023)	15	1	2026	$42.7 (2022$)	3.8%
Commercial Refrigerators, Refrigerator-Freezers, and Freezers† 88 FR 70196 (October 10, 2023)	83	10	2028	$226.4 (2022$)	1.6%
Dehumidifiers† 88 FR 76510 (November 6, 2023)	20	4	2028	$6.9 (2022$)	0.4%
Consumer Furnaces 88 FR 87502 (December 18, 2023)	15	1	2029	$162.0 (2022$)	1.8%

Refrigerators, Refrigerator-Freezers, and Freezers 89 FR 3026 (January 17, 2024)	63	13	2029 and 2030‡	$830.3 (2022$)	1.3%
Consumer Conventional Cooking Products 89 FR 11548 (February 14, 2024)	35	9	2028	$66.7 (2022$)	0.3%
Consumer Clothes Dryers 89 FR ~~Citation~~18164 (~~MONTH DAY~~March 12, 2024)	19	8	2028	$~~X.X~~180.7 (2022$)	~~X~~1.4%
Residential Clothes Washers 89 FR ~~Citation~~19026 (~~MONTH DAY~~March 15, 2024)	22	7	2028	$~~X.X~~320.0 (2022$)	~~X~~1.8%

* This column presents the total number of OEMs identified in the energy conservation standard rule that is contributing to cumulative regulatory burden.
** This column presents the number of OEMs producing MREFs that are also listed as OEMs in the identified energy conservation standard that is contributing to cumulative regulatory burden.
*** This column presents industry conversion costs as a percentage of equipment revenue during the conversion period. Industry conversion costs are the upfront investments manufacturers must make to sell compliant products/equipment. The revenue used for this calculation is the revenue from just the covered product/equipment associated with each row. The conversion period is the time frame over which conversion costs are made and lasts from the publication year of a final rule to the compliance year of the energy conservation standard. The conversion period typically ranges from 3 to 5 years, depending on the rulemaking.
† These rulemakings are at the NOPR stage, and all values are subject to change until finalized through publication of a final rule.
‡ For the refrigerators, refrigerator-freezers, and freezers energy conservation standards direct final rule, the compliance year (2029 or 2030) varies by product class.

As shown in Table V.23, most of the rulemakings with the largest overlap of MREF OEMs include RFs, consumer conventional cooking products, residential clothes washers, consumer clothes dryers, and MREFs, which are all part of the multi-product Joint Agreement submitted by interested parties.[82] The multi-product Joint Agreement states the "jointly recommended compliance dates will achieve the overall energy and economic benefits of this agreement while allowing necessary lead-times for manufacturers to redesign products and retool manufacturing plants to meet the

[82] The microwave ovens energy conservation standards final rule (88 FR 39912), which has 8 overlapping OEMs, was published prior to the joint submission of the multi-product Joint Agreement.

recommended standards across product categories." (Joint Agreement, No. 34 at p. 2) As discussed previously, the staggered compliance dates help mitigate manufacturers' concerns about their ability to allocate sufficient resources to comply with multiple concurrent amended standards and about the need to align compliance dates for products that are typically designed or sold as matched pairs. See section IV.J.3 of this document for stakeholder comments about cumulative regulatory burden. See Table V.24 for a comparison of the estimated compliance dates based on EPCA-specified timelines and the compliance dates detailed in the Joint Agreement.

Table V.24 Expected Compliance Dates for Multi-Product Joint Agreement

Rulemaking	Estimated Compliance Year based on EPCA Requirements	Compliance Year in the Joint Agreement
Consumer Clothes Dryers	2027	2028
Residential Clothes Washers	2027	2028
Consumer Conventional Cooking Products	2027	2028
Dishwashers	2027	2027*
Refrigerators, Refrigerator-Freezers, and Freezers	2027	2029 or 2030 depending on the product class
Miscellaneous Refrigeration Products	2029	2029

*Estimated compliance year. The Joint Agreement states, "3 years after the publication of a final rule in the *Federal Register.*" (Joint Agreement, No. 34 at p. 2)

3. National Impact Analysis

This section presents DOE's estimates of the national energy savings and the NPV of consumer benefits that would result from each of the TSLs considered as potential amended standards.

a. Significance of Energy Savings

To estimate the energy savings attributable to potential amended standards for MREFs, DOE compared their energy consumption 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 amended standards (2029–2058). Table V.25 presents DOE's projections of the national energy savings for each TSL considered for MREFs. The savings were calculated using the approach described in section IV.H.2 of this document.

Table V.25 Cumulative National Energy Savings for MREFs; 30 Years of Shipments (2029–2058)

	Trial Standard Level				
	1	**2**	**3**	**4**	**5**
	Quads				
Primary energy	0.10	0.20	0.21	0.31	0.54
FFC energy	0.10	0.20	0.22	0.32	0.55

OMB Circular A-4[83] requires agencies to present analytical results, including separate schedules of the monetized benefits and costs that show the type and timing of benefits and costs. Circular A-4 also directs agencies to consider the variability of key elements underlying the estimates of benefits and costs. For this rulemaking, DOE undertook a sensitivity analysis using 9 years, 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.[84] The review timeframe established in EPCA is generally not

[83] U.S. Office of Management and Budget. *Circular A-4: Regulatory Analysis*. Available at *www.whitehouse.gov/omb/information-for-agencies/circulars/* (last accessed January 5, 2024). DOE used the prior version of Circular A-4 (2003) as a result of the effective date of the new version.
[84] 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

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 based on a 9-year analytical period are presented in Table V.26. The impacts are counted over the lifetime of MREFs purchased in 2029–2037.

Table V.26 Cumulative National Energy Savings for MREFs; 9 Years of Shipments (2029–2037)

	Trial Standard Level				
	1	**2**	**3**	**4**	**5**
	quads				
Primary energy	0.03	0.05	0.06	0.09	0.15
FFC energy	0.03	0.06	0.06	0.09	0.15

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 guidelines on regulatory analysis,[85] DOE calculated NPV using both a 7-percent and a 3-percent real discount rate. Table V.27 shows the consumer NPV results with impacts counted over the lifetime of products purchased in 2029–2058.

standards. (42 U.S.C. 6295(m)) While adding a 6-year review to the 3-year compliance period adds up to 9 years, DOE notes that it may undertake reviews at any time within the 6-year period and that the 3-year compliance date may yield to the 6-year backstop. A 9-year analysis period may not be appropriate given the variability that occurs in the timing of standards reviews and the fact that for some products, the compliance period is 5 years rather than 3 years.

[85] U.S. Office of Management and Budget. *Circular A-4: Regulatory Analysis*. Available at *www.whitehouse.gov/omb/information-for-agencies/circulars/* (last accessed January 5, 2024). DOE used the prior version of Circular A-4 (2003) as a result of the effective date of the new version.

Table V.27 Cumulative Net Present Value of Consumer Benefits for MREFs; 30 Years of Shipments (2029–2058)

	Trial Standard Level				
	1	2	3	4	5
	Billion 2022$				
3 percent	0.~~47~~49	0.~~66~~72	0.~~81~~87	0.~~64~~77	~~-2.25~~1.68
7 percent	0.19	0.~~22~~24	0.~~28~~31	0.~~11~~17	-1.~~61~~36

The NPV results based on the aforementioned 9-year analytical period are presented in Table V.28. The impacts are counted over the lifetime of products purchased in 2029–2037. 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.

Table V.28 Cumulative Net Present Value of Consumer Benefits for MREFs; 9 Years of Shipments (2029–2037)

	Trial Standard Level				
	1	2	3	4	5
	Billion 2022$				
3 percent	0.17	0.23	0.~~28~~29	0.~~18~~20	-0.~~99~~91
7 percent	0.09	0.10	0.~~13~~14	0.~~03~~04	-0.~~88~~83

The previous results reflect the use of a 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~~a low benefits scenario ~~with~~which combines a lower rate of price decline ~~than the reference case~~ and ~~one~~AEO 2023 Low Economic Growth, as well as a high benefits scenario ~~with~~which combines a higher rate of price decline ~~than the reference case~~and AEO 2023 High Economic Growth. The results of these alternative cases are presented in appendix 10C of the direct final rule TSD. In the high benefits scenario where high-price-decline case is applied, the NPV of consumer benefits is higher than in the default case. In the low benefits scenario where low-price-decline case is applied, the NPV of consumer benefits is lower than in the default case.

c. Indirect Impacts on Employment

DOE estimates that amended energy conservation standards for MREFs will reduce energy expenditures 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. As described in section IV.N of this document, DOE used an input/output model of the U.S. economy to estimate indirect employment impacts of the TSLs that DOE considered. There are uncertainties involved in projecting employment impacts, especially changes in the later years of the analysis. Therefore, DOE generated results for near-term timeframes (2029–2033), 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 III.E.1.d of this document, DOE has concluded that the standards adopted in this direct final rule will not lessen 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

DOE considered any lessening of competition that would be likely to result from amended standards. As discussed in section III.E.1.e of this document, EPCA directs the Attorney General of the United States ("Attorney General") to determine the impact, if any, of any lessening of competition likely to result from a proposed standard and to transmit such determination in writing to the Secretary within 60 days of the publication of a proposed rule, together with an analysis of the nature and extent of the impact. To assist the Attorney General in making this determination, DOE is providing DOJ with copies of this direct final rule and the direct final rule TSD for review.

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. Chapter 15 in the direct final rule TSD presents the estimated impacts on electricity-generating capacity, relative to the no-new-standards case, for the TSLs that DOE considered in this rulemaking.

Energy conservation resulting from potential energy conservation standards for MREFs is expected to yield environmental benefits in the form of reduced emissions of certain air pollutants and greenhouse gases. Table V.29 provides DOE's estimate of cumulative emissions reductions expected to result from the TSLs considered in this rulemaking. 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.

Table V.29 Cumulative Emissions Reduction for MREFs Shipped in 2029–2058

	Trial Standard Level				
	1	2	3	4	5
Electric Power Sector and Site Emissions					
CO_2 (*million metric tons*)	1.64	3.33	3.63	5.32	9.12
CH_4 (*thousand tons*)	0.12	0.25	0.27	0.40	0.68
N_2O (*thousand tons*)	0.02	0.03	0.04	0.06	0.10
NO_x (*thousand tons*)	0.77	1.57	1.70	2.50	4.28
SO_2 (*thousand tons*)	0.56	1.13	1.23	1.81	3.10
Hg (*tons*)	0.00	0.01	0.01	0.01	0.02
Upstream Emissions					
CO_2 (*million metric tons*)	0.16	0.33	0.36	0.53	0.91
CH_4 (*thousand tons*)	14.90	30.19	32.88	48.24	82.73
N_2O (*thousand tons*)	0.00	0.00	0.00	0.00	0.00
NO_x (*thousand tons*)	2.55	5.18	5.64	8.27	14.19
SO_2 (*thousand tons*)	0.01	0.02	0.02	0.03	0.05
Hg (*tons*)	0.00	0.00	0.00	0.00	0.00
Total FFC Emissions					
CO_2 (*million metric tons*)	1.81	3.66	3.99	5.85	10.03
CH_4 (*thousand tons*)	15.02	30.44	33.15	48.64	83.41
N_2O (*thousand tons*)	0.02	0.04	0.04	0.06	0.10
NO_x (*thousand tons*)	3.33	6.75	7.34	10.77	18.47
SO_2 (*thousand tons*)	0.57	1.15	1.25	1.84	3.15
Hg (*tons*)	0.00	0.01	0.01	0.01	0.02

As part of the analysis for this direct final rule, DOE estimated monetary benefits likely to result from the reduced emissions of CO_2 that DOE estimated for each of the considered TSLs for MREFs. Section IV.L of this document discusses the estimated SC-CO_2 values that DOE used. Table V.30 presents the value of CO_2 emissions reduction at each TSL for each of the SC-CO_2 cases. The time-series of annual values is presented for the selected TSL in chapter 14 of the direct final rule TSD.

Table V.30 Present Value of CO_2 Emissions Reduction for MREFs Shipped in 2029–2058

TSL	SC-CO_2 Case			
	Discount Rate and Statistics			
	5% Average	3% Average	2.5% Average	3% 95th percentile
	million 2022$			
1	18.2	77.6	121.3	235.6
2	36.9	157.5	246.1	478.1
3	40.0	170.8	266.8	518.2
4	58.6	250.3	391.1	759.4
5	100.5	429.5	671.2	1,303.2

As discussed in section IV.L.2 of this document, DOE estimated the climate benefits likely to result from the reduced emissions of methane and N_2O that DOE estimated for each of the considered TSLs for MREFs. Table V.31 presents the value of the CH_4 emissions reduction at each TSL, and Table V.32 presents the value of the N_2O emissions reduction at each TSL. The time-series of annual values is presented for the selected TSL in chapter 14 of the direct final rule TSD.

Table V.31 Present Value of Methane Emissions Reduction for MREFs Shipped in 2029–2058

TSL	SC-CH_4 Case			
	Discount Rate and Statistics			
	5%	3%	2.5%	3%
	Average	Average	Average	95th percentile
	million 2022$			
1	6.9	20.7	28.9	54.8
2	14.1	42.0	58.6	111.1
3	15.3	45.6	63.6	120.6
4	22.3	66.9	93.3	176.8
5	38.4	114.8	160.3	303.6

Table V.32 Present Value of Nitrous Oxide Emissions Reduction for MREFs Shipped in 2029–2058

TSL	SC-N_2O Case			
	Discount Rate and Statistics			
	5%	3%	2.5%	3%
	Average	Average	Average	95th percentile
	million 2022$			
1	0.1	0.3	0.4	0.7
2	0.1	0.6	0.9	1.5
3	0.2	0.6	0.9	1.6
4	0.2	0.9	1.4	2.4
5	0.4	1.5	2.4	4.1

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 global and U.S. economy continues to evolve rapidly. DOE, together with other Federal agencies, will continue to review 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. DOE notes, however, that the adopted standards in this direct final rule would be economically justified even without inclusion of monetized benefits of reduced GHG emissions.

DOE also estimated the monetary value of the economic benefits associated with NO_X and SO_2 emissions reductions anticipated to result from the considered TSLs for MREFs. The dollar-per-ton values that DOE used are discussed in section IV.L of this document. Table V.33 presents the present value for NO_X emissions reduction for each TSL calculated using 7-percent and 3-percent discount rates, and Table V.34 presents similar results for SO_2 emissions reductions. The results in these tables reflect application of EPA's low dollar-per-ton values, which DOE used to be conservative. The time-series of annual values is presented for the selected TSL in chapter 14 of the direct final rule TSD.

Table V.33 Present Value of NO_X Emissions Reduction for MREFs Shipped in 2029–2058

TSL	3% Discount Rate	7% Discount Rate
	million 2022$	
1	155.0	60.6
2	314.4	123.0
3	341.0	133.0
4	499.7	194.6
5	857.1	333.1

Table V.34 Present Value of SO_2 Emissions Reduction for MREFs Shipped in 2029–2058

TSL	3% Discount Rate	7% Discount Rate
	million 2022$	
1	37.1	14.7
2	75.3	29.9
3	81.6	32.3
4	119.6	47.2
5	205.1	80.8

Not all the public health and environmental benefits from the reduction of greenhouse gases, NOx, and SO_2 are captured in the values above, and additional unquantified benefits from the reductions of those pollutants as well as from the reduction of direct PM and other co-pollutants may be significant. DOE has not included monetary benefits of the reduction of Hg emissions because the amount of reduction is very small.

7. Other Factors

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

8. Summary of Economic Impacts

Table V.35 presents the NPV values that result from adding the estimates of the economic benefits resulting from reduced GHG and NO_X and SO_2 emissions to the NPV of consumer benefits calculated for each TSL considered in this rulemaking. The consumer benefits are domestic U.S. monetary savings that occur as a result of purchasing the covered MREFs and are measured for the lifetime of products shipped in 2029–2058. The climate benefits associated with reduced GHG emissions resulting from the adopted standards are global benefits and are also calculated based on the lifetime of MREFs shipped in 2029–2058.

Table V.35 Consumer NPV Combined with Present Value of Climate Benefits and Health Benefits

Category	TSL 1	TSL 2	TSL 3	TSL 4	TSL 5
Using 3% discount rate for Consumer NPV and Health Benefits (billion 2022$)					
5% Average SC-GHG case	0.7	1.1	1.3	1.3	-1.0
3% Average SC-GHG case	0.8	1.2	1.4	1.6	-0.6
2.5% Average SC-GHG case	0.8	1.4	1.6	1.7	-0.4
3% 95th percentile SC-GHG case	1.0	1.6	1.9	2.2	0.4
Using 7% discount rate for Consumer NPV and Health Benefits (billion 2022$)					
5% Average SC-GHG case	0.3	0.4	0.5	0.4	-1.1
3% Average SC-GHG case	0.4	0.6	0.7	0.7	-0.6
2.5% Average SC-GHG case	0.4	0.7	0.8	0.8	-0.4
3% 95th percentile SC-GHG case	0.6	1.0	1.1	1.3	0.4

C. Conclusion

When considering new or amended energy conservation standards, the 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 amended 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.

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. These include the impacts on identifiable subgroups of consumers who may be disproportionately affected by a national standard and impacts on employment.

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., an issue known as the "energy efficiency gap". 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).[86] 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.

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[86] Gillingham and Palmer (2014), Gerarden et al. (2015) and Allcott and Greenstone (2012) discuss a wide range of potential factors contributing to the energy efficiency gap.

First, if consumers forgo 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 standard 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.[87]

~~While DOE is not prepared at present to provide a fuller~~DOE continues to explore additional potential updates to the quantifiable framework for estimating the benefits and costs of changes in consumer purchase decisions due to an energy conservation standard, and 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.[88] 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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[87] P.C. Reiss and M.W. White. Household Electricity Demand, Revisited. *Review of Economic Studies*. 2005. 72(3): pp. 853–883. doi: *10.1111/0034-6527.00354*.

[88] Sanstad, A. H. *Notes on the Economics of Household Energy Consumption and Technology Choice*. 2010. Lawrence Berkeley National Laboratory. Available at *www1.eere.energy.gov/buildings/appliance_standards/pdfs/consumer_ee_theory.pdf* (last accessed November 29, 2023).

1. Benefits and Burdens of TSLs Considered for MREF Standards

Tables V.36 and V.37 summarize the quantitative impacts estimated for each TSL for MREFs. The national impacts are measured over the lifetime of MREFs purchased in the 30-year period that begins in the anticipated year of compliance with amended standards (2029–2058). The energy savings, emissions reductions, and value of emissions reductions refer to full-fuel-cycle results. DOE is presenting monetized benefits of GHG emissions reductions in accordance with the applicable Executive ~~Orders~~orders and DOE would reach the same conclusion presented in this document in the absence of the ~~social cost of greenhouse gases~~estimated benefits from reductions in GHG emissions, including the Interim Estimates presented by the Interagency Working Group. The efficiency levels contained in each TSL are described in section V.A of this document.

Table V.36 Summary of Analytical Results for MREFs TSLs Shipped in 2029-2058: National Impacts

Category	TSL 1	TSL 2	TSL 3	TSL 4	TSL 5
Cumulative FFC National Energy Savings					
Quads	0.10	0.20	0.22	0.32	0.55
Cumulative FFC Emissions Reduction					
CO_2 (*million metric tons*)	1.81	3.66	3.99	5.85	10.03
CH_4 (*thousand tons*)	15.02	30.44	33.15	48.64	83.41
N_2O (*thousand tons*)	0.02	0.04	0.04	0.06	0.10
NO_x (*thousand tons*)	3.33	6.75	7.34	10.77	18.47
SO_2 (*thousand tons*)	0.57	1.15	1.25	1.84	3.15
Hg (*tons*)	0.00	0.01	0.01	0.01	0.02
Present Value of Benefits and Costs (*3% discount rate, billion 2022$*)					
Consumer Operating Cost Savings	0.62	1.26	1.37	2.00	3.44
Climate Benefits*	0.10	0.20	0.22	0.32	0.55
Health Benefits**	0.19	0.39	0.42	0.62	1.06
Total Benefits†	0.91	1.85	2.01	2.94	5.04
Consumer Incremental Product Costs‡	0.~~15~~13	0.~~60~~54	0.~~56~~50	1.~~37~~23	5.~~69~~12
Consumer Net Benefits	0.~~47~~49	0.~~66~~72	0.~~81~~87	0.~~64~~77	-~~2.25~~1.68
Total Net Benefits	0.~~76~~78	1.~~25~~31	1.~~45~~51	1.~~57~~71	-0.~~64~~07
Present Value of Benefits and Costs (*7% discount rate, billion 2022$*)					
Consumer Operating Cost Savings	0.27	0.54	0.59	0.86	1.47
Climate Benefits*	0.10	0.20	0.22	0.32	0.55
Health Benefits**	0.08	0.15	0.17	0.24	0.41
Total Benefits†	0.44	0.90	0.97	1.42	2.43
Consumer Incremental Product Costs‡	0.~~08~~07	0.~~33~~30	0.~~30~~28	0.~~75~~69	~~3.08~~2.83
Consumer Net Benefits	0.19	0.~~22~~24	0.~~28~~31	0.~~11~~17	-1.~~61~~36
Total Net Benefits	0.~~36~~37	0.~~57~~60	0.~~67~~69	0.~~67~~73	-0.~~65~~40

Note: This table presents the costs and benefits associated with MREFs shipped during the period 2029−2058. These results include benefits to consumers which accrue after 2058 from the products shipped in 2029−2058.

* Climate benefits are calculated using four different estimates of the SC-CO_2, SC-CH_4 and SC-N_2O. Together, these represent the global SC-GHG. For presentational purposes of this table, the climate benefits associated with the average SC-GHG at a 3 percent discount rate are shown; however, DOE emphasizes the importance and value of considering the benefits calculated using all four sets of SC-GHG estimates. To monetize the benefits of reducing GHG emissions, this analysis uses the interim estimates presented in the *Technical Support Document: Social Cost of Carbon, Methane, and Nitrous Oxide Interim Estimates Under Executive Order 13990* published in February 2021 by the IWG.

** Health benefits are calculated using benefit-per-ton values for NO_X and SO_2. DOE is currently only monetizing (for NO_X and SO_2) $PM_{2.5}$ precursor health benefits and (for NO_X) ozone precursor health benefits but will continue to assess the ability to monetize other effects such as health benefits from reductions in direct $PM_{2.5}$ emissions. The health benefits are presented at real discount rates of 3 and 7 percent. See section IV.L of this document for more details.

† Total and net benefits include consumer, climate, and health benefits. For presentation purposes, total and net benefits for both the 3-percent and 7-percent cases are presented using the average SC-GHG with 3-percent discount rate.

‡ Costs include incremental equipment costs.

Table V.37 Summary of Analytical Results for MREF TSLs: Manufacturer and Consumer Impacts

Category	TSL 1	TSL 2	TSL 3	TSL 4	TSL 5
Manufacturer Impacts					
Industry NPV (million 2022$) (No-new-standards case INPV = 807.7)	773.7 to 777.2	758.7 to 770.6	761.9 to 772.1	715.6 to 747.4	386.7 to 524.5
Industry NPV (% change)	(4.2) to (3.8)	(6.1) to (4.6)	(5.7) to (4.4)	(11.4) to (7.5)	(52.1) to (35.1)
Consumer Average LCC Savings (2022$)					
FCC	17.53	17.55	17.55	12.97	(58.75)
BICC	16.08	1.53	1.53	1.53	(97.38)
FC	21.06	21.06	45.59	26.22	(265.96)
BIC	18.99	19.27	53.56	53.56	(293.40)
C-3A	30.95	30.95	30.95	30.95	(242.46)
C-3A-BI	36.19	36.19	36.19	36.19	(249.95)
C-13A	24.36	37.86	37.86	10.60	(89.25)
Shipment-Weighted Average*	37.52	21.11	25.23	15.24	(99.49)
Consumer Simple PBP (years)					
FCC	2.0	5.0	5.0	6.8	13.0
BICC	2.4	8.1	8.1	8.1	15.4
FC	6.5	6.5	4.2	8.5	29.9
BIC	6.9	9.0	4.4	4.4	31.7
C-3A	1.7	1.7	1.7	1.7	45.4
C-3A-BI	1.6	1.6	1.6	1.6	42.0
C-13A	1.1	1.3	1.3	7.3	19.5
Shipment-Weighted Average*	2.6	4.7	4.3	7.1	17.1
Percent of Consumers that Experience a Net Cost					
FCC	1.9	30.6	30.6	46.8	81.6
BICC	0.9	15.1	15.1	15.1	23.7
FC	10.0	10.0	1.8	44.0	98.2
BIC	19.2	52.7	4.6	4.6	98.4
C-3A	0.0	0.0	0.0	0.0	99.6
C-3A-BI	0.0	0.0	0.0	0.0	99.3
C-13A	0.3	0.6	0.6	47.2	93.9
Shipment-Weighted Average*	3.1	22.9	20.3	43.7	84.5

Parentheses indicate negative (-) values.
* Weighted by shares of each product class in total projected shipments in 2029.

DOE first considered TSL 5, which represents the max-tech efficiency levels. For coolers (*i.e.,* FCC, FC, BICC, and BIC), which account for approximately 82 percent of MREF shipments, DOE expects that products would require use of VIPs, VSCs, and triple-glazed doors at this TSL. DOE expects that VIPs would be used in the products' side walls. In addition, the products would use the best-available-efficiency variable-speed compressors, forced-convection heat exchangers with multi-speed brushless-DC ("BLDC") fans, and increase in cabinet wall thickness as compared to most baseline products. TSL 5 would save an estimated 0.55 quads of energy, an amount which DOE considers significant. Under TSL 5, the NPV of consumer benefit would be negative, *i.e.*, -$1.~~61~~36 billion using a discount rate of 7 percent, and -$~~2.25~~1.68 billion using a discount rate of 3 percent.

The cumulative emissions reductions at TSL 5 are 10.0 Mt of CO_2, 3.15 thousand tons of SO_2, 18.5 thousand tons of NO_X, 0.02 tons of Hg, 83.4 thousand tons of CH_4, and 0.10 thousand tons of N_2O. The estimated monetary value of the climate benefits from reduced GHG emissions (associated with the average SC-GHG at a 3-percent discount rate) at TSL 5 is $0.6 billion. The estimated monetary value of the health benefits from reduced SO_2 and NO_X emissions at TSL 5 is $0.4 billion using a 7-percent discount rate and $1.1 billion using a 3-percent discount rate.

Using a 7-percent discount rate for consumer benefits and costs, health benefits from reduced SO_2 and NO_X emissions, and the 3-percent discount rate case for climate benefits from reduced GHG emissions, the estimated total NPV at TSL 5 is -$0.~~64~~4 billion. Using a 3-percent discount rate for all benefits and costs, the estimated total NPV at TSL 5 is -$0.~~65~~07 billion. The estimated total monetized NPV is provided for additional information, however, consistent with the statutory factors and framework for along with appropriate consideration of its full range of statutory factors when determining whether a proposed standard level is economically justified, DOE considers a range of quantitative and qualitative benefits and burdens, including the costs and cost savings for consumers, impacts to consumer subgroups, energy savings, emission reductions, and impacts on manufacturers.

At TSL 5, for the product classes with the largest market share, which are FCC, FC, and C-13A and together account for approximately 92 percent of annual shipments, the LCC savings are all negative (-$45.3, -$178.8, and -$73.4, respectively) and their payback periods are 13.0 years, 29.9 years, and 19.5 years, respectively, which are all longer than their corresponding average lifetimes. For these product classes, the fraction of consumers experiencing a net LCC cost is 81.6 percent, 98.2 percent, and 93.9 percent due to increases in first cost of $185.0, $420.5, and $167.5, respectively. Overall, a majority of MREF consumers (84.5 percent) would experience a net cost and the average LCC savings would be negative for all analyzed product classes.

At TSL 5, the projected change in INPV ranges from a decrease of $421.0 million to a decrease of $283.2 million, which corresponds to decreases of 51.2 percent and 35.1 percent, respectively. DOE estimates that industry must invest $555.1 million to comply with standards set at TSL 5.

DOE estimates that approximately 2.9 percent of current MREF shipments meet the max-tech levels. For FCC, FC, and C-13A, which together account for approximately 92 percent of annual shipments, DOE estimates that zero shipments currently meet max-tech efficiencies.

At TSL 5, manufacturers would likely need to implement all the most efficient design options analyzed in the engineering analysis. Manufacturers that do not currently offer products that meet TSL 5 efficiencies would need to develop new product platforms, which would require significant investment. Conversion costs are driven by the need for changes to cabinet construction, such as increasing foam insulation thickness and/or incorporating VIP technology. Increasing insulation thickness could result in a loss of interior volume or an increase in exterior volume. If manufacturers chose to maintain exterior dimensions, increasing insulation thickness would require redesign of the cabinet as well as the designs and tooling associated with the interior of the product, such as the liner, shelving, racks, and drawers. Incorporating VIPs into MREF designs could also require redesign of the cabinet to maximize the efficiency benefit of this technology. In addition to insulation changes, manufacturers may need to implement triple-pane glass, which could require implementing reinforced hinges and redesigning the door structure.

At this level, DOE estimates a 13-percent drop in shipments in the year the standard takes effect compared to the no-new-standards case, as some consumers may forgo purchasing a new MREF due to the increased upfront cost of baseline models.

At TSL 5 for MREFs, the Secretary concludes that the benefits of energy savings, emission reductions, and the estimated monetary value of the emissions reductions would be outweighed by the economic burden on many consumers, negative NPV of consumer benefits, and the impacts on manufacturers, including the significant potential reduction in INPV. A majority of MREF consumers (84.5 percent) would experience a net cost and the average LCC savings would be negative. Additionally, manufacturers would need to make significant upfront investments to update product platforms. The potential reduction in INPV could be as high as 52.1 percent. Consequently, the Secretary has concluded that TSL 5 is not economically justified.

DOE then considered the Recommended TSL (*i.e.*, TSL 4), which represents EL 3 for all analyzed product classes except for C-3A and C-3A-BI, for which this TSL corresponds to EL 1 and BIC, for which this TSL corresponds to EL 2. At the

Recommended TSL, products of most classes would use high-efficiency single-speed compressors with forced-convection evaporators and condensers using brushless DC fan motors. Doors would be double-glazed with low-conductivity gas fill (*e.g.,* argon) and a single low-emissivity glass layer. Products would not require use of VIPs, but the FC product class would require thicker walls than corresponding baseline products. The Recommended TSL would save an estimated 0.32 quads of energy, an amount DOE considers significant. Under the Recommended TSL, the NPV of consumer benefit would be $0.~~11~~17 billion using a discount rate of 7 percent, and $0.~~64~~77 billion using a discount rate of 3 percent.

The cumulative emissions reductions at the Recommended TSL are 5.9 Mt of CO_2, 1.8 thousand tons of SO_2, 10.8 thousand tons of NO_X, 0.01 tons of Hg, 48.6 thousand tons of CH_4, and 0.06 thousand tons of N_2O. The estimated monetary value of the climate benefits from reduced GHG emissions (associated with the average SC-GHG at a 3-percent discount rate) at the Recommended TSL is $0.3 billion. The estimated monetary value of the health benefits from reduced SO_2 and NO_X emissions at the Recommended TSL is $0.2 billion using a 7-percent discount rate and $0.6 billion using a 3-percent discount rate.

Using a 7-percent discount rate for consumer benefits and costs, health benefits from reduced SO_2 and NO_X emissions, and the 3-percent discount rate case for climate benefits from reduced GHG emissions, the estimated total NPV at the Recommended TSL is $0.7 billion. Using a 3-percent discount rate for all benefits and costs, the estimated total NPV at the Recommended TSL is $1.~~6~~7 billion. The estimated total monetized NPV is provided for additional information, however, consistent with the statutory factors and framework for determining whether a standard level is economically justified, DOE considers a range of quantitative and qualitative benefits and burdens, including the costs and cost savings for consumers, impacts to consumer subgroups, energy savings, emission reductions, and impacts on manufacturers.

At the Recommended TSL, for the product classes with the largest market share, which are FCC, FC, and C-13A, the LCC savings are $12.6, $28.0, and $12.0, respectively, and their payback periods are 6.8 years, 8.5 years, and 7.3 years, respectively, which are all shorter than their corresponding average lifetimes. For these product classes, the fraction of consumers experiencing a net LCC cost is 46.8 percent, 44.0 percent, and 47.2 percent, and increases in first cost for these classes are $91.7, $360.9, and $124.3, respectively. Overall, the LCC savings would be positive for all MREF product classes, and, while 43.7 percent of MREF consumers would experience a net cost, slightly more than half of MREF consumers would experience a net benefit (52.9 percent).

At the Recommended TSL (*i.e.*, TSL 4), the projected change in INPV ranges from a decrease of $92.1 million to a decrease of $60.3 million, which correspond to decreases of 11.4 percent and 7.5 percent, respectively. DOE estimates that industry must invest $130.7 million to comply with standards set at Recommended TSL.

DOE estimates that approximately 3.9 percent of shipments currently meet the required efficiencies at the Recommended TSL. For most product classes (*i.e.,* FCC, BICC, BIC, C-13A, C-13A-BI, C-3A, C-3A-BI), DOE expects manufacturers could reach the required efficiencies with relatively straightforward component swaps, such as implementing incrementally more efficient compressors, rather than the full platform redesigns required at max-tech. DOE expects that FC manufacturers would need to increase foam insulation thickness and incorporate variable-speed compressor systems at this level. At the Recommended TSL, DOE estimates a 4-percent drop in shipments in the year the standard takes effect compared to the no-new-standards case, as some consumers may forgo purchasing a new MREF due to the increased upfront cost of baseline models.

After considering the analysis and weighing the benefits and burdens, the Secretary has concluded that at a standard set at the recommended TSL for MREFs would be economically justified. At this TSL, the average LCC savings are positive for all product classes for which an amended standard is considered, with a shipment-weighted average of $15.2 savings. The FFC national energy savings are significant and the NPV of consumer benefits is positive using both a 3-percent and 7-percent discount rate. The standard levels at TSL 4 are economically justified even without weighing the estimated monetary value of emissions reductions. When those emissions reductions are included – representing $0.3 billion in climate benefits (associated with the average SC-GHG at a 3-percent discount rate), and $0.6 billion (using a 3-percent discount rate) or $0.2 billion (using a 7-percent discount rate) in health benefits – the rationale becomes stronger still.

As stated, DOE conducts the walk-down analysis to determine the TSL that represents the maximum improvement in energy efficiency that is technologically feasible and economically justified as required under EPCA. The walk-down is not a comparative analysis, as a comparative analysis would result in the maximization of net benefits instead of energy savings that are technologically feasible and economically justified, which would be contrary to the statute. See 86 FR 70892, 70908. Although DOE has not conducted a comparative analysis to select the adopted energy conservation standards, DOE notes that the Recommended TSL represents the option with positive LCC savings ($15.2) for all product classes compared to TSL 5 (-$99.5). Further, when comparing the cumulative NPV of consumer benefit using a 7% discount rate, TSL 4 ($0.7 billion) has a higher benefit value than TSL 5 (-$0.~~6~~4 billion), while for a 3-percent discount rate, TSL 4 ($1.~~6~~7 billion) is also higher than TSL 5 (-$0.~~6~~07 billion), which yields negative NPV in both cases. These additional savings and benefits at the Recommended TSL are significant. DOE considers the impacts to be, as a whole, economically justified at the Recommended TSL.

Although DOE considered amended standard levels for MREFs by grouping the efficiency levels for each product class into TSLs, DOE evaluates all analyzed efficiency levels in its analysis. For all product classes, except for BIC and C-3A-BI, the amended standard level represents the maximum energy savings that does not result in negative LCC savings. DOE did not include efficiency levels with negative LCC savings in any TSLs with the exception of TSL 5, which represents the max-tech efficiency levels. Specifically, for FC, FCC, BICC, C-13 A, and C13-A-BI, DOE did not include EL4 in a TSL due to negative LCC savings, and for C-3A, DOE did not include EL 2 or 3, and for C-3A-BI, DOE did not include EL 3 for the same reason. For BIC and C-3A-BI, the standard level represents the maximum energy savings that is economically justified. For BIC, DOE did not include EL4 in any TSL due to negative LCC savings. TSL 4, the Recommended TSL and the one adopted here, includes an EL for BIC that is lower than the EL at TSL 2. That is because TSL 2 represents ENERGY STAR for all product classes for which an ENERGY STAR criterion exists, including EL 3 for BIC. As such, DOE analyzed TSL 2 with a higher efficiency level for BIC than TSL 4 because of the ENERGY STAR criterion. TSL 4 also includes an EL for C-3A-BI, EL1, that is lower than another EL, EL2, ~~considered but not discussed as part of DOE's consideration of~~

~~TSL 5.~~ that has positive LCC savings. DOE has considered standards at those ELs for those products and found them not to be economically justified. ~~For all product classes, except for BIC and C-3A-BI, the amended standard level represents the maximum energy savings that does not result in negative LCC savings. For BIC and C-3A-BI, the standard level represents the maximum energy savings that is economically justified; for these classes, DOE examined higher ELs, which were not included in TSL 4 (EL3 and EL2, respectively).~~ Although these ELs have positive LCC savings, they would result in a majority of purchasers experiencing a net cost (53% and 57%, respectively). Further, for BIC products, DOE expects some manufacturers would likely need to increase insulation thickness to meet efficiency levels above EL 2, which could require new cabinet designs and fixtures. Due to the high percentage of consumers with a net cost and the extensive redesigns that would be needed to support EL3, DOE has concluded that this efficiency level for BIC is not economically justified. However, at the Recommended TSL (EL 2 for BIC), DOE expects manufacturers could likely meet the efficiency level required for BIC without significant redesign. The ELs at the amended standard level result in positive LCC savings for all product classes and reduce the decrease in INPV and conversion costs to the point where DOE has concluded they are economically justified, as discussed for the Recommended TSL in the preceding paragraphs.

Therefore, based on the previous considerations, DOE adopts the energy conservation standards for MREFs at the Recommended TSL.

While DOE considered each potential TSL under the criteria laid out in 42 U.S.C. 6295(o) as discussed in the preceding paragraphs, DOE notes that the Recommended TSL for MREFs in this direct final rule is part of a multi-product Joint Agreement covering six rulemakings (RFs; MREFs; conventional cooking products; residential clothes washers; consumer clothes dryers; and dishwashers). The signatories indicate that the Joint Agreement for the six rulemakings should be considered as a joint statement of recommended standards, to be adopted in its entirety. As discussed in section V.B.2.e of this document, many MREF OEMs also manufacture RFs, conventional cooking products, residential clothes washers, consumer clothes dryers, and dishwashers. Rather than requiring compliance with five amended standards in a single year (2027),[89] the negotiated multi-product Joint Agreement staggers the compliance dates for the five amended standards over a 4-year period (2027-2030). In response to the March 2023 NOPR, AHAM expressed concerns about the timing of ongoing home appliance rulemakings. Specifically, AHAM commented that the combination of the stringency of DOE's proposals, the short lead-in time required under EPCA to comply with standards, and the overlapping timeframe of multiple standards affecting the same manufacturers represents significant cumulative regulatory burden for the home appliance industry. (AHAM, No. 31 at p. 13) AHAM has submitted similar comments to other ongoing consumer product rulemakings.[90] However, as AHAM is a key signatory of the Joint Agreement, DOE understands that the compliance dates recommended in the Joint Agreement would help reduce cumulative regulatory burden. These compliance dates help relieve concern on the part of some manufacturers about their ability to allocate sufficient resources to comply with multiple concurrent amended standards, about the need to align compliance dates for products that are typically designed or sold as matched

[89] The refrigerators, refrigerator-freezers, and freezers rulemaking (88 FR 12452); consumer conventional cooking products rulemaking (88 FR 6818); residential clothes washers rulemaking (88 FR 13520); consumer clothes dryers rulemaking (87 FR 51734); and dishwashers rulemaking (88 FR 32514) utilized a 2027 compliance year for analysis at the proposed rule stage. The miscellaneous refrigeration products rulemaking (88 FR 12452) utilized a 2029 compliance year for the NOPR analysis.
[90] AHAM has submitted written comments regarding cumulative regulatory burden for the other five rulemakings included in the multi-product Joint Agreement. AHAM's written comments on cumulative regulatory burden are available at: *www.regulations.gov/document/EERE-2017-BT-STD-0003-0069* (pp. 19-22) for refrigerators, refrigerator-freezers, and freezers; *www.regulations.gov/comment/EERE-2014-BT-STD-0005-2285* (pp. 44-47) for consumer conventional cooking products; *www.regulations.gov/comment/EERE-2017-BT-STD-0014-0464* (pp. 40-44) for residential clothes washers; *www.regulations.gov/comment/EERE-2014-BT-STD-0058-0046* (pp. 12-13) for consumer clothes dryers; and *www.regulations.gov/comment/EERE-2019-BT-STD-0039-0051* (pp. 21-24) for dishwashers.

pairs, and about the ability of their suppliers to ramp up production of key components. The Joint Agreement also provides additional years of regulatory certainty for manufacturers and their suppliers while still achieving the maximum improvement in energy efficiency that is technologically feasible and economically justified.

The amended energy conservation standards for MREFs, which are expressed in kWh/yr, are shown in Table V.38.

Table V.38 Amended Energy Conservation Standards for MREFs

Product class	Equations for maximum energy use (kWh/yr)
1. Freestanding compact coolers ("FCC")	5.52AV + 109.1
2. Freestanding coolers ("FC")	5.52AV + 109.1
3. Built-in compact coolers ("BICC")	5.52AV + 109.1
4. Built-in coolers ("BIC")	6.30AV + 124.6
C-3A. Cooler with all-refrigerator—automatic defrost	4.11AV + 117.4
C-3A-BI. Built-in cooler with all-refrigerator—automatic defrost	4.67AV + 133.0
C-5-BI. Built-in cooler with refrigerator-freezer -automatic defrost with bottom-mounted freezer	5.47AV + 196.2 + 28I
C-9. Cooler with upright freezer with automatic defrost without an automatic icemaker	5.58AV + 147.7 + 28I
C-9-BI. Built-in cooler with upright freezer with automatic defrost without an automatic icemaker	6.38AV + 168.8 + 28I
C-13A. Compact cooler with all-refrigerator—automatic defrost	4.74AV + 155.0
C-13A-BI. Built-in compact cooler with all-refrigerator—automatic defrost	5.22AV + 170.5
AV = Total adjusted volume, expressed in ft^3, as determined in appendix A to subpart B of 10 CFR part 430. I = 1 for a product with an automatic icemaker and = 0 for a product without an automatic icemaker.	

2. 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 (1) the annualized national economic value (expressed in 2022$) 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 climate and health benefits.

Table V.39 shows the annualized values for MREFs under the Recommended TSL, expressed in 2022$. The results under the primary estimate are as follows.

Using a 7-percent discount rate for consumer benefits and costs and NOx and SO_2 reduction benefits, and a 3-percent discount rate case for GHG social costs, the estimated cost of the standards for MREFs is $~~78.8~~72.7 million per year in increased product costs, while the estimated annual benefits are $90.6 million in reduced product operating costs, $18.3 million in climate benefits, and $25.6 million in health benefits. The net benefit amounts to $~~55.6~~61.7 million per year. Using a 3-percent discount rate for all benefits and costs, the estimated cost of the adopted standards for MREFs is $~~78.5~~70.8 million per year in increased equipment costs, while the estimated annual benefits are $115 million in reduced operating costs, $18.3 million in climate benefits, and $35.6 million in health benefits. The net benefit amounts to $~~90.3~~98 million per year.

Table V.39 Annualized Benefits and Costs of Adopted Standards Shipped in 2029-2058 (TSL 4, the Recommended TSL) for MREFs

	Million 2022$/year		
	Primary Estimate	Low-Net-Benefits Estimate	High-Net-Benefits Estimate
	3% discount rate		
Consumer Operating Cost Savings	115.0	111.5	116.3
Climate Benefits*	18.3	17.7	18.5
Health Benefits**	35.6	34.5	36.0
Total Monetized Benefits†	168.9	163.7	170.7
Consumer Incremental Product Costs‡	~~78.5~~70.8	74.9	68.7
~~Monetized~~ Net Benefits	~~90.3~~98.0	88.8	102.0
Change in Producer Cashflow (INPV)‡‡	(7.7) - (5.0)		
	7% discount rate		
Consumer Operating Cost Savings	90.6	88.1	91.5
Climate Benefits* (3% discount rate)	18.3	17.7	18.5
Health Benefits**	25.6	24.9	25.8
Total Benefits†	134.4	130.7	135.7
Consumer Incremental Product Costs‡	~~78.8~~72.7	75.8	70.9
Net Benefits	~~55.6~~61.7	54.9	64.8
Change in Producer Cashflow (INPV)‡‡	(7.7) - (5.0)		

Note: This table presents the costs and benefits associated with MREFs shipped during the period 2029−2058. These results include consumer, climate, and health benefits that accrue after 2058 from the products shipped in 2029−2058. The Primary, Low Net Benefits, and High Net Benefits Estimates utilize projections of energy prices from the *AEO2023* Reference case, Low Economic Growth case, and High Economic Growth case, respectively. In addition, incremental equipment costs reflect a medium decline rate in the Primary Estimate, a low decline rate in the Low Net Benefits Estimate, and a high decline rate in the High Net Benefits Estimate. The methods used to derive projected price trends are explained in section IV.H.3 of this document. Note that the Benefits and Costs may not sum to the Net Benefits due to rounding.

* Climate benefits are calculated using four different estimates of the global SC-GHG (see section IV.L of this document). For presentational purposes of this table, the climate benefits associated with the average SC-GHG at a 3 percent discount rate are shown, but DOE does not have a single central SC-GHG point estimate, and it emphasizes the importance and value of considering the benefits calculated using all four sets of SC-GHG estimates. To monetize the benefits of reducing GHG emissions, this analysis uses the interim estimates presented in the *Technical Support Document: Social Cost of Carbon, Methane, and Nitrous Oxide Interim Estimates Under Executive Order 13990* published in February 2021 by the IWG.

** Health benefits are calculated using benefit-per-ton values for NO_X and SO_2. DOE is currently only monetizing (for SO_2 and NO_X) $PM_{2.5}$ precursor health benefits and (for NO_X) ozone precursor health benefits but will continue to assess the ability to monetize other effects such as health benefits from reductions in direct $PM_{2.5}$ emissions. See section IV.L of this document for more details.

† Total benefits for both the 3-percent and 7-percent cases are presented using the average SC-GHG with 3-percent discount rate, but DOE does not have a single central SC-GHG point estimate.

‡ Costs include incremental equipment costs.

‡‡Operating Cost Savings are calculated based on the life cycle costs analysis and national impact analysis as discussed in detail below. See sections IV.F and IV.H of this document. DOE's national impacts analysis includes all impacts (both costs and benefits) along the distribution chain beginning with the increased costs to the manufacturer to manufacture the product and ending with the increase in price experienced by the consumer. DOE also separately conducts a detailed analysis on the impacts on manufacturers (*i.e.*, manufacturer impact analysis, or "MIA"). See section IV.J of this document. In the detailed MIA, DOE models manufacturers' pricing decisions based on assumptions regarding investments, conversion costs, cashflow, and margins. The MIA produces a range of impacts, which is the direct final rule's expected impact on the INPV. The change in INPV is the present value of all changes in industry cash flow, including changes in production costs, capital expenditures, and manufacturer profit margins. The annualized change in INPV is calculated using the industry weighted average cost of capital value of 7.7 percent that is estimated in the manufacturer impact analysis (see chapter 12 of the direct final rule TSD for a complete description of the industry weighted average cost of capital). For MREFs, the annualized change in INPV ranges from $7.7 million to $5.0 million. DOE accounts for that range of likely impacts in analyzing whether a trial standard level is economically justified. See section V.C of this document. DOE is presenting the range of impacts to the INPV under two manufacturer markup scenarios: the Preservation of Gross Margin scenario, which is the manufacturer markup scenario used in the calculation of Consumer Operating Cost Savings in this table; and the Preservation of Operating Profit scenario, where DOE assumed manufacturers would not be able to increase per-unit operating profit in proportion to increases in manufacturer production costs. DOE includes the range of estimated annual change in INPV in the above table, drawing on the MIA explained further in section IV.J of this document to provide additional context for assessing the estimated impacts of this direct final rule to society, including potential changes in production and consumption, which is consistent with OMB's Circular A-4 and E.O. 12866. If DOE were to include the INPV into the annualized net benefit calculation for this direct final rule, the annualized net benefits would range from $~~82.6 million to $85~~90.3 million to $93.0 million at 3-percent discount rate and would range from $~~47.9~~54.0 million to $~~50.6~~56.7 million at 7-percent discount rate. Parentheses indicate negative (-) values.

VI. Procedural Issues and Regulatory Review

A. Review Under Executive Orders 12866, 13563, and 14094

Executive Order ("E.O.") 12866, "Regulatory Planning and Review," as supplemented and reaffirmed by E.O. 13563, "Improving Regulation and Regulatory Review," 76 FR 3821 (Jan. 21, 2011) and amended by E.O. 14094, "Modernizing Regulatory Review," 88 FR 21879 (April 11, 2023), requires agencies, to the extent permitted by law, 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 E.O. 13563 requires agencies to use the best available techniques to quantify anticipated present and future benefits and costs as accurately as possible. In its guidance, the Office of Information and Regulatory Affairs ("OIRA") in the Office of Management and Budget ("OMB") 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 this preamble, this final regulatory action is consistent with these principles.

Section 6(a) of E.O. 12866 also requires agencies to submit "significant regulatory actions" to OIRA for review. OIRA has determined that this final regulatory action constitutes a "significant regulatory action" within the scope of section 3(f)(1) of E.O. 12866. DOE has provided to OIRA an assessment, including the underlying analysis, of benefits and costs anticipated from the final 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 why the planned regulatory action is preferable to the identified potential alternatives. These assessments are summarized in this preamble and further detail can be found in the technical support document for this rulemaking.

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") and a final regulatory flexibility analysis ("FRFA") for any rule that by law must be proposed for public comment, unless the agency certifies that the rule, if promulgated, will not have a significant economic impact on a substantial number of small entities. As required by E.O. 13272, "Proper Consideration of Small Entities in Agency Rulemaking," 67 FR 53461 (Aug. 16, 2002), DOE published procedures and policies on February 19, 2003, to ensure that the potential impacts of its rules on small entities are properly considered during the rulemaking process. 68 FR 7990. DOE has made its procedures and policies available on the Office of the General Counsel's website (*www.energy.gov/gc/office-general-counsel*).

DOE is not obligated to prepare a regulatory flexibility analysis for this rulemaking because there is not a requirement to publish a general notice of proposed rulemaking under the Administrative Procedure Act. *See* 5 U.S.C. 601(2), 603(a). As discussed previously, DOE has determined that the Joint Agreement meets the necessary requirements under EPCA to issue this direct final rule for energy conservation standards for MREFs under the procedures in 42 U.S.C. 6295(p)(4). DOE notes that the NOPR for energy conservation standards for MREFs published elsewhere in this *Federal Register* contains an IRFA.

C. Review Under the Paperwork Reduction Act

Manufacturers of MREFs must certify to DOE that their products comply with any applicable energy conservation standards. In certifying compliance, manufacturers must test their products according to the DOE test procedures for 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 35 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 of 1969 ("NEPA"), DOE has analyzed this proposed action rule in accordance with NEPA and DOE's NEPA implementing regulations (10 CFR part 1021). DOE has determined that this rule qualifies for categorical exclusion under 10 CFR part 1021, subpart D, appendix B5.1 because it is a rulemaking that establishes energy conservation standards for consumer products or industrial equipment, none of the exceptions identified in B5.1(b) apply, no extraordinary circumstances exist that require further environmental analysis, and it meets the requirements for application of a categorical exclusion. *See* 10 CFR 1021.410. Therefore, DOE has determined that promulgation of this direct final rule is not a major Federal action significantly affecting the quality of the human environment within the meaning of NEPA, and does not require an environmental assessment or an environmental impact statement.

E. Review Under Executive Order 13132

E.O. 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~~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 E.O. 12988, "Civil Justice Reform," imposes on Federal agencies the general duty to adhere to the following requirements: (1) eliminate drafting errors and ambiguity, (2) write regulations to minimize litigation, (3) provide a clear legal standard for affected conduct rather than a general standard, and (4) promote simplification and burden reduction. 61 FR 4729 (Feb. 7, 1996). Regarding the review required by section 3(a), section 3(b) of E.O. 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 E.O. 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 E.O. 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 *www.energy.gov/sites/prod/files/gcprod/documents/umra_97.pdf.*

DOE has concluded that this direct final rule may require expenditures of $100 million or more in any one year by the private sector. Such expenditures may include (1) investment in research and development and in capital expenditures by MREF manufacturers in the years between the direct final rule and the compliance date for the new standards and (2) incremental additional expenditures by consumers to purchase higher-efficiency MREFs, starting at the compliance date for the applicable standard.

Section 202 of UMRA authorizes a Federal agency to respond to the content requirements of UMRA in any other statement or analysis that accompanies the direct final rule. (2 U.S.C. 1532(c)) The content requirements of section 202(b) of UMRA relevant to a private sector mandate substantially overlap the economic analysis requirements that apply under section 325(o) of EPCA and Executive Order 12866. This **SUPPLEMENTARY INFORMATION** section and the TSD for this direct final rule respond to those requirements.

Under section 205 of UMRA, DOE is obligated to identify and consider a reasonable number of regulatory alternatives before promulgating a rule for which a written statement under section 202 is required. (2 U.S.C. 1535(a)) DOE is required to select from those alternatives the most cost-effective and least burdensome alternative that achieves the objectives of the rule unless DOE publishes an explanation for doing otherwise, or the selection of such an alternative is inconsistent with law. As required by 42 U.S.C. 6295(m), this direct final rule establishes amended energy conservation standards for MREFs that are designed to achieve the maximum improvement in energy efficiency that DOE has determined to be both technologically feasible and economically justified, as required by 6295(o)(2)(A) and 6295(o)(3)(B). A full discussion of the alternatives considered by DOE is presented in chapter 17 of the TSD for this direct final rule.

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

Section 654 of the Treasury and General Government Appropriations Act, 1999 (Pub. L. No. 105–277) requires Federal agencies to issue a Family Policymaking Assessment for any proposed rule or policy that may affect family well-being. Although this direct final rule would not have any impact on the autonomy or integrity of the family as an institution as defined, this rule could impact a family's well-being. When developing a Family Policymaking Assessment, agencies must assess whether: (1) the action strengthens or erodes the stability or safety of the family and, particularly, the marital commitment; (2) the action strengthens or erodes the authority and rights of parents in the education, nurture, and supervision of their children; (3) the action helps the family perform its functions, or substitutes governmental activity for the function; (4) the action increases or decreases disposable income or poverty of families and children; (5) the proposed benefits of the action justify the financial impact on the family; (6) the action may be carried out by State or local government or by the family; and (7) the action establishes an implicit or explicit policy concerning the relationship between the behavior and personal responsibility of youth, and the norms of society.

DOE has considered how the proposed benefits of this direct final rule compare to the possible financial impact on a family (the only factor listed that is relevant to this rule). As part of its rulemaking process, DOE must determine whether the energy conservation standards contained in this direct final rule are economically justified. As discussed in section V.C.1 of this document, DOE has determined that the standards are economically justified because the benefits to consumers far outweigh the costs to manufacturers. Families will also see LCC savings as a result of this direct final rule. Further, the standards will also result in climate and health benefits for families.

I. Review Under Executive Order 12630

Pursuant to E.O. 12630, "Governmental Actions and Interference with Constitutionally Protected Property Rights," 53 FR 8859 (March 18, 1988), DOE has determined that this rule would not result in any takings that might require compensation under the Fifth Amendment to the U.S. Constitution.

J. Review Under the Treasury and General Government Appropriations Act, 2001

Section 515 of the Treasury and General Government Appropriations Act, 2001 (44 U.S.C. 3516, note) provides for Federal agencies to review most disseminations of information to the public under information quality guidelines established by each agency pursuant to general guidelines issued by OMB. OMB's guidelines were published at 67 FR 8452 (Feb. 22, 2002), and DOE's guidelines were published at 67 FR 62446 (Oct. 7, 2002). Pursuant to OMB Memorandum M-19-15, Improving Implementation of the Information Quality Act (April 24, 2019), DOE published updated guidelines which are available at

www.energy.gov/sites/prod/files/2019/12/f70/DOE%20Final%20Updated%20IQA%20Guidelines%20Dec%202019.pdf. 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

E.O. 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 amended 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. Information Quality

On December 16, 2004, OMB, in consultation with the Office of Science and Technology Policy ("OSTP"), issued its Final Information Quality Bulletin for Peer Review ("the Bulletin"). 70 FR 2664 (Jan. 14, 2005). The Bulletin establishes that certain scientific information shall be peer reviewed by qualified specialists before it is disseminated by the Federal Government, including influential scientific information related to agency regulatory actions. The purpose of the Bulletin is to enhance the quality and credibility of the Government's scientific information. Under the Bulletin, the energy conservation standards rulemaking analyses are "influential scientific information," which the Bulletin defines as "scientific information the agency reasonably can determine will have, or does have, a clear and substantial impact on important public policies or private sector decisions." 70 FR 2664, 2667.

In response to OMB's Bulletin, DOE conducted formal peer reviews of the energy conservation standards development process and the analyses that are typically used and prepared a report describing that peer review.[91] 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. Because available data, models, and technological understanding have changed since 2007, DOE has engaged with the National Academy of Sciences to review DOE's analytical methodologies to

[91] The 2007 "Energy Conservation Standards Rulemaking Peer Review Report" is available at the following website: *energy.gov/eere/buildings/downloads/energy-conservation-standards-rulemaking-peer-review-report-0* (last accessed November 29, 2023).

ascertain whether modifications are needed to improve DOE's analyses. DOE is in the process of evaluating the resulting report.[92]

M. Congressional Notification

As required by 5 U.S.C. 801, DOE will report to Congress on the promulgation of this direct final rule prior to its effective date. The report will state that the Office of Information and Regulatory Affairs has determined that this action meets the criteria set forth in 5 U.S.C. 804(2).

VII. 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, ~~and~~ Small businesses.

Signing Authority

[92] The report is available at *www.nationalacademies.org/our-work/review-of-methods-for-setting-building-and-equipment-performance-standards* (last accessed November 29, 2023).

This document of the Department of Energy was signed on ~~[Date],~~April 10, 2024, by Jeffrey Marootian, Principal Deputy Assistant Secretary for Energy Efficiency and Renewable Energy, pursuant to delegated authority from the Secretary of Energy. That document with the original signature and date is maintained by DOE. For administrative purposes only, and in compliance with requirements of the Office of the Federal Register, the undersigned DOE Federal Register Liaison Officer has been authorized to sign and submit the document in electronic format for publication, as an official document of the Department of Energy. This administrative process in no way alters the legal effect of this document upon publication in the *Federal Register*.

Signed in Washington, DC, on ~~[XXXXX, 20XX]~~ April 11, 2024.

Treena V. Garrett
Federal Register Liaison Officer,
U.S. Department of 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 revising 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*. ~~(a~~ (i) Coolers manufactured on or after October 28, 2019, and before January 31, 2029, shall have an Annual Energy Use (AEU) no more than:

Product Class	AEU (kWh/yr)
(A) Freestanding compact.	7.88AV + 155.8
(B) Freestanding.	7.88AV + 155.8
(C) Built-in compact.	7.88AV + 155.8
(D) Built-in.	7.88AV + 155.8

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

(b) The following standards apply to products manufacturer starting on January 31, 2029.(ii) Coolers manufactured on or after January 31, 2029, shall have an Annual Energy Use (AEU) no more than:

Product Class	AEU (kWh/yr)
(A) Freestanding compact.	5.52AV + 109.1
(B) Freestanding.	5.52AV + 109.1
(C) Built-in compact.	5.52AV + 109.1
(D) Built-in.	6.30AV + 124.6
Note: AV = Total adjusted volume, expressed in ft^3, as determined in appendix A to subpart B of this part.	

(2) *Combination cooler refrigeration products.* (ai) Combination cooler refrigeration products manufactured on or after October 28, 2019, and before January 31, 2029, shall have an Annual Energy Use (AEU) no more than:

Product Class	AEU (kWh/yr)
(A) C-3A. Cooler with all-refrigerator – automatic defrost	4.57AV + 130.4
(B) C-3A-BI. Built-in cooler with all-refrigerator – automatic defrost	5.19AV + 147.8
(C) C-9. Cooler with upright freezer with automatic defrost without an automatic icemaker	5.58AV + 147.7
(D) C-9-BI. Built-in cooler with upright freezer with automatic defrost without an automatic icemaker	6.38AV + 168.8
(E) C-9I. Cooler with upright freezer with automatic defrost with an automatic icemaker	5.58AV + 231.7
(F) C-9I-BI. Built-in cooler with upright freezer with automatic defrost with an automatic icemaker	6.38AV + 252.8
(G) C-13A. Compact cooler with all-refrigerator – automatic defrost	5.93AV + 193.7
(H) C-13A-BI. Built-in compact cooler with all-refrigerator – automatic defrost	6.52AV + 213.1
Note: AV = Total adjusted volume, expressed in ft^3, as determined in appendix A to subpart B of this part.	

(b

(ii) Combination cooler refrigeration products manufactured on or after January 31, 2029, shall have an Annual Energy Use (AEU) no more than:

Product Class	**AEU (kWh/yr)**
(A) C-3A. Cooler with all-refrigerator – automatic defrost	4.11AV + 117.4
(B) C-3A-BI. Built-in cooler with all-refrigerator – automatic defrost	4.67AV + 133.0
(C) C-5-BI. Built-in cooler with refrigerator-freezer with automatic defrost with bottom-mounted freezer	5.47AV + 196.2 + 28I
(D) C-9. Cooler with upright freezer with automatic defrost without an automatic icemaker	5.58AV + 147.7 + 28I
(E) C-9-BI. Built-in cooler with upright freezer with automatic defrost without an automatic icemaker	6.38AV + 168.8 + 28I
(F) C-13A. Compact cooler with all-refrigerator – automatic defrost	4.74AV + 155.0
(G) C-13A-BI. Built-in compact cooler with all-refrigerator – automatic defrost	5.22AV + 170.5
Note: AV = Total adjusted volume, expressed in ft^3, as determined in appendix A to subpart B of this part. I = 1 for a product with an automatic icemaker and = 0 for a product without an automatic icemaker.	

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