DEPARTMENT OF ENERGY

10 CFR Part 431

[EERE–2017–BT–STD–0007]

RIN 1904–AD82

Energy Conservation Program: Energy Conservation Standards for Commercial Refrigerators, Freezers, and Refrigerator-Freezers

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

ACTION: Notice of proposed rulemaking and announcement of public meeting.

SUMMARY: The Energy Policy and Conservation Act, as amended (''EPCA''), prescribes energy conservation standards for various consumer equipment and certain commercial and industrial equipment, including commercial refrigerators, freezers, and refrigerator-freezers (''commercial refrigeration equipment'' or ''CRE''). EPCA also requires the U.S. Department of Energy (''DOE'' ''the Department'') to periodically determine whether more stringent standards would be technologically feasible and economically justified, and would result in significant energy savings. In this notice of proposed rulemaking (''NOPR''), DOE proposes new and amended energy conservation standards for CRE, and also announces a public meeting to receive comment on these proposed standards and associated analyses and results.

DATES:

Comments: DOE will accept comments, data, and information regarding this NOPR no later than December 11, 2023.

Comments regarding the likely competitive impact of the proposed standard should be sent to the Department of Justice contact listed in the **ADDRESSES** section on or before November 9, 2023.

Meeting: DOE will hold a public meeting on Tuesday, November 7th, 2023, from 10 a.m. to 4 p.m., in Washington, DC. This meeting will also be broadcast as a webinar.

ADDRESSES: The public meeting will be held at the U.S. Department of Energy, Forrestal Building, Room 6E–069, 1000 Independence Avenue SW, Washington, DC 20585. See section VII of this document, ''Public Participation,'' for further details, including procedures for attending the in-person meeting, webinar registration information, participant instructions, and information about the capabilities available to webinar participants.

Interested persons are encouraged to submit comments using the Federal Rulemaking Portal at *www.regulations.gov* under docket number EERE–2017–BT–STD–0007. Follow the instructions for submitting comments. Alternatively, interested persons may submit comments, identified by docket number EERE–2017–BT–STD–0007, by any of the following methods:

(1) *Email: CRE2017STD0007@ee.doe.gov.* Include the docket number EERE–2017–BT–STD–0007 in the subject line of the message.

(2) *Postal Mail:* Appliance and Equipment Standards Program, U.S. Department of Energy, Building Technologies Office, Mailstop EE–5B, 1000 Independence Avenue SW, Washington, DC 20585–0121. Telephone: (202) 287–1445. If possible, please submit all items on a compact disc (''CD''), in which case it is not necessary to include printed copies.

(3) *Hand Delivery/Courier:* Appliance and Equipment Standards Program, U.S. Department of Energy, Building Technologies Office, 950 L'Enfant Plaza SW, 6th Floor, Washington, DC 20024. Telephone: (202) 287–1445. If possible, please submit all items on a CD, in which case it is not necessary to include printed copies.

No telefacsimiles (''faxes'') will be accepted. For detailed instructions on submitting comments and additional information on this process, see section VII of this document.

Docket: The docket for this activity, which includes **Federal Register** notices, 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 web page can be found at *www.regulations.gov/docket/EERE-2017-BT-STD-0007.* The docket web page contains instructions on how to access all documents, including public comments, in the docket. See section VII of this document for information on how to submit comments through *www.regulations.gov.*

EPCA requires the Attorney General to provide DOE a written determination of whether the proposed standard is likely to lessen competition. 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 proposed standards. Interested persons may contact the Division at *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 proposed rulemaking.

FOR FURTHER INFORMATION CONTACT:

Mr. Jeremy Dommu, U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, Building Technologies Office, EE–5B, 1000 Independence Avenue SW, Washington, DC 20585–0121. Telephone: (202) 586–9870. 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: (202) 586–3593. Email: *Kristin.Koernig@hq.doe.gov.*

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I. Synopsis of the Proposed 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) Title III, part C of EPCA established the Energy Conservation Program for Certain Industrial Equipment. (42 U.S.C. 6311–6317) Such equipment includes CRE, the subject of this proposed rulemaking.

Pursuant to EPCA, any new or amended energy conservation standard must be designed to achieve the maximum improvement in energy efficiency that DOE determines is technologically feasible and economically justified. (42 U.S.C. 6316(e)(1); 42 U.S.C. 6295(o)(2)(A)) Furthermore, the new or amended standard must result in a significant conservation of energy. (42 U.S.C. 6316(e)(1); 42 U.S.C. 6295(o)(3)(B))

EPCA established standards for certain categories of CRE (42 U.S.C. 6313(c)(2)–(4)) and directs DOE to conduct future rulemakings to determine whether to amend these standards. (42 U.S.C. 6313(c)(6)(B)). EPCA also provides that not later than 6 years after issuance of any final rule establishing or amending a standard, DOE must publish either a notice of determination that standards for the equipment do not need to be amended, or a notice of proposed rulemaking including new proposed energy conservation standards (proceeding to a final rule, as appropriate). (42 U.S.C. 6316(e)(1); 42 U.S.C. 6295(m)(1))

In accordance with these and other statutory provisions discussed in this document, DOE analyzed the benefits and burdens of six trial standard levels (''TSLs'') for CRE. The TSLs and their associated benefits and burdens are discussed in detail in sections V.A through V.C of this document. As discussed in section V.C, DOE has tentatively determined that TSL 5 represents the maximum improvement in energy efficiency that is technologically feasible and economically justified and to establish new energy conservation standards for covered equipment not yet subject to energy conservation standards. The proposed standards, which are expressed in maximum daily energy consumption (''MDEC''), are shown in table I.1. These proposed standards, if adopted, would apply to all CRE listed in table I.1 manufactured in, or imported into, the United States on or after the date that is (1) 3 years after the date on which the final new and amended standards are published or (2) if the Secretary determines, by rule, that 3 years is inadequate, not later than 5 years after the date on which the final

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

rule is published. (42 U.S.C. 6313(c)(6)(C)).

DOE notes that the U.S. Environmental Protection Agency (''EPA'') proposed refrigerant restrictions pursuant to the American Innovation and Manufacturing Act (''AIM Act'')[2] affecting CRE in a NOPR published on December 15, 2022 (''December 2022 EPA NOPR''). 87 FR 76738. The proposal would prohibit manufacture or import of such CRE starting January 1, 2025, and would ban sale, distribution, purchase, receipt, or export of such CRE starting January 1, 2026. *Id.* at 87 FR 76809. See section IV.C.1.a of this document for more details. DOE understands that it would be beneficial to CRE equipment manufacturers to align the compliance date of any DOE amended or established standards as closely as possible with the refrigerant prohibition dates proposed by the December 2022 EPA NOPR. Therefore, DOE is proposing that the proposed standards, if adopted, would apply to all CRE listed in table I.1 manufactured in, or imported into, the United States on or after the date that is 3 years after the date on which the final new and amended standards are published.

TABLE I.1—PROPOSED ENERGY CONSERVATION STANDARDS FOR CRE

Equipment class	Maximum daily energy consumption (kWh/day)
VOP.RC.H	0.31 × TDA + 1.99
VOP.RC.M	0.56 × TDA + 3.57
VOP.RC.L	2.04 × TDA + 6.36
VOP.RC.I	2.59 × TDA + 8.08
SVO.RC.H	0.32 × TDA + 1.55
SVO.RC.M	0.58 × TDA + 2.79
SVO.RC.L	2.04 × TDA + 6.36
SVO.RC.I	2.59 × TDA + 8.08
HZO.RC.H	0.19 × TDA + 1.56
HZO.RC.M	0.34 × TDA + 2.81
HZO.RC.L	0.54 × TDA + 6.81
HZO.RC.I	0.69 × TDA + 8.64
VCT.RC.H	0.07 × TDA + 0.97
VCT.RC.M	0.134 × TDA + 1.74
VCT.RC.L	0.47 × TDA + 2.51
VCT.RC.I	0.56 × TDA + 2.97
HCT.RC.M	0.16 × TDA + 0.13
HCT.RC.L	0.34 × TDA + 0.26
HCT.RC.I	0.38 × TDA + 0.29
VCS.RC.H	0.06 × V + 0.14
VCS.RC.M	0.1 × V + 0.26
VCS.RC.L	0.21 × V + 0.54
VCS.RC.I	0.25 × V + 0.63
HCS.RC.M	0.1 × V + 0.26
HCS.RC.L	0.21 × V + 0.54
HCS.RC.I	0.25 × V + 0.63
SOC.RC.H	0.22 × TDA + 0.05

TABLE I.1—PROPOSED ENERGY CONSERVATION STANDARDS FOR CRE—Continued

Equipment class	Maximum daily energy consumption (kWh/day)
SOC.RC.M	0.39 × TDA + 0.1
SOC.RC.L	0.83 × TDA + 0.2
SOC.RC.I	1.04 × TDA + 0.25
CB.RC.M	0.03 × V + 0.39
CB.RC.L	0.13 × V + 1.37
VOP.SC.H	0.69 × TDA + 1.94
VOP.SC.M	1.25 × TDA + 3.48
VOP.SC.L	3.29 × TDA + 9.15
VOP.SC.I	4.18 × TDA + 11.63
SVO.SC.H	0.65 × TDA + 1.77
SVO.SC.M	1.18 × TDA + 3.18
SVO.SC.L	3.25 × TDA + 8.78
SVO.SC.I	4.13 × TDA + 11.16
HZO.SC.H	0.27 × TDA + 2.06
HZO.SC.M	0.48 × TDA + 3.71
HZO.SC.L	1.48 × TDA + 5.5
HZO.SC.I	1.97 × TDA + 7.34
VCT.SC.H	0.053 × V + 0.85
VCT.SC.M	0.054 × V + 0.86
VCT.SC.L	0.234 × V + 2.38
VCT.SC.I	0.6 × TDA + 3.2
HCT.SC.M	0.06 × V + 0.37
HCT.SC.L	0.08 × V + 1.23
HCT.SC.I	0.34 × TDA + 0.43
VCS.SC.H	0.0082 × V + 0.21
VCS.SC.M	0.02 × V + 0.54
VCS.SC.L	0.155 × V + 0.97
VCS.SC.I	0.25 × V + 0.88
HCS.SC.M	0.022 × V + 0.41
HCS.SC.L	0.043 × V + 0.81
HCS.SC.I	0.31 × V + 0.81
SOC.SC.H	0.17 × TDA + 0.33
SOC.SC.M	0.304 × TDA + 0.59
SOC.SC.L	1.1 × TDA + 2.1
SOC.SC.I	1.53 × TDA + 0.36
CB.SC.M	0.049 × V + 0.54
CB.SC.L	0.180 × V + 1.92
PD.SC.M	0.11 × V + 0.81
VCT.RC.M.PT	0.139 × TDA + 1.81
VCT.SC.M.PT	0.056 × V + 0.86
VCT.SC.L.PT	0.243 × V + 2.47
VCS.SC.M.PT	0.02 × V + 0.56
VCS.SC.L.PT	0.161 × V + 1.01
VCT.RC.M.SD	0.143 × TDA + 1.86
VCT.SC.M.SD	0.058 × V + 0.86
VCT.RC.M.SDPT	0.149 × TDA + 1.93
VCT.SC.M.SDPT	0.060 × V + 0.86
VCT.RC.M.RI	0.140 × TDA + 1.83
VCT.SC.M.RI	0.057 × V + 0.86
VCS.SC.M.RI	0.02 × V + 0.57
VCS.SC.L.RI	0.162 × V + 1.02
VCT.RC.M.RT	0.146 × TDA + 1.9
VCT.SC.M.RT	0.059 × V + 0.86
VCS.SC.M.RT	0.02 × V + 0.59
VCS.SC.L.RT	0.169 × V + 1.06
HCS.SC.L.FA	0.052 × V + 0.97

The equipment classes are separated by equipment family, condensing unit configuration, and operating temperature. Equipment Families: VOP—Vertical Open; SVO—Semi-Vertical Open; HZO—Horizontal Open; VCT—Vertical Closed Transparent; HCT—Horizontal Closed Transparent; VCS—Vertical Closed Solid; HCS—Horizontal Closed Solid; SOC—Service Over Counter; CB—Chef Base; PD—Pull Down. Condensing Unit Configurations: RC—Remote Condensing; SC—Self Contained. Operating Temperatures: H—High Temperature; M—Medium Temperature; L—Low Temperature; I—Ice Cream Temperature.

TABLE I.2—DESCRIPTION OF COEFFICIENTS FOR PROPOSED MAXIMUM DAILY ENERGY CONSUMPTION STANDARDS FOR CRE

Unique design characteristic	Abbreviation
Pass-through Door	PT
Sliding Door	SD
Sliding and Pass-through Doors	SDPT
Roll-in Door	RI
Roll-through Door	RT
Forced Air Evaporator	FA

DOE requests comments on its proposal to require that the proposed standards, if adopted, would apply to all CRE listed in table I.1 manufactured in, or imported into, the United States on or after the date that is 3 years after the date on which the final new and amended standards are published. More generally, DOE requests comment on whether it would be beneficial to CRE manufacturers to align the compliance date of any DOE amended or established standards as closely as possible with the refrigerant prohibition dates proposed by the December 2022 EPA NOPR.

A. Benefits and Costs to Consumers

Table I.3 presents DOE's evaluation of the economic impacts of the proposed standards—represented by TSL 5—on consumers of CRE, as measured by the average life-cycle cost (''LCC'') savings and the simple payback period (''PBP'').[3] The average LCC savings are positive for all equipment classes, and the PBP is less than the average lifetime for the vast majority of CRE equipment classes,[4] which is estimated to be 13.9 years (see section IV.F.7 of this document).

[2] Under subsection (i) of the AIM Act, entitled ''Technology Transitions,'' the EPA may by rule restrict the use of hydrofluorocarbons (''HFCs'') in sectors or subsectors where they are used. A person or entity may also petition EPA to promulgate such a rule. ''H.R.133—116th Congress (2019–2020): Consolidated Appropriations Act, 2021.'' *Congress.gov,* Library of Congress, December 27, 2020, available at *www.congress.gov/bill/116thcongress/house-bill/133.*

[3] 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.8 of this document). The simple PBP, which is designed to compare specific efficiency levels, is measured relative to the baseline product (see section IV.F.9 of this document).

[4] For the HZO.RC.M equipment class, the estimated PBP at TSL 5 is 13.8 years for an estimated average lifetime of approximately 13 years.

TABLE I.3—IMPACTS OF PROPOSED ENERGY CONSERVATION STANDARDS ON CONSUMERS OF CRE

Equipment class	Average LCC savings (2022$)	Simple payback period (years)
CB.SC.L	566.92	2.2
CB.SC.M	44.90	5.0
HCS.SC.L	7.77	5.1
HCS.SC.M	84.89	1.8
HCT.SC.I	55.03	7.1
HCT.SC.L *		
HCT.SC.M *		
HZO.RC.L	46.57	13.0
HZO.RC.M	40.29	13.8
HZO.SC.L	841.89	2.8
HZO.SC.M	199.91	5.2
SOC.RC.M	929.51	3.3
SOC.SC.M	698.37	5.4
SVO.RC.M	406.59	7.3
SVO.SC.M	602.17	4.3
VCS.SC.H	162.47	3.7
VCS.SC.I	486.70	3.4
VCS.SC.L	260.73	3.2
VCS.SC.M	128.81	4.1
VCT.RC.L	331.04	6.4
VCT.RC.M	133.62	10.9
VCT.SC.H *		
VCT.SC.I	77.46	8.3
VCT.SC.L	120.34	5.8
VCT.SC.M	82.53	7.6
VOP.RC.L	1524.52	3.6
VOP.RC.M	707.13	5.7
VOP.SC.M	992.17	3.6

* For these equipment classes, TSL 5 corresponds to efficiency level 0.

DOE's analysis of the impacts of the proposed standards on consumers is described in section IV.F of this document.

B. Impact on Manufacturers [5]

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 (2023–2057). Using a real discount rate of 10.0 percent, DOE estimates that the INPV for manufacturers of CRE in the case without new and amended standards is $3,286.4 million. Under the proposed standards, the change in INPV is estimated to range from −4.8 percent to −0.9 percent, which is approximately −$159.3 million to −$30.9 million. In order to bring equipment into compliance with new and amended standards, it is estimated that the industry would incur total conversion costs of $226.4 million.[6]

DOE's analysis of the impacts of the proposed standards on manufacturers is described in section IV.J of this document. The analytic results of the manufacturer impact analysis (''MIA'') are presented in section V.B.2 of this document.

C. National Benefits and Costs

DOE's analyses indicate that the proposed energy conservation standards for CRE would save a significant amount of energy. Relative to the case without new and amended standards, the lifetime energy savings for CRE purchased in the 30-year period that begins in the anticipated year of compliance with the new and amended standards (2028–2057) amount to 3.11 quadrillion British thermal units (''Btu''), or quads.[7] This represents a savings of 16.8 percent relative to the energy use of these equipment in the case without new or amended standards (referred to as the ''no-new-standards case'').

The cumulative net present value (''NPV'') of total consumer benefits of the proposed standards for CRE ranges from $2.4 billion (at a 7-percent discount rate) to $7.1 billion (at a 3-percent discount rate). This NPV expresses the estimated total value of future operating-cost savings minus the estimated increased equipment costs for CRE purchased in 2028–2057.

In addition, the proposed standards for CRE are projected to yield significant environmental benefits. DOE estimates that the proposed standards would result in cumulative emission reductions (over the same period as for energy savings) of 55.8 million metric tons (''Mt'') [8] of carbon dioxide (''CO_2''), 17.1 thousand tons of sulfur dioxide (''SO_2''), 104.2 thousand tons of nitrogen oxides (''NO_X''), 472 thousand tons of methane (''CH_4''), 0.54 thousand tons of nitrous oxide (''N_2O''), and 0.12 tons of mercury (''Hg'').[9]

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-

[5] All monetary values in this document are expressed in 2022 dollars.

[6] Conversion costs are incurred between the publication of the final rule (modeled as 2025) and the compliance year (modeled as 2028) and are included in the change in INPV presented in this section.

[7] 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.2 of this document.

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

[9] DOE calculated emissions reductions relative to the no-new-standards-case, which reflects key assumptions in the *Annual Energy Outlook 2023* (''*AEO2023*''). *AEO2023* reflects, to the extent possible, laws and regulations adopted through mid-November 2022, including the Inflation Reduction Act. See section IV.K of this document for further discussion of *AEO2023* assumptions that effect air pollutant emissions.

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 emissions avoided) developed by an Interagency Working Group on the Social Cost of Greenhouse Gases (''IWG'').[10] 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 $3.04 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 estimated the monetary health benefits of SO_2 and NO_X emissions reductions using benefit per ton estimates from the Environmental Protection Agency,[11] as discussed in section IV.L of this document. DOE estimated the present value of the health benefits would be $2.32 billion using a 7-percent discount rate, and $5.94 billion using a 3-percent discount rate.[12] DOE is currently only monetizing health benefits from changes in ambient fine particulate matter ($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.4 summarizes the monetized benefits and costs expected to result from the proposed standards for CRE. 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.

TABLE I.4—SUMMARY OF MONETIZED BENEFITS AND COSTS OF PROPOSED ENERGY CONSERVATION STANDARDS FOR CRE (TSL 5)

	Billion 2022$
3% discount rate	
Consumer Operating Cost Savings	12.8
Climate Benefits *	3.04
Health Benefits **	5.94
Total Benefits †	21.8
Consumer Incremental Equipment Costs	5.74
Net Benefits	16.1
Change in Producer Cashflow (INPV‡‡)	(0.16)–(0.03)
7% discount rate	
Consumer Operating Cost Savings	5.55
Climate Benefits * (3% discount rate)	3.04
Health Benefits **	2.32
Total Benefits †	10.9
Consumer Incremental Equipment Costs	3.17
Net Benefits	7.74
Change in Producer Cashflow (INPV‡‡)	(0.16)–(0.03)

Note: This table presents the costs and benefits associated with CRE shipped in 2028–2057. These results include consumer, climate, and health benefits that accrue after 2057 from the equipment shipped in 2028–2057.

* 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.

[10] 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.*

[11] U.S. EPA. Estimating the Benefit per Ton of Reducing Directly Emitted $PM_{2.5}$, $PM_{2.5}$ Precursors and Ozone Precursors from 21 Sectors. Available at *www.epa.gov/benmap/estimating-benefit-ton-reducing-pm25-precursors-21-sectors.*

[12] 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.

‡‡ 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 NIA includes all impacts (both costs and benefits) along the distribution chain beginning with the increased costs to the manufacturer to manufacture the equipment and ending with the increase in price experienced by the consumer. DOE also separately conducts a detailed analysis on the impacts on manufacturers (the MIA). See section IV.J. 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 10.0 percent that is estimated in the MIA (see chapter 12 of the NOPR TSD for a complete description of the industry weighted average cost of capital). For commercial refrigeration equipment, those values are −$159 million to −$31 million. DOE accounts for that range of likely impacts in analyzing whether a TSL 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 proposal 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 proposed rule, the net benefits would range from $15.94 billion to $16.07 billion at 3-percent discount rate and would range from $7.58 billion to $7.71 billion at 7-percent discount rate. Parentheses () indicate negative values. DOE seeks comment on this approach.

The benefits and costs of the proposed 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 equipment purchase prices and installation costs, plus (3) the value of climate and health benefits of emission reductions, all annualized.[13]

The national operating cost savings are domestic private U.S. consumer monetary savings that occur as a result of purchasing the covered equipment and are measured for the lifetime of CRE shipped in 2028–2057. The benefits associated with reduced emissions achieved as a result of the proposed standards are also calculated based on the lifetime of CRE shipped in 2028–2057. Total benefits for both the 3-percent and 7-percent cases are presented using the average GHG social costs with 3-percent discount rate. Estimates of SC-GHG values are presented for all four discount rates in section V.L of this document.

Table I.5 presents the total estimated monetized benefits and costs associated with the proposed standard, 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 NO_X and SO_2 emissions, and the 3-percent discount rate case for climate benefits from reduced GHG emissions, the estimated cost of the standards proposed in this rule is $334.6 million per year in increased equipment costs, while the estimated annual benefits are $586.1 million in reduced equipment operating costs, $174.4 million in climate benefits, and $245.5 million in health benefits. In this case, the net benefit would amount to $671.4 million per year.

Using a 3-percent discount rate for all benefits and costs, the estimated cost of the proposed standards is $329.8 million per year in increased equipment costs, while the estimated annual benefits are $737.7 million in reduced operating costs, $174.4 million in climate benefits, and $341.3 million in health benefits. In this case, the net benefit would amount to $923.5 million per year.

TABLE I.5—ANNUALIZED MONETIZED BENEFITS AND COSTS OF PROPOSED ENERGY CONSERVATION STANDARDS FOR CRE (TSL 5)

	Million 2022$/year		
	Primary estimate	Low-net-benefits estimate	High-net-benefits estimate
3% discount rate			
Consumer Operating Cost Savings	737.7	714.3	773.7
Climate Benefits *	174.4	173.5	178.9
Health Benefits **	341.4	339.7	349.9
Total Benefits †	1253.3	1227.5	1302.8
Consumer Incremental Equipment Costs	329.8	337.9	328.3
Net Benefits	923.5	889.5	974.1
Change in Producer Cashflow (INPV ‡‡)	(17)–(3)	(17)–(3)	(17)–(3)
7% discount rate			
Consumer Operating Cost Savings	586.1	569.3	613.0
Climate Benefits * (3% discount rate)	174.4	173.5	178.9
Health Benefits **	245.5	244.7	250.9
Total Benefits †	1006.0	987.5	1042.8
Consumer Incremental Equipment Costs	334.6	341.7	333.5
Net Benefits	671.4	645.7	709.3

[13] To convert the time-series of costs and benefits into annualized values, DOE calculated a present value in 2023, 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 2023. 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.

TABLE I.5—ANNUALIZED MONETIZED BENEFITS AND COSTS OF PROPOSED ENERGY CONSERVATION STANDARDS FOR CRE (TSL 5)—Continued

	Million 2022$/year		
	Primary estimate	Low-net-benefits estimate	High-net-benefits estimate
Change in Producer Cashflow (INPV ‡‡)	(17)–(3)	(17)–(3)	(17)–(3)

Note: This table presents the costs and benefits associated with CRE shipped in 2028–2057. These results include benefits to consumers which accrue after 2057 from the equipment shipped in 2028–2057. 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 sections V.F.1 and V.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.

‡‡ 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. DOE's NIA includes all impacts (both costs and benefits) along the distribution chain beginning with the increased costs to the manufacturer to manufacture the equipment and ending with the increase in price experienced by the consumer. DOE also separately conducts a detailed analysis on the impacts on manufacturers (the MIA). See section IV.J. 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 10.0 percent that is estimated in the MIA (see chapter 12 of the NOPR TSD for a complete description of the industry weighted average cost of capital). For commercial refrigeration equipment, those values are −$16.65 million to −$3.23 million. DOE accounts for that range of likely impacts in analyzing whether a TSL is economically justified. See section V.C. 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 annualized change in INPV in the above table, drawing on the MIA explained further in section IV.J, to provide additional context for assessing the estimated impacts of this proposal 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 proposed rule, the annualized net benefits would range from $906.8 million to $920.3 million at 3-percent discount rate and would range from $654.7 million to $668.2 million at 7-percent discount rate. Parentheses ( ) indicate negative values. DOE seeks comment on this approach.

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

D. Conclusion

DOE has tentatively concluded that the proposed standards represent the maximum improvement in energy efficiency that is technologically feasible and economically justified, and would result in the significant conservation of energy. Specifically, with regards to technological feasibility, design options used to achieve these standard levels are already commercially available for all equipment classes covered by this proposal. As for economic justification, DOE's analysis shows that the benefits of the proposed standard exceed, to a great extent, the burdens of the proposed standards.

Using a 7-percent discount rate for consumer benefits and costs and NO_X and SO_2 reduction benefits, and a 3-percent discount rate case for GHG social costs, the estimated cost of the proposed standards for CRE is $334.6 million per year in increased equipment costs, while the estimated annual benefits are $586.1 million in reduced equipment operating costs, $174.4 million in climate benefits and $245.5 million in health benefits. The net benefit amounts to $671.4 million per year.

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.[14] For example, some covered products and equipment have substantial energy consumption occur during periods of peak energy demand. The impacts of these equipment on the energy infrastructure can be more pronounced than equipment with relatively constant demand. Accordingly, DOE evaluates the significance of energy savings on a case-by-case basis.

As previously mentioned, the standards are projected to result in estimated national energy savings of 3.11 quad FFC, the equivalent of the primary annual energy use of 33 million homes. The NPV of consumer benefit for these projected energy savings is $2.38 billion using a discount rate of 7 percent, and $7.10 billion using a discount rate of 3 percent. The cumulative emissions reductions associated with these energy savings are 55.8 Mt of CO_2, 17.1 thousand tons of SO_2, 104.2 thousand tons of NO_X, 0.12 tons of Hg, 472.0 thousand tons of CH_4, and 0.54 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) is $ 3.04 billion. The estimated monetary value of the health benefits from reduced SO_2 and NO_X emissions is $ 2.32 billion using a 7-percent discount rate and $ 5.94 billion using a 3-percent discount rate. As such, DOE has initially determined the energy savings from the proposed standard levels are ''significant'' within the meaning of 42 U.S.C. 6295(o)(3)(B). A more detailed discussion of the basis for these tentative conclusions is contained in the

[14] 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).

remainder of this document and the accompanying technical support document (''NOPR TSD'').[15]

DOE also considered more stringent energy efficiency levels as potential standards and is still considering them in this rulemaking. However, DOE has tentatively concluded that the potential burdens of the more stringent energy efficiency levels would outweigh the projected benefits.

Based on consideration of the public comments DOE receives in response to this document and related information collected and analyzed during the course of this rulemaking effort, DOE may adopt energy efficiency levels presented in this document that are either higher or lower than the proposed standards, or some combination of level(s) that incorporate the proposed standards in part.

II. Introduction

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

A. Authority

EPCA authorizes DOE to regulate the energy efficiency of a number of consumer equipment and certain industrial equipment. Title III, part C of EPCA, added by Public Law 95–619, title IV, section 441(a) (42 U.S.C. 6311–6317, as codified), established the Energy Conservation Program for Certain Industrial Equipment, which sets forth a variety of provisions designed to improve energy efficiency. This equipment includes CRE, the subject of this document. (42 U.S.C. 6311(1)(E))

EPCA established standards for certain categories of CRE (42 U.S.C. 6313(c)(2)–(4)) and directs DOE to conduct future rulemakings to determine whether to amend these standards. (42 U.S.C. 6313(c)(6)(B))

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 equipment 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. 6316(e)(1); 42 U.S.C. 6295(m)(1))

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 EPCA include definitions (42 U.S.C. 6311), test procedures (42 U.S.C. 6314), labeling provisions (42 U.S.C. 6315), energy conservation standards (42 U.S.C. 6313), and the authority to require information and reports from manufacturers (42 U.S.C. 6316; 42 U.S.C. 6296).

Federal energy efficiency requirements for covered equipment established under EPCA generally supersede State laws and regulations concerning energy conservation testing, labeling, and standards. (42 U.S.C. 6316(a) and (b); 42 U.S.C. 6297) DOE may, however, grant waivers of Federal preemption for particular State laws or regulations, in accordance with the procedures and other provisions set forth under EPCA. (*See* 42 U.S.C. 6316(a) and 42 U.S.C. 6316(e) (applying the preemption waiver provisions of 42 U.S.C. 6297))

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 equipment. (42 U.S.C. 6316(e)(1); 42 U.S.C. 6295(o)(3)(A) and 42 U.S.C. 6295(r)) Manufacturers of covered equipment must use the Federal test procedures as the basis for: (1) certifying to DOE that their equipment complies with the applicable energy conservation standards adopted pursuant to EPCA (42 U.S.C. 6316(e)(1); 42 U.S.C. 6295(s)), and (2) making representations about the efficiency of that equipment (42 U.S.C. 6314(d)). Similarly, DOE must use these test procedures to determine whether the equipment complies with relevant standards promulgated under EPCA. (42 U.S.C. 6316(e)(1); 42 U.S.C. 6295(s)) The DOE test procedures for CRE appear at title 10 of the Code of Federal Regulations (''CFR'') part 431, subpart C, appendix B (''appendix B'').

DOE must follow specific statutory criteria for prescribing new or amended standards for covered equipment, including CRE. Any new or amended standard for a covered equipment 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)) Furthermore, DOE may not adopt any standard that would not result in the significant conservation of energy. (42 U.S.C. 6316(e)(1); 42 U.S.C. 6295(o)(3))

Moreover, DOE may not prescribe a standard: (1) for certain equipment, including CRE, if no test procedure has been established for the equipment, or (2) if DOE determines by rule that the standard is not technologically feasible or economically justified. (42 U.S.C. 6316(e)(1); 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. 6316(e)(1); 42 U.S.C. 6295(o)(2)(B)(i)) DOE must make this determination after receiving comments on the proposed standard, and by considering, to the greatest extent practicable, the following seven statutory factors:

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

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

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

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

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

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

(7) Other factors the Secretary of Energy (''Secretary'') considers relevant. (42 U.S.C. 6316(e)(1); 42 U.S.C. 6295(o)(2)(B)(i)(I)–(VII))

Further, EPCA establishes a rebuttable presumption that a standard is economically justified if the Secretary finds that the additional cost to the consumer of purchasing an equipment 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. 6316(e)(1); 42 U.S.C. 6295(o)(2)(B)(iii))

EPCA also contains what is known as an ''anti-backsliding'' provision, which prevents the Secretary from prescribing any amended standard that either increases the maximum allowable energy use or decreases the minimum required energy efficiency of a covered equipment. (42 U.S.C. 6316(e)(1); 42 U.S.C. 6295(o)(1)) Also, the Secretary

[15] The NOPR TSD is available in the docket for this rulemaking at *www.regulations.gov/docket/EERE-2017-BT-STD-0007.*

may not prescribe an amended or new standard if interested persons have established by a preponderance of the evidence that the standard is likely to result in the unavailability in the United States in any covered equipment type (or class) of performance characteristics (including reliability), features, sizes, capacities, and volumes that are substantially the same as those generally available in the United States. (42 U.S.C. 6316(e)(1); 42 U.S.C. 6295(o)(4))

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

B. Background

1. Current Standards

On March 28, 2014, DOE published a final rule in the **Federal Register** that prescribed the current energy conservation standards for CRE manufactured on and after March 27, 2017 (''March 2014 Final Rule''). 79 FR 17725. These standards are set forth in DOE's regulations at 10 CFR 431.66(e).

For CRE with two or more compartments (*i.e.,* hybrid refrigerators, hybrid freezers, hybrid refrigerator-freezers, and non-hybrid refrigerator-freezers), 10 CFR 431.66(e)(2) specifies that the maximum daily energy consumption for each model shall be the sum of the applicable standard for each of the compartments, as specified in 10 CFR 431.66(e)(1). For wedge cases, 10 CFR 431.66(e)(3) specifies instructions to comply with the applicable standards specified in 10 CFR 431.66(e)(1).[16] Certain exclusions to the standards at 10 CFR 431.66(e)(1) are specified at 10 CFR 431.66(f) (*i.e.,* the energy conservation standards do not apply to salad bars, buffet tables, and chef bases or griddle stands).

2. History of Standards Rulemaking for CRE

On July 16, 2021, DOE published a request for information (''RFI'') in the **Federal Register** to undertake an early assessment review for amended energy conservation standards for CRE to determine whether to amend applicable energy conservation standards for this equipment. (''July 2021 RFI'') 86 FR 37708. Specifically, through the published notice and request for information, DOE sought data and information that could enable the agency to determine whether amended energy conservation standards would: (1) result in a significant savings of energy; (2) be technologically feasible; and (3) be economically justified. *Id.*

On June 28, 2022, DOE published in the **Federal Register** a notification of the availability of a preliminary technical support document for CRE (''June 2022 Preliminary Analysis''). 87 FR 38296. In that notification, DOE sought comment on the analytical framework, models, and tools that DOE used to evaluate potential standards for CRE, the results of preliminary analyses performed, and the potential energy conservation standard levels derived from these analyses, which DOE presented in the accompanying Preliminary TSD (''June 2022 Preliminary TSD'').[17] *Id.* DOE held a public meeting related to the June 2022 Preliminary Analysis on August 8, 2022 (hereafter, the ''August 8, 2022, public meeting'').

DOE received comments in response to the June 2022 Preliminary Analysis from the interested parties listed in table II.1.

TABLE II.1—WRITTEN COMMENTS RECEIVED IN RESPONSE TO THE JUNE 2022 PRELIMINARY ANALYSIS

Commenter(s)	Abbreviation	Comment No. in the docket	Commenter type
AHT Cooling Systems	AHT	48	Manufacturer.
Air-Conditioning, Heating and Refrigeration Institute	AHRI	46	Trade Association.
Appliance Standards Awareness Project, American Council for an Energy-Efficient Economy, and the Natural Resources Defense Council.	Joint Commenters	39	Efficiency Organizations.
California Investor-Owned Utilities	CA IOUs	43	Energy Utilities.
Continental Refrigerator	Continental	38	Manufacturer.
Hillphoenix	Hillphoenix	* 42	Manufacturer.
Hussmann Corporation	Hussmann	45	Manufacturer.
ITW-Food Equipment Group, LLC dba Traulsen/Kairak	ITW	41	Manufacturer.
National Automatic Merchandising Association	NAMA	37	Trade Association.
North American Association of Food Equipment Manufacturers	NAFEM	40	Trade Association.
Northwest Energy Efficiency Alliance	NEEA	47	Efficiency Organizations.
Zero Zone, Inc	Zero Zone	44	Manufacturer.

* Hillphoenix requested that its response be treated as Confidential Business Information.

A parenthetical reference at the end of a comment quotation or paraphrase provides the location of the item in the public record.[18] Where interested parties have provided written comments that are substantively consistent with their oral comments provided during the August 8, 2022, public meeting, DOE cites the written comments throughout this document. DOE did not identify any oral comments provided during the August 8, 2022, public

[16] A wedge case is a CRE that forms the transition between two regularly shaped display cases. 10 CFR 431.62.

[17] The June 2022 Preliminary TSD is available in the docket for this rulemaking at *www.regulations.gov/document/EERE-2017-BT-STD-0007-0013.*

[18] The parenthetical reference provides a reference for information located in the docket of DOE's rulemaking to develop energy conservation standards for CRE. (Docket No. EERE–2017–BT–STD–0007, which is maintained at *www.regulations.gov*). The references are arranged as follows: (commenter name, comment docket ID number, page of that document).

meeting, that are substantively different from written comments provided by interested parties.

C. Deviation From Process Rule

In accordance with 10 CFR 431.4 and section 3(a) of 10 CFR part 430, subpart C, appendix A (''Process Rule''), DOE notes that it is deviating from the provision in the Process Rule regarding the pre-NOPR and NOPR stages for an energy conservation standard rulemaking.

1. Framework Document

Section 6(a)(2) of the Process Rule states that if DOE determines it is appropriate to proceed with a rulemaking, the preliminary stages of a rulemaking to issue or amend an energy conservation standard that DOE will undertake will be a framework document and preliminary analysis, or an advance notice of proposed rulemaking. While DOE published a preliminary analysis for this rulemaking (*see* 87 FR 38296), DOE did not publish a framework document in conjunction with the preliminary analysis. DOE notes, however, that chapter 2 of the June 2022 Preliminary TSD that accompanied the June 2022 Preliminary Analysis—entitled *Analytical Framework, Comments from Interested Parties, and DOE Responses*—describes the general analytical framework that DOE used in evaluating and developing potential new and amended energy conservation standards.[19] As such, publication of a separate framework document would be largely redundant of chapter 2 of the June 2022 Preliminary TSD.

2. Public Comment Period

Section 6(f)(2) of the Process Rule specifies that the length of the public comment period for a NOPR will be not less than 75 calendar days. For this NOPR, DOE is instead providing a 60-day comment period, consistent with EPCA requirements. (42 U.S.C. 6316(e)(1); 42 U.S.C. 6295(p).

As noted previously, DOE requested comment in the July 2021 RFI on the analysis conducted in support of the last energy conservation standard rulemaking for CRE and provided a 45-day comment period. (*See* 86 FR 37708). In its June 2022 Preliminary Analysis and accompanying TSD, for which DOE provided a 60-day comment period, DOE's analysis remained largely the same as the analysis conducted in support of the last energy conservation standards rulemaking for CRE. DOE requested comment in the June 2022 Preliminary Analysis on the analysis conducted in support of this current rulemaking. In this NOPR, DOE incorporated the most recent data inputs but largely relied on many of the same analytical assumptions and approaches used in the June 2022 Preliminary Analysis. Given that the analysis presented in this NOPR remains largely the same as the June 2022 Preliminary Analysis, and in light of the 45-day comment period DOE has already provided with the July 2021 RFI and the 60-day comment period DOE has already provided with its June 2022 Preliminary Analysis, DOE has determined that a 60-day comment period is appropriate and will provide interested parties with a meaningful opportunity to comment on the proposed rule.

3. Amended Test Procedures

Section 8(d)(1) of the Process Rule specifies that test procedure rulemakings establishing methodologies used to evaluate proposed energy conservation standards will be finalized prior to publication of a NOPR proposing new or amended energy conservation standards. Additionally, new test procedures and amended test procedures that impact measured energy use or efficiency will be finalized at least 180 days prior to the close of the comment period for (1) a NOPR proposing new or amended energy conservation standards or (2) a notice of proposed determination that standards do not need to be amended.

On September 26, 2023, DOE published a **Federal Register** notice amending and establishing test procedures for CRE (''September 2023 Test Procedure Final Rule''). 88 FR 66152. DOE determined that the amendments adopted in the September 2023 Test Procedure Final Rule will not alter the measured efficiency of CRE currently subject to energy conservation standards. 88 FR 66152, 66156. However, the measured energy use for chef bases or griddle stands and high-temperature refrigerators would likely change as a result of the September 2023 Test Procedure Final Rule. Nonetheless, the September 2023 Test Procedure Final Rule aligns with the requirements that the CRE industry has developed or proposed. Specifically, AHRI 1200–2023[20] was approved by the American National Standards Institute on June 12, 2023, and addendum B to ASHRAE 72–2022[21] was proposed on September 15, 2023. AHRI 1200–2023 specifies that high-temperature refrigerators shall be tested at an integrated average temperature of 55 °F ± 2.0 °F, consistent with the September 2023 Test Procedure Final Rule. The addendum B to ASHRAE 72–2022 proposal specifies a dry-bulb temperature of 86.0 °F with a tolerance for the average over test period of ± 1.8 °F and a tolerance for the individual measurements of ± 3.6 °F; wet-bulb temperature of 73.7 °F with a tolerance for the average over test period of ± 1.8 °F and a tolerance for the individual measurements of ± 3.6 °F; and radiant heat temperature of greater than or equal to 81.0 °F, consistent with the September 2023 Test Procedure Final Rule. Both AHRI 1200–2023 and the proposed addendum B to ASHRAE 72–2022 were developed by the CRE industry over several years, and the September 2023 Test Procedure Final Rule aligns with the provisions included in both test standards for chef bases or griddle stands and high-temperature refrigerators. As such, DOE finds it appropriate to deviate from the requirement that the amended test procedures for chef bases or griddle stands and high-temperature refrigerators be finalized at least 180 days prior to the close of the comment period for this NOPR.

III. General Discussion

DOE developed this proposal after considering oral and written comments, data, and information from interested parties that represent a variety of interests. The following discussion addresses issues raised by these commenters.

A. General Comments

This section summarizes general comments received from interested parties regarding rulemaking timing and process.

NEEA generally supported the process outlined in the June 2022 Preliminary Analysis. (NEEA, No. 47 at p. 5) NEEA commented that DOE's analysis in the June 2022 Preliminary TSD showed a strong standard for CRE equipment would be economically justified and deliver significant energy savings to the Nation. (*Id.*) As a result, NEEA recommended DOE adopt increased efficiency standards for existing classes

[19] The June 2022 Preliminary TSD is available in the docket for this rulemaking at *www.regulations.gov/document/EERE-2017-BT-STD-0007-0013.*

[20] AHRI Standard 1200–2023 (I–P), *2023 Standard for Performance Rating of Commercial Refrigerated Display Merchandisers and Storage Cabinets,* copyright 2023.

[21] Proposed Addendum b to Standard 72–2022, Method of Testing Open and Closed Commercial Refrigerators and Freezers. *See https://osr.ashrae.org/Online-Comment-Database/ShowDoc2/Table/DocumentAttachments/FileName/4130-72-2022%20Addendum%20b.21_072823_chair_approved.pdf/download/false.*

of CRE and continue to push the industry toward more-efficient products and greater energy savings across all CRE equipment classes via technical, market, and economic analyses. (*Id.*) NEEA recommended further that DOE consider energy-saving technologies in CRE and that DOE collect additional data for analysis. (*Id.*) NEEA stated that they believe further analysis of specific features would help establish stronger standards, especially when the analysis improved representativeness of equipment in the market and appropriately characterized energy use and energy savings. (*Id.*) NEEA stated it recognized CRE as a complex energy conservation standard with many combinations of equipment and a variety of use cases and commended DOE for the depth of analysis and concerted efforts to incorporate new classes and utilize available data for analysis. (*Id.*) NEEA commented that DOE's analysis demonstrated significant cost-effective savings, and NEEA recommended DOE adopt increased energy conservation standards for existing CRE equipment classes as supported by the analysis in the June 2022 Preliminary TSD. (*Id.*)

Other commenters expressed concern with the rulemaking timeline. NAFEM commented that it had previously requested a comment period extension, which was denied, and requested to see the CRE engineering spreadsheets, which were provided on August 18, 2022, leaving an 11-calendar-day review period. (NAFEM, No. 40 at p. 2) NAFEM acknowledged that DOE had initiated multiple energy efficiency rulemakings on a compressed schedule, but NAFEM stated that this did not serve as justification for neglecting to provide important information and adequate time for review. (*Id.*) NAFEM disagreed with DOE's justification that the comment period could be shortened due to similarities between the June 2022 Preliminary TSD and its 2014 counterpart. (*Id.*) NAFEM commented that many of its concerns regarding the July 2021 RFI were dismissed or remain unresolved in the June 2022 Preliminary TSD. (*Id.*) Furthermore, NAFEM commented that DOE's claim was inaccurate that the engineering spreadsheets ''do not contain any new or additional information that was not already published with the TSD in June.'' (*Id.*) NAFEM added that it would have had two additional weeks to analyze the spreadsheets if DOE had adhered to the appendix A Process Rule permitting no less than a 75-day comment period. (*Id.* at pp. 2–3) NAFEM concluded that it was unable to provide a complete list of errors or concerns due to insufficient time and presented its comments as representative, but not exhaustive, of the types of problems and inaccuracies contained in the spreadsheets. (*Id.* at p. 3)

Hussmann commented that it supports the comments provided by AHRI and NAFEM and noted that it and other commenters were denied extensions to the August 29, 2022, comment deadline. (Hussmann, No. 45 at p. 1). Hussmann stated that it hopes discussions with DOE will improve this rulemaking. (*Id.*)

NAMA shared its view that, despite this CRE rulemaking being one of the most complex DOE has undertaken within EERE, DOE reduced the time for public comment. (NAMA, No. 37 at p. 4) NAMA additionally commented that DOE released the engineering spreadsheets on August 8, 2022, leaving only 7 working days for review prior to the comment receipt deadline, and that this limited notice violated all elements of the notice and comment in the Administrative Procedure Act.[22] (*Id.*) NAMA added that the United States has admonished other countries for similar regulatory actions. (*Id.*)

ITW commented that the June 2022 Preliminary TSD made clear the importance of the CRE engineering spreadsheet, prompting ITW to request that DOE grant access to the spreadsheet. (ITW, No. 41 at p. 1). ITW stated that DOE provided the spreadsheet but did not extend the comment period to allow adequate time for review of information ITW considered critical. (*Id.*)

In response to comments regarding timing and the 2022 Engineering Spreadsheet Related to the Preliminary Analysis for Commercial Refrigerators, Refrigerator-Freezers and Freezers Standards (''engineering spreadsheet''), DOE published this document in the rulemaking docket on August 18, 2022 after commenters requested its publication. This practice was consistent with prior rulemakings conducted for CRE, such as when DOE did not include an engineering spreadsheet with the notice of availability of preliminary technical support document published on March 30, 2011 (''March 2011 Preliminary Analysis''). Instead, DOE published the engineering spreadsheet with its NOPR on September 11, 2013. Similarly, in this rulemaking, DOE did not publish the engineering spreadsheet used for the preliminary analysis at the time of the June 2022 Preliminary Analysis publication. Consistent with past practice, DOE is publishing the engineering spreadsheet that supports this NOPR analysis along with this NOPR.

With respect to comments regarding the comment-period, DOE discusses deviations from the Process Rule, and the justifications for such deviations, in section II.C of this NOPR.

In response to comments regarding the Administrative Procedure Act, 5 U.S.C. 553 provides requirements for a notice of proposed rulemaking. The June 2022 Preliminary Analysis was not a notice of proposed rulemaking as it was a notification that announced the availability of the preliminary analysis DOE had conducted for purposes of evaluating the need for amended energy conservation standards for CRE. However, DOE provided notice of that preliminary analysis and sought comment on the analysis. *See* 87 FR 38296. The June 2022 Preliminary Analysis was in compliance with EPCA and the Process Rule.

Other commenters had general comments regarding the June 2022 Preliminary Analysis, the accompanying June 2022 Preliminary TSD, and the rulemaking process. NAMA commented that the June 2022 Preliminary TSD is flawed and should be re-written, with CRE categories split into ranges by size. (NAMA, No. 37 at p. 8) NAMA stated that if the engineering analysis were to be incorrect, then the technology screening would be incorrect also, which means the baseline machine design was incorrect and the rest of the report could not be used. (*Id.*) NAMA recommended that DOE begin the process again, using machines that are currently available on the market as its baseline. (*Id.*) NAMA also recommended that DOE use low-GWP refrigerants and incorporate most of the design options shown in table 5.8.10 of NAMA's written submission, along with current costs. (*Id.*) NAMA added that if this approach is not possible, DOE should acknowledge the costs already incurred by manufacturers to meet the goals established by the Biden Administration to reduce global warming. (*Id.*)

NAMA commented that while it appreciated DOE's willingness to hold a hearing on the proposed energy efficiency standards levels, it believed that the August 8, 2022, public meeting was rushed and abruptly terminated before all questions were answered. (NAMA, No. 37 at p. 4) NAMA requested that DOE return to ''in-person'' meetings to support dialogue on these subjects. (*Id.*)

[22] *See* 5 U.S.C. 551–559.

NAMA commented that the market dynamic was currently distorted due to the COVID–19 pandemic and a lack of available equipment, making efficiency a secondary priority to availability. (*Id.* at p. 16)

NAMA recommended that DOE should cease the rulemaking on this category of CRE until after the beverage vending machines rulemaking is in the final rule stage and until the test procedure for CRE equipment is finalized. (*Id.* at p. 17) NAMA commented that due to the fact that the rulemakings for beverage vending machines and CRE affect the same manufacturers, overlapping comment periods result in result increased complexity to the responses. (*Id.*) NAMA also stated that a final test procedure should be established before setting future standard levels, and that the Process Rule requires DOE to finish the test procedure rulemaking before engaging in cost and energy calculations for a new standard. (*Id.*) NAMA further commented that DOE has requested comments on the CRE test procedure at the same time as it requested comments on the NOPR for future standards levels. (*Id.*) NAMA stated that, it is illogical to set future standards levels because the final test procedure for CRE is not yet known. (*Id.*)

Finally, NAMA commented that it does not believe the June 2022 Preliminary TSD or other documents for this rulemaking reflect the state of the CRE industry in 2022 or the projections for equipment manufactured after this rule becomes effective. (*Id.* at p. 19) NAMA requested that DOE conduct a complete revision of all energy efficiency changes, the base case, the standards cases, and the economic analysis after the test procedure final standard is issued and the Cooperative Research and Development Agreement (''CRADA'')[23] extension is complete. (*Id.*) NAMA stated its belief that accurate information will show that a new set of standards levels for the classes of CRE covered by NAMA is unwarranted. (*Id.*) NAMA commented that the payback period will grow significantly when the net present value is re-calculated using accurate numbers. (*Id.*) NAMA recommended allowing manufacturers to complete the change to hydrocarbon refrigerants, which NAMA asserted would have up to 10 times the environmental impact of any new DOE standards. (*Id.*)

In response to NAMA's comments, DOE is maintaining the current equipment class structure in this NOPR, except for the new equipment classes which are proposed and discussed in section IV.A.1.c of this document. In accordance with section 6(d)(3) of the Process Rule, DOE may make any necessary changes to the engineering analysis or the candidate standard levels based on consideration of the comments received. DOE notes that it considered CRE that are currently available on the market when developing the NOPR engineering analysis. DOE acknowledges and accounts for the December 2022 EPA NOPR in this NOPR analysis. As noted in section I of this document, the December 2022 EPA NOPR would prohibit manufacture or import of such CRE starting January 1, 2025, and would ban sale, distribution, purchase, receipt, or export of such CRE starting January 1, 2026. 87 FR 76809. The December 2022 EPA NOPR compliance date would occur prior to the expected the compliance date of any DOE amended or established standards (*i.e.,* on or after the date that is 3 years after the date on which the final new and amended standards are published). Thus, the transition to refrigerants in compliance with the December 2022 EPA NOPR (including hydrocarbon refrigerants) would have already occurred prior to the expected the compliance date of any DOE amended or established standards. Additionally, DOE considered the December 2022 EPA NOPR when developing the NOPR engineering analysis baseline as discussed in section IV.C.1.a of this document. In the no-new-standards case, DOE incorporated the cost of refrigerant transition as discussed in section IV.J.2.c of this document. DOE also revised the components considered in the engineering analysis baseline in this NOPR as discussed in section IV.C.1.a of this document and updated the costs as discussed in section IV.C.2. of this document. In response to market distortions, DOE used the latest shipments, market shares, and MPCs based on manufacturer feedback. Supply chain constraints are discussed in section V.B.2.c of this document.

In response to the comments about the August 8, 2022, public meeting, DOE notes that it responded to all questions asked during the August 8, 2022, public meeting.[24] Similar to the process with the June 2022 Preliminary Analysis, DOE welcomes comments in response to this NOPR and participation in the public meeting, and DOE provides information on public participation in response to this NOPR in section VII. of this document.

DOE notes that section 8(d)(1) of the Process Rule specifies that test procedure rulemakings establishing methodologies used to evaluate proposed energy conservation standards will be finalized prior to publication of a NOPR proposing new and amended energy conservation standards. Additionally, energy conservation standards for refrigerated bottled or canned beverage vending machines are separate from CRE, and evaluated through a separate rulemaking process, and are located at 10 CFR 431.296.

AHT stated that there is a high risk of eliminating the entire equipment class if DOE were to further increase restrictions for horizontal closed transparent self-contained low temperature (''HCT.SC.L''), horizontal closed transparent self-contained medium temperature (''HCT.SC.M''), horizontal closed transparent self-contained ice-cream freezer (''HCT.SC.I''), and vertical closed transparent self-contained low temperature (''VCT.SC.L.'') equipment classes and recommended that DOE maintain the current regulatory framework in design options and efficiency standards for these equipment classes. (AHT, No. 48 at p. 6)

In response to AHT's comments, DOE has revised the components considered in the engineering analysis baseline in this NOPR as discussed in section IV.C.1.a of this document and presented the results of this NOPR analysis in section V of this document. DOE also notes that it observed CRE models currently available and rated to the DOE Compliance Certification Database (''CCD'') that currently comply with the proposed energy conservation standards in this NOPR for the equipment classes listed in AHT's comment.

B. Scope of Coverage

This NOPR covers those commercial refrigeration equipment that meet the definition of ''commercial refrigerators, refrigerator-freezers, and freezers,'' as codified at 10 CFR 431.62.

A ''commercial refrigerator, freezer, and refrigerator-freezer'' means refrigeration equipment that—(1) is not consumer equipment (as defined in § 430.2); (2) is not designed and marketed exclusively for medical, scientific, or research purposes; (3) operates at a chilled, frozen, combination chilled and frozen, or variable temperature; (4) displays or stores merchandise and other perishable

[23] Most of the activities of the 2019–2021 CRADA were directed toward reduction of the risk involved in a possible leak situation if it were ever to occur. ORNL did extensive testing on leak scenarios and proposed new methods to reduce the risk from such a leak in a public space.

[24] *See www.regulations.gov/document/EERE-2017-BT-STD-0007-0049.*

materials horizontally, semi-vertically, or vertically; (5) has transparent or solid doors, sliding or hinged doors, a combination of hinged, sliding, transparent, or solid doors, or no doors; (6) is designed for pull-down temperature applications or holding temperature applications; and (7) is connected to a self-contained condensing unit or to a remote condensing unit. 10 CFR 431.62.

However, this NOPR does not include some types of commercial refrigerators, refrigerator-freezers, and freezers that meet the definition at 10 CFR 431.62. These include blast chillers, blast freezers, buffet tables or preparation tables, and mobile refrigerated cabinets.

See section IV.A.1 of this document for discussion of the equipment classes analyzed in this NOPR.

C. Test Procedure

EPCA sets forth generally applicable criteria and procedures for DOE's adoption and amendment of test procedures. (42 U.S.C. 6314(a)) Manufacturers of covered equipment must use these test procedures to certify to DOE that their equipment complies with energy conservation standards and to quantify the efficiency of their equipment. (42 U.S.C. 6314(d); 42 U.S.C. 6316(e)(1); 42 U.S.C. 6295(s)) DOE's current energy conservation standards for CRE are expressed in terms of maximum daily energy consumption as measured using appendix B. (*See* 10 CFR 431.66(e))

D. Technological Feasibility

1. General

In each energy conservation standards rulemaking, DOE conducts a screening analysis based on information gathered on all current technology options and prototype designs that could improve the efficiency of the 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 equipment or in working prototypes to be technologically feasible. 10 CFR 431.4; sections 6(b)(3)(i) and 7(b)(1) of the 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 equipment utility or availability; (3) adverse impacts on health or safety, and (4) unique-pathway proprietary technologies. 10 CFR 431.4; sections 6(b)(3)(ii)–(v) and 7(b)(2)–(5) of the Process Rule. Section IV.B of this document discusses the results of the screening analysis for CRE, 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 NOPR TSD.

2. Maximum Technologically Feasible Levels

When DOE proposes to adopt a new or amended standard for a type or class of covered equipment, it must determine the maximum improvement in energy efficiency or maximum reduction in energy use that is technologically feasible for such equipment. (42 U.S.C. 6316(e)(1); 42 U.S.C. 6295(p)(1)) Accordingly, in the engineering analysis, DOE determined the maximum technologically feasible (''max-tech'') improvements in energy efficiency for CRE, using the design parameters for the most efficient equipment available on the market or in working prototypes. The max-tech levels that DOE determined for this rulemaking are described in section IV.C.1.b of this proposed rule and in chapter 5 of the NOPR TSD.

E. Energy Savings

1. Determination of Savings

For each TSL, DOE projected energy savings from application of the TSL to CRE purchased in the 30-year period that begins in the year 2028 with the proposed standards (2028–2057).[25] The savings are measured over the entire lifetime of CRE purchased in the previous 30-year 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 equipment would likely evolve in the absence of new and amended energy conservation standards.

DOE used its national impact analysis (''NIA'') spreadsheet model to estimate national energy savings (''NES'') from potential amended and new standards for CRE. 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 equipment 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 generate and transmit the site electricity. 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.1 of this document.

2. Significance of Savings

To adopt any new or amended standards for covered equipment, DOE must determine that such action would result in significant energy savings. (42 U.S.C. 6316(e)(1); 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.[27] For example, some covered products and equipment have most of their energy consumption occur during periods of peak energy demand. The impacts of these equipment on the energy infrastructure can be more pronounced than equipment 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

[25] Each TSL is composed of specific efficiency levels for each product class. The TSLs considered for this NOPR are described in section V.A of this document. DOE conducted a sensitivity analysis that considers impacts for products shipped in a 9-year period. Note that the analysis does not consider benefits and costs resulting from the December 2022 EPA NOPR.

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

[27] The numeric threshold for determining the significance of energy savings established in a final rule published on February 14, 2020 (85 FR 8626, 8670), was subsequently eliminated in a final rule published on December 12, 2021 (86 FR 70892, 70906).

confront the global climate crisis, among other factors.

As stated, the standard levels proposed in this document are projected to result in national energy savings of 3.11 quad FFC, the equivalent of the primary annual energy use of 33 million homes. Based on the amount of FFC savings, the corresponding reduction in emissions, and the need to confront the global climate crisis, DOE has initially determined the energy savings from the proposed standard levels are ''significant'' within the meaning of 42 U.S.C. 6316(e)(1); 42 U.S.C. 6295(o)(3)(B).

F. 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. 6316(e)(1); 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 proposed rulemaking.

a. Economic Impact on Manufacturers and Consumers

In determining the impacts of a potential new or amended standard on manufacturers, DOE conducts an MIA, as discussed in section IV.J of this document. DOE first uses an annual cash-flow approach to determine the quantitative impacts. This step includes both a short-term assessment—based on the cost and capital requirements during the period between when a regulation is issued and when entities must comply with the regulation—and a long-term assessment over a 30-year period. The industry-wide impacts analyzed include (1) 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 and 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; for CRE, DOE evaluated the impacts on small businesses.

DOE requests comment on the impacts to CRE manufacturers and consumers from the Inflation Reduction Act (IRA) and the Infrastructure Investment and Jobs Act (IIJA).

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

EPCA requires DOE to consider the savings in operating costs throughout the estimated average life of the covered equipment in the type (or class) compared to any increase in the price of, or in the initial charges for, or maintenance expenses of, the covered equipment that are likely to result from a standard. (42 U.S.C. 6316(e)(1); 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 equipment (including its installation) and the operating expense (including energy, maintenance, and repair expenditures) discounted over the lifetime of the equipment. The LCC analysis requires a variety of inputs, such as equipment prices, equipment energy consumption, energy prices, maintenance and repair costs, equipment lifetime, and discount rates appropriate for consumers. To account for uncertainty and variability in specific inputs, such as equipment lifetime and discount rate, DOE uses a distribution of values, with probabilities attached to each value.

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

For its LCC and PBP analysis, DOE assumes that consumers will purchase the covered equipment in the first full year of compliance with new and 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 and 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. 6316(e)(1); 42 U.S.C. 6295(o)(2)(B)(i)(III)) As discussed in section III.E of this document, DOE uses the NIA spreadsheet models to project national energy savings.

d. Lessening of Utility or Performance of Equipment

In establishing equipment classes and in evaluating design options and the impact of potential standard levels, DOE evaluates potential standards that would not lessen the utility or performance of the considered equipment. (42 U.S.C. 6316(e)(1); 42 U.S.C. 6295(o)(2)(B)(i)(IV)) Based on data available to DOE, the standards proposed in this document would not reduce the utility or performance of the equipment under consideration in this proposed rulemaking.

e. Impact of Any Lessening of Competition

EPCA directs DOE to consider the impact of any lessening of competition, as determined in writing by the Attorney General, that is likely to result from a proposed standard. (42 U.S.C. 6316(e)(1); 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 proposed standard and to transmit such determination to the Secretary within 60 days of the publication of a proposed rule, together with an analysis of the nature and extent of the impact. (42 U.S.C. 6316(e)(1); 42 U.S.C. 6295(o)(2)(B)(ii)) DOE will transmit a copy of this proposed rule to the Attorney General with a request that the Department of Justice (''DOJ'') provide its determination on this issue. DOE will publish and respond to the Attorney General's determination in the final rule. DOE invites comment from the public regarding the competitive impacts that are likely to result from this proposed rule. In addition, stakeholders may also provide comments separately to DOJ regarding these potential impacts. See the **ADDRESSES** section for information to send comments to DOJ.

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

DOE maintains 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 proposed standards are likely to result in environmental benefits in the form of reduced emissions of air pollutants and 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. 6316(e)(1); 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

EPCA creates a rebuttable presumption that an energy conservation standard is economically justified if the additional cost to the equipment that meets the standard is less than three times the value of the first year's energy savings resulting from the standard, as calculated under the applicable DOE test procedure. (42 U.S.C. 6316(e(1)); 42 U.S.C. 6295(o)(2)(B)(iii)) DOE's LCC and PBP analyses generate values used to calculate the effects that proposed 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. 6316(e)(1) and 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 V.B.1.c of this proposed rule.

IV. Methodology and Discussion of Related Comments

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

DOE used several analytical tools to estimate the impact of the standards proposed in this document. The first tool is a spreadsheet that calculates the LCC savings and PBP of potential amended and new 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 proposed rulemaking: *www.regulations.gov/docket/EERE-2017-BT-STD-0007.* Additionally, DOE used output from the 2023 version of the Energy Information Administration's (''EIA's'') *Annual Energy Outlook* (''*AEO*''), a widely known energy projection for the United States, for the emissions and utility impact analyses.

A. Market and Technology Assessment

DOE develops information in the market and technology assessment that provides an overall picture of the market for the equipment concerned, including the purpose of the equipment, the industry structure, manufacturers, market characteristics, and technologies used in the equipment. This activity includes both quantitative and qualitative assessments, based primarily on publicly-available information. The subjects addressed in the market and technology assessment for this rulemaking include (1) a determination of the scope of the rulemaking and equipment 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 CRE. The key findings of DOE's market assessment are summarized in the following sections. See chapter 3 of the NOPR TSD for further discussion of the market and technology assessment.

1. Equipment Classes and Definitions

When evaluating and establishing energy conservation standards, DOE may establish separate standards for a group of covered equipment (*i.e.,* establish a separate equipment class) if DOE determines that separate standards are justified based on the type of energy used, or if DOE determines that a product's capacity or other performance-related feature justifies a different standard. (42 U.S.C. 6316(e)(1); 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.*)

a. Current Equipment Classes

DOE currently separates CRE into 49 equipment classes, which are categorized according to the following performance-related features: (1) operating temperature—refrigerator (≥32 °F), freezer (<32 °F), or ice-cream freezer (≤ − 5 °F); (2) presence of doors—open or closed; (3) door type—solid or transparent; (4) condensing unit—remote or self-contained; (5) configuration—horizontal, vertical, semi-vertical, or service over counter; (6) temperature pull-down capability. Definitions supporting the equipment classes are as follows:

Closed solid means equipment with doors, and in which more than 75 percent of the outer surface area of all doors on a unit are not transparent.

Closed transparent means equipment with doors, and in which 25 percent or more of the outer surface area of all doors on the unit are transparent.

Commercial freezer means a unit of commercial refrigeration equipment in which all refrigerated compartments in the unit are capable of operating below 32 °F (±2 °F).

Commercial refrigerator means a unit of commercial refrigeration equipment in which all refrigerated compartments in the unit are capable of operating at or above 32 °F (±2 °F).

Commercial refrigerator, freezer, and refrigerator-freezer means refrigeration equipment that—(1) Is not a consumer product (as defined in § 430.2);

(2) Is not designed and marketed exclusively for medical, scientific, or research purposes;

(3) Operates at a chilled, frozen, combination chilled and frozen, or variable temperature;

(4) Displays or stores merchandise and other perishable materials horizontally, semi-vertically, or vertically;

(5) Has transparent or solid doors, sliding or hinged doors, a combination of hinged, sliding, transparent, or solid doors, or no doors;

(6) Is designed for pull-down temperature applications or holding temperature applications; and

(7) Is connected to a self-contained condensing unit or to a remote condensing unit.

Door means a movable panel that separates the interior volume of a unit of commercial refrigeration equipment from the ambient environment and is designed to facilitate access to the refrigerated space for the purpose of loading and unloading product. This includes hinged doors, sliding doors, and drawers. This does not include night curtains.

Holding temperature application means a use of commercial refrigeration equipment other than a pull-down temperature application, except a blast chiller or freezer.

Horizontal Closed means equipment with hinged or sliding doors and a door angle greater than or equal to 45°.

Horizontal Open means equipment without doors and an air-curtain angle greater than or equal to 80° from the vertical.

Ice-cream freezer means:

(1) Prior to the compliance date(s) of any amended energy conservation standard(s) issued after January 1, 2023 for ice-cream freezers, a commercial freezer that is capable of an operating temperature at or below −5.0 °F and that the manufacturer designs, markets, or intends specifically for the storing, displaying, or dispensing of ice cream or other frozen desserts; or

(2) Upon the compliance date(s) of any amended energy conservation standard(s) issued after January 1, 2023 for ice-cream freezers, a commercial freezer that is capable of an operating temperature at or below −13.0 °F and that the manufacturer designs, markets, or intends specifically for the storing, displaying, or dispensing of ice cream or other frozen desserts.

Pull-down temperature application means a commercial refrigerator with doors that, when fully loaded with 12 ounce beverage cans at 90 degrees F, can cool those beverages to an average stable temperature of 38 degrees F in 12 hours or less.

Remote condensing unit means a factory-made assembly of refrigerating components designed to compress and liquefy a specific refrigerant that is remotely located from the refrigerated equipment and consists of 1 or more refrigerant compressors, refrigerant condensers, condenser fans and motors, and factory supplied accessories.

Self-contained condensing unit means a factory-made assembly of refrigerating components designed to compress and liquefy a specific refrigerant that is an integral part of the refrigerated equipment and consists of 1 or more refrigerant compressors, refrigerant condensers, condenser fans and motors, and factory supplied accessories.

Semivertical open means equipment without doors and an air-curtain angle greater than or equal to 10° and less than 80° from the vertical.

Service over counter means equipment that has sliding or hinged doors in the back intended for use by sales personnel, with glass or other transparent material in the front for displaying merchandise, and that has a height not greater than 66 inches and is intended to serve as a counter for transactions between sales personnel and customers.

Transparent means greater than or equal to 45-percent light transmittance, as determined in accordance with the ASTM Standard E 1084–86 (Reapproved 2009), at normal incidence and in the intended direction of viewing.

Vertical Closed means equipment with hinged or sliding doors and a door angle less than 45°.

Vertical Open means equipment without doors and an air-curtain angle greater than or equal to 0° and less than 10° from the vertical.

10 CFR 431.62.

On March 28, 2014, DOE published in the **Federal Register** the March 2014 Final Rule that established the current equipment classes and corresponding standards for CRE. 79 FR 17725. DOE currently sets forth energy conservation standards and relevant definitions for CRE equipment classes at 10 CFR 431.66 and 10 CFR 431.62, respectively. Table IV.1 shows the current CRE equipment classes and standards.

TABLE IV.1—CURRENT CRE EQUIPMENT CLASSES

Condensing unit configuration	Equipment family	Operating temperature (°F)	Equipment class designation	Maximum daily energy consumption (kilowatt-hours per day) *
Remote Condensing (RC).	Vertical Open (VOP)	≥32	VOP.RC.M	0.64 × TDA + 4.07
		<32	VOP.RC.L	2.2 × TDA + 6.85
		≤−5	VOP.RC.I	2.79 × TDA + 8.7
	Semivertical Open (SVO)	≥32	SVO.RC.M	0.66 × TDA + 3.18
		<32	SVO.RC.L	2.2 × TDA + 6.85
		≤−5	SVO.RC.I	2.79 × TDA + 8.7
	Horizontal Open (HZO)	≥32	HZO.RC.M	0.35 × TDA + 2.88
		<32	HZO.RC.L	0.55 × TDA + 6.88
		≤−5	HZO.RC.I	0.7 × TDA + 8.74
	Vertical Closed Transparent (VCT)	≥32	VCT.RC.M	0.15 × TDA + 1.95
		<32	VCT.RC.L	0.49 × TDA + 2.61
		≤−5	VCT.RC.I	0.58 × TDA + 3.05
	Horizontal Closed Transparent (HCT)	≥32	HCT.RC.M	0.16 × TDA + 0.13
		<32	HCT.RC.L	0.34 × TDA + 0.26
		≤−5	HCT.RC.I	0.4 × TDA + 0.31
	Vertical Closed Solid (“VCS”)	≥32	VCS.RC.M	0.1 × V + 0.26
		<32	VCS.RC.L	0.21 × V + 0.54

TABLE IV.1—CURRENT CRE EQUIPMENT CLASSES—Continued

Condensing unit configuration	Equipment family	Operating temperature (°F)	Equipment class designation	Maximum daily energy consumption (kilowatt-hours per day) *
		≤−5	VCS.RC.I	0.25 × V + 0.63
	Horizontal Closed Solid (HCS)	≥32	HCS.RC.M	0.1 × V + 0.26
		<32	HCS.RC.L	0.21 × V + 0.54
		≤−5	HCS.RC.I	0.25 × V + 0.63
	Service Over Counter (SOC)	≥32	SOC.RC.M	0.44 × TDA + 0.11
		<32	SOC.RC.L	0.93 × TDA + 0.22
		≤−5	SOC.RC.I	1.09 × TDA + 0.26
Self-Contained (SC)	Vertical Open (VOP)	≥32	VOP.SC.M	1.69 × TDA + 4.71
		<32	VOP.SC.L	4.25 × TDA + 11.82
		≤−5	VOP.SC.I	5.4 × TDA + 15.02
	Semivertical Open (SVO)	≥32	SVO.SC.M	1.7 × TDA + 4.59
		<32	SVO.SC.L	4.26 × TDA + 11.51
		≤−5	SVO.SC.I	5.41 × TDA + 14.63
	Horizontal Open (HZO)	≥32	HZO.SC.M	0.72 × TDA + 5.55
		<32	HZO.SC.L	1.9 × TDA + 7.08
		≤−5	HZO.SC.I	2.42 × TDA + 9
	Vertical Closed Transparent (VCT)	≥32	VCT.SC.M	0.1 × V + 0.86
		<32	VCT.SC.L	0.29 × V + 2.95
		≤−5	VCT.SC.I	0.62 × TDA + 3.29
	Vertical Closed Solid (VCS)	≥32	VCS.SC.M	0.05 × V + 1.36
		<32	VCS.SC.L	0.22 × V + 1.38
		≤−5	VCS.SC.I	0.34 × V + 0.88
	Horizontal Closed Transparent (HCT)	≥32	HCT.SC.M	0.06 × V + 0.37
		<32	HCT.SC.L	0.08 × V + 1.23
		≤−5	HCT.SC.I	0.56 × TDA + 0.43
	Horizontal Closed Solid (HCS)	≥32	HCS.SC.M	0.05 × V + 0.91
		<32	HCS.SC.L	0.06 × V + 1.12
		≤−5	HCS.SC.I	0.34 × V + 0.88
	Service Over Counter (SOC)	≥32	SOC.SC.M	0.52 × TDA + 1
		<32	SOC.SC.L	1.1 × TDA + 2.1
		≤−5	SOC.SC.I	1.53 × TDA + 0.36
	Pull-Down (PD)	≥32	PD.SC.M	0.11 × V + 0.81

* The term "V" means the chilled or frozen compartment volume (ft^3) as defined in the Association of Home Appliance Manufacturers ("AHAM") Standard HRF 1–2008. The term "TDA" means the total display area (ft^2) of the case, as defined in Air-Conditioning, Heating, and Refrigeration Institute ("AHRI") Standard 1200–2006.

b. New Definitions

In the June 2022 Preliminary TSD, DOE sought comment on whether updates to the existing equipment class structure are appropriate. In response, ITW commented that DOE failed to recognize that manufacturers might use other options to produce cabinets with increased heat loads due to their physical features (other than those required by a simple reach-in refrigerator), citing the following applications as examples: (1) pass-through refrigerators—cabinets with doors on both sides, providing access to stored items from either side; (2) roll-in refrigerators—cabinets with ramps and door sweeps that allow for loading of bakery carts; and (3) roll-through refrigerators—cabinets with ramps and door sweeps on both sides that allow for bakery carts to move in and out from one side to the other. (ITW, No. 41 at p. 33)

NAFEM stated that it and other commenters recommended separating forced-air and cold-wall refrigeration systems into different categories in response to the July 2021 RFI, yet it appeared that DOE deferred making a decision until a future proposed rule. (NAFEM, No. 40 at p. 3)

Continental commented that DOE should provide separate equipment classes and standard levels to segregate forced-air from cold-wall models, as well as roll-in from reach-in models, and pass-through from non-pass-through models, because these equipment types have differentiating characteristics that impact energy consumption, and separate energy standard levels are needed to avoid weighting standards in an unfair manner. (Continental, No. 38 at p. 2)

In response to commenter's suggestions and after a review of similar terms defined by the California Code of Regulations,[28] DOE is proposing to define the terms ''cold-wall evaporator,'' ''forced-air evaporator,'' ''pass-through doors,'' ''roll-in door,'' ''roll-through doors,'' and ''sliding door'' as follows:

Cold-wall evaporator means an evaporator that comprises a portion or all of the commercial refrigerator, freezer, and refrigerator freezer cabinet's interior surface that transfers heat through means other than fan-forced convection.

Forced-air evaporator means an evaporator that employs the use of fan-forced convection to transfer heat within the commercial refrigerator, freezer, and refrigerator freezer cabinet.

[28] *See https://govt.westlaw.com/calregs/Document/I7AE76FC19E3011EDA9D5EB8195EB4110?viewType=FullText&originationContext=documenttoc&transitionType=CategoryPageItem&contextData=(sc.Default)&bhcp=1.*

Pass-through doors means doors located on both the front and rear of the commercial refrigerator, freezer, and refrigerator freezer.

Roll-in door means a door that includes a door sweep to seal the bottom of the door and may include a ramp that allows wheeled racks of product to be rolled into the commercial refrigerator, freezer, and refrigerator freezer.

Roll-through doors means doors located on both the front and rear of the commercial refrigerator, freezer, and refrigerator freezer, that includes a door sweep to seal the bottom of the door and may include a ramp that allows wheeled racks of product to be rolled into and through the commercial refrigerator, freezer, and refrigerator freezer.

Sliding door means a door that opens when a portion of the door moves in a direction generally parallel to its surface.

In addition to proposing to define the terms ''cold-wall evaporator,'' ''forced-air evaporator,'' ''pass-through doors,'' ''roll-in door,'' ''roll-through doors,'' and ''sliding door,'' DOE is proposing to allow certain equipment classes that contain CRE with forced-air evaporators, CRE with pass-through doors, CRE with roll-in doors, CRE with roll-through doors, and CRE with sliding doors to use a higher amount of energy use than the proposed standards, if the standard has been proposed to be amended for an equipment class, while also complying with EPCA's ''anti-backsliding'' provision. This proposal recognizes the unique utility and different energy use characteristics of certain types of CRE. DOE discusses these unique utility and different energy use characteristics in further detail in section IV.C.1.a.

DOE has also reviewed the current definitions for CRE at 10 CFR 431.62 and is proposing to revise the definition for ''rating temperature'' to update the reference to the required integrated average temperature (''IAT'') or lowest application product temperature (''LAPT''), as applicable, as follows:

Rating temperature means the integrated average temperature a unit must maintain during testing, as determined in accordance with section 2.1. or section 2.2. of appendix B to subpart C of part 431, as applicable.

DOE requests comment on the proposed definitions for ''cold-wall evaporator,'' ''forced-air evaporator,'' ''pass-through doors,'' ''roll-in door,'' ''roll-through doors,'' ''sliding door,'' and ''rating temperature.''

c. Equipment Class Modifications

In the June 2022 Preliminary TSD, DOE had initially determined that additional equipment classes may be appropriate to address certain CRE available on the market. Specifically, DOE initially determined to split several commercial refrigerator equipment classes and establish separate classes for high-temperature refrigerators. Also, DOE initially determined to establish standards for chef bases or griddle stands with operating temperatures of ≥32 °F or <32 °F (10 CFR 431.66(f) currently excludes chef bases or griddle stands from energy conservation standards). See chapter 3 of the June 2022 Preliminary TSD for additional details.

In the September 2023 Test Procedure Final Rule, DOE established and amended definitions and test procedures for high-temperature refrigerators, medium-temperature refrigerators, and chef bases or griddle stands. 88 FR 66152, 66154–66155. Specifically, DOE established definitions for ''high-temperature refrigerators'' and ''medium-temperature refrigerators,'' amended the definition for ''chef bases or griddle stands,'' and incorporated by reference AHRI Standard 1200–2023 (I–P), which provides a IAT of 55 °F ±2.0 °F for which high-temperature refrigerators may be tested. *Id.* DOE also established a definition for ''low-temperature freezers'' and amended the definition for ''ice-cream freezers.'' *Id.* The newly established and amended definitions in the test procedure final rule are as follows.

Chef base or griddle stand means commercial refrigeration equipment that has a maximum height of 32 inches, including any legs or casters, and that is designed and marketed for the express purpose of having a griddle or other cooking appliance placed on top of it that is capable of reaching temperatures hot enough to cook food.

High-temperature refrigerator means a commercial refrigerator that is not capable of an operating temperature at or below 40.0 °F.

Medium-temperature refrigerator means a commercial refrigerator that is capable of an operating temperature at or below 40.0 °F.

Ice-cream freezer means:

(1) Prior to the compliance date(s) of any amended energy conservation standard(s) issued after January 1, 2023 for ice-cream freezers, a commercial freezer that is capable of an operating temperature at or below −5.0 °F and that the manufacturer designs, markets, or intends specifically for the storing, displaying, or dispensing of ice cream or other frozen desserts; or

(2) Upon the compliance date(s) of any amended energy conservation standard(s) issued after January 1, 2023 for ice-cream freezers, a commercial freezer that is capable of an operating temperature at or below −13.0 °F and that the manufacturer designs, markets, or intends specifically for the storing, displaying, or dispensing of ice cream or other frozen desserts.

Low-temperature freezer means a commercial freezer that is not an ice-cream freezer.

88 FR 66152, 66223–66224.

Based on CRE models certified to DOE's Compliance Certification Management System (''CCMS'') under the LAPT designation for commercial refrigerators, DOE has tentatively determined that high-temperature refrigerators can be categorized under the self-contained and remote condensing unit configurations and under the vertical closed transparent (''VCT''), vertical closed solid (''VCS''), service over counter (''SOC''), vertical open (''VOP''), semi-vertical open (''SVO''), and horizontal open (''HZO'') equipment families. For these equipment families with high-temperature equipment, DOE proposes to sub-categorize them as high-temperature refrigerators (operating temperature greater than 40.0 °F) and medium-temperature refrigerators (operating temperature greater than or equal to 32.0 °F and less than or equal to 40.0 °F). DOE proposes to maintain the categorization of commercial refrigerator (operating temperature greater than or equal to 32.0 °F) for the remaining equipment families (*i.e.,* any horizontal closed transparent (''HCT''), horizontal closed solid (''HCS''), chef bases (''CB''), or pull-down (''PD'') equipment that operates above 40 °F, if commercialized, would be considered a ''commercial refrigerator'' and required to comply with the ''medium-temperature refrigerator'' standard when tested at the LAPT). For this NOPR, DOE has directly analyzed high temperature refrigerators in the self-contained condensing unit configuration for the VCT and VCS equipment families.

DOE has also tentatively determined that chef bases or griddle stands can be categorized under the self-contained condensing unit configuration and the ≥32 °F or <32 °F operating temperatures (*i.e.,* commercial refrigerator or low-temperature freezer, respectively).

Accordingly, DOE is considering potential equipment classes for high-temperature refrigerators and chef bases or griddle stands and is proposing potential equipment class structure modifications as presented in table IV.2.

TABLE IV.2—PROPOSED EQUIPMENT CLASSES AND EQUIPMENT CLASS MODIFICATIONS

Condensing unit configuration	Equipment family	Rating temperature **	Operating temperature (°F)	Equipment class designation
Self-Contained (SC)	Vertical Open (VOP)	HR (55 °F)	x >40	VOP.SC.H *
		MR (38 °F)	40 ≥ x ≥32	VOP.SC.M
		LF (0 °F)	x <32	VOP.SC.L
		IF (−15 °F)	x ≤−13	VOP.SC.I
	Semivertical Open (SVO)	HR (55 °F)	x >40	SVO.SC.H *
		MR (38 °F)	40 ≥ x ≥32	SVO.SC.M
		LF (0 °F)	x <32	SVO.SC.L
		IF (−15 °F)	x ≤−13	SVO.SC.I
	Horizontal Open (HZO)	HR (55 °F)	x >40	HZO.SC.H *
		MR (38 °F)	40 ≥ x ≥32	HZO.SC.M
		LF (0 °F)	x <32	HZO.SC.L
		IF (−15 °F)	x ≤−13	HZO.SC.I
	Vertical Closed Transparent (VCT)	HR (55 °F)	x >40	VCT.SC.H *
		MR (38 °F)	40 ≥ x ≥32	VCT.SC.M
		LF (0 °F)	x <32	VCT.SC.L
		IF (−15 °F)	x ≤−13	VCT.SC.I
	Vertical Closed Solid (VCS)	HR (55 °F)	x >40	VCS.SC.H *
		MR (38 °F)	40 ≥ x ≥32	VCS.SC.M
		LF (0 °F)	x <32	VCS.SC.L
		IF (−15 °F)	x ≤−13	VCS.SC.I
	Horizontal Closed Transparent (HCT)	CR (38 °F)	x ≥32	HCT.SC.M
		LF (0 °F)	x <32	HCT.SC.L
		IF (−15 °F)	x ≤−13	HCT.SC.I
	Horizontal Closed Solid (HCS)	CR (38 °F)	x ≥32	HCS.SC.M
		LF (0 °F)	x <32	HCS.SC.L
		IF (−15 °F)	x ≤−13	HCS.SC.I
	Service Over Counter (SOC)	HR (55 °F)	x >40	SOC.SC.H *
		MR (38 °F)	40 ≥ x ≥32	SOC.SC.M
		LF (0 °F)	x <32	SOC.SC.L
		IF (−15 °F)	x ≤−13	SOC.SC.I
	Pull-Down (PD)	CR (38 °F)	x ≥32	PD.SC.M
	Chef Base (CB)	CR (38 °F)	x ≥32	CB.SC.M *
		LF (0 °F)	x <32	CB.SC.L*
Remote Condensing (RC)	Vertical Open (VOP)	HR (55 °F)	x >40	VOP.RC.H *
		MR (38 °F)	40 ≥ x ≥32	VOP.RC.M
		LF (0 °F)	x <32	VOP.RC.L
		IF (−15 °F)	x ≤−13	VOP.RC.I
	Semivertical Open (SVO)	HR (55 °F)	x >40	SVO.RC.H *
		MR (38 °F)	40 ≥ x ≥32	SVO.RC.M
		LF (0 °F)	x <32	SVO.RC.L
		IF (−15 °F)	x ≤−13	SVO.RC.I
	Horizontal Open (HZO)	HR (55 °F)	x >40	HZO.RC.H *
		MR (38 °F)	40 ≥ x ≥32	HZO.RC.M
		LF (0 °F)	x <32	HZO.RC.L
		IF (−15 °F)	x ≤−13	HZO.RC.I
	Vertical Closed Transparent (VCT)	HR (55 °F)	x >40	VCT.RC.H *
		MR (38 °F)	40 ≥ x ≥32	VCT.RC.M
		LF (0 °F)	x <32	VCT.RC.L
		IF (−15 °F)	x ≤−13	VCT.RC.I
	Horizontal Closed Transparent (HCT)	CR (38 °F)	x ≥32	HCT.RC.M
		LF (0 °F)	x <32	HCT.RC.L
		IF (−15 °F)	x ≤−13	HCT.RC.I
	Vertical Closed Solid (VCS)	HR (55 °F)	x >40	VCS.RC.H *
		MR (38 °F)	40 ≥ x ≥32	VCS.RC.M
		LF (0 °F)	x <32	VCS.RC.L
		IF (−15 °F)	x ≤−13	VCS.RC.I
	Horizontal Closed Solid (HCS)	CR (38 °F)	x ≥32	HCS.RC.M
		LF (0 °F)	x <32	HCS.RC.L
		IF (−15 °F)	x ≤−13	HCS.RC.I
	Service Over Counter (SOC)	HR (55 °F)	x >40	SOC.RC.H *
		MR (38 °F)	40 ≥ x ≥32	SOC.RC.M
		LF (0 °F)	x <32	SOC.RC.L
		IF (−15 °F)	x ≤−13	SOC.RC.I
	Chef Base (CB)	CR (38 °F)	x ≥32	CB.RC.M *
		LF (0 °F)	x <32	CB.RC.L *

* Proposed new equipment class.

** HR—High-Temperature Refrigerator.
LF—Low Temperature Freezer.
MR—Medium-Temperature Refrigerator.
IF—Ice-Cream Freezer.
CR—Commercial Refrigerator.

DOE received several comments in response to the June 2022 Preliminary Analysis regarding the amendments to the equipment classes for CRE.

Equipment Classes With Newly Proposed Standards

NEEA supported DOE's proposed definitions in the June 2022 CRE Test Procedure NOPR for blast chillers and blast freezers, buffet tables and preparation tables, and high-temperature CRE, noting that these definitions allowed consideration of potential standards, categorization of equipment classes, and testing of the equipment separate from other CRE. (NEEA, No. 47 at p. 2)

The Joint Commenters supported DOE's consideration of potential standards for additional equipment categories. (Joint Commenters, No. 39 at p. 1) The Joint Commenters stated that DOE found cost-effective potential energy savings for chef bases/griddle stands and high-temperature refrigerators in the June 2022 Preliminary TSD and commented that they support DOE setting standards for these equipment classes. (*Id.*)

The CA IOUs commended DOE for proposing to expand the scope of the energy conservation standards for CRE to include chef bases or griddle stands and high-temperature refrigeration. (CA IOUs, No. 43 at p. 1) The CA IOUs stated that these added product classes constitute a significant inventory of equipment with a substantial cumulative energy load that were previously outside the scope of DOE's regulation. (*Id.* at pp. 1–2)

AHRI commented that it has no objection to the added equipment classes detailed in the June 2022 Preliminary TSD. (AHRI, No. 46 at p. 2) However, Continental recommended that DOE delay inclusion of any new categories until applicable industry standard test procedures are published and have been thoroughly evaluated. (Continental, No. 38 at p. 2)

DOE has proposed standards for new equipment classes (*e.g.,* chef bases, and high-temperature refrigerators) in this NOPR, as supported by commenters. And as described in the September 2023 Test Procedure Final Rule, DOE has incorporated by reference the latest versions of ASHRAE 72 and AHRI 1200, which were evaluated by each respective committee and subject to public reviews, in the CRE test procedure. 88 FR 66152. In addition, based on the September 2023 Test Procedure Final Rule, chef bases or griddle stands must be tested at a dry-bulb temperature of 86.0 °F and wet-bulb temperature of 73.7 °F. 88 FR 66152, 66203. Therefore, DOE has considered higher ambient temperature conditions in the analysis of chef bases or griddle stands compared to other CRE, which are tested at a dry-bulb temperature of 75.2 °F and wet-bulb temperature of 64.4 °F. See chapter 5 of the NOPR TSD for additional information.

Equipment Classes Without Proposed Standards

NEEA recommended that DOE analyze the new equipment classes and consider adopting efficiency standards that would better reflect the specific energy consumption of equipment subclasses, resulting in more significant energy savings. (NEEA, No. 47 at p. 4) NEEA commented that DOE had analyzed two of the four new product classes and, as was shown in the CRE June 2022 Preliminary TSD analysis, energy conservation standards were viable for high-temperature CRE and chef bases and griddle stands. (*Id.*) NEEA commented that for vertical closed transparent self-contained high temperature (''VCT.SC.H''), vertical closed solid self-contained high temperature (''VCS.SC.H''), and chef bases self-contained low temperature (''CB.SC.L''), the average life-cost savings ranged from $300–$500 at EL 3, presenting justification of the energy and cost savings for these equipment classes. (*Id.*) NEEA added that DOE should conduct similar analyses on blast chillers and buffet tables, citing DOE's test procedures for these classes as key to allowing data collection. (*Id.* at p. 4) NEEA commented that DOE's analysis of high-temperature refrigerators and chef bases indicated that additional significant savings would likely be available from these products. (*Id.*)

Similarly, the Joint Commenters commented that DOE stated DOE lacked sufficient information to fully analyze buffet/preparation tables and blast chillers/freezers in the June 2022 Preliminary TSD, but the Joint Commenters noted that the California Energy Commission (''CEC'') Modernized Appliance Efficiency Database System (''MAEDbS'') includes over 100 buffet/preparation tables with a broad range of energy usage. (Joint Commenters, No. 39 at p. 1) The Joint Commenters requested that DOE further investigate the energy usage and savings potential for these products. (*Id.*)

However, Continental agreed with DOE that a preliminary analysis of energy consumption for buffet tables and preparation tables is not appropriate until a standard test procedure is established for these equipment types. (Continental. No. 38 at p. 2).

Consistent with comments from NEEA and based on the new rating temperature in the September 2023 Test Procedure Final Rule for high-temperature refrigerators, DOE is proposing to amend the energy conservation standards for high-temperature refrigerators and to establish energy conservation standards for chef bases or griddle stands in this NOPR. See table IV.2.

With respect to the comments from NEEA and the Joint Commenters regarding blast chillers and blast freezers, DOE notes that it lacks sufficient data and information regarding blast chillers and blast freezer performance, and related design options, for units tested via the DOE test procedure. As stated in the September 2023 Test Procedure Final Rule, blast chillers and blast freezers are designed for ''rapid temperature pull-down'' capable of reducing the internal temperature from 135 °F to 40 °F within a period of 4 hours. 88 FR 66152, 66189. Therefore, in this NOPR, DOE is not currently able to model expected performance of this equipment because the established test procedure is significantly different from the test procedure applicable to other CRE categories, which are intended for ''holding temperature application''. Due to a lack of data and information regarding performance of blast chillers and blast freezers, DOE has not conducted an analysis of potential energy conservation standards for these equipment categories.

DOE requests comment on blast chiller or freezer design options, design specifications, and energy consumption data tested per the DOE test procedure located in appendix D of 10 CFR 431.64.

With respect to the comments from NEEA and the Joint Commenters regarding buffet tables and preparation tables, while DOE acknowledges that

CEC's MAEDbS database contains data for buffet/preparation tables, DOE notes that title 20 of the California Code of Regulations requires refrigerated buffet/preparation tables to follow the ANSI/ASTM F2143–01 test method.[29] This test method has been revised several times, with ASTM F2143–16 being the most recent version. In the September 2023 Test Procedure Final Rule, DOE stated that ASTM F2143–16 cannot be referenced as a standalone test method but determined the approach based on ASTM F2143–16 with additional requirements is representative for buffet/preparation tables. 88 FR 66152, 66175. Therefore, in this NOPR, DOE is not able to model expected performance of this equipment at this time because the established test procedure is significantly different from the test procedure applicable to other CRE categories, and from the test procedure used to measure energy consumption for the CEC's MAEDbS. Due to a lack of data and information regarding performance and related design options of refrigerated buffet/preparation tables, DOE has not conducted an analysis of potential energy conservation standards for these equipment categories.

DOE requests comment on refrigerated buffet/preparation table design options, design specifications, and energy consumption data tested per the DOE test procedure located in appendix C of 10 CFR 431.64.

Customer Order Storage Cabinets

The CA IOUs supported creating a separate equipment class for customer-order refrigerated storage lockers. (CA IOUs, No. 43 at p. 10) The CA IOUs commented that they expect the refrigerated storage locker market to increase as grocery delivery and pick up continues to be a growing segment of grocery sales. (*Id.*) The CA IOUs stated that they support aggregating the maximum daily energy consumption values for all compartments in a refrigerated storage locker according to 10 CFR 431.66(e)(2). (*Id.*) The CA IOUs also pointed out that ''temperature controlled pick up lockers'' can be refrigerated lockers; however, some of these models can be either refrigerated or heated or neither. (*Id.*)

The CA IOUs recommended that DOE analyze the individual refrigerator, freezer, and refrigerator/freezer compartments in customer-order refrigerated storage lockers as a separate equipment family as noted in the CA IOUs comments on DOE's July 2021 CRE Test Procedure RFI. (*Id.*) The CA IOUs highlighted the Traulsen waiver[30] to show that these compartments will have distinct door-opening conditions compared to the CRE equipment families. (*Id.*)

In response to the CA IOUs comments, DOE has not conducted an analysis specifically for customer order storage cabinets in this NOPR.[31] DOE has analyzed a representative volume for the VCS equipment families of which customer order storage cabinets are typically included. In the September 2023 Test Procedure Final Rule, DOE provides a discussion of customer order storage cabinets and determination to adopt a test procedure based on existing test procedure waivers. 88 FR 66152, 66211–66213.

Comments on Specific Equipment Classes

The Joint Commenters recommended that DOE analyze additional equipment classes and stated that DOE did not directly analyze the vertical closed solid remote condensing medium temperature (''VCS.RC.M''), vertical closed solid remote condensing low temperature (''VCS.RC.L''), horizontal closed transparent remote condensing medium temperature (''HCT.RC.M''), or horizontal closed transparent remote condensing low temperature (''HCT.RC.L'') equipment classes in the June 2022 Preliminary TSD. (Joint Commenters, No. 39 at p. 2) The Joint Commenters commented that the number of models for each of these classes in the CCD suggests their market share could be larger than the estimated volume of shipments for these classes in the analysis for the March 2014 Final Rule. (*Id.*) The Joint Commenters stated that there are nearly 500 VCS.RC.M models certified in the CCD, and there are more HCT.RC.M models in the CCD than horizontal closed transparent self-contained medium temperature (''HCT.SC.M''), an equipment class that was analyzed by DOE in the June 2022 Preliminary TSD. (*Id.*) The Joint Commenters commented that, based on these data, the market share of these equipment classes may be larger than estimated, and the Joint Commenters encouraged DOE to analyze these additional equipment classes. (*Id.*)

AHRI asked that DOE clarify whether DOE removed the vertical self-contained class from the June 2022 Preliminary TSD. (AHRI, No. 46 at p. 2) And Zero Zone commented that it did not see any evaluation of solid-door remote commercial refrigerators and inquired whether DOE is dropping that equipment class or has no plans to change the energy requirements. (Zero Zone, No. 44 at p. 5)

With respect to the comments from the Joint Commenters, AHRI, and Zero Zone, DOE notes that the equipment classes mentioned by the Joint Commenters were not directly analyzed as primary equipment classes in the June 2022 Preliminary Analysis, but are analyzed as secondary equipment classes in this NOPR using DOE's primary to secondary equipment class multipliers. See chapter 5 of the NOPR TSD for additional details on secondary equipment classes. Additionally, DOE notes that in the June 2022 Preliminary Analysis, DOE analyzed vertical closed solid, self contained equipment, as well as other vertical self-contained equipment (*e.g.,* vertical open self-contained medium temperature (''VOP.SC.M'') and vertical closed transparent self-contained medium temperature (''VCT.SC.M'')). See table 5.8.1 of the June 2022 Preliminary TSD for a full list of primary equipment classes DOE analyzed in the June 2022 Preliminary Analysis.

AHRI commented that breaking equipment classes into smaller (under 30 cubic feet) and larger units (over 30 cubic feet) could be beneficial. (AHRI, No. 46 at p. 7) Additionally, NAMA commented that DOE appeared to have overlooked or not fully recognized the existence of smaller refrigerated single- and double-door beverage (and food) coolers. (NAMA, No. 37 at p. 5) NAMA stated that energy efficiency analyses of larger (*e.g.,* 60 cubic feet) units may not be applicable to smaller (*e.g.,* 24 cubic feet) units. (*Id.*) NAMA recommended that, for purposes of DOE analysis, units under 30 cubic feet should be considered differently from those over 30 cubic feet in refrigerated volume. (*Id.*)

In response to the June 2021 Test Procedure RFI, True Manufacturing Company, Inc. (''True'') commented that there are examples where the ice-cream freezer maximum allowable energy consumption is less than for an equivalent commercial freezer.[32] (Docket No. EERE–2017–BT–TP–0008,

[29] See table A–1 in 20 CCR section 1604.a.2 located at *https://govt.westlaw.com/calregs/Document/ID5812C41DABD11ED852BC9A091C0DD8F?viewType=FullText&originationContext=documenttoc&transitionType=CategoryPageItem&contextData=(sc.Default).*

[30] CA IOUs provided the footnote reference 83 FR 46148 for the granted waiver.

[31] DOE defines customer order storage cabinet at § 431.62 to mean a commercial refrigerator, freezer, or refrigerator-freezer that stores customer orders and includes individual, secured compartments with doors that are accessible to customers for order retrieval.

[32] *See www.regulations.gov/comment/EERE-2017-BT-TP-0008-0004.*

True, No. 4 at p. 3) True provided three examples of common VCT.SC.L CREs found in the marketplace where the maximum DOE energy allowance for the ice-cream freezer is less than that of the equivalent commercial freezer. (*Id.*) True also commented that when comparing the VCS.SC.I and VCS.SC.L formulas, for cabinets with a volume of 4 cubic feet or less, the energy use allowance for the ice-cream freezer is less than for the equivalent commercial freezer. (*Id.*)

Additionally, in response to the July 2021 RFI, Glastender, Inc. (''Glastender'') provided a chart and commented that the energy allowance for VCT.SC.M CRE is less than the energy allowance for VCS.SC.M CRE when the refrigerated volume is less than 10 cubic feet. (Glastender, No. 4 at p. 1). Glastender commented that it believed the requirement curves were generated from primarily larger volume models and smaller volume refrigerators need to be considered when generating new curves. (*Id.*)

In response to comments from AHRI and NAMA, DOE is maintaining the current equipment class structure in this NOPR, except for the new equipment classes which are proposed and discussed in section IV.A.1.c of this document. DOE considers all volumes and TDAs when developing the proposed standards in this NOPR in addition to the representative volume or TDA for each directly analyzed equipment class. Based on market research and feedback received during manufacturer interviews, DOE expects the use of sliding and pass-through doors represent equipment utilities that have unique energy use characteristics that differentiate CRE in the VCT.SC.M equipment class and that beverage coolers are a common type of equipment in the VCT.SC.M equipment class that use sliding and pass-through doors. Therefore, based on market research and feedback received during manufacturer interviews, DOE has proposed separate energy use equations based on an energy consumption multiplier for CRE with sliding and pass-through doors.

In response to comments from AHRI, NAMA, True, and Glastender, DOE considered all volumes and TDAs when developing the proposed standards in this NOPR in addition to the representative volume or TDA for each directly analyzed equipment class. When developing the proposed standards in this NOPR, DOE generally applied the energy use reduction percentage selected in section V.C of this document to the baseline energy use equation's slope and intercept. However, in three directly analyzed equipment classes, VCT.SC.M, VCS.SC.I, and HCT.SC.I, DOE has tentatively determined that, based on the efficiency distribution of the market across the equipment classes, additional consideration is necessary. For these three classes, DOE maintained the current standard equation intercept and calculated a slope based on the current intercept and the proposed energy use level at the representative volume or TDA. This approach addresses the standard line crossover that True and Glastender mentioned in their comments and better represents the energy use characteristics of CRE at volumes and TDAs that are smaller than the representative volume or TDA for these three classes. Additionally, DOE reviewed the proposed standard for VCT.SC.I and VCT.SC.L and observed that the standard lines do not have the crossover that True mentioned in its comment.

See section IV.C.1 of this document and chapter 5 of the NOPR TSD for additional details.

The Joint Commenters recommended that DOE eliminate the equipment class for pull-down CREs. (Joint Commenters, No. 39 at p. 2) The Joint Commenters stated that while there are currently no pull-down models certified in DOE's CCD, the Joint Commenters are concerned that models could be certified as pull-down CRE in the future in order to be subject to a less-stringent standard. (*Id.*)

In response to the Joint Commenters, DOE notes that the ''pull-down temperature application'' is defined in 42 U.S.C. 6311(9)(d) and the equipment class was established by the Energy Policy Act of 2005 (Pub. L. 109–58).[33] In the September 2023 Test Procedure Final Rule, DOE established verification provisions for pull-down temperature applications based on the EPCA definition, which are intended to ensure CRE are certified correctly as pull-down temperature applications. 88 FR 66152, 66187–66189. Therefore, DOE is not proposing to eliminate the equipment class for pull-down CREs in this NOPR.

Equipment Rating

The CA IOUs recommended changing the key metric for service over the counter (''SOC'') refrigeration from total display area (''TDA'') to either refrigerated volume or refrigerated floor area. (CA IOUs, No. 43 at pp. 9–10). The CA IOUs commented that the current energy conservation standard for SOC is based on TDA, which incentivizes the use of more glass to increase the TDA and the corresponding maximum daily energy consumption. (*Id.* at p. 9) The CA IOUs stated that basing the energy conservation standard for SOC equipment on refrigerated volume would ensure that any increases in an SOC unit's maximum allowable energy consumption is directly linked to an increase in the equipment's useful holding capacity. (*Id.*) The CA IOUs commented that this change would ensure that manufacturers wanting to increase TDA would be incentivized to use glass with better thermal insulation properties. (*Id.*) The CA IOUs commented also that switching to a refrigerated volume metric would also be more consistent with other closed refrigeration categories with display functionality, such as refrigerators with glass doors. (*Id.*) The CA IOUs stated that the burden of shifting to refrigerated volume as a metric could be minimized by allowing either physical measurement or measurement based on a diagram or computer-aided design (''CAD'') drawing. (*Id.* at p. 10) The CA IOUs added that an alternative metric for deli cases without shelving could also be refrigerated floor area, which would be the available surface area for product, although the CA IOUs noted that most SOC refrigerators are sold with shelving that can be added or removed depending on food product being displayed. (*Id.*)

However, in response to the July 2021 RFI, other commenters indicated that TDA is the appropriate metric for the respective equipment classes, and the industry has adapted to the use of TDA or volume and that no change is necessary (see chapter 2 of the June 2022 Preliminary TSD for additional information). Therefore, in this NOPR, DOE has not evaluated revising the capacity metrics for any equipment classes.

The CA IOUs commented that they support the proposal to rate equipment capable of operating at temperatures of multiple equipment classes at all relevant temperature conditions. (CA IOUs, No. 43 at p. 8–9)

Consistent with the CA IOUs comment, in the September 2023 Test Procedure Final Rule, DOE specified in 10 CFR 429.42 that basic models of CRE that operate in multiple equipment classes must be certified and comply with the energy conservation standards for each applicable equipment class. 88 FR 66152, 66162.

2. CRE Market

In response to the June 2022 Preliminary Analysis, DOE received

[33] *See* 119 STAT. 639 at *https://www.govinfo.gov/content/pkg/PLAW-109publ58/pdf/PLAW-109publ58.pdf.*

several comments regarding the CRE market.

NAMA commented that it was not listed in the proposed regulation or list of manufacturers. (NAMA, No. 37 at p. 4) NAMA added that the names of CRE manufacturers represented by NAMA, which were filed in the DOE's CCMS, were not mentioned. (*Id.*)

In response to this comment from NAMA, for this NOPR, DOE updated its assessment of manufacturer trade groups to include NAMA and reviewed the list of CRE manufacturers based on the list of supporters on NAMA's website.[34] See chapter 3 of the NOPR TSD for additional information regarding CRE original equipment manufacturers (''OEMs'') and manufacturer trade groups.

Continental commented that relying on manufacturer model counts in the CCD is not an accurate way of approximating company market share and stated that model counts in DOE's CCD reflect the variety of models offered, but do not represent the sales or market share of a company. (Continental, No. 38, p. 2)

In the June 2022 Preliminary TSD, DOE used manufacturer model counts to identify key CRE OEMs operating in the United States. DOE presented an abridged list of OEMs with more than 1-percent share of basic model listings in chapter 3 of the June 2022 Preliminary TSD. DOE understands that model counts do not reflect company market shares. For this NOPR, DOE conducted confidential manufacturer interviews. During these interviews, DOE asked manufacturers about their estimated CRE market share, annual shipments by equipment class, and the estimated market shares of other CRE manufacturers. DOE used the information from confidential interviews, data from the shipments analysis, and model listings from CCD to estimate manufacturer market shares, which were then used to weight certain inputs used in the MIA (*e.g.,* industry financial parameters, manufacturer markups). DOE does not present these company-specific market share estimates in the NOPR TSD chapter 3 as the information is protected under nondisclosure agreements (''NDAs''). See chapter 3 of the NOPR TSD for additional details on the CRE market and manufacturers.

DOE requests comment on publicly available market data on CRE manufacturers or identification of any CRE manufacturers with large market shares not identified in Chapter 3 of the NOPR TSD.

[34] DOE reviewed the ''2022 Annual Dues Donors'' accessible at *namanow.org/foundation/supporters/* to identify members of NAMA (last accessed March 31, 2023).

3. Technology Options

In the preliminary market analysis and technology assessment, DOE identified technology options that would be expected to improve the efficiency of CRE, as measured by the DOE test procedure and shown in table IV.3.

TABLE IV.3—TECHNOLOGY OPTIONS FOR CRE

Insulation:
Improved resistivity of insulation (insulation type).
Increased insulation thickness.
Vacuum-insulated panels.
Lighting:
Higher-efficiency lighting.
Occupancy Sensors.
Improved transparent doors: *
Low-emissivity coatings.*
Inert gas fill.*
Vacuum-insulated glass.*
Additional panes.*
Anti-sweat heater controls.*
Anti-fog films.*
Frame design.*
Compressor.**
Improved compressor efficiency.**
Alternative refrigerants.**
Variable-speed compressors.**
Linear compressors.**
Evaporator:
Increased surface area.
Improved evaporator coil design.
Low-pressure differential evaporator.
Condenser: **
Increased surface area.**
Tube-and-fin enhancements.**
Microchannel heat exchanger.**
Fans and fan motors:
Evaporator fan motors.
Evaporator fan blades.
Evaporator fan controls.
Condenser fan motors.**
Condenser fan blades.**
Condenser fan controls.**
Other technologies:
Defrost systems.
Expansion valve improvements.
Air curtain design.***
Night curtains.***
Liquid suction heat exchanger.**

* Only applies to equipment classes with doors.
** Only applies to self-contained equipment classes.
*** Only applies to equipment classes without doors (open equipment classes).

DOE received several comments in response to the June 2022 Preliminary Analysis regarding the technology options.

a. Compressors

NEEA referred to its previous comment to the July 2021 RFI that DOE consider the energy-use impact of compressor technologies like scroll compressors and variable-speed compressors. (NEEA No. 47 at pp. 4–5) NEEA commented that DOE had expressed agreement with NEEA in the June 2022 Preliminary TSD that variable-speed compressors represented an energy-saving technology and estimated that implementing variable-speed compressors could save 3–38 percent of energy consumption, depending on equipment class. (*Id.* at p. 4) NEEA pointed out that DOE had not tested a model with a variable-speed compressor and encouraged DOE to further research the energy-savings potential of variable-speed compressors in CRE. (*Id.*) NEEA commented that, in the June 2022 Preliminary TSD Table 5.5.1,[35] DOE noted propane variable-speed compressors as a design option for a majority of CRE equipment classes. (*Id.*) NEEA encouraged DOE to collect data and consider other equipment classes that could utilize variable-speed compressors to improve the energy-savings potential and common use of this technology option. (*Id.* at pp. 4–5)

Consistent with the preliminary analysis, DOE has included R–290 variable-speed compressors as a technology option in this NOPR. Due to the refrigerant transition in response to the December 2022 EPA NOPR, DOE has analyzed R–290 compressors (single and variable speed) for all self-contained equipment classes. See section IV.C.1 of this document and chapter 5 of the NOPR TSD for additional details on the refrigerant transition and analyzed compressors. Additionally, scroll compressors have not been included as a design option in this NOPR. While DOE has not observed scroll compressors in any directly analyzed models, DOE is aware that scroll compressors may be used on very large, self-contained CRE. Based on market research, DOE observed that fixed-speed scroll compressors have similar efficiencies to hermetic, reciprocating compressors; therefore, DOE has not considered scroll compressors in this analysis.

Continental commented that variable-speed compressors hold promise for reducing energy consumption of self-contained CRE, but the increased technical complexity and related increases in material and service costs have thus far limited use of this technology. (Continental, No. 38 at p. 2) Similarly, AHRI commented that variable-speed compressors do not

[35] Technical Support Document: Commercial Refrigeration Equipment: Table 5.5.1 Design Options by Equipment. Class. PreTSD CRE 2022. June 2022. *https://www.regulations.gov/document/EERE-2017-BT-STD-0007-0013.*

contribute significantly to energy savings in specific products and present additional technical challenges for servicers. (AHRI, No. 46 at p. 5) Further, AHRI commented that DOE should not assume that equipment employing variable-speed compressors will automatically have an energy-efficiency increase of 15–20 percent and that this design option is more complex and requires more careful analysis. (*Id.*)

To estimate the performance impacts of transitioning to a variable-speed compressor, DOE incorporated the performance data for variable-speed R–290 compressors currently available on the market into DOE's engineering spreadsheet. DOE assumed that variable-speed compressors would operate at the minimum speed under steady-state operation. DOE also assumed that the fan motors would operate during the compressor run time (*i.e.,* the fan motor operating duration would likely increase compared to a single-speed compressor). Overall, DOE estimated a 0.5–25 percent energy consumption reduction when implementing variable-speed compressors, with savings varying depending on equipment class. See chapters 3 and 5 of the NOPR TSD for additional details on variable speed compressors.

b. R–290

NAMA stated that it began evaluating the changes necessary for CRE to utilize lower GWP refrigerants, such as R–290, in 2018, and NAMA pointed out that the ASHRAE 15 standard was changed in the summer of 2020 to allow CRE using up to 114 grams of A–3 refrigerants to be placed in public places and that CRE with A–3 refrigerants began to appear in the U.S. market in the first quarter of 2021. (NAMA, No. 37 at p. 6) NAMA stated that manufacturers had to re-design heat exchangers, use new compressors and expansion valves, and make all switches, electrical components, motors, wiring, connectors, and larger electrical components (*e.g.,* compressors) compliant with ''spark-proof connections'' to manufacture machines using A–3 refrigerant. (*Id.* at pp. 6–7) NAMA commented that the June 2022 Preliminary TSD did not adequately address this level of re-design using expensive components, nor the re-design of factories to comply with health and safety regulations through greater ventilation, safety sensors, and other measures. (*Id.* at p.7) NAMA noted that every model, product line, quality assurance facility, factory, warehouse, and service center must be updated to install, warehouse, and service units with R–290 refrigerant, and only a handful of State and local building codes have been updated to accommodate these changes. (*Id.*) NAMA stated that significant work remains to be done in finalizing these codes, and they are unlikely to be complete before 2026. (*Id.*) NAMA commented that DOE did not address this transition in the June 2022 Preliminary TSD. (*Id.*)

Similarly, AHRI commented that the June 2022 Preliminary TSD cited an example of a transition from an R–134a (ASHRAE Class A1) to an R–290 (propane or an ASHRAE Class A3) compressor as the only required change, but AHRI added that compressors, switches, and other components in the system must also be upgraded to comply with UL60335–2–89 requirements to reduce the risk of ignition. (AHRI, No. 46 at p. 13)

The CA IOUs noted that their comments to the July 2021 RFI stated that since energy conservation standards were last analyzed, the market has developed higher-efficiency compressors, and self-contained CRE has increasingly shifted to R–290. (CA IOUs, No. 43 at pp. 4–6) While the CA IOUs thanked DOE for analyzing these technology advances, they noted that the June 2022 Preliminary TSD analyzes the refrigerant propane as a technology option for nearly all self-contained refrigeration categories except for vertical open self-contained medium temperature (''VOP.SC.M''), semi-vertical self-contained medium temperature (''SVO.SC.M''), and horizontal glass self-contained ice cream (''HCT.SC.I'') categories. (*Id.* at pp. 4–5) The CA IOUs stated that propane had already become an industry standard for self-contained refrigeration equipment, and the CA IOUs recommended considering it as a baseline refrigerant for all self-contained refrigeration categories. (*Id.* at p. 5) The CA IOUs further commented that the June 2022 Preliminary TSD excludes variable-speed compressors as a technology option for almost all categories where it does not consider propane as an option. (*Id.*) The CA IOUs commented that variable-speed compressors can use any refrigerant and are not limited to propane. (*Id.*) The CA IOUs stated that the current market availability of variable-speed compressors that use refrigerants other than propane is limited to compressors above 1 horsepower, and the CA IOUs recommended that DOE work with manufacturer stakeholders to determine future market availability of variable-speed compressors for all refrigerants. (*Id.* at pp. 5–6)

NEEA stated support for DOE's consideration of propane refrigerants as an energy-saving technology option in the technology assessment and engineering analysis for CRE, but NEEA noted that table 5.5.18 in the June 2022 Preliminary TSD showed that DOE had not considered propane as an option for all CRE equipment classes. (NEEA, No. 47 at p. 4) NEEA commented that CRE refrigerants are transitioning from hydrofluorocarbons (''HFC'') refrigerants to alternative options like propane (R–290) and NEEA anticipated an increase in the use of propane in other equipment classes. (*Id.*) NEEA recommended that DOE ensure its analysis take into consideration the current availability of propane products in the product classes not currently considered by DOE as a design option (*e.g.,* VOP.SC.M and SVO.SC.M). (*Id.*) NEEA further recommended DOE anticipate that more products would likely become available with propane refrigerants if the charge limit (currently 150 grams under the EPA's Significant New Alternatives Policy (''SNAP'')) for propane were to increase, as allowed in ASHRAE 15–2022. (*Id.*)

Similarly, the Joint Commenters commented that DOE excluded propane compressors as a design option for some equipment classes due to propane charge limits, but the Joint Commenters further commented that ASHRAE 15 is proposing to increase the charge limits for higher-flammability refrigerants. (Joint Commenters, No. 39 at p. 2) Additionally, the Joint Commenters stated that models are available on the market in some of the equipment classes for which DOE excluded propane technology options, including the VOP.SC.M, SVO.SC.M, and HCT.SC.I categories. (*Id.* at pp. 2–3) The Joint Commenters recommended that DOE consider propane refrigerant for these additional equipment classes. (*Id.* at p. 3)

In the June 2022 Preliminary Analysis, DOE considered only CRE that could meet the 150-gram charge limit for R–290, per the EPA's SNAP regulations.[36] Based on the December 2022 EPA NOPR's proposed GWP limits, DOE anticipates EPA will harmonize with UL 60335–2–89 and allow R–290 charge limits of 304g for closed CRE and 494g for open CRE. Therefore, DOE has updated its engineering analysis in the NOPR to analyze R–290 compressors as a technology option for all self-contained CRE. See section IV.C.1 of this

[36] See *https://www.govinfo.gov/content/pkg/FR-2015-04-10/pdf/2015-07895.pdf.*

document and chapter 5 of the NOPR TSD for additional information.

Additionally, based on information gathered from interviews, component data, and teardowns, DOE has reevaluated the cost associated with the switch to R–290 on self-contained units. Because DOE has analyzed R–290 as the baseline for all self-contained classes in response to the December 2022 EPA NOPR, the costs associated with additional components necessary to comply with safety standards for R–290 are incorporated into the core case cost.[37] See the engineering analysis in section IV.C.1 of this document for more detail on the refrigerant transition.

c. Insulation

AHT commented that the combination of an additional half inch of insulation and vacuum-insulated panels (''VIPs'') does not make sense and should not be included as two cumulative potential savings. (AHT, No. 48 at p. 6)

Based on feedback from manufacturers, DOE has not analyzed increased insulation thickness or VIPs as a design option in this NOPR. See section IV.B.1 of this document and chapters 3 and 4 of the NOPR TSD for additional information.

ITW commented that, in terms of improved resistivity of insulation, some manufacturers have introduced new hydrofluorolefin (''HFO'') low-GWP blowing agents with claims of improved efficiencies and thermal resistivities from 2 to 11 percent compared to the previous typical HFC–245fa blowing agents and that DOE expected that manufacturers had already incorporated these new agents into models currently available on the market. (ITW, No. 41 at p. 25) ITW commented that, in fact, such claims for HFOs were ''marketing hype'' and without much promised improvement in thermal performance. (*Id.*)

Regarding ITW's comment on foam blowing agents, DOE calibrated its engineering analysis based on directly analyzed units, and, therefore, DOE expects that the analysis represents the foam blowing agents currently in use for units available on the market.

d. Doors

AHT commented that the best design option to save energy for open CRE is to add transparent doors. (AHT, No. 48 at p. 1) AHT noted that the existing equipment class definitions and corresponding energy conservation standards permit manufacturers that cannot reach the energy limits for closed transparent units to remove the transparent doors, which would then require compliance with the increased energy limits of open units. (*Id.*)

AHRI commented that efficient doors are generally used today, but there remain instances where charge sizes are insufficient and may only be allowed to be increased sufficiently if doors are not present on equipment. (AHRI, No. 46 at p. 13)

Zero Zone commented that a commenter referenced Zero Zone marketing literature for customer preference on certain types of cases with doors in section 2.3.2.5 of the June 2022 Preliminary TSD. (Zero Zone, No 44 at p. 5). Zero Zone stated that an interview with two grocers is not an exhaustive industry study and also noted that, since that marketing literature was published, Zero Zone has developed an open-case product line. (*Id.*)

With respect to the comment from AHT, AHRI, and Zero Zone, DOE notes that open cases provide distinct utility with respect to features such as unobstructed view and access to product, as well as simplified stocking, cleaning, and maintenance. While DOE understands there are different charge size limitations for refrigerant safety for open and closed CRE, DOE has tentatively determined to not analyze the addition of doors to open cases or the removal of doors on closed cases due to the distinct utility differences between open and closed CRE.

e. Evaporators and Condensers

Continental commented that larger evaporator coils take up more internal space, reducing product storage and utility of the equipment. (Continental, No. 38 at p. 2)

Zero Zone disagreed with DOE's evaluation of the high-performance coil. (Zero Zone, No. 44 at p. 4) Zero Zone commented that using wavy fins without changing the fin pitch in an application with high-glide refrigerants can lead to a build up of frost and ice across the evaporator coil. (*Id.*) Zero Zone commented additionally that adding another tube row transverse to airflow without a change to the physical dimensions of the coil will compact the tubes, impeding airflow and causing the accumulation of frost and snow. (*Id.*) Zero Zone stated that it does not believe the addition of either of these design changes to an evaporator coil would create a ''high-performance'' coil. (*Id.*) Zero Zone commented that if coil design allowed for an increased evaporator temperature, a superheat setting at a value that avoids liquid carryover and compressor damage would be very difficult. (*Id.*) Zero Zone provided a white paper called ''High-glide Refrigerants: What's the Point?'' to describe the challenges with superheat settings in door cases. (*Id.*)

Based on feedback from manufacturer interviews and commenters, DOE has not considered increased evaporator or condenser sizes in this NOPR. DOE has tentatively determined that manufacturers have maximized the heat exchanger size without reducing internal storage or increasing the external dimensions of the unit, both of which would impact product utility. In addition, due to refrigerant transition in response to the December 2022 EPA NOPR, DOE has analyzed refrigerants with charge size limitations in this NOPR. Because manufacturers have only partially converted to refrigerants that would be allowed per the December 2022 EPA NOPR, there is still uncertainty in refrigerant charge size, and therefore the evaporator and condenser design, required for all sizes of CRE.

In the June 2022 Preliminary Analysis, DOE analyzed ''baseline'' and ''high efficiency'' evaporator and condenser design options. While DOE understands the exact characteristics of the evaporator or condenser may change depending on equipment class, the evaporator and condenser design options normalize the overall conductance-area (''UA'') based on the design load. Based on stakeholder comments, interviews with manufacturers, and CoilDesigner[38] simulation, DOE tentatively determined that the ''high efficiency'' evaporator and condenser design options are representative of current manufacturer designs. Therefore, DOE tentatively determined to analyze the ''high efficiency'' evaporator and condenser coil as ''baseline'' in this NOPR and remove the ''high efficiency'' evaporator and condenser design options in the NOPR. See chapters 3 and 5 of the TSD for additional details.

Zero Zone commented that it believes one CRE manufacturer holds a patent on split-circuit evaporators. (Zero Zone, No. 44 at p. 5) Zero Zone stated that

[37] The ''core case'' consists of components, such as structural members, shelving, wiring, air curtain grilles, and trim, that do not change at higher design option levels. To develop the core case cost, DOE dismantled units available on the market component-by component to develop a bill of materials and cost model for the core of the refrigerated case. The core case cost is just one component of the overall baseline cost, which takes into account all manufacturer production costs associated with baseline equipment. Therefore, changes in CRE case design due to the transition to R–290are accounted for in the core case and design option manufacturer production costs.

[38] *See https://ots-rd.com/software-development/ for further information on the CoilDesigner software.*

DOE suggested manufacturers use this product with propane even though DOE does not include patented design options in rulemakings. (*Id.*) Zero Zone commented that DOE should plan energy levels around the use of A2L refrigerants in large, self-contained appliances instead of focusing on propane. (*Id.*)

Based on a limited review of patents listed for split-circuit evaporators, DOE was able to find several patents for dual circuit evaporators, which are all either expired or abandoned.[39] Zero Zone did not specify what is meant by ''split-circuit evaporators,'' and DOE was unable to locate any patent that would impact CRE manufacturer's ability to use evaporators with multiple circuits. Additionally, Zero Zone did not specify the manufacturer that it believes holds a patent on split-circuit evaporators. As such, DOE has tentatively determined that each manufacturer's design is unique and would not infringe on active patents and notes that even if there is an intellectual property claim on a specific split-circuit design, manufacturers could use a multiple circuit design with multiple evaporators without necessarily using split-circuit evaporators.

f. Fan Motors

Zero Zone commented that it already uses electronically commutated motors (''ECM'') fan motors to meet the current energy standard and stated that it believes most of industry is also using this style of motor. (Zero Zone, No. 44 at p. 5) Zero Zone requested that DOE include the ECM motor in the base model. (*Id.*) Zero Zone stated that the opening height for this type of product has a disproportional impact on energy consumption because larger opening heights disproportionally increase energy use. (*Id.*) Zero Zone commented that DOE's models account for this characteristic. (*Id.*)

DOE has maintained fan motor improvements as a technology option in this NOPR. As indicated by Zero Zone, DOE has observed that ECM fan motors are incorporated to a large extent in CRE. While DOE has observed ECMs incorporated in baseline equipment for multiple analyzed equipment classes, DOE has tentatively determined that certain baseline equipment still incorporates other less-efficient motor types. For these classes, DOE has maintained a transition to ECMs as a design option change. DOE has also updated its motor costs relative to the June 2022 Preliminary Analysis in this analysis to reflect current pricing. See chapter 3 and 5 of the NOPR TSD for additional details.

Zero Zone commented that DOE suggested using permanent magnet synchronous motors for CRE. (Zero Zone, No. 44 at p. 6) Zero Zone noted that the study DOE references was completed in 2019, and the motors have not permeated the market since that time. (*Id.*) Zero Zone stated that the motors of such fans operate at 1800 RPM, creating unacceptable fan noise, and although its fan suppliers are aware of this technology, they do not recommend this style of motor for use in CRE. (*Id.*) Zero Zone recommended screening permanent magnet synchronous motors from use in CRE. (*Id.*)

In response to Zero Zone, DOE has observed that permanent magnet synchronous motors are available on the market for CRE. However, DOE has not identified specific commercialized designs of permanent magnet synchronous motors with the appropriate size and rated airflow for the equipment analyzed in this NOPR. Based on these observations along with further discussions with manufacturers, DOE has not considered permanent magnet synchronous motors as a design option in this NOPR, as discussed further in section IV.C.1 of this document and chapter 5 of the NOPR TSD.

g. Defrost

Continental commented that, to its knowledge, variable defrost controls have not proven to reduce energy consumption in CRE. (Continental, No. 38 at p. 2)

Zero Zone commented that variable defrost is an unreliable option that results in lost food product and therefore a monetary impact when it does not operate as intended. (Zero Zone, No. 44 at p. 4) Zero Zone commented that the potential energy savings of variable defrost are outweighed by the potential loss of product. (*Id.*)

While DOE considered variable defrost as a design option in the preliminary analysis, DOE has tentatively determined to not consider this design option in the NOPR. For further discussion, see section IV.C.1.b of this document and chapter 5 of the NOPR TSD.

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.

(*See* 10 CFR 431.4; sections 6(b)(3) and 7(b) of the Process Rule).

In summary, 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 comments from interested parties pertinent to the screening criteria, 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.

DOE received the following comments in response to the June 2022 Preliminary Analysis regarding the screening analysis.

ITW listed six design options that ITW stated sounded good but proved problematic: variable-speed

[39] *See https://patents.google.com/patent/US3537274; https://patents.google.com/patent/US3866439A/en; https://patents.google.com/patent/US20120137724A1/en.*

compressors that force other components to run; synchronous-reluctance fan motors with performance that does not match CRE applications; enhanced-UA condenser or evaporator coils that increase energy consumption; microchannel condenser coils that cannot be cleaned; additional one-half-inch insulation that adds cost but not value; and vacuum-insulated panels that prove too fragile for CRE. (ITW, No. 41 at pp. 34–35)

AHRI provided feedback on Table 4.3.1 ''Retained Design Options,'' stating that improved transparent doors; higher efficiency lighting; ECM motors; evaporator and condenser fans, motors, blades and controls (closed self-contained cases); compressors; and variable-speed compressor horizontal closed transparent self-contained ice cream freezer (''HCT.SCI'') (specific to some specific smaller self-contained equipment) were already in use to meet the current standard. (AHRI, No. 46 at p. 15) AHRI stated vacuum-insulated glass (''VIG'') was not economically viable. (*Id.*) AHRI stated thicker insulation, synchronous-speed motors, and larger evaporators (due to space constraints) had reduced utility. (*Id.*) AHRI stated vacuum-insulated panels (prone to puncture, cannot be repaired), microchannel condensers (leak and plug during operation), evaporator and condenser fans, motors, blades, and controls (open cases), high-tech defrost fans (do not necessarily save energy and are unreliable), variable-defrost systems (do not reduce energy consumption), expansion valves, and larger evaporators (limitations due to flammable refrigerants) are not technically viable. (*Id.*) AHRI noted that in previous comments to DOE these options were considered to be max-tech, but, after further consultation with members, AHRI found them to be not technically viable design options. (*Id.*) AHRI stated that antisweat controls and night curtains, and occupancy sensors had a limited market. (*Id.*) And AHRI concluded that variable speed compressors (specific to some smaller, self-contained equipment—already used in some equipment) were a viable design option. (*Id.*)

Zero Zone commented that vacuum-insulated glass is not a viable design option. (Zero Zone, No. 44 at p. 6) Zero Zone stated that its door supplier reported that the one vacuum-insulated glass supplier in the United States no longer offers the product because its high cost prevented customers from using it. (*Id.*)

NAMA commented that several of the design options shown in the June 2022 Preliminary TSD could reduce the overall machine capacity, such as larger condensers or evaporators, more insulation, and changes to the type of glass that require new structural components. (NAMA, No. 37 at p. 15) NAMA commented that the external dimensions of a CRE appliance are limited by the height of breakrooms and built-in areas, and the width and length are limited by the machine's integration with other machines with which CRE are paired. (*Id.*) NAMA commented that the June 2022 Preliminary TSD did not address the resultant change in utility or performance caused by a reduction in overall capacity. (*Id.*) NAMA stated that smaller capacity resulted in customers opening the door for longer periods of time and necessitated more frequent re-stocking, making the appliance more difficult for business owners to operate. (*Id.*)

NAMA also commented that several of the design options suggested by DOE (*e.g.,* lower-wattage refrigeration systems, vacuum-panel insulation, different evaporators or condensers, and lower-wattage fan motors) could affect the overall performance of the machine. (*Id.*) NAMA stated that overall performance of CRE is critical and can be significantly affected by a difference of 1 degree Celsius. (*Id.*) NAMA requested that DOE review the design options for energy efficiency and also their ability to maintain critical design features and performance. (*Id.*)

Based on these comments, DOE has tentatively determined to screen out two technology options mentioned by commenters, increased insulation thickness and vacuum-insulated panels, which are discussed in more detail in section IV.B.1 of this document.

However, DOE disagrees with commenters that permanent magnet synchronous motors meet the criteria of ''impacts on product utility'' because, although the permanent magnet synchronous motors currently available on the market are not optimized for size and rated airflow of CRE,[40] there is not a significant adverse impact on the utility of the product. DOE also disagrees with commenters that increased evaporator or condenser surface areas meet the criteria of ''impacts on product utility'' because there is not a significant adverse impact on the utility of the product unless the increased evaporator or condenser requires a reduction in the overall CRE capacity. DOE notes that it did not consider any technology options that reduce the overall CRE capacity, consistent with the criteria ''impacts on product utility.''

DOE also disagrees with commenters that microchannel condensers, evaporator fan controls, variable defrost systems, expansion valve improvements, and increased evaporator surface area meet the criteria of ''technological feasibility.'' Microchannel heat exchangers are often used in the automobile industry, and the stationary air conditioning and refrigeration markets have seen recent increases in implementation of microchannel heat exchangers. As noted by commenters and based on feedback during manufacturer interviews, DOE only considered evaporator fan controls as a design option on closed self-contained CRE equipment classes. DOE notes that the amount of energy saved for each design option is not a criterion for the screening analysis and is discussed in the engineering analysis. For increased evaporator surface area, DOE considered the limitations due to flammable refrigerants (*e.g.,* R–290) consistent with industry safety standards as discussed in section IV.C.1.a of this document.

Additionally, DOE disagrees with commenters that vacuum-insulated glass is not a viable design option. DOE is aware of vacuum-insulated glass door suppliers outside of the United States and notes that that ''not economically viable'' is not one of the screening criteria specified in the Process Rule. DOE considered the cost of each design option in the engineering analysis.

Finally, in response to commenters, DOE notes that ''high-tech defrost fans,'' ''lower-wattage refrigeration systems,'' and ''lower-wattage fan motors'' are not technology options DOE has analyzed in the preliminary or NOPR analysis.

DOE discusses the screened-out technologies in section IV.B.1 of this document, lists the remaining technology options in section IV.B.2 of this document, and discusses the design options in section IV.C of this document and chapter 5 of the NOPR TSD.

1. Screened-Out Technologies

For CRE, the screening criteria were applied to the technology options to either retain or eliminate technology for consideration in the engineering analysis. The screened-out technology options and the rationale for screening out each technology option considered in this analysis is detailed below.

a. Increased Insulation Thickness

In response to the June 2022 Preliminary Analysis, Continental commented that increasing insulation thickness, even by half an inch as

[40] *See www.qmpower.com/wp-content/uploads/2022/06/Product_Info-QSync_12W_60Hz-6.2.22-WEB.pdf.*

proposed by DOE, would expand equipment sizes and/or reduce internal capacity, both of which would have significant negative impact on utility for the end user. (Continental, No. 38 at p. 2)

Zero Zone commented that DOE's expectation that manufacturers will increase the thickness of insulation does not take into account the importance of physical dimensions in CRE equipment. (Zero Zone, No. 44 at p. 4) Zero Zone added that customers need replacement equipment that will fit in the existing available space and fit through 80-inch doorways. (*Id.*) Zero Zone stated that increasing the thickness of the internal insulation reduces the refrigerated volume, and equipment classes that use refrigerated volume in their allowable energy calculation would therefore see a ''double hit.'' (*Id.*) Zero Zone asserted that the resources in engineering design hours and retooling costs for the sheet metal necessary to accommodate such adjustments to insulation would be overly burdensome to manufacturers. (*Id.* at pp. 4–5) Zero Zone stated that increasing the thickness of internal insulation would result in stranded inventory for manufacturers and would affect end users' ability to replace their aging equipment due to size limitations. (*Id.* at p. 5)

As discussed in chapter 3 of the NOPR TSD, increasing insulation thickness increases the thermal resistivity of the exterior of the unit, which in turn reduces the heat load that must be removed by the CRE's refrigeration system. However, to increase insulation thickness, either an increase to the size of the unit or a decrease to the refrigerated volume of the unit must occur. Because CRE is typically required to meet standard dimensions to fit into a fixed amount of space, the refrigerated volume of the unit may need to be decreased to accommodate increased insulation thickness, thus limiting the capacity of the unit. As a result, DOE has tentatively determined that increased insulation thickness meets the screening criterion of ''impacts on product utility.'' In this NOPR, DOE has screened out increased insulation thickness as a design option for improving the energy efficiency of CRE.

b. Vacuum-Insulated Panels

In response to the June 2022 Preliminary Analysis, Continental commented that vacuum-insulated panels are relatively expensive, introduce significant complexity to manufacturing, reduce equipment structural stability, are subject to damage, and are not easily replaceable, requiring replacement of the entire unit. (Continental, No. 38 at p. 2)

AHRI commented that cost estimates in the June 2022 Preliminary TSD were significantly underestimated related to pandemic-related scarcity pricing. (AHRI, No. 46 at pp. 14–15) AHRI stated it planned to complete a survey to clarify the cost of vacuum panels (estimated by DOE to be considerably less expensive than is accurate) among other components, but could not do so within the 30-day deadline, especially given that the comment period for the test procedure and the walk-in cooler and walk-in freezer Preliminary TSD overlapped. (*Id.* at p. 15) AHRI stated that components are difficult to obtain because of longer shipping times and this impacts research and development and testing timelines and time for listing through nationally recognized testing laboratories. (*Id.*) AHRI commented that these factors should be considered in future timing and rulemaking processes. (*Id.*)

Zero Zone commented that vacuum-insulation panels are insufficiently robust and can lose their vacuum through bending or flexing. (Zero Zone, No 44 at p. 6) Zero Zone commented also that it can be difficult to determine the vacuum has been lost until the final product operation reveals condensation. (*Id.*) Zero Zone stated that large commercial refrigerators flex during shipping and customers fasten items to commercial refrigerators with screws, which can increase the risk of failure when using vacuum panels. (*Id.*) Zero Zone noted that a vacuum panel failure in a continuous line-up of remote commercial refrigerators results in the entire line up being moved to access the panel, which can result in replacement of the refrigerator. (*Id.*) Zero Zone recommended that DOE should not include vacuum-insulated panels as a design option. (*Id.*)

As discussed in chapter 3 of the NOPR TSD, VIPs allow reduction in insulation thickness while maintaining or increasing thermal resistivity, due to the reduced conductivity that occurs in a low vacuum. Because VIPs consist of an outer airtight membrane surrounding a core material to form a cavity, any puncture to a panel renders the VIP ineffective. This may prevent customers from being able to install any screws or fasteners into the panel. VIPs cannot be repaired once a leak is detected in the field and would require replacement upon puncture or failure. In the June 2022 Preliminary Analysis TSD, DOE stated that it had not observed VIPs incorporated in CRE but had observed VIPs used in other refrigeration products (*e.g.,* consumer refrigerators) (*see* section 2.5.1.6 of the June 2022 Preliminary TSD).

Based on comments received and feedback during manufacturer interviews, DOE has tentatively determined that because of the significant difference in shelf loads between commercial and consumer refrigeration units, CRE may require brackets or other supporting structures to accommodate the heavier shelf loads, installed with screws or fasteners that could puncture the VIP. As a result, DOE has tentatively determined that vacuum-insulated panels meet the screening criterion of ''impacts on product utility.'' In this NOPR, DOE has screened out vacuum-insulated panels as a design option for improving the energy efficiency of CRE.

c. Linear compressors

As discussed in chapter 3 of the June 2022 Preliminary TSD and chapter 3 of the NOPR TSD, linear compressors use a linear rather than rotary motion to reduce the need for a crankshaft and linkage, resulting in reduced friction and side forces. Most linear compressors use a free-piston arrangement and can be controlled for a range of capacities. Compressor manufacturers had begun development on linear compressors for residential refrigerators. However, a lack of availability on the market of linear compressors with a large enough cooling capacity for commercial refrigeration sizes has prevented further development of this technology for commercial refrigeration applications and, therefore, DOE has tentatively determined that linear compressors meet the screening criterion of ''practicability to manufacture, install, and service.'' DOE did not receive any comments on its tentative determination to screen out linear compressors in response to the June 2022 Preliminary Analysis, and, in this NOPR, DOE has screened out linear compressors as a design option for improving the energy efficiency of CRE.

d. Air curtain design

As discussed in chapter 3 of the June 2022 Preliminary TSD and chapter 3 of the NOPR TSD, an air curtain is a fan-powered device that creates a moving wall (curtain) of air, which separates two spaces of different temperatures. Air curtains are used in CRE to minimize the infiltration of warmer external air into the refrigerated space. DOE's research had presented the possibility of advanced air-curtain designs with levels of performance beyond the traditional air curtains generally employed in open display cases being used in the CRE industry.

However, DOE has tentatively determined that advanced air-curtain designs are currently only in the research stage and, therefore, DOE has initially determined that advanced air-curtain designs meet the screening criterion of ''practicability to manufacture, install, and service.'' DOE did not receive any comments on its tentative determination to screen out air curtains in response to the June 2022 Preliminary Analysis, and, in this NOPR, DOE has screened out improved air curtains as a design option for improving the energy efficiency of CRE.

2. Remaining Technologies

Through a review of each technology, DOE tentatively concludes that all of the other identified technologies listed in section IV.A.2 of this document met all five screening criteria to be examined further as design options in DOE's NOPR analysis. In summary, DOE did not screen out the following technology options presented in table IV.4.

TABLE IV.4—REMAINING TECHNOLOGY OPTIONS FOR CRE

Insulation	Evaporator
Improved resistivity of insulation (insulation type)	Increased surface area
Lighting	Improved evaporator coil design
Higher-efficiency lighting	Low-pressure differential evaporator
Occupancy Sensors	Condenser **
Improved transparent doors *	Increased surface area **
Low-emissivity coatings *	Tube-and-fin enhancements **
Inert gas fill *	Microchannel heat exchanger **
Vacuum-insulated glass *	Compressor **
Additional panes *	Improved compressor efficiency **
Anti-sweat heater controls *	Alternative refrigerants **
Anti-fog films *	Variable-speed compressors **
Frame design *	Other technologies
Fans and fan motors	Defrost systems
Evaporator fan motors	Expansion valve improvements
Evaporator fan blades	Night curtains ***
Evaporator fan controls	Liquid suction heat exchanger **
Condenser fan motors **	
Condenser fan blades **	
Condenser fan controls **	

* Only applies to equipment classes with doors.
** Only applies to self-contained equipment classes.
*** Only applies to equipment classes without doors (open equipment classes).

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

DOE requests comment on the decision to screen out increased insulation thickness, vacuum-insulated panels, linear compressors, and air curtain design as design options for improving the energy efficiency of CRE.

C. Engineering Analysis

The purpose of the engineering analysis is to establish the relationship between the efficiency and cost of CRE. 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 equipment cost at each efficiency level (*i.e.,* the ''cost analysis''). In determining the performance of higher-efficiency equipment, DOE considers technologies and design option combinations not eliminated by the screening analysis. For each equipment class, DOE estimates the baseline cost, as well as the incremental cost for the 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 equipment (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 equipment on the market) may be extended using the design-option approach to ''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 this rulemaking, DOE relies on a design-option approach, supported with the testing and reverse engineering of directly analyzed CRE. The design options were incrementally added to the baseline configuration and continued through the ''max-tech'' configuration (*i.e.,* implementing the ''best available'' combination of available design options).

Consistent with the March 2014 Final Rule analysis (see chapter 5 of the

March 2014 Final Rule TSD[41]), DOE estimated the performance of design option combinations using an engineering analysis spreadsheet model. This model estimates the daily energy consumption of CRE in kWh/day at various performance levels using a design-option approach. DOE generally relied on test data, CCD information, feedback from manufacturer interviews, publicly available component information, and reverse engineering to support and calibrate the engineering analysis spreadsheet model. The model calculates energy consumption at each performance level separately for each analysis configuration.

In the March 2014 Final Rule analysis, DOE selected 25 high shipment volume equipment classes, referred to as ''primary'' classes, to analyze directly in the engineering analysis (see chapter 5 of the March 2014 Final Rule TSD[42]). In this NOPR, DOE has followed a similar approach of directly analyzing 28 primary equipment classes. DOE directly analyzed the same primary equipment classes as the March 2014 Final Rule, except that the PD.SC.M equipment class was not included, and DOE directly analyzed four new equipment classes: VCT.SC.H, VCS.SC.H, chef base self-contained medium temperature (''CB.SC.M''), chef base self-contained low temperature (''CB.SC.L''). Additional details of the engineering analysis are available in chapter 5 of the NOPR TSD.

a. Baseline Energy Use

For each equipment 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 equipment class represents the characteristics of 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.

In the June 2022 Preliminary TSD, DOE utilized the current standards for CRE for classes with current standards and the energy consumption based on the assumed baseline specifications modeled in the engineering analysis spreadsheet for classes without current standards as the baseline energy use for each analyzed equipment class. For higher efficiency levels, DOE assessed CRE efficiencies as a percent improvement relative to the baseline model. This provided a consistent efficiency comparison across each equipment class. DOE considered the efficiency improvements associated with implementing available design options beyond the baseline to the max-tech efficiency level. See chapter 5 of the June 2022 Preliminary TSD for additional details.

In response to the June 2022 Preliminary Analysis, Zero Zone commented that, while it believes DOE is developing models and setting energy levels based on average energy values, no data were provided to confirm or deny that suspicion. (Zero Zone, No. 44 at p. 2) Zero Zone stated that setting energy values at an average expected level and requiring manufacturers to have all products meet the average energy level is incorrect, and such approach necessitates that manufacturers develop equipment with low enough average energy levels that the worst measured performance of any product is less than DOE's average value. (*Id.*) Zero Zone provided figures illustrating that if DOE's regulated average energy requirement is 30 kWh/day, then industry must shift to a new average that is less than the uncertainty level in order to be sure that products do not exceed the energy level requirement. (*Id.*) Zero Zone requested that DOE account for this lower energy level penalty and provide which options are included in each energy level so that Zero Zone can fully evaluate the proposals. (*Id.* at p. 3)

Zero Zone additionally commented that DOE's proposed CRE test procedure requires manufacturers to calculate the uncertainty level and apply it to their rating, but DOE does not appear to apply the test requirements for uncertainty to its own work. (*Id.* at p. 2) Zero Zone stated that DOE proposed a 5-percent tolerance on total display area, but that one variation caused a 4.62-percent variation in allowable energy swinging on Zero Zone's five-door case. (*Id.*) Zero Zone requested that DOE take into account all uncertainty when estimating energy consumption of CRE. (*Id.*)

In response to the comment from Zero Zone, DOE notes that the engineering spreadsheet model that is used to develop the baseline and efficiency levels is calibrated using publicly available CCD data, which are subject to the requirements of the determination of represented value at 10 CFR 429.42(a), as well as ENERGY STAR data and manufacturer-submitted data. The DOE requirements specify that manufacturers must determine the represented value, which includes the certified rating, for each basic model of commercial refrigerator, freezer, or refrigerator-freezer either by testing, in conjunction with the applicable sampling provisions, or by applying an alternative efficiency determination method (''AEDM''). In the case where the reported value is derived from testing, at least two or more units should be tested pursuant to 10 CFR 429.42 and the appropriate sampling statistics must be applied in order to develop the represented value. 79 FR 22277, 22296. Any represented value of energy consumption or other measure of energy use of a basic model for which consumers would favor lower values shall be greater than or equal to the higher of: (1) the mean of the sample or, (2) the upper 95 percent confidence limit (UCL) of the true mean divided by 1.10. 10 CFR 429.42(a)(1)(ii)(A). These requirements provide a statistical assessment of test results used to determine the represented value for a basic model which indicates a high level of confidence that the model population average energy use is less than or equal to the standard. DOE did not consider additional uncertainty in the proposed maximum daily energy consumption standard equation in this NOPR analysis.

DOE expects that Zero Zone is referring to section J., Enforcement Provisions, of the June 2022 Test Procedure NOPR and the respective proposed regulatory text at 10 CFR 429.134. As stated in the June 2022 Test Procedure NOPR, product-specific enforcement provisions specify which ratings or measurements DOE will use to determine compliance with applicable energy or water conservation standards. 87 FR 39164, 39211. Generally, DOE provides that the certified metric is used for enforcement purposes (*e.g.,* calculation of the applicable energy conservation standard) if the average value measured during assessment and enforcement testing is within a specified percent of the rated value. *Id.* Otherwise, the average measured value would be used. *Id.* DOE proposed to add a new product-specific enforcement provision section stating that the certified volume for CRE will be considered valid only if the measurement(s) (either the measured volume for a single unit sample or the average of the measured volumes for a multiple unit sample) is within five percent of the certified volume; otherwise, the measured volume would be used as the basis for determining the

[41] *See www.regulations.gov/document/EERE-2010-BT-STD-0003-0102.*

[42] *See www.regulations.gov/document/EERE-2010-BT-STD-0003-0102.*

applicable energy conservation standard. *Id.* at 87 FR 39212. Similarly, DOE proposed that the certified TDA for CRE will be considered valid only if the measurement(s) (either the measured TDA for a single unit sample or the average of the measured TDAs for a multiple unit sample) is within five percent of the certified TDA. *Id.* If the certified TDA is found to not be valid, the measured TDA would be used to determine the applicable energy conservation standard. *Id.* These proposals in the June 2022 Test Procedure NOPR are specific to how DOE conducts enforcement testing and a tolerance on the certified volume or TDA of a given CRE model is used to decide whether the certified volume or TDA will be used to determine compliance with the applicable standard, or, if the average measured volume or TDA is outside of the tolerance, the average measured volume or TDA of the assessment and enforcement units will be used to determine compliance with the applicable standard.

Refrigerants. In response to the June 2022 Preliminary Analysis, DOE received several comments from stakeholders regarding how refrigerants were considered in the preliminary engineering analysis.

AHRI commented that many states that adopted the SNAP Rules do not allow the use of the refrigerant R404A. (AHRI, No. 46 at p. 3) AHRI requested clarification regarding whether this addresses self-contained cases. (*Id.*)

NAFEM expressed concern about DOE's position not to account for future refrigerant regulatory changes by the EPA. (NAFEM, No. 40 at p. 3). NAFEM stated its concern that DOE had not analyzed refrigerant transitions of remote condensing systems in the June 2022 Preliminary TSD and had declined to evaluate alternative refrigerants as a design option for remote CRE due to the lack of a test procedure. (*Id.*) NAFEM recommended that DOE and EPA better coordinate their actions to achieve their mutual goals, and NAFEM volunteered to educate DOE technical staff so that any proposed rule accurately reflects industry knowledge. (*Id.*)

The Joint Commenters requested that DOE analyze propane refrigerant for additional equipment classes. (Joint Commenters, No. 39 at p. 1)

AHRI commented that a preliminary transition was in process from R–404A to refrigerants with a global warming potential of approximately 1500 and refrigerants used in colder temperature applications have a GWP of 2200. (AHRI, No. 46 at p. 12) AHRI noted that most lower-GWP refrigerants were limited by building codes because the necessary standard, UL 60335–2–89, was just published recently in October 2021. (*Id.*) AHRI commented that the second, more complex and costly refrigerant transition in January 2026 was unaccounted for in the June 2022 Preliminary TSD, and that the two transitions will have a significant reduction in radiative-forcing, short-lived climate-polluting HFCs and should be taken into consideration in the social cost of carbon and environmental impact assessments. (*Id.*)

AHRI commented that EPA does not yet allow for R–290 or an ASHRAE Class A3 refrigerant to be used and few of the thousands of State and local building codes have been updated to charge refrigeration equipment and store necessary quantities to supply end-user needs. (*Id.* at p. 13) AHRI stated that significant work must be done to finalize codes prior to the anticipated 2026 transition and AHRI noted that AZ, CO, IN, ME, MO, NY, TN, TX, VT, WA, and WV would allow for the use these new refrigerants once the EPA listed them. (*Id.* at pp. 13–14)

AHRI pointed out that manufacturers are still testing refrigerants for the 2026 transition, and that because refrigerant and component manufacturers have largely been focused on larger markets than many of the equipment types sold in the CRE space, not all of the details are known about the impact of specific refrigerants to energy efficiency. (*Id.* at p. 13) AHRI stated, however, that some proposed blends are known to have higher glide and lower efficiencies (some significantly lower) than those in use, especially for colder-temperature applications. (*Id.*) AHRI commented that, in addition, the energy efficiency impact of an important mitigation strategy related to refrigerants has not been addressed—the need to continuously operate fans to reduce the risk of reaching a flammable concentration. (*Id.*) AHRI noted that, in some cases, glide is high enough that evaporator re-design is needed, making costs even higher to conform with energy conservation standards. (*Id.*)

AHRI commented that most lower-GWP refrigerants have a different flammability classification than those currently used today and cost estimates must also include new electrical components required to be ''spark-proof'' to eliminate the risk of ignition in case of a leak. (*Id.* at p. 12) AHRI noted that motors, wiring, compressors, and other components must all comply with this flammability classification, making them more costly than estimated in the June 2022 Preliminary TSD. (*Id.*)

NAMA stated that several of the design options mentioned in the June 2022 Preliminary TSD are either not available or not realistic in NAMA equipment, such as the change to an A–3 refrigerant that would require nearly a dozen other components to also be changed. (NAMA, No. 37 at p. 7).

NAMA commented that DOE failed to mention the CRADA between the NAMA Foundation, DOE, and Oak Ridge National Laboratory (''ORNL'') in the June 2022 Preliminary TSD. (*Id.* at p. 12) NAMA stated that most of the activities during the 2019–2021 CRADA were focused on reducing the risk during a potential leak situation. (*Id.*) NAMA stated that in nearly all scenarios tested by ORNL, additional fans were necessary to reduce the mixture of air and refrigerant below the lower flammability limit (''LFL''), but the energy used by these fans was not accounted for in the June 2022 Preliminary TSD. (*Id.*) NAMA commented that the proposed DOE test procedure would actually penalize self-contained bottle cooler manufacturers for using additional ventilation. (*Id.*) NAMA further stated that the COVID–19 pandemic had delayed progress in the CRADA and that NAMA had requested an extension so that the remaining items (over half) could be studied. (*Id.*) NAMA commented that these remaining items look at possible energy efficiency gains, and the lack of results had put its industry behind schedule to meet any new energy efficiency requirements from DOE. (*Id.*) NAMA requested that DOE delay new minimum energy efficiency standards until manufacturers have the research from ORNL to pursue the research and development of new technologies. (*Id.*)

Zero Zone commented that DOE asserted multi-circuit evaporators are a design option that would allow larger pieces of equipment to use propane in multiple small systems. (Zero Zone, No. 44 at p. 5) Zero Zone commented that using propane in systems over 150 grams requires additional leak-mitigation equipment. (*Id.*) Zero Zone stated that until the release of UL 60335–2–89, CRE could only use 150-gram charges of propane and were not required to have mitigation strategies, which explains why DOE has not observed mitigation on CRE on the market. (*Id.*) Zero Zone requested that DOE include the mitigation cost in its evaluation. (*Id.*)

As recommended by stakeholders, DOE is considering the impact of the December 2022 EPA NOPR on CRE in this NOPR. As described in section I of this document, DOE understands that it would be beneficial to CRE equipment manufacturers to align the compliance date of any DOE amended or established standards as closely as possible with the refrigerant prohibition dates proposed by the December 2022 EPA NOPR. Therefore, DOE is proposing that the proposed standards, if adopted, would apply to all CRE listed in table I.1 manufactured in, or imported into, the United States on or after the date that is 3 years after the date on which the final established and amended standards are published. The December 2022 EPA NOPR proposed to prohibit manufacture or import of such CRE starting January 1, 2025, which is at least 3 years earlier than the expected compliance date for any amended CRE standards associated with the proposals in this document. Hence, the proposed refrigerant prohibitions listed in the December 2022 EPA NOPR are assumed to be enacted for the purpose of DOE's analysis in support of this NOPR.

Refrigerants not prohibited from use in CRE in the December 2022 EPA NOPR are presumed to be permitted for use in CRE. Table IV.5 summarizes the relevant provisions from the December 2022 EPA NOPR.

TABLE IV.5—DECEMBER 2022 EPA NOPR SUMMARY FOR CRE

Sectors and subsectors	Proposed GWP limit	Compliance date
Retail food refrigeration—stand-alone units	150	January 1, 2025.
Retail food refrigeration—refrigerated food processing and dispensing equipment	150	January 1, 2025.
Retail food refrigeration—supermarket systems with refrigerant charge capacities of 200 pounds or greater	150	January 1, 2025.
Retail food refrigeration—supermarket systems with refrigeration charge capacities less than 200 pounds charge.	300	January 1, 2025.
Retail food refrigeration—supermarket systems, high temperature side of cascade system	300	January 1, 2025.
Retail food refrigeration—remote condensing units with refrigerant charge capacities of 200 pounds or greater	150	January 1, 2025.
Retail food refrigeration—remote condensing units with refrigerant charge capacities less than 200 pounds	300	January 1, 2025.
Retail food refrigeration—remote condensing units, high temperature side of cascade systems	300	January 1, 2025.

In the December 2022 EPA NOPR, self-contained CRE (EPA refers to self-contained CRE as ''stand-alone equipment'') are limited to a GWP of 150 for all DOE self-contained equipment classes. Commercial refrigeration equipment has typically used R–404A or R–134a refrigerant, which have a GWP above 150. Because of the high GWP of R–404A and R–134a, significant research has been conducted to find alternative refrigerants with less or no GWP. Naturally occurring substances such as carbon dioxide, ammonia, and hydrocarbons (specifically propane (*i.e.,* R–290) for commercial refrigeration equipment) all have very low GWP. DOE notes that several manufacturers currently rate CRE models to both ENERGY STAR [43] and DOE [44] with CRE equipment using R–290 (GWP of 3) and manufacturers indicated in manufacturer interviews that the industry is planning to transition to R–290 for self-contained CRE. EPA currently lists R–290 as acceptable with use conditions for self-contained CRE,[45] however, EPA has not yet updated the use conditions for R–290 consistent with the latest industry safety standards for CRE. EPA currently lists R–290 as acceptable with use conditions for a refrigerant charge of up to 150 grams in self-contained CRE, but in a recent proposed rule, EPA proposed to increase the allowable charge to 304 grams for closed equipment and 494 grams for open equipment to harmonize with the maximum charge quantity allowed by industry safety standards [46] and to be consistent with the December 2022 EPA NOPR (*i.e.,* prohibitions for retail food refrigeration—standalone units, when using or intended to use a regulated substance, or a blend containing a regulated substance with a global warming potential of 150 or greater). Therefore, DOE has tentatively determined that once EPA finalizes the proposed increases to the allowable charge limits, all self-contained CRE equipment can use R–290.

DOE expects that the use of R–290 generally will improve efficiency as compared with the refrigerants currently in use (*e.g.,* R–404A), which are proposed to be prohibited by the December 2022 EPA NOPR, because R–290 has higher refrigeration-cycle efficiency than the current refrigerants. Thus, DOE expects the December 2022 EPA NOPR to require redesign that will improve the efficiency of self-contained CRE equipment. Hence, the baseline levels for self-contained CRE in this NOPR reflect the design changes made by manufacturers in response to the December 2022 EPA NOPR, which incorporates refrigerant conversion to R–290. The expected efficiency improvement associated with this refrigerant change varies by class and is presented in table IV.6.

DOE considered the requirement for components to be ''spark-proof'' for use with the R–290 refrigerant (*i.e.,* propane) and the associated costs were included in the cost of baseline models.

In chapter 2 of the June 2022 Preliminary TSD, DOE stated that DOE has not observed any additional leak monitoring or ventilation components for leak mitigation in any analyzed self-contained equipment that currently incorporates R–290 refrigerant.[47] (See June 2022 Preliminary TSD, Chapter 2). As a result, for the representative equipment sizes considered in the preliminary engineering analysis, DOE initially determined that leak mitigation controls are not needed and therefore did not account for any additional energy consuming components with the transition to R–290 refrigerant. (*Id.*) Based on the CRE that DOE tested and tore down in support of this NOPR, DOE

[43] *See www.energystar.gov/productfinder/product/certified-commercial-refrigerators-and-freezers/results.*

[44] *See www.regulations.doe.gov/certification-data/#q=Product_Group_s%3A*.*

[45] *See www.epa.gov/snap/substitutes-stand-alone-equipment.*

[46] SNAP Proposed Rule 26 (88 FR 33722) harmonizes with UL Standard 60335–2–89, Edition 2, published on October 27, 2021.

[47] *See www.regulations.gov/document/EERE–2017–BT–STD–0007–0013.*

has not observed any refrigerant leak mitigation controls that consume additional energy use for self-contained CRE that use 150 grams of R–290 or less. DOE expects that any refrigerant leak mitigation controls that manufacturers implement on self-contained CRE would not use any additional energy use as measured according to the DOE test procedure (*e.g.,* any ventilation fans used to disperse refrigerant in the event of a refrigerant leak would not be on and using energy unless a refrigerant leak was detected).

In response to the comment from NAMA, DOE acknowledges the ongoing research at ORNL under the CRADA. DOE recognizes that leak mitigation technologies are still under development and requests comment and data on the use of such technologies, how they may impact CRE energy use as measured according to the DOE test procedure, and the associated cost of such technologies. DOE welcomes any additional comments and supporting data, including any additional results of the CRADA, in response to this NOPR.

DOE is also aware of small CRE equipment using R–600a, which is a similar refrigerant to R–290. DOE has tentatively determined that R–600a has similar refrigeration-cycle efficiency as R–290 and that the performance of CRE using R–290 is representative of CRE using R–600a.

As discussed in section IV.C.1.a, remote condensing CRE have proposed GWP limits of either 150 or 300, depending on the refrigerant system charge size or refrigerant system type. In chapter 2 of the June 2022 Preliminary TSD, DOE noted that the current and proposed DOE test procedures account for the refrigeration load of remote cases plus any energy consumed by components within the equipment.[48] (See June 2022 TSD, Chapter 2) By reference to table 1 in AHRI 1200, the test procedure calculates an expected compressor energy consumption associated with the case refrigeration load, independent of compressor details including refrigerant type. (*Id.*) Hence, DOE initially determined that alternative refrigerants in remote CRE cases do not result in changes in measured energy consumption. (*Id.*) Therefore, DOE did not consider alternative refrigerants in remote CRE cases in the preliminary engineering analysis. (*Id.*) In this NOPR, DOE has tentatively determined that the current standard is representative of the baseline energy use for remote-condensing CRE using refrigerants that comply with the December 2022 EPA NOPR when tested according to the DOE test procedure.

DOE's analysis considers that these efficiency improvements, equipment costs, and manufacturer investments required to comply with the December 2022 EPA NOPR will be in effect prior to the time of compliance for the proposed amended DOE CRE standards for all CRE equipment classes and sizes. DOE has updated its baseline equipment costs to reflect current costs based on feedback received during manufacturer interviews, information collected during CRE teardowns, and market research.

TABLE IV.6—EFFECT OF USE OF R–290 ON ENERGY USE IN BASELINE MODELS

Equipment class	Energy use reduction below DOE standard (%)
VOP.SC.M	4.4
SVO.SC.M	9.2
HZO.SC.M	19.5
HZO.SC.L	4.8
VCT.SC.M	18.8
VCT.SC.L	2.8
VCS.SC.M	20.5
VCS.SC.L	8.5
HCT.SC.M	0.0
HCT.SC.L	0.0
HCS.SC.M	20.1
HCS.SC.L	22.1
SOC.SC.M	2.7
VCT.SC.I	0.0
HCT.SC.I	0.0
VCS.SC.I	3.3

The expected energy efficiency improvement associated with the change to R–290 is based on R–290 single-speed compressors currently available on the market suitable for CRE equipment. In this NOPR, DOE did not consider additional single-speed compressor efficiency improvements beyond the baseline because DOE expects that the single-speed compressors currently available on the market for refrigerants that comply with the December 2022 EPA NOPR represent the maximum single-speed compressor efficiency achievable for each respective equipment class.

DOE requests comment on its proposal to use baseline levels for CRE equipment based upon the anticipated design changes that will be made by manufacturers in response to the December 2022 EPA NOPR.

DOE further requests comment on its estimates of energy-use reduction associated with the design changes made by manufacturers in response to the December 2022 EPA NOPR.

Baseline Components. NAMA commented that the June 2022 Preliminary TSD contained errors and appeared to have been prepared prior to significant changes that occurred from 2019–2022. (NAMA, No. 37, p. 4–5) NAMA commented also that features DOE seemed to believe represented future improvements to design had already been implemented, leading to inaccurate baseline model assumptions by DOE about energy efficiency levels and incremental costs. (*Id.* at p. 5)

NAMA stated that DOE's design changes, project energy efficiency improvements, and cost data on the 12 design options under consideration appeared outdated by 10 years and applicable only to very large machines greater than 50 cubic feet in volume. (*Id.* at p. 7) NAMA further commented that the design options were not representative of the possible changes, availability, and costs associated with refrigerated bottle coolers and small self-contained display cabinets. (*Id.*) NAMA recommended that DOE change its categories and make allowances for the differences in energy efficiency between small and large equipment, as well as differences in cost and cost-benefit analysis. (*Id.* at p. 9) NAMA commented that DOE could use data on shipments to modify DOE percentages according to sales-weighted numbers. (*Id.*) NAMA proposed that DOE restructure its categories in the June 2022 Preliminary TSD to include two ranges: Range 1, which would be less than 30 cubic feet, and Range 2, which would be 30 cubic feet and over in volume. (*Id.*) NAMA commented that it believes using these categories would enable a more accurate assessment of the energy savings and cost burden. (*Id.*)

NAFEM and NAMA commented that the design options in the 2014 TSD were so stringent that industry had to go beyond DOE's standards and incorporate features such as LED lighting, brushless DC evaporator fan motors, high-performance doors, and brushless DC condenser fan motors. (NAFEM, No. 40 at pp. 5–6; NAMA, No. 37 at p. 5)

Zero Zone similarly stated that it disagrees with the design options that fall above the 2017 equipment class maximum daily energy consumption standard level and that LED lighting, high-efficiency fan motors (like ECM), and high-performance doors are already employed to meet current maximum energy consumption levels. (Zero Zone, No. 44 at p. 3) Zero Zone commented that this information is available on company specification sheets and that an analysis using this available information would show that the slope

[48] *See www.regulations.gov/document/EERE–2017–BT–STD–0007–0013.*

of the manufacturer production costs versus daily energy use in DOE's engineering spreadsheet should be re-evaluated. (*Id.*)

ITW recommended adding technologies to the baseline as they were applied by industry, citing examples including ECM fans, high-efficiency compressors, and evaporator fan controls. (ITW, No. 41 at p. 34)

NAFEM and NAMA stated that because these and other technologies were already necessary to meet the 2014 standard, DOE should not be able to claim any new energy efficiency benefits when incorporating such technologies into the June 2022 Preliminary TSD. (NAFEM, No. 40 at p. 6; NAMA, No. 37 at p. 5) Zero Zone similarly commented that DOE's graph in the June 2022 Preliminary TSD indicates that using high-performance doors would reduce the calculated daily energy use from 35.14 kWh/day to 26.60 kWh/day, but Zero Zone stated that this design option is already employed by manufacturers, and that DOE is therefore double counting the impact of high-performance doors. (Zero Zone, No. 44 at p. 3).

AHRI commented that design options included in the June 2022 Preliminary TSD—such as high efficiency doors, fans, motors, and ECM in self-contained cases—are largely already incorporated by manufacturers to meet current standards and that counting them a second time will not cause the equipment to meet the proposed energy efficiency levels. (AHRI, No. 46 at p. 3) AHRI noted that vacuum-packed doors and insulation are a few of the recommended design options that are not already in use by manufacturers. (*Id.*) AHRI commented that low-temperature vertical closed transparent (''VCT'') classes already use high-efficiency doors and that DOE's model is incorrect regarding low-temperature VCT equipment classes as DOE assumes no-sweat anti-heat. (*Id.* at p. 6) AHRI noted that DOE's baseline does not meet current energy-efficiency standards, as the current standard for VCT remote low temperature allowable is 34.46 kWh/day compared to 35.14 kWh/day in DOE's baseline design without design options. (*Id.*) AHRI noted also that there is no room for anti-sweat controls under the ASHRAE test conditions and therefore this technology is not logical. (*Id.*)

AHRI commented that many potential energy saving scenarios in the June 2022 Preliminary TSD contain elements that are already in use or are technically impractical for refrigeration equipment. (*Id.* at p. 14) AHRI stated that the tear-down analysis must have used equipment built before 2019, which would have excluded design features needed to meet current energy conservation standards, such as efficient doors and LED lights. (*Id.*) AHRI commented that variable-speed compressors are impactful with significant changing loads, but not for most refrigeration systems. (*Id.*) AHRI also stated that the analysis failed to recognize concerns with proposed product features; for example, retailers generally do not want occupancy lighting because a light that is off indicates to consumers that equipment is not working properly and that food may be spoiled. (*Id.*) AHRI commented that energy-saving opportunities are lower after the elimination of design features that are technically infeasible, already in use, or cost prohibitive. (*Id.*) AHRI stated that design options are also limited by the equipment footprint: larger compressors or additional insulation requirements increase case sizes and reduce storage capacity, creating less utility and requiring remodeling to fit in current spaces. (*Id.*) AHRI commented that the June 2022 Preliminary TSD failed to address the impact of design options on performance or other design features, such as temperature, and offered the example of the VCT.RC.M equipment class in which some OEMs have begun incorporating high-efficiency, triple-pane doors and increased insulation. (*Id.*) AHRI stated the baseline components in the tear-down analysis included evaporator fans that are shaded pole motors and have not been used in years. (*Id.*)

Continental stated that some selections in the June 2022 Preliminary TSD technology options have not been sufficiently evaluated for their current usage, anticipated contribution to energy reduction, technological viability, cost impact, and/or bearing on the utility of the equipment. (Continental, No. 38 at p. 2) Continental noted that many manufacturers already use improved transparent doors, high-efficiency LED lighting, and high-efficiency ECM fans to meet current standards for DOE and/or ENERGY STAR. (*Id.*)

Zero Zone commented that DOE did not conduct manufacturer interviews. (Zero Zone, No. 44 at p. 5) Zero Zone stated that each of its models in the compliance database uses a unique code to identify the components provided. (*Id.*) Zero Zone questioned how DOE determined what is included in this base line. (*Id.*)

With respect to comments from NAMA, NAFEM, ITW, AHRI, Continental, and Zero Zone, DOE followed a similar approach to the March 2014 Final Rule analysis in the June 2022 Preliminary Analysis but incorporated additional design options and updated the design option assumptions based on publicly available manufacturer specifications and preliminary test data. In support of this NOPR, manufacturer interviews were conducted and interviews yielded feedback on several aspects of the June 2022 Preliminary Analysis, including typical CRE baseline components. Further, DOE has reviewed the current CRE market, incorporated feedback from the June 2022 Preliminary Analysis, and incorporated information gathered during manufacturer interviews to update the baseline components in this NOPR to reflect current designs and ensure that design options have not already been implemented in a representative baseline CRE for each equipment class.

For the June 2022 Preliminary Analysis, DOE directly analyzed multiple equipment classes intended to represent the majority of industry shipments for CRE. Within each analyzed equipment class, DOE also selected a volume or TDA for the analysis to best represent the range of equipment available in that equipment class. For currently covered equipment classes, the representative volumes and TDAs selected were consistent with those analyzed for the March 2014 Final Rule. DOE has retained the June 2022 Preliminary Analysis approach in this NOPR. Although the NOPR analysis is conducted at one representative volume or TDA for each directly analyzed class, DOE considers the components, design options, costs, and energy use characteristics of CRE across the entire equipment class.

See chapter 5 of the NOPR TSD for additional details on the baseline components in each equipment class.

AHT commented that internal LED lighting is a common characteristic in all closed transparent equipment classes, yet in the June 2022 Preliminary Analysis, DOE does not indicate lights for the baseline design options for horizontal closed transparent self-contained equipment classes (HCT.SC.M, HCT.SC.L, HCT.SC.I). (AHT, No. 48 at p. 1) AHT stated that good internal illumination is of high importance for these units because their purpose is to display refrigerated or frozen food to the end consumer, whereas open units may be sufficiently illuminated with external ceiling lights. (*Id.* at pp. 1–2) AHT commented that DOE's energy rating regulation does not consider the energy consumption of such external lights or the additional headload, further disadvantaging closed units compared to open units. (*Id.* at p. 2) AHT commented that the energy consumption of open units relying on external lights is substantially higher than the test result suggests because the additional lighting is often higher than the 800 lux stated in the test procedure. (*Id.*)

AHT commented that manufacturers have already incorporated many of the proposed design options to meet current limits for HCT.SC.M/L/I and provided the example of a unit from the HCT.SC.M equipment class with around 25 ft^2 of TDA, which already uses high-efficiency reciprocating compressors, brushless DC condenser fan motors, variable-speed compressors, and an additional half inch of insulation to achieve the measured consumption of 1.9 kWh/24h in the test. (*Id.* at pp. 2–3)

Based on a review of these comments, manufacturer feedback, and the available equipment on the market, DOE has included lighting and additional components at the baseline for horizontal closed transparent CRE equipment in this NOPR. See chapter 5 of the NOPR TSD for additional details.

Regarding fan motors, the CA IOUs referred DOE to their comments on the July 2021 RFI in which they stated that there has been continued improvement in fan motors since energy conservation standards were last analyzed. (CA IOUs, No. 43 at p. 2) The CA IOUs expressed gratitude that DOE included electronically commutated permanent magnet motors, also known as brushless permanent magnet motors or brushless DC motors and synchronous motors; however, the CA IOUs also commented that the list of fan motor technology options analyzed for the closed-door refrigeration categories is incomplete, as shown in the CA IOUs Table 1, which lists all analyzed fan types alongside all self-contained equipment families. (*Id.* at pp. 2–3) The CA IOUs recommended that the evaporator fan technology options analyzed in the vertical closed refrigeration category also be analyzed for the horizontal closed refrigeration category. (*Id.* at p. 2) The CA IOUs stated that several horizontal glass case manufacturers offer medium- to low-temperature convertible units, suggesting that analyzing the same technology options for these two equipment classes makes sense. (*Id.*)

The Joint Commenters recommended that DOE analyze evaporator technologies for horizontal, closed CREs as DOE had done for the majority of CRE equipment classes. (Joint Commenters, No. 39 at p. 2) The Joint Commenters stated that DOE's analysis found that these evaporator-related technology options result in significant energy savings for other equipment classes analyzed. (*Id.*) The Joint Commenters stated that they are unsure why DOE excluded evaporator technology options for horizontal closed CREs. (*Id.*)

In response to the comments from the CA IOUs and the Joint Commenters, DOE notes that the horizontal closed category (horizontal closed transparent or solid equipment classes) consists of CRE that utilize either cold-wall or forced-air evaporators depending on the equipment class. DOE observed that each primary equipment class that utilizes forced air evaporators has an evaporator fan and motor and each primary equipment class that utilizes cold-wall evaporators does not have an evaporator fan and motor. Therefore, classes with a cold-wall evaporator did not have an evaporator fan motor design option. See chapter 5 of the NOPR TSD for additional details.

The CA IOUs commented that the June 2022 Preliminary TSD analysis for several equipment categories (*e.g.,* chef bases/griddle stands, semi-vertical open, and horizontal closed transparent) assumes shaded-pole motors as the baseline; however, the CA IOUs stated that shaded-pole motors are rarely used in new equipment in the industry and recommended that DOE analyze permanent split capacitor (''PSC'') motors as the baseline. (CA IOUs, No. 43 at p. 3) Similarly, AHRI commented that there are inconsistencies with the assumptions made regarding efficiency levels in the June 2022 Preliminary TSD: (1) the VOP.RC.M (open dairy cases) class in the baseline already have ECMs, which should have been the baseline motor, and (2) LED lighting contributing to increased efficiency. (AHRI, No. 46 at p. 2)

With respect to the comment from the CA IOUs, for chef bases or griddle stands, DOE has tentatively determined that, based on teardowns conducted in support of this NOPR, shaded-pole motors (''SPMs'') are used for fan motors in baseline equipment. See chapter 5 of the NOPR TSD for additional details.

Regarding the equipment noted by commenters, DOE has also updated baseline components in this NOPR for all equipment classes (including those components and classes mentioned by commenters) to better reflect baseline CRE. See chapter 5 of the NOPR TSD for additional detail.

Equipment Classes with Unique Energy Use Characteristics. ITW commented that, in terms of design-options compliance with the MDEC value, DOE failed to recognize that manufacturers might use other options farther down the list of compliant design options to produce cabinets with increased heat loads due to their physical features (other than those required by a simple reach-in refrigerator), citing the following applications as examples: (1) pass-through refrigerators—cabinets with doors on both sides, providing access to stored items from either side; (2) roll-in refrigerators—cabinets with ramps and door sweeps that allow for loading of bakery carts; and (3) roll-through refrigerators—cabinets with ramps and door sweeps on both sides that allow for bakery carts to move in and out from one side to the other. (ITW, No. 41 at p. 33) ITW commented that in the 2014 TSD, DOE proposed many of the same design options to achieve compliance and manufacturers adopted many of the options, such as ECM fans and high-efficiency compressors, with the industry trending toward R–290 refrigeration systems. (*Id.*) ITW commented that DOE does not prescribe technologies; it recommends them and industry selects the technology used for compliance. (*Id.*)

NAFEM stated that it and other commenters recommended separating forced-air and cold-wall refrigeration systems into different categories, yet DOE deferred making a decision until a future proposed rule. (NAFEM, No. 40 at p. 3) NAFEM commented that the preliminary TSD stage is the appropriate stage to adopt a position on these categories and that DOE's deferral missed an opportunity for DOE to work with NAFEM members to fully understand the issues. (*Id.*)

NAFEM also commented that DOE's decision to defer accounting for different door configurations (roll-in, roll-through, and pass-through doors) presented a similar missed opportunity for DOE to work with NAFEM members. (*Id.*)

With respect to the comments from ITW and NAFEM, DOE recognizes that certain CRE equipment classes may contain equipment that utilize either forced-air evaporators or cold-wall evaporators and that certain CRE equipment classes may contain equipment that have different door configurations (*e.g.,* roll-in, roll-through, and pass-through). Based on CCD data, information from commenters and manufacturer interviews, and DOE's directly analyzed units showing an energy use difference between certain types of CRE, DOE has tentatively determined to include separate energy use equations based on an energy use multiplier for certain equipment classes that contain CRE with unique utility. This energy use multiplier will require models with certain characteristics (*e.g.,* roll-in doors, roll-thru doors, pass-thru doors, forced-air evaporators) to comply with an energy conservation standard that has a higher maximum daily energy consumption than the proposed energy conservation standard for a specific equipment class. DOE has initially determined that the energy use multipliers do not result in maximum daily energy consumptions that are higher than the current energy conservation standard for a given equipment class (*i.e.,* complying with EPCA's ''anti-backsliding'' provision, which prevents the Secretary from prescribing any amended standard that either increases the maximum allowable energy use or decreases the minimum required energy efficiency of a covered equipment. (42 U.S.C. 6316(e)(1); 42 U.S.C. 6295(o)(1))).

In section IV.A.1.b of this NOPR, DOE proposes definitions for pass-through, roll-in, roll-through, and sliding doors. Based on CCD data, information from commenters and manufacturer interviews, and DOE's directly analyzed units showing an energy use difference between certain types of CRE, DOE has tentatively developed an energy use multiplier for equipment classes that DOE observed CRE with pass-through, roll-in, roll-through, or sliding doors on the market. DOE has tentatively developed multipliers for pass-through, sliding, and roll-in doors (roll-through is a combination of pass-through and roll-in), which in combination account for all the different door designs currently observed on the market. See table IV.7 for additional details.

TABLE IV.7—DESCRIPTION OF EQUIPMENT CLASS MULTIPLIERS FOR UNIQUE DOOR CHARACTERISTICS

Door type	Applicable equipment classes	Equipment type coefficient	Equipment class multiplier
Pass-through	VCT.RC.M; VCT.SC.M; VCT.SC.L; VCS.SC.M; VCS.SC.L	PT	1.04
Sliding	VCT.RC.M; VCT.SC.M	SD	1.07
Pass-through and Sliding	VCT.RC.M; VCT.SC.M	SDPT	1.11
Roll-in	VCT.RC.M; VCT.SC.M; VCS.SC.M; VCS.SC.L	RI	1.05
Roll-through	VCT.RC.M; VCT.SC.M; VCS.SC.M; VCS.SC.L	RT	1.09

In section IV.A.1.b of this NOPR, DOE additionally proposes definitions for cold-wall and forced-air evaporators. Based on CCD data, information from commenters and manufacturer interviews, and DOE's directly analyzed units showing an energy use difference between certain types of CRE, DOE has tentatively developed an energy use multiplier for equipment classes that were directly analyzed in this NOPR as CRE with a cold-wall evaporator and which DOE observed CRE with forced-air evaporators in those equipment classes on the market. DOE has tentatively developed this multiplier to account for the additional energy use associated with a forced-air evaporator as compared to a cold-wall evaporator. See table IV.8 for additional details.

TABLE IV.8—DESCRIPTION OF EQUIPMENT CLASS MULTIPLIERS FOR UNIQUE REFRIGERATION SYSTEMS

Refrigeration system	Applicable equipment classes	Equipment type coefficient	Equipment class multiplier
Forced Air	HCS.SC.L	FA	1.2

DOE requests comment on its proposal to apply an energy use multiplier to certain equipment classes that contain CRE with unique utility and energy use characteristics. DOE additionally requests comment on the proposed multiplier values and equipment classes for which these multipliers would be applied.

b. 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 equipment.

After conducting the screening analysis described in section IV.B of this document and chapter 4 of the NOPR TSD, DOE considered the remaining design options in the engineering analysis to achieve higher efficiency levels. See chapter 5 of the NOPR TSD for additional detail on the design options.

Design Options beyond Baseline. In response to the June 2022 Preliminary Analysis, the CA IOUs recommended analyzing variable-speed fan control as a technology option for vertical, medium-temperature refrigerators. (CA IOUs, No. 43 at p. 2)

With respect to the recommendation from the CA IOUs, DOE has not considered variable-speed fan technology as a design option for this NOPR. For open cases, the evaporator fan must run continuously to maintain the air curtain so any variable-speed function could disrupt the air curtain. For closed cases, DOE did not receive any data to show energy use savings associated with variable-speed fan control and has tentatively determined that variable-speed fan control would not reduce energy use according to the DOE test procedure. DOE notes that it did consider evaporator fan control (*i.e.,* cycling the evaporator fan on and off as opposed to running constantly) as a design option. See chapter 5 of the NOPR TSD for additional information.

NAFEM commented that DOE should make it easier for the public to understand how it calculates possible improvements that reduce energy consumption, providing the example of the efficiency of permanent-magnet synchronous motors (also known as synchronous-reluctance motors). (NAFEM, No. 40 at p. 6) NAFEM commented that these motors, for which NAFEM stated DOE claimed a theoretical efficiency of 75 percent, are not available in the rated wattages found in the 2022 spreadsheet, despite being the basis for two design-level options. (*Id.*)

Based on feedback during manufacturer interviews, feedback from commenters, and a review of the current market, DOE has tentatively determined to remove permanent-magnet synchronous motors (previously referred to as synchronous-reluctance motors) from the NOPR analysis because motors currently available on the market do not span the range of CRE fan wattages and revolutions per minute needed for proper operation. For more information, see chapter 5 of the NOPR TSD.

The CA IOUs commented that the June 2022 Preliminary TSD inconsistently considered variable defrost for certain low- and medium-temperature categories. (CA IOUs, No. 43 at p. 6) As an example, the CA IOUs stated that the June 2022 Preliminary TSD analyzed variable defrost for horizontal open self-contained cases—medium temperature (''HZO.SC.M'') but not horizontal open self-contained cases—low temperature (''HZO.SC.L''). (*Id.*) The CA IOUs recommended that DOE review technology options analyzed across equipment categories for consistency and that DOE analyze variable defrost as a technology option for vertical glass door self-contained freezers (''VCT.SC.L'') and vertical solid door self-contained ice cream freezers (''VCS.SC.I'') because there are after-market controllers available to enable variable defrost in any freezer category. (*Id.*)

While DOE considered variable defrost as a design option in the June 2022 Preliminary Analysis, DOE has tentatively determined to remove this design option in the NOPR. Based on manufacturer feedback and test data, DOE has tentatively determined that there is variation across equipment classes and defrost types that would not allow for a variable-defrost control design option that is representative of each class. And based on discussions with manufacturers, all manufacturers are already controlling the defrost period on a time- or temperature-based defrost specific to each individual model to minimize the defrost time and energy consumption. For further discussion, see chapter 5 of the NOPR TSD.

AHT commented that it is unable to comprehend the listed energy-saving potentials for the different temperature classes and the values seem incorrect. (AHT, No. 48 at p. 6) AHT asked why the potential savings for variable-speed compressors, for example, are rated at 20 percent in the ice cream class, 35 percent in the low-temperature class, and zero percent in the medium-temperature class. (*Id.*)

DOE reviewed its engineering spreadsheet model and compressors analyzed and tentatively determined the discrepancy noted by AHT occurs because of the energy efficiency ratios (''EERs'') for single-speed and variable-speed compressors available on the market. Based on compressors analyzed from several manufacturers of CRE compressors, single-speed compressors available on the market, operating at medium back pressure (''MBP'') (medium-temperature refrigerators), typically have EERs more similar to those of variable-speed compressors available on the market, operating at MBP, when compared to compressors operating at low back pressure (''LBP'') (low-temperature freezers and ice-cream freezers). This means that there is less potential energy savings for medium-temperature refrigerators that use variable-speed compressors. The difference in EERs is based on the operation of a single-speed vs variable-speed compressor, which has a significant decrease in cooling capacity as the operating temperature decreases. See chapter 5 of the NOPR TSD for additional details on the compressor analysis.

Efficiency Levels and Max-Tech. AHRI commented that DOE has not defined efficiency levels in adequate detail and recommended that DOE verify its analysis for accuracy and consistency. (AHRI, No. 46 at p. 3)

NAMA commented that DOE should reduce the demands to make additional changes and acknowledge that manufacturers have already made changes that would contribute significantly to the Administration's climate change initiatives. (NAMA, No. 37 at p. 8) NAMA stated that the actual energy savings that can be attributed to DOE's design options in the June 2022 Preliminary TSD engineering analysis are closer to a 5–10-percent reduction from baseline energy usage after removing design options that are not technically feasible or that were accomplished years ago. (*Id.*) NAMA noted that its estimate of a 5–10-percent reduction is significantly lower than DOE's estimate of a 41-percent reduction in energy use. (*Id.*)

DOE has considered commenters' feedback, information gathered through manufacturer interviews, and additional testing of analysis units to update the analysis, including the efficiency levels and max tech. See chapters 3 and 5 of the NOPR TSD for a description of each design option and how each is incorporated into the NOPR analysis.

AHT commented that the limits from the March 2014 Final Rule have almost eliminated the equipment classes HCT.SC.M, HCT.SC.L, and HCT.SC.I. (AHT, No. 48 at p. 2) AHT stated that the closed units within these classes are among the most efficient food display equipment in retail stores and corresponding open units consume far more energy while being regulated less strictly. (*Id.*) AHT commented that the 72.6-percent reduction of energy consumption for the HCT.SC.M, the 60.4-percent reduction of energy consumption for the HCT.SC.L, and the 61.6-percent reduction of energy consumption for the HCT.SC.I are impossible, and AHT recommended repeating the engineering analysis for these equipment classes. (*Id.* at p. 3–6)

DOE has considered commenters' feedback, information gathered through manufacturer interviews, and additional testing of analysis units to update the analysis for horizontal closed transparent equipment. See chapter 5 of the NOPR TSD for additional details on the baseline specifications and design options analyzed for these equipment classes.

The Joint Commenters stated that, for several of the equipment classes analyzed, multiple models at comparable sizes in DOE's CCD exceed the max-tech efficiency level in the engineering analysis. (Joint Commenters, No. 39 at p. 3) The Joint Commenters provided an example that DOE's max-tech level for the representative service over counter remote condensing medium temperature (''SOC.RC.M'') unit is 14.7 kWh/day, yet there are multiple models in the CCD at a comparable size with energy consumption as low as about 10 kWh/day. (*Id.*) The Joint Commenters added that multiple models of vertical open self-contained medium temperature (''VOP.SC.M'') units significantly exceed DOE's max-tech level of 23.5 kWh/day at similar total display areas. (*Id.*) The Joint Commenters stated that models are available beyond DOE's max-tech levels for additional equipment classes as well and recommended that DOE set max-tech levels that are at least as high as efficiencies currently available on the market. (*Id.*)

While DOE considers the maximum efficiency level for CRE available on the market, there are certain components or technologies for equipment classes that manufacturers may choose to implement that are not directly analyzed as a design option. For example, some manufacturers may have different airflow designs for open cases that affect energy use, which are calibrated specific to a CRE model, referred to as an ''air curtain''. Air curtains are only applicable on open units (such as the VOP.SC.M equipment class mentioned by the Joint Commenters) and are intended to mitigate heat infiltration into the CRE. See section IV.B.1.d of this NOPR or chapters 3 and 4 of the NOPR TSD for additional details on air curtains. DOE analyzes design options that pass the screening criteria and have a measurable impact on CRE efficiency.

c. Engineering Spreadsheet Model

In performing the engineering analysis in the March 2014 Final Rule, DOE selected representative units for each primary equipment class to serve as analysis points in the development of cost-efficiency curves. 79 FR 17726, 17746. In selecting these units, DOE researched the offerings of major manufacturers to select models that were generally representative of the typical offerings produced within the given equipment class. *Id.* Unit sizes, configurations, and features were based on high-shipment-volume designs prevalent in the market. *Id.* Using these data, a set of specifications was developed defining a representative unit for each primary equipment class. *Id.* These specifications include geometric dimensions, quantities of components (such as fans), operating temperatures, and other case features that are necessary to calculate energy consumption. *Id.* Modifications to the units modeled were made as needed to ensure that those units were representative of typical models from industry, rather than a specific unit offered by one manufacturer. *Id.* This process created a representative unit for each equipment class with typical characteristics for physical parameters (*e.g.,* volume, TDA), and minimum performance of energy-consuming components (*e.g.,* fans, lighting). *Id.*

As noted in the Executive Summary of the June 2022 Preliminary Analysis, DOE analyzed the same representative volumes and TDAs developed in the March 2014 Final Rule. *See* 79 FR 17726, 17746. In the June 2022 Preliminary Analysis, DOE kept the same design specifications in most cases, but updated some design specifications to better match the directly analyzed units available on the market. DOE received several comments on the updates made to the engineering spreadsheet model, summarized below.

NAFEM stated that, as demonstrated in its 2015 brief,[49] errors and omissions in the engineering spreadsheet have significant effects on DOE's CRE analyses and final standards-setting process. (NAFEM, No. 40 at p. 2) NAFEM commented that its members could provide important information to DOE to improve and correct its engineering spreadsheets to make any future proposed CRE rules less controversial and more representative of real-world applications. (*Id.* at p. 4) NAFEM stated that any concerns identified by NAFEM are only limited examples of issues it believes exist throughout the document. (*Id.*)

NAFEM stated that ITW compared the March 2014 Final Rule engineering spreadsheet to the 2022 engineering spreadsheet related to the preliminary analysis for CRE. (NAFEM, No. 40 at p. 4) NAFEM commented that the equipment classes subject to review were VCT.SC.M, VCT.SC.L, VCS.SC.M, and VCS.SC.L, which included self-contained refrigerators and freezers at medium and low temperatures with both solid and transparent vertical closed doors. (*Id.*) NAFEM commented that many of the observations provided by ITW applied to other equipment classes as well. (*Id.* at p. 5)

ITW commented that the CRE engineering spreadsheet made generalized assumptions that could be considered opinion versus facts and all product types in an equipment class are not reflected. (ITW, No. 41 at p. 2) ITW commented that the spreadsheet requires validation, that costs are inaccurate to the point of being useless, that more collaboration with manufacturers is needed, and that DOE should build confidence in the spreadsheet by making it more visible. (*Id.*)

Zero Zone commented that some of DOE's models have errors and asked that DOE share the raw data for these models, including, at minimum, the type and number of models that were reverse engineered and/or lab tested. (Zero Zone, No. 44 at p. 1)

With respect to the comments from NAFEM, ITW, and Zero Zone, DOE developed and calibrated the engineering spreadsheet model based on test data from directly analyzed units, feedback from manufacturer interviews, and market data from the CCD. DOE has also published the engineering spreadsheet model for the June 2022 Preliminary Analysis and for this NOPR. In support of this NOPR, DOE tested 70 CRE models and reverse engineered 47 CRE models. These models consisted of all equipment families within the scope of this NOPR except pull-down temperature applications, and all temperature classes. The volume range of these models is 3 ft^3–69 ft^3 and the TDA range is 5 ft^2–32 ft^2.

NAFEM requested an explanation regarding the 75-percent reduction in ''Infiltrated Air Mass Flow (lb/hr)'' on the 2022 engineering spreadsheet under ''Design Specifications'' when compared with the 2014 spreadsheet. (NAFEM, No. 40 at p. 6)

ITW similarly commented that DOE failed to provide any supporting documentation, calculations, or impact analysis for updates from the 2013 and 2014 CRE engineering spreadsheets to the 2022 revision used to estimate performance in terms of Infiltrated Air Mass Flow [lb/hr] and Polyurethane Foam K-Factor [Btu*in/ft^2h°F]. (ITW, No. 41 at p. 18) ITW commented that some design specifications listed in table 5A.2.5 through table 5A.2.8 were updated in the June 2022 Preliminary TSD while other changes received only brief commentary, such as ''Improved Resistivity of Insulation'' found in section 3.3.1.1 concerning polyurethane foam. (*Id.*) ITW further commented that this issue was discovered at the end of the comment period and that said comment period required extension because the changes do not represent a thermal efficiency improvement for polyurethane foam insulation. (*Id.*) ITW questioned why two differing methods were used to calculate the ''Conduction Through Walls and Solid Doors [Btu/hr]'' and requested justification for the change, stating that one formula in the spreadsheet or the other could be correct, but not both. (*Id.*)

ITW added that DOE spent considerable time in 2013 and 2014 developing the energy consumption model and calculating the right values for Infiltrated Air Mass Flow [lb/hr], working with manufacturers' detailed specifications, calculating sensible and latent heat loads due to infiltration, and reviewing and revising the infiltrated air mass flow values for certain equipment classes, including VCT and VCS based on stakeholder feedback. (*Id.* at pp. 18–23) ITW commented that, by contrast, in the 2022 CRE engineering spreadsheet, DOE made significant changes to the Infiltrated Air Mass Flow value for 17 different equipment classes, including VCT and VCS models, without an explanation other than DOE did update design specifications. (*Id.* at p. 23) ITW stated that the formulas used to calculate the ''Load Due to Infiltration [Btu/hr]'' on the engineering spreadsheet tab ''Calculations'' and the CRE cabinet specification have not changed from 2014. (*Id.*) ITW summarized its comment by stating DOE needed to explain this discrepancy or recalculate the 17 classes with revised or reverted values for Infiltrated Air Mass Flow [lb/hr]. (*Id.*) ITW concluded that its calculations resulted in the following assumptions: (1) DOE underestimated by 28 percent the theoretical quantity of heat (BTU/hr) infiltrating the representative 49 (cu ft) VCS.SC.M model during the 2014 CRE

[49] NAFEM included its 2015 brief in addition to their comment responses. NAFEM specifically referenced pp. 35–51 for this comment.

rulemaking; (2) DOE would overstate a decline in thermal performance for the foam insulation by 25 percent for the same model in the June 2022 Preliminary TSD; (3) if 1 and 2 were correct, DOE would need to correct its energy use model for all equipment classes; and (4) discrepancies in DOE's own parameter Conduction Through Walls and Solid Doors [Btu/hr] between the 2014 TSD and the June 2022 Preliminary TSD should have been flagged for further explanation and discussion in the June 2022 Preliminary TSD. (*Id.* at pp. 25–26)

ITW commented that DOE discarded specific data when faced with energy consumption values above the MDEC for the baseline unit in the 2022 engineering spreadsheet, instead calculating new values for the baseline unit and not DOE's own energy model. (*Id.* at p. 34) ITW questioned whether DOE trusted its engineering spreadsheet. (*Id.*)

Based on comments received from NAFEM and ITW, DOE has re-evaluated the infiltrated air-mass flow and insulation design specifications in this NOPR. Based on feedback provided from manufacturers during manufacturer interviews, DOE updated the infiltrated air-mass flow and insulation design specifications in this NOPR to be more consistent with the March 2014 Final Rule. See chapter 5 of the NOPR TSD for additional details.

Zero Zone commented that the fraction of power into case for evaporator motors is missing. (Zero Zone, No. 44 at p. 3) Zero Zone stated that this heat load is illustrated in the component load in the model diagram tab but not included in the daily energy consumption calculations. (*Id.*)

DOE reviewed the engineering spreadsheet model published to the docket [50] and found that this calculation was included (see the ''Calculations'' tab, row 176).

ITW commented that to review data in the CRE engineering spreadsheets, the Excel macros needed to function, but the 2013 and 2014 CRE engineering spreadsheet macros were not found to be executable in Excel using a 64-bit Windows 10 computer and instead required Excel running on a 32-bit WindowsNT machine. (ITW, No. 41 at p. 6)

In response to the comment from ITW, DOE notes that the data and formulas are reviewable regardless of the version of the Windows operating system being used because the macros do not affect the underlying data and formulas.

d. Industry Trade Association Survey

In response to the June 2022 Preliminary Analysis, three industry trade associations surveyed their members to provide feedback to DOE on the June 2022 Preliminary Analysis. The survey is located on the docket,[51] and DOE has provided a summary of the engineering-related results of the survey.

AHRI, NAMA, and NAFEM stated that more than 50 percent of the data in the survey was shared by small businesses (<1250 employees). (Trade Associations Survey, No. 50 at p. 8) The manufacturers surveyed manufacture all equipment types (to varying degrees) directly analyzed in the June 2022 Preliminary Analysis, besides VCT.SC.I equipment. (*Id.* at pp. 9–10)

The survey provided a heat map of design options currently used across different equipment classes. (*Id.* at p. 11) AHRI, NAMA, and NAFEM noted that all members reported using LED lighting and are unaware of any higher-efficiency lighting that could be incorporated into their equipment. (*Id.*) DOE notes that, based on the survey, all design options besides vacuum-insulated panels are currently used by at least a small percentage of the market, but many technologies are used by less than 50 percent of manufacturers surveyed. (*See Id.*)

AHRI, NAMA, and NAFEM provided a chart asking manufacturers why certain design options were not used. (*Id.* at p. 12) The responses included: ''not economically justified,'' ''reduced utility,'' ''not technologically feasible, '' ''limited market (not as desireable),'' ''already in use to meet current ECS,'' and ''option not available for this equipment.'' (*Id.*) AHRI, NAMA, and NAFEM added that the most common response was that the design options were already in use by manufacturers, and the second most common response was that those design options not already in use were not economically justified. (*Id.*)

AHRI, NAMA, and NAFEM stated that some manufacturers identified ways to use design options to meet EL 1–3 proposed in the June 2022 Preliminary Analysis; however, no manufacturers thought EL 4–6 was feasible for any equipment class. (*Id.* at p. 14) As a follow up to what ELs manufacturers thought were appropriate, AHRI, NAMA, and NAFEM stated that manufacturers responded that a 1-percent increase in energy efficiency over today's levels would be acceptable, and numerous responses stated that max tech has already been achieved. (*Id.* at p. 15)

AHRI, NAMA, and NAFEM commented that manufacturers reported using the most energy-efficient foam insulation available, with an average K factor of 0.15. (*Id.* at p. 19) AHRI, NAMA, and NAFEM stated that manufacturers primarily use high-pressure, two-component foam systems, with the remainder using an application technique, such as foam boards and spray polyurethane foam insulation. (*Id.*) AHRI, NAMA, and NAFEM noted that refurbished equipment is not reinsulated to meet the current standard. (*Id.*) AHRI, NAMA, and NAFEM also commented that increased thickness either increases the cabinet footprint or decreases internal dimensions in cases, making them more costly for consumers, especially for equipment replacement, which would require a redesign of the architecture of the store. (*Id.*) AHRI, NAMA, and NAFEM commented that survey respondents stated that increased insulation thickness would require a new foam mixture, as well as tooling and design changes, and decrease the display/storage area or increase the footprint of the equipment. (*Id.* at p. 20)

AHRI, NAMA, and NAFEM noted that survey respondents indicated that VIPs could not be incorporated into the foam matrix without early failures, raising concerns that VIPs are not a viable design option. (*Id.* at p. 19)

DOE has considered the results of this survey as part of its NOPR engineering analysis.

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 equipment, and the availability and timeliness of purchasing the equipment on the market. The cost approaches are summarized as follows:

- *Physical teardowns:* Under this approach, DOE physically dismantles a commercially available equipment, component by component, to develop a detailed bill of materials for the equipment.
- *Catalog teardowns:* In lieu of physically deconstructing equipment, DOE identifies each component using parts diagrams (available from manufacturer websites or appliance

[50] *See www.regulations.gov/document/EERE-2017-BT-STD-0007-0032.*

[51] *See www.regulations.gov/document/EERE-2017-BT-STD-0007-0050.*

repair websites, for example) to develop the bill of materials for the equipment.

• *Price surveys:* If neither a physical nor catalog teardown is feasible (*e.g.,* 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 physical and catalog teardowns. See chapter 5 of the NOPR TSD for additional details.

DOE received several comments in response to the June 2022 Preliminary Analysis related to the manufacturer production costs (''MPCs'').

NAFEM commented that it compared inflation index and cost model values in DOE's engineering spreadsheets with ITW's own calculations for the same values. (NAFEM, No. 40 at p. 5) NAFEM stated that significant discrepancies existed between DOE's and ITW's calculations of the inflation index for evaporator and condenser fan motors, evaporator coil, condenser coil, insulation, and core case cost. (*Id.*)

NAFEM commented also that it found inaccuracies in DOE's calculations used for a cost analysis of design-level technology options. (*Id.* p. 5) For example, according to NAFEM, the simulated condenser and evaporator coil costs for self-contained models were off or low by 250 percent and the costs for evaporator and condenser fan blades were off by more than 300 percent, having not been updated since before DOE published the March 2014 Final Rule. (*Id.*)

NAFEM commented that it reviewed the calculations and assumptions for DOE's energy analysis at the 16 design option levels, and NAFEM noted that ITW would supply DOE with a current inflation rate for review as a cost structure update for 2022. (*Id.* at pp. 5–6)

NAMA commented that it conducted an analysis of the effect of present inflation levels on the cost of components, summarizing the results of its analysis in a table showing the major components in efficiency compared with cost increases from October 2020 to April 2021 and from October 2021 to April 2022. (NAMA, No. 37 at pp. 13–14) NAMA recommended that DOE factor in the unprecedented inflation of basic constituents in CRE machines into the costs shown for design options and into the economic analysis. (*Id.* at p. 14)

ITW presented several examples of spreadsheet data comparing the 2014 TSD and June 2022 Preliminary TSD engineering spreadsheets. (ITW, No. 41 at pp. 36–47) ITW noted that, for all evaluations, MPC appeared to be down in 2022 relative to the 2014 reference, but the 2022 engineering spreadsheet did not reflect actual market changes, and when specifications and ordering were held to the 2014 reference, energy was up. (*Id.* at p. 37) ITW summarized that, as a result, the 2014 and 2022 engineering spreadsheets did not appear to have a strong correlation. (*Id.*)

AHRI commented that the baseline case should be modified to reflect current market prices, including the use of LEDs and energy-efficient doors, enhanced frames, and ECM fan motors. (AHRI, No. 46 at p. 6) AHRI commented that components were incorporated and upgraded to meet DOE's previous CRE energy-efficiency requirements and that the no-standards-case efficiency distribution will need to be amended based on those corrections. (*Id.*) AHRI stated that prices of various design options need to be upgraded for the no-standards-case efficiency distribution. (*Id.*)

ITW commented that, in DOE's engineering analysis in the June 2022 Preliminary TSD, DOE failed to establish an accurate baseline cost and, as a result, justification for any change to the MDEC was suspect to bias and/or error. (ITW, No. 41 at pp. 27–28) ITW commented that costs have not fallen by 12.4 percent or even remained flat as stated in the June 2022 Preliminary TSD, section 5.6 Core Case Costs, and that, in fact, costs have risen by up to 24.9 percent. (*Id.* at p. 28) ITW commented that it cannot make determinations or move forward without correcting the cost issue found in the June 2022 Preliminary TSD, considering that costs have not gone down since 2013 or 2014. (*Id.*)

In response to these comments, DOE has updated the NOPR analysis to reflect current inflation rates (*i.e.,* 2022 dollars) and component and design option costs based on feedback from commenters, feedback from manufacturer interviews, a review of market data, and teardowns of directly analyzed units. See chapter 5 of the NOPR TSD for additional details.

NAFEM commented that DOE should make it easier for the public to understand how it calculates possible improvements that reduce energy consumption. (NAFEM, No. 40 at p. 6) NAFEM identified the costs of microchannel condenser coils as an example where it believes improved clarity would be beneficial. (*Id.*)

With respect to the comment from NAFEM, DOE has further described the cost and efficiency assumptions for each design option, including microchannel condensers, in chapter 5 of the NOPR TSD.

NAMA commented that it found errors in the June 2022 Preliminary TSD for design options as follows: (a) high-efficiency reciprocating compressor for VCS.SC.M is shown at a cost of $9.23 but for VCT.SC.M it is shown as $4.01; (b) UA evaporator coil is shown for VCT.SC.H at $16.01 but for VCT.RC.M is $65.84, for VCS.SC.M is $14.33 and for VCT.SC.M is $22.90; (c) variable-speed compressor for VCS.SC.M is $72.54, for VCT.SC.M is $79.27 but for VCT.SC.L is $168.34; and (d) VIG door for VCT.SC.M is $837.38 but for VCT.RC.M is projected at $2,095.84. (NAMA, No. 37 at pp. 10–11) NAMA requested DOE's justification for variations in the cost of the same component and further stated that this rulemaking should be withdrawn and replaced with accurate estimates, particularly for machines under 30 cubic feet in capacity. (*Id.* at p. 12)

With respect to the comment from NAMA, DOE assigns design specifications and costs for each equipment class based on a representative volume or TDA. Therefore, components may be a different size or capacity than other equipment classes, which likely yields a different cost. DOE expects that the different representative volumes or TDAs account for the differences described by NAMA. For example, the VCT.SC.M primary equipment class analyzed has 2 doors, whereas the VCT.RC.M primary equipment class analyzed has 5 doors. For more information on the design option costs, see chapter 5 of the NOPR TSD.

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 industry average manufacturer markup by examining the prior CRE rulemaking and annual Securities and Exchange Commission (''SEC'') 10–K reports [52] filed by publicly traded manufacturers primarily engaged in commercial refrigeration manufacturing and whose combined equipment range includes CRE. 79 FR 17725, 17758. *See* section IV.J.2.d of this

[52] U.S. Securities and Exchange Commission's Electronic Data Gathering, Analysis, and Retrieval system is available at *www.sec.gov/edgar/searchedgar/companysearch* (last accessed March 30, 2023).

document and chapter 12 of the NOPR TSD for additional information on the manufacturer markup.

DOE seeks comment on the method for estimating manufacturing production costs.

3. Cost-Efficiency Results

The results of the engineering analysis are reported as cost-efficiency data (or ''curves'') in the form of daily energy consumption (in kWh) versus MPC (in dollars). DOE developed curves representing the primary equipment classes. The methodology for developing the curves started with determining the energy consumption for baseline equipment and MPCs for this equipment. Above the baseline, design options were implemented until all available technologies were employed (*i.e.,* at a max-tech level). See chapter 5 of the NOPR TSD for additional detail on the engineering analysis and appendix 5B of the NOPR TSD for complete cost-efficiency results.

In response to the June 2022 Preliminary Analysis, the Joint Commenters recommended that DOE evaluate additional, intermediate-efficiency levels for certain equipment classes that fall between the downstream efficiency levels currently analyzed. (Joint Commenters, No. 39 at p. 4) The Joint Commenters commented that EL 5 for the VCS.SC.M equipment class is cost effective but EL 6 is not; however, an intermediate level between EL 5 and EL 6 (a so-called ''EL 5.5'') could be cost effective. (*Id.*) The Joint Commenters stated that they provided a table (table 1) showing examples of classes in which an intermediate efficiency level may be cost effective. (*Id.*)

NAMA stated that DOE had requested comments on the design options for each equipment class, but provided very little information on which commenters can base comments. (NAMA, No. 37 at p. 10) NAMA provided a detailed review of each of the design options considered by DOE in annex A to its comment and commented that DOE estimated that options AD4, 8, 9, 11, 12, and 13 in table 5.8.8 (results for VCT.SC.M) each have energy savings of less than 3 percent. (*Id.* at pp. 10, 21–40) NAMA further stated that the change suggested by AD4 is not possible. (*Id.* at p. 10) NAMA commented that for other options, the savings potential is very small despite being extremely expensive, even using DOE's estimates, which NAMA stated are erroneous. (*Id.*) NAMA stated that it provided significantly different energy savings and cost estimates that it believes to be more accurate than those provided by DOE. (*Id.*)

In response to the comments from the Joint Commenters and NAMA, DOE updated the EL structure in its NOPR analysis to better reflect the cost-effective design path that manufacturers can take to achieve the ELs. DOE notes that design options are typically ordered by cost effectiveness, which may result in design options with low energy savings and high costs at the end of the design option order. DOE has updated the NOPR analysis based on comments received and manufacturer interview feedback. DOE provides additional details on design options in chapters 3–5 of the NOPR TSD.

D. Markups Analysis

The markups analysis develops appropriate markups (*e.g.,* wholesaler 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 equipment to cover business costs and profit margin.

In the June 2022 Preliminary Analysis, DOE considered the following distribution channels:

1a. Contractor channel with replacement (Manufacturer → Wholesaler → Mechanical Contractor → Consumer)

1b. Contractor channel with new construction (Manufacturer → Wholesaler → Mechanical Contractor → General Contractor → Consumer)

2. Wholesale channel (Manufacturer → Wholesaler → Consumer)

3. National account channel (Manufacturer → Consumer).

Following the June 2022 Preliminary Analysis, AHRI suggested that DOE should revise several channels, create a fourth channel for reused or refurbished equipment, and refer to consumers as ''end-users'' because the term consumer may imply individuals or families. (AHRI, No. 46 at pp. 3–4) AHRI also recommended DOE to include other CRE purchaser categories, such as buyer's clubs, restaurant consortiums, food service consultants, and governmental bids. (*Id.*). Further, in the Trade Associations Survey, some manufacturers proposed including an additional channel under channel 2 for OEM to OEM that ''moves through a supply chain similarly to a wholesaler.'' (Trade Associations Survey, No. 50 at p. 24)

In consideration of the AHRI feedback, DOE included an additional national account channel in which manufacturers sell the equipment to contractors, who in turn sell the equipment to end users. With regard to the suggested addition of distribution channels for reused or refurbished equipment, DOE notes that the markup analysis only pertains to new equipment purchases; therefore, DOE did not consider such distribution channels in the markups analysis. However, refurbishments were considered in the LCC analysis (see section IV.F of this document for details). In the Trade Associations Survey, no market share inputs were provided for the OEM-to-OEM channel. As a result, DOE did not consider this in the final distribution channels. DOE re-estimated the market shares of distribution channels based on manufacturer inputs from the Trade Associations Survey. DOE clarifies that it considers all purchasers of CRE in its analyses and is using the term CRE ''purchaser'' and ''consumer'' interchangeably in this document.

The CA IOUs commented that DOE should separate distribution channels by condensing unit configuration. (CA IOUs, No. 43 at p. 6) The CA IOUs stated that there are differences in the sales structure for remote-condensing and self-contained equipment that necessitate a separate pricing analysis. (*Id.*)

DOE acknowledges that equipment with different condensing unit configurations would have different applications and thus different sales structures. In the markups analysis, DOE contends that each equipment type (*e.g.,* display cases and solid-door equipment) consists of equipment with different condensing unit configurations, and their relative pricing structures are already reflected through the channels market shares. For example, the display-case equipment type is represented by a higher fraction of remote-condensing units used in large grocery store chains; hence, a greater share of shipments go through the national account channel, which provides better price advantages.

DOE developed baseline and incremental markups for each actor in the distribution chain. Baseline markups are applied to the price of equipment 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 and amended standards.[53]

DOE developed baseline and incremental markups for wholesalers and contractors using U.S. Census Bureau data from the 2017 Annual Wholesale Trade Report and the 2017 U.S. Economic Census, respectively.

DOE requests comment on the CRE distribution channels and overall on the markups analysis.

Chapter 6 of the NOPR TSD provides details on DOE's development of the markups analysis for CRE.

E. Energy Use Analysis

The purpose of the energy use analysis is to determine the annual energy consumption of CRE at different efficiencies in representative U.S. commercial buildings, and to assess the energy savings potential of increased CRE efficiency. The energy use analysis estimates the range of energy use of CRE 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.

For CRE, DOE calculated the energy consumption of the equipment as part of the engineering analysis (see chapter 5 of the NOPR TSD).

DOE requests comment on its approach for the energy use analysis.

Chapter 7 of the NOPR TSD addresses DOE's energy use analysis for CRE.

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 CRE. The effect of new and amended energy conservation standards on individual purchasers 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 equipment over the life of that equipment, 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 equipment.

• The PBP is the estimated amount of time (in years) it takes consumers to recover the increased purchase cost (including installation) of more-efficient equipment 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 CRE in the absence of new and amended energy conservation standards. In contrast, the PBP for a given efficiency level is measured relative to the baseline equipment.

For each considered efficiency level in each equipment class, DOE calculated the LCC and PBP for a nationally representative set of commercial buildings that use CRE. DOE developed commercial buildings samples from the DOE EIA's 2018 Commercial Buildings Energy Consumption Survey (''2018 CBECS'').[54] DOE divided the 2018 CBECS sample into building types characterized by their principal building activity (CBECS variable ''PBA'') using a subset of the data that excluded vacant buildings. DOE then grouped building types into six categories: (1) large food sales, (2) small food sales, (3) large food service, (4) small food service, (5) large other, and (6) small other. DOE defined small buildings as those less than or equal to 5,000 ft^2, while large buildings are defined as those greater than 5,000 ft^2. For each sample commercial building, DOE determined the energy consumption and the appropriate energy price of CRE. By developing a representative sample of CRE purchasers, the analysis captures the variability in energy prices associated with the use of CRE.

Inputs to the calculation of total installed cost include the cost of the equipment—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, equipment lifetimes, and discount rates. DOE created distributions of values for equipment 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 CRE user samples. For this rulemaking, DOE conducted probability analyses by randomly sampling from probability distributions using Python. To calculate the LCC and PBP for CRE, DOE performed 10,000 Monte Carlo simulations for each variable. During a single trial, random values are selected from the defined probability distributions for each variable, which enables the estimation of LCC and PBP with uncertainty evaluation. 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 purchaser, equipment efficiency is chosen based on its probability. If the chosen equipment 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 equipment, DOE avoids overstating the potential benefits from increasing equipment efficiency.

DOE calculated the LCC and PBP for consumers of CRE as if each were to purchase new equipment in the expected year of required compliance with new and amended standards. New and amended standards would apply to CRE manufactured 3 years after the date on which any new and amended standards are published. (42 U.S.C. 6313(c)(6)(C)(i). At this time, DOE estimates publication of a final rule in the second half of 2024. Therefore, for purposes of its analysis, DOE used 2028 as the first full year of compliance with any amended standards for CRE.

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 Python model,

[53] 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.

[54] U.S. Department of Energy—Energy Information Administration. 2018 Commercial Buildings Energy Consumption Survey (CBECS). 2018. Available at *www.eia.gov/consumption/commercial/data/2018/* (last accessed February 1, 2023).

and of all the inputs to the LCC and PBP analyses, are contained in chapter 8 of the NOPR TSD and its appendices.

TABLE IV.9—SUMMARY OF INPUTS AND METHODS FOR THE LCC AND PBP ANALYSIS *

Inputs	Source/method
Equipment Cost	Derived by multiplying MPCs by manufacturer and retailer markups and sales tax, as appropriate. Apply price learning between present (2022) and compliance year (2028) for LED lighting and variable-speed compressor electronics, using historical data to derive a price scaling index to project equipment costs for those components.
Installation Costs	Assumed not to change with efficiency level and, therefore, not considered in the LCC and PBP analyses.
Annual Energy Use	Obtained from the test procedure for each equipment class at each considered efficiency level.
Energy Prices	Electricity: Edison Electric Institute Typical Bills and Average Rates reports. Variability: Regional energy prices across nine census divisions.
Energy Price Trends	Based on *AEO2023*[55] price projections.
Repair and Maintenance Costs	Material costs derived from the engineering analysis and labor costs derived from RS Means 2023. Assumed additional labor time for maintaining equipment with microchannel heat exchangers; considered replacement of LED lighting, evaporators, condensers, and compressors; assumed LED lighting repair frequency decreases due to the presence of occupancy sensor.
Equipment Lifetime	Average: 10 years for large businesses and 20 years for small buildings.
Discount Rates	Approach involves identifying all possible debt or asset classes that might be used to purchase the considered equipment or might be affected indirectly. Primary data source was the Federal Reserve Board's Survey of Consumer Finances.
Compliance Date	2028.

* 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 NOPR TSD.

1. Equipment Cost

To calculate consumer equipment 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 equipment and higher-efficiency equipment because DOE applies an incremental markup to the increase in MSP associated with higher-efficiency equipment.

DOE used a price learning analysis to account for changes in LED lamp prices that are expected to occur between the time for which DOE has data for lamp prices (2022) and the assumed compliance date of the rulemaking (2028). See chapter 8 of the NOPR TSD for more details on how price learning for LED lighting was applied.

In response to the June 2022 Preliminary Analysis, the Joint Commenters noted that while DOE included price trends for lighting design options, other design options, such as variable-speed compressors and high-efficiency fans were not included, and the Joint Commenters encouraged DOE to incorporate price trends for additional CRE design options. (Joint Commenters, No. 39 at p. 5)

As discussed in section IV.C of this document, DOE included variable-speed compressors as a technology option for higher efficiency levels in certain equipment classes. To develop future prices specific for that technology, DOE applied a different price trend to the electronic control board of the variable-speed compressor. DOE estimated that the cost of that control board was 50 percent of the cost of the variable frequency drive (''VFD'') included in the variable speed compressor. DOE used Producer Price Index (''PPI'') data on ''semiconductors and related device manufacturing'' between 1967 and 2021 to estimate the historic price trend of electronic components in the control.[56] The regression, performed as an exponential trend line fit, results in an R-square of 0.99, with an annual price decline rate of 6.5 percent. See chapter 8 of the TSD for further details on this topic.

DOE requests comment on its price learning assumptions and methodology.

2. Installation Cost

Installation cost includes labor, overhead, and any miscellaneous materials and parts needed to install the equipment.

In response to the June 2022 Preliminary Analysis, the CA IOUs commented that DOE overestimated installation costs for self-contained equipment compared to remote condensing equipment. (CA IOUs, No. 43 at p. 7) DOE notes that, in the LCC and PBP, such costs were assumed not to vary by EL within the same equipment class, and, therefore, were not considered in the June 2022 Preliminary Analysis.

AHRI commented that more efficient equipment can be more expensive to install and may require more time to set up due to additional programming, equipment size changes with type of insulation used, and technician training. (AHRI, No. 46 at p. 5) Thus, AHRI concluded that installation cost may change with efficiency level. (*Id.*) Similarly, AHRI, NAMA, and NAFEM commented that adding components to CRE and increasing their energy efficiency would lead to increased installation costs due to additional programing time and floor space rearrangement needs. (Trade Associations Survey, No. 50 at p. 25) AHRI, NAMA, and NAFEM also stated that technicians require additional technical training to install such equipment. (*Id.*)

In response to these comments, DOE found no evidence that any of the analyzed design options considered in this NOPR require additional installation time. DOE estimates that installation workers may already have the required skills to install the analyzed design options or would adjust their labor rates equally across all efficiency levels if necessary skills are lacking. Therefore, as in the June 2022 Preliminary Analysis, DOE assumed that installation costs do not vary by efficiency level (within the same equipment class) and did not account for installation costs in the LCC and PBP analyses.

[55] 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 March 30, 2023).

[56] Semiconductors and related device manufacturing PPI series ID: PCU334413334413; *www.bls.gov/ppi/*.

DOE requests comment and data to inform how any of the analyzed design options would require additional installation time, training, or other related skills compared to the baseline equipment.

3. Annual Energy Consumption

For each equipment class, DOE determined the annual energy consumption for each sample equipment user of CRE at different efficiency levels using the approach described 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 equipment 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 for each census division using data from Edison Electric Institute (''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 commercial sector, DOE calculated electricity prices using the methodology described in Coughlin and Beraki (2019).[57]

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. For CRE, DOE calculated weighted-average values for average and marginal price for the nine census divisions for the commercial sector for both large-size (greater than 5,000 ft^2) and small-size (less than 5,000 ft^2) buildings. As the EEI data are published separately for summer and winter, DOE calculated seasonal prices for each division and sector. Each EEI utility in a given region was assigned a weight based on the number of consumers it serves. DOE adjusted these regional weighted-average prices to account for systematic differences between investor-owned utilities (''IOUs'') and publicly owned utilities (''POUs''), as the latter are not included in the EEI data set. See chapter 8 of the NOPR TSD for details.

To estimate energy prices in future years, DOE multiplied the 2022 energy prices by the projection of annual average price changes for each of the nine census divisions from the Reference case in *AEO2023,* which has an end year of 2050.[58] To estimate price trends after 2050, a simple average of the 2046–2050 values was used for 2051 and all subsequent years.

5. Repair and Maintenance Costs

Repair costs are associated with repairing or replacing equipment components that have failed in an appliance or equipment; maintenance costs are associated with maintaining the operation of the equipment. Typically, small incremental increases in equipment efficiency entail no, or only minor, changes in repair and maintenance costs compared to baseline efficiency equipment. DOE does not account for lost time when CRE fails or breaks, as DOE does not have data indicating how that would affect outcomes considered in the LCC, such as operating cost. In the June 2022 Preliminary Analysis, DOE calculated repair costs by considering the typical failure rate of refrigeration system components (compressor, lighting, and evaporator and condenser fan motors), component MPCs and associated markups, and the labor cost of repairs, which is assumed to be performed by private vendors. As discussed in sections 8.3.3 and 8.3.4 of the June 2022 Preliminary Analysis TSD, DOE considered the following specific CRE components and associated failure probabilities during typical CRE lifetime in its repair cost approach: compressor (25 percent), evaporator fan motor (50 percent), condenser fan motor (25 percent), and LED lighting (100 percent), with the presence of occupancy sensors decreasing LED lighting repair frequency by half.

In response to the June 2022 Preliminary Analysis, Continental commented that microchannel condenser coils require more frequent cleaning due to the accumulation of debris and are more susceptible to corrosion and leaks, which often requires replacement. (Continental No. 38 at p. 2) And AHRI stated that microchannel condenser coils require more frequent cleaning. (AHRI, No. 46 at pp. 5–6)

In response to these comments regarding the impact of microchannel condenser coils on repair and maintenance costs and based on feedback from manufacturer interviews, DOE agrees with commenters that microchannel condenser coils are subject to more accumulation of debris, which may result in extended cleaning time. However, DOE found no evidence that microchannel condenser coils may be more susceptible to corrosion and leaks, or that these problems are not repairable with similar labor and material inputs as baseline units. Accordingly, DOE has updated its maintenance costs of equipment with microchannel condenser coils to account for an additional 10 minutes of annual cleaning.

Continental commented that controls for defrost, lighting, and anti-sweat heaters can be challenging for technicians to diagnose and fix, leading to additional labor time and material replacement costs. (Continental No. 38 at p. 2) AHRI, NAMA, and NAFEM commented that adding higher-efficiency CRE components leads to increased repair and maintenance costs due to the component purchase price and labor time. (Trade Associations Survey, No. 50 at p. 26)

With respect to the comments from Continental and AHRI, NAMA, and NAFEM, DOE clarifies that neither vacuum-insulated panels nor controls for defrost and anti-sweat heaters are considered design options. DOE did not consider preventative maintenance for other design options, such as lighting occupancy sensors and night curtains, because DOE assumed they have similar average lifetimes to the equipment in which they are installed.

AHRI commented that additional labor costs should be considered for flammable refrigerants. (AHRI, No. 46 at p. 15) AHRI, NAMA, and NAFEM commented that equipment using alternative refrigerants (R–290) should have higher repair costs because leaks are harder to detect. (Trade Associations Survey, No. 50 at p. 26) DOE reiterates in response that equipment classes are analyzed individually and all analyzed self-contained equipment classes use R–290, so there are no refrigerant changes by efficiency level.

AHRI commented that labor shortages have caused an increase in servicing costs. (AHRI, No. 46 at p. 15) AHRI, NAMA, and NAFEM commented that there is a shortage of qualified service technicians for CRE in the United States

[57] Coughlin, K. and B. Beraki. 2019. Non-residential Electricity Prices: A Review of Data Sources and Estimation Methods. Lawrence Berkeley National Lab. Berkeley, CA. Report No. LBNL–2001203. Available at *ees.lbl.gov/publications/non-residential-electricity-prices* (last accessed March 9, 2023).

[58] EIA. *Annual Energy Outlook 2023.* Available at *www.eia.gov/outlooks/aeo/* (last accessed March 28, 2023).

and higher standards would exacerbate the issue and lead to longer equipment downtimes for food retailers. (Trade Associations Survey, No. 50 at p. 30) In response to these comments, DOE clarifies that short-term labor supply variations are not included in its analysis because economic theory maintains that labor markets are expected to adjust in the long-term period considered in the LCC analysis.

DOE requests comment and data on its assumptions and approach regarding consideration of repair and maintenance costs in the LCC and PBP analyses. Specifically, DOE requests data on the expected lifetimes and repair and maintenance frequencies of the considered design options in this NOPR.

6. Equipment Lifetime

DOE used a lifetime distribution to characterize the probability that CRE will be retired from service at a given age. For the June 2022 Preliminary Analysis, consistent with the approach followed in the March 2014 Final Rule, which was based on discussions with industry experts, DOE had assumed that lifetime of CRE is correlated to the frequency of store renovations. DOE had also estimated an average lifetime of 10 years for all large-size and small food-service buildings and 15 years for small food-sales buildings, and other businesses with CRE (per the CBECS sample) correlating such buildings with businesses that may have longer renovation cycles, such as independent grocery stores.[59] DOE also assumed that the probability function for the annual survival of CRE would take the form of a Weibull distribution. A Weibull distribution is a probability distribution commonly used to measure failure rates.[60] Further, in the June 2022 Preliminary Analysis, due to lack of data to suggest otherwise, DOE had assumed that retired but functional CRE had low salvage value and that the refurbished/used market for CRE was negligible. Therefore, DOE had not considered such CRE in the LCC analysis.

In response to the June 2022 Preliminary Analysis, AHRI commented that smaller businesses use their equipment for 15–25 years due to the cost of upgrading. (AHRI, No. 46 at p. 6) AHRI added that, in some cases, compressor racks may be used for 30–40 years, while display cases are switched out once during this time. (*Id.*) AHRI commented that businesses replacing CRE may also buy used equipment or ''reskin'' equipment by changing out sheet metal panels and bumpers. (*Id.*) NAMA recommended that DOE estimate the number of refurbished machines with an increased energy usage versus refurbished energy-compliant ones. (NAMA, No. 37 at p. 16)

Based on these comments, DOE has adjusted the mean lifetime distribution assumption for CRE to 10 years for large-size buildings and 20 years for small-size buildings, with a maximum lifetime of 40 years for each. DOE clarifies that it does not analyze the energy use of refurbished CRE because such equipment is not subject to new standards. However, DOE accounted for purchasers who sell their CRE to a refurbisher before the end of the equipment lifetime, by assigning a credit equivalent to the residual value of the used equipment at the selling year. See the following section (IV.F.7) for details on the residual value approach.

DOE requests comment and data regarding the CRE lifetime assumptions and methodology.

See chapter 8 of the NOPR TSD for more information.

7. Residual Value

To model the phenomenon of CRE sold for refurbishment, DOE utilized a residual value for such equipment in the LCC. The residual value represents the remaining dollar value of surviving CRE at the average age of refurbishment, estimated to be 5 years for small-size food service buildings (*e.g.,* restaurants) and 10 years for small-size food sales and other commercial buildings. To account for the value of CRE with remaining life to the consumer, the LCC model applies this residual value as a ''credit'' at the end of the CRE lifetime and discounts it back to the start of the analysis period. Per manufacturer feedback, this was only applied to a fraction of self-contained CRE in small buildings, totaling about 10 percent of all CRE in the LCC sample.

DOE requests comment and data on the assumed business types and the corresponding CRE lifetimes at which refurbishment may occur.

8. Discount Rates

In the calculation of LCC, DOE applies discount rates appropriate to commercial consumers to estimate the present value of future operating cost savings.

For purchasers of CRE in the commercial sector, DOE used the cost of capital to estimate the present value of cash flows to be derived from a typical company project or investment. Most companies use both debt and equity capital to fund investments, so the cost of capital is the weighted-average cost to the firm of equity and debt financing. This corporate finance approach is referred to as the weighted-average cost of capital. DOE used currently available economic data in developing commercial discount rates, with Damodaran Online being the primary data source.[61] The weighted-average discount rates for the commercial sector for CRE is 6.4 percent.

See chapter 8 of the NOPR TSD for further details on the development of discount rates.

9. 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 equipment efficiencies under the no-new-standards case (*i.e.,* the case without amended or new energy conservation standards).

To estimate the energy efficiency distribution of CRE for 2028, DOE used test data, feedback from manufacturer interviews, surveys (*see* Trade Associations Survey, No. 50), and the Single Compartment Commercial Refrigeration Equipment data from DOE's CCMS, accessed in March 2023.[62] As discussed in the engineering analysis, DOE assumed that all manufacturers will switch to R–290 in response to the December 2022 EPA NOPR, a proposed rule to restrict use of certain HFC refrigerants in specific equipment, including CRE. The EPA compliance date is 2025, which is earlier than the expected DOE CRE ECS compliance date of 2028. This approach reduces the potential maximum energy savings below the baseline compared to the June 2022 Preliminary Analysis.

To create a robust sample for the energy efficiency distribution used in the LCC analysis, DOE grouped the 28 CRE equipment classes into 21 separate groups. For the equipment classes that DOE relied on CCMS model count data

[59] See section 8.3.5 of the June 2022 Preliminary Analysis TSD and section 8.2.3.5 of the March 2014 Final Rule TSD for details.

[60] Weibull distributions are commonly used to model appliance lifetimes.

[61] Damodaran, A. Data: Cost of Capital by Industry Sector, United States. 2023. (Last accessed March 1, 2023.) *http://pages.stern.nyu.edu/~adamodar/.*

[62] U.S. Department of Energy. Compliance Certification Management System (CCMS) for Refrigeration Equipment—Commercial, Single Compartment. Available at *www.regulations.doe.gov/certification-data/CCMS-4-Refrigeration_Equipment_-_Commercial__Single_Compartment.html#q=Product_Group_s%3A%22Refrigeration%20Equipment%20-%20Commercial%2C%20Single%20Compartment%22* (last accessed April 4, 2023).

to formulate the efficiency distributions, this approach was used to allow equipment classes with a limited sample to share the efficiency distribution of a group of similar classes with a larger sample in the CCMS. DOE compared energy use data from the CCMS with energy use equations from the engineering analysis to derive model counts at each efficiency level. Equipment classes whose efficiency distributions were derived from aggregated data from manufacturer interviews, surveys, and test data were assigned their own groups. The estimated market shares for the no-new-standards case for CRE and the corresponding groupings are shown in table IV.10. See chapter 8 of the NOPR TSD for further information on the derivation of the efficiency distributions.

In response to the June 2022 Preliminary Analysis, Continental commented that DOE's approach to derive the no-standards-case efficiency distribution by relying on manufacturer model counts in the CCMS database is erroneous. (Continental, No. 38 at p. 2) Continental stated that model counts in DOE's CCMS do not reflect sales or market share, but rather the variety of different models that manufacturers offer. (*Id.*)

For this NOPR, as discussed in previous sections, DOE was able to conduct manufacturer interviews and collect shipments data for several equipment classes. The equipment classes for which data was collected account for 85 percent of total shipments and are marked with an asterisk in table IV.10. For the remainder of the equipment classes for which DOE was not able to collect representative shipments data from manufacturers, DOE utilized the CCMS database to estimate the no-new-standards-case efficiency distribution.

TABLE IV.10—NO-NEW-STANDARDS CASE EFFICIENCY DISTRIBUTIONS IN 2028

Equipment class	Group	Market share by efficiency level							
		EL 0 (%)	EL 1 (%)	EL 2 (%)	EL 3 (%)	EL 4 (%)	EL 5 (%)	EL 6 (%)	EL 7 (%)
VOP.RC.M	1	73	27	0	....	....	....	....	....
VOP.RC.L	1	73	27	0	....	....	....	....	....
VOP.SC.M *	2	86	5	4	0	0	5	....	....
VCT.RC.M	3	93	1	6	0	0	....	....	....
VCT.RC.L	3	93	1	6	0	....	....	....	....
VCT.SC.H *	4	60	15	17	5	0	0	0	3
VCT.SC.M *	5	48	17	17	1	0	0	17	0
VCT.SC.L*	6	35	5	0	50	0	0	10	0
VCT.SC.I	7	44	19	27	10	0	....	....	....
VCS.SC.H *	8	70	30	0	0	0	0	0	0
VCS.SC.M *	9	71	8	2	11	3	5	....	....
VCS.SC.L*	10	77	8	0	1	14	0	0	....
VCS.SC.I	11	100	0	0	0	0	0	0	....
SVO.RC.M	12	76	24	0	....	....	....	....	....
SVO.SC.M	13	66	2	2	8	8	2	1	10
SOC.RC.M	14	98	1	1	0	0	....	....	....
SOC.SC.M	15	36	7	9	6	15	0	2	25
HZO.RC.M	16	100	0	....	....	....	....	....	....
HZO.RC.L	16	100	0	....	....	....	....	....	....
HZO.SC.M	17	81	4	15	0	0	0	....	....
HZO.SC.L	17	81	4	15	0	0	0	....	....
HCT.SC.M	18	72	6	0	9	2	0	2	9
HCT.SC.L	18	72	6	0	9	2	0	2	9
HCT.SC.I	18	72	6	0	9	2	0	2	9
HCS.SC.M	19	88	12	0	0	....	....	....	....
HCS.SC.L	19	88	12	0	0	....	....	....	....
CB.SC.M *	20	50	40	10	0	0	0	0	....
CB.SC.L *	21	70	30	0	0	0	0	0	....

* The distributions for these equipment classes were derived from aggregated data from the Trade Associations Survey, test data, and manufacturer interview data.

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

While DOE acknowledges that economic factors may play a role when consumers purchase CRE, assignment of CRE efficiency for a given installation, based solely on economic measures such as life-cycle cost or simple payback period, most likely would not fully and accurately reflect actual real-world installations. There are a number of market failures discussed in the economics literature that illustrate how purchasing decisions in the commercial sector with respect to energy efficiency are unlikely to be perfectly correlated with energy use. One study in particular showed evidence of substantial gains in energy efficiency that could have been achieved without negative repercussions on profitability, but the investments had not been undertaken by firms.[63] The study found that multiple organizational and institutional factors caused firms to require shorter payback periods and higher returns than the cost of capital for alternative investments of similar risk. A number of other case studies similarly demonstrate the existence of market failures preventing the adoption of energy-efficient technologies in a variety of commercial sectors around the world, including

[63] DeCanio, S.J. (1998). ''The Efficiency Paradox: Bureaucratic and Organizational Barriers to Profitable Energy-Saving Investments,'' *Energy Policy,* 26(5), 441–454.

office buildings,[64] supermarkets,[65] and the electric motor market.[66]

DOE requests comment on its methodology and data to better inform the no-standards-case efficiency distribution for CRE.

10. 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 equipment, compared to baseline equipment, through energy cost savings. Payback periods that exceed the life of the equipment 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 equipment 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 equipment 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. 6316(e)(1); 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 new and amended standards would be required.

G. Shipments Analysis

DOE uses projections of annual equipment shipments to calculate the national impacts of potential amended or new energy conservation standards on energy use, NPV, and future manufacturer cash flows.[67] The shipments model takes an accounting approach, tracking market shares of each equipment class and the vintage of units in the stock. Stock accounting uses equipment shipments as inputs to estimate the age distribution of in-service equipment stocks for all years. The age distribution of in-service equipment 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.

The shipments analysis projects units of open and closed refrigeration cases sold in future years in each of food sales, food service, and all other applications combined. These equipment classifications and applications are defined in EIA's 2018 CBECS. DOE estimates demand for these equipment categories in these applications by calculating demand coming from new construction as well as the replacement of retiring units, for each year.

To calculate new demand for these equipment classes in each application, DOE combined new and existing floorspace projections from *AEO2023* with saturation estimates based on 2018 CBECS and *AEO2023.* Shipments to meet this demand for these CRE equipment categories in each application are then disaggregated across the analyzed CRE classes, using fixed market shares derived from data collected during manufacturer interviews.

To compute demand for replacements, DOE used the lifetime distributions determined in the LCC analysis, which estimates an average lifetime of 10 years for large grocery/multi-line stores (food-sales buildings) and restaurants (food-service buildings), and an average lifetime of 20 years for small food-sales and food-service buildings, with a maximum lifetime of 40 years for all equipment. In each analysis year of the model, DOE calculated retirements across the distribution to compute all demand arising from the retirements.

In response to the June 2022 Preliminary Analysis, AHRI stated that significantly higher-cost equipment would drive growth of the refurbished equipment market and lead to continued use of older equipment with lower efficiencies and higher GWP refrigerants. (AHRI, No. 46 at p. 15) As discussed in section IV.F.6 of this NOPR, DOE revised its assumptions of lifetime of equipment for small buildings from 15 years at the stage of the preliminary analysis to 20 years in this NOPR. To account for the use of refurbished equipment, DOE assumed an elasticity effect for a fraction of the CRE shipments, which is limited to small-size buildings. DOE applied an elasticity constant of −0.5 to shipments for small-size buildings and scaled this constant down to −0.15 over a period of 20 years (then constant thereafter) from the current year of calculations.

DOE requests comment on the price elasticity assumptions for the CRE shipments analysis as they relate to the overall CRE market and the market for refurbished CRE.

AHRI stated that DOE incorrectly estimated the number of existing units in use, as well as their average lifespan and noted that there are significantly more units in current use than DOE estimated. (*Id.* at p. 7). In response, DOE notes that it collected shipments data during manufacturer interviews and re-estimated the market shares for each equipment class based on the collected data. DOE then used the shipment and stock estimates from the floorspace and saturations calculations and scaled them to the data obtained from the manufacturers for the year 2022. DOE notes that, due to lack of shipments data for some equipment classes with a small market share, DOE estimated their shipments based on other equipment classes with similar characteristics for those equipment classes. For example, in this NOPR, DOE assumed that shipments of VCT.SC.H are one percent of VCT.SC.I and that shipments for HZO.SC.M are equivalent to HZO.SC.L. More information on these assumptions can be found in chapter 9 of the NOPR TSD. DOE also compared its shipments data with the numbers provided by ENERGY STAR in its unit shipment and market penetration report for the calendar year 2021.[68] DOE's shipment results are generally consistent with the figures provided by ENERGY STAR,

[64] Prindle 2007, op. cit. Howarth, R.B., Haddad, B.M., and Paton, B. (2000). ''The economics of energy efficiency: insights from voluntary participation programs,'' *Energy Policy,* 28, 477–486.

[65] Klemick, H., Kopits, E., Wolverton, A. (2017). ''Potential Barriers to Improving Energy Efficiency in Commercial Buildings: The Case of Supermarket Refrigeration,'' *Journal of Benefit-Cost Analysis,* 8(1), 115–145.

[66] de Almeida, E.L.F. (1998), ''Energy efficiency and the limits of market forces: The example of the electric motor market in France'', Energy Policy, 26(8), 643–653. Xenergy, Inc. (1998), United States Industrial Electric Motor Systems Market Opportunity Assessment (Available at: *www.energy.gov/sites/default/files/2014/04/f15/mtrmkt.pdf*) (Last accessed Jan. 3, 2023).

[67] 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.

[68] ENERGY STAR®. ENERGY STAR® Unit Shipment and Market Penetration Report Calendar Year 2021 Summary. 2021. U.S. Environmental Protection Agency and U.S. Department of Energy. (Last accessed April 11, 2022.) *https://energystar.gov/sites/default/files/asset/document/2021%20Unit%20Shipment%20Data%20Summary%20Report_0.pdf.*

which reported 50-percent market penetration for the reported year.

Historically, the annual amount of CRE capacity shipped has been depicted in linear feet, which is also an alternative way to express shipments data. DOE determined the linear feet shipped for any given year by multiplying each unit shipped by its associated average length and then summing all the linear footage values. Chapter 9 of the NOPR TSD presents the representative equipment-class lengths used for the conversion of per-unit shipments to linear footage within each equipment class.

AHRI commented that changes to market shares would result in corresponding changes to shipping methodologies and added that some of the imposed requirements would cause retailers to favor open cases, or to take doors off completely. (AHRI, No. 46 at pp. 7–8) AHRI added that the impact of pending refrigerant regulations is unknown. (*Id.* at p. 8) AHRI also stated that because door cases have a greater maximum allowable charge compared to cases with doors, customers wishing to use A2L refrigerants may choose to use larger commercial refrigerators without doors. (*Id.* at p. 8) In response to these comments, DOE did not find any significant shift from closed cases to open cases or vice versa. The ratio between closed cases and open cases is approximately 93 percent and 7 percent respectively, as derived from manufacturer provided data for the year 2022. Based on these data, DOE concluded that any shift in the market may already have occurred and currently DOE does not anticipate any new market trends in this direction.

AHRI shared, in response to DOE's inquiring about market trends in the June 2022 Preliminary Analysis, that architecture in facilities is anticipated to change due to the refrigerant transition. (AHRI, No. 46 at p. 7) AHRI added that these changes are due in part to the lack of available refrigerants and the likely consequent growth in market share in self-contained and smaller units. (*Id.*) AHRI commented that a great deal of uncertainty exists about this direction. (*Id.*) DOE appreciates AHRI's comments and continues to request information on market trends and shipments data to better inform the shipments analysis.

Chapter 9 of the NOPR TSD provides additional details regarding the shipments analysis.

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 and amended standards at specific efficiency levels.[69] (''Consumer'' in this context refers to consumers of the equipment being regulated.) DOE calculates the NES and NPV for the potential standard levels considered based on projections of annual equipment 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, equipment costs, and NPV of consumer benefits over the lifetime of CRE sold from 2028 through 2057.

DOE evaluates the impacts of new and amended standards by comparing a case without such standards with standards-case projections. The no-new-standards case characterizes energy use and consumer costs for each equipment class in the absence of new and 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 equipment class if DOE adopted new and 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 equipment with efficiencies greater than the standard.

DOE utilized the Python programming language for its shipments' analysis. The final results of the shipments analysis are available in the NIA spreadsheet developed for this analysis, accessible at *www.regulations.gov/docket/EERE-2017-BT-STD-0007.* 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 the NOPR. Discussion of these inputs and methods follows the table. See chapter 10 of the NOPR 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	2028.
Efficiency Trends	N/A (No efficiency trends were applied).
Annual Energy Consumption per Unit	Expressed as a function of energy use at each TSL.
Total Installed Cost per Unit	Expressed as a function of cost at each TSL. Incorporates projection of future equipment prices.
Annual Energy Cost per Unit	Annual weighted-average values as a function of the annual energy consumption per unit and energy prices.
Repair and Maintenance Cost per Unit	Annual, weighted-average values from the LCC model.
Energy Price Trends	*AEO2023* projections (to 2050) and extrapolation thereafter.
Energy Site-to-Primary and FFC Conversion	A time-series conversion factor based on *AEO2023.*
Discount Rate	3 percent and 7 percent.
Present Year	2023.

1. Equipment Efficiency Trends

A key component of the NIA is the trend in energy efficiency projected for the no-new-standards case and each of the standards cases. Section IV.F.9 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 equipment classes for the first full year of anticipated compliance (2028) with an amended or new standard.

[69] The NIA accounts for impacts in the 50 States and U.S. territories.

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 (2028). In this scenario, the market shares of equipment 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 equipment 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 equipment class, market shares by efficiency level were held fixed to their estimated distribution in 2028.[70]

DOE requests comment on its assumption of no efficiency trend for CRE and seeks historical CRE efficiency data, ideally by equipment class or alternatively by equipment family, or overall for the CRE market as a whole.

2. National Energy Savings

The national energy savings analysis involves a comparison of national energy consumption of the considered equipment between each potential standards case and the case with no new and amended energy conservation standards. DOE calculated the national energy consumption by multiplying the number of units (stock) of each equipment (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.

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 document, 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[71] that EIA uses to prepare its AEO. 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 NOPR 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 equipment shipped during the projection period.

As discussed in section IV.F.1 of this document, DOE developed price trends for CRE with variable speed compressors and CRE with LED lighting. DOE applied the same trends to project component prices for each representative unit of each equipment class containing variable speed compressors and/or LED lighting. By 2057, which is the end date of the projection period, the average CRE LED lighting price is expected to drop by approximately 25 percent, while the average price of variable speed compressors is expected to drop by approximately 42 percent, relative to projected 2028 prices. Because these component prices do not typically contribute substantively to the overall price of equipment, overall equipment prices are projected to decrease by at most 7 percent by 2057 relative to 2028. The price of equipment at the current baseline efficiency level is expected to drop by at most 3 percent in the same period. For details on the price learning methodology and assumptions, see chapter 8 of the NOPR 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 commercial 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. To estimate repair and maintenance costs, DOE considered the typical failure rate of refrigeration system components, component MPCs and associated markups, and the labor cost of repairs. 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 and stock compared to the Reference case. NIA results based on these cases are presented in appendix 10C of the NOPR TSD.

Use of higher-efficiency equipment is occasionally associated with a direct rebound effect, which refers to an increase in utilization of the equipment due to the increase in efficiency. DOE did not find any data on the rebound effect specific to CRE that would indicate that end-users or CRE purchasers would alter the utilization of their equipment as a result of an increase in efficiency. CRE are typically plugged in and operate continuously; therefore, DOE assumed a rebound rate of 0.

In calculating the NPV, DOE multiplies the net savings in future years by a discount factor to determine their present value. For this NOPR, 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.[72] The discount rates for the determination of NPV are in contrast to the discount rates used in the LCC analysis, which are designed to

[70] DOE notes that, as discussed in section IV.C.1.a.i of this document, DOE has accounted for CRE efficiency trends by assuming that all self-contained units will have transitioned to R–290 (propane) by 2028.

[71] 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/forecasts/aeo/index.cfm* (last accessed March 9, 2023).

[72] United States Office of Management and Budget. *Circular A–4: Regulatory Analysis.* September 17, 2003. Section E. Available at *georgewbush-whitehouse.archives.gov/omb/memoranda/m03-21.html* (last accessed February 17, 2023).

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 and 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 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.

In response to the June 2022 Preliminary Analysis, AHRI commented that the cost per energy efficiency improvement will be very high and especially challenging for small business owners, and in particular for restaurants and small retailers located in rural and urban food deserts, in which profit margins are low. (AHRI, No. 46 at p. 8)

For this NOPR, DOE analyzed the impacts of the considered standard levels on small businesses. For this subgroup, DOE applied discount rates specific to small businesses to the same consumer sample that was used in the standard LCC analysis. DOE used the LCC and PBP model to estimate the impacts of the considered efficiency levels on this subgroup. For details on the subgroup analysis, see chapter 11 of the NOPR TSD.

J. Manufacturer Impact Analysis

1. Overview

DOE performed an MIA to estimate the financial impacts of new and amended energy conservation standards on manufacturers of CRE 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 new and 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, equipment shipments, manufacturer markups, and investments in R&D and manufacturing capital required to produce compliant equipment. The key GRIM outputs are the INPV, which is the sum of industry annual cash flows over the analysis period, discounted using the industry-weighted average cost of capital, and the impact to domestic manufacturing employment. The model uses standard accounting principles to estimate the impacts of more stringent energy conservation standards on a given industry by comparing changes in INPV and domestic manufacturing employment between a no-new-standards case and the various 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 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 NOPR TSD.

DOE conducted the MIA for this rulemaking in three phases. In Phase 1 of the MIA, DOE prepared a profile of the CRE manufacturing industry based on the market and technology assessment and publicly available information. This included a top-down analysis of CRE 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 CRE manufacturing industry, including company filings of form 10–K from the SEC,[73] corporate annual reports, the U.S. Census Bureau's *ASM,*[74] the U.S. Census Bureau's *Economic Census,*[75] the U.S. Census Bureau's *Quarterly Survey of Plant Capacity Utilization,*[76] and reports from Dun & Bradstreet.[77]

In Phase 2 of the MIA, DOE prepared a framework industry cash-flow analysis to quantify the potential impacts of new and amended energy conservation standards. The GRIM uses several factors to determine a series of annual cash flows starting with the announcement of the standard and extending over a 30-year period following the 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 CRE in order to develop other key GRIM inputs, including equipment 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 GRIM and to identify key issues or concerns. See section IV.J.3 of this document for a description of the key issues raised by manufacturers

[73] U.S. Securities and Exchange Commission. *Electronic Data Gathering, Analysis, and Retrieval system.* Available at *www.sec.gov/edgar/searchedgar/companysearch* (last accessed April 20, 2022).

[74] U.S. Census Bureau. *Annual Survey of Manufactures.* (2013–2022). Available at *www.census.gov/programs-surveys/asm.html* (last accessed February 1, 2023).

[75] U.S. Census Bureau. *Economic Census.* (2012 and 2017). Available at *www.census.gov/programs-surveys/economic-census.html* (last accessed February 1, 2023).

[76] U.S. Census Bureau. *Quarterly Survey of Plant Capacity Utilization.* (2010–2022). Available at *www.census.gov/programs-surveys/qpc/data/tables.html* (Last accessed December 14, 2022).

[77] Dun & Bradstreet Hoovers. Subscription login accessible at *app.dnbhoovers.com/* (last accessed March 27, 2023).

during the interviews. As part of Phase 3, DOE also evaluated subgroups of manufacturers that may be disproportionately impacted by new and 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 section VI.B of this document, ''Review under the Regulatory Flexibility Act,'' and in chapter 12 of the NOPR 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 2023 (the base year of the analysis) and continuing to 2057. DOE calculated INPVs by summing the stream of annual discounted cash flows during this period. For manufacturers of CRE, DOE used a real discount rate of 10.0 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 NOPR TSD.

a. Manufacturer Production Costs

Manufacturing more efficient equipment is typically more expensive than manufacturing baseline equipment due to the use of more complex components, which are typically more costly than baseline components. The changes in the MPCs of covered equipment can affect the revenues, gross margins, and cash flow of the industry. For this NOPR, DOE relied on a design-option approach, supported with the testing and reverse engineering of directly analyzed CRE. The design options were incrementally added to the baseline configuration and continued through the ''max-tech'' configuration (*i.e.,* implementing the ''best available'' combination of available design options). For a complete description of the MPCs, see section IV.C of this document and chapter 5 of the NOPR 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 2023 (the base year) to 2057 (the end year of the analysis period). See section IV.J.2.b of this document and chapter 9 of the NOPR 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 equipment designs into compliance. DOE evaluated the level of conversion-related expenditures that would be needed to comply with each considered efficiency level in each equipment class. For the MIA, DOE classified these conversion costs into two major groups: (1) product conversion costs; and (2) capital conversion costs. Product conversion costs are investments in research, development, testing, marketing, and other non-capitalized costs necessary to make equipment 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 equipment designs can be fabricated and assembled.

DOE based its estimates of the product conversion costs that would be required to meet each efficiency level on information obtained from manufacturer interviews; the design pathways analyzed in the engineering analysis; the equipment teardown analysis; the shipments analysis; and model count information. DOE estimated product development effort, including engineer, laboratory technician, and marketing resources, associated with design options and scaled the costs based on the number of basic models (or product platforms, depending on the nature of the design option). Product development effort varied by design option. DOE modeled door design changes (*i.e.,* moving from a double-pane to triple-pane door, incorporating vacuum-insulated glass) would require more complex system redesigns and more cost, as compared to implementing more efficient components (*e.g.,* incorporating a PSC motor or an ECM). DOE also assumed additional engineering effort would be required to optimize variable-speed compressors to ensure energy efficiency benefits, based on interview feedback.

To estimate industry product conversion costs, DOE multiplied the product development cost estimate at each efficiency level for each equipment class by the number of industry basic models or product platforms that would require redesign. DOE used its CCD [78] and California Energy Commission's MAEDbS [79] to identify CRE models covered by this proposed rulemaking. To identify chef bases and high-temperature CRE models, DOE further relied on publicly available data aggregated from web scraping retail websites. DOE used the no-new-standards case efficiency distribution from the shipments analysis to estimate the model efficiency distribution. DOE also included the estimated cost of testing to the DOE test procedure for chef bases and high-temperature units using the estimated per-unit testing cost of $5,000 detailed in the September 2023 Test Procedure Final Rule. 88 FR 66152, 66215.

In addition to the sources used to derive product conversion costs, DOE relied on additional sources of information such as the Trade

[78] 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 February 21, 2023).

[79] California Energy Commission's Modernized Appliance Efficiency Database System is available at *cacertappliances.energy.ca.gov/Pages/Search/AdvancedSearch.aspx* (last accessed February 21, 2023).

Associations Survey[80] to estimate the capital conversion costs manufacturers would incur to comply with potential new and amended energy conservation standards. During interviews, manufacturers provided estimates and descriptions of the required tooling changes required by the considered design options. (*See* Trade Associations Survey. No. 50 at pp. 16–18) Based on these inputs, DOE assumed that most component swaps, while requiring moderate product conversion costs, would not require changes to existing production lines or equipment, and, therefore, would not require notable capital expenditures because one-for-one component swaps would not require changes to existing production equipment (*i.e.,* manufacturers will continue to be able to use their existing production equipment and production lines to manufacture CREs that achieve higher efficiency levels through component swaps, which are typically associated with lower ELs). However, based on manufacturer feedback, DOE modeled some tooling and capital expenditures when manufacturers implement improved door designs and variable-speed compressors. For improved door designs, some manufacturers noted that they would need new fixtures. Incorporating additional panes of glass for high-volume equipment classes could also necessitate heavier duty lifting equipment to transport and assemble heavier glass packs. For variable-speed compressors, which could be larger than existing single-speed compressors, manufacturers may need new tools for the baseplate. To estimate industry capital conversion costs, DOE scaled the estimated capital expenditures at each efficiency level for each equipment class by the number of applicable OEMs.

As previously stated, the Trade Associations Survey included information about the anticipated capital investments associated with a range of design options. (*Id.* at pp. 16–18) The survey results showed high capital investments associated with increasing insulation thickness and incorporating vacuum-insulated panels. (*Id.* at p. 18) As discussed in section IV.B.1 of this document, DOE excluded these technologies from further consideration in the engineering analysis. Other design options potentially requiring notable capital investment included microchannel heat exchangers, additional panes of glass, and variable-speed compressors. DOE compared the feedback from the Trade Associations Survey with information from the equipment teardown analysis and manufacturer interviews and incorporated the feedback where applicable.

DOE requests detailed comment and information on the capital investments associated with each analyzed design option. In particular, DOE requests detailed comment and feedback on the specific changes in equipment and tooling required to incorporate microchannel heat exchangers, as DOE currently models microchannel heat exchangers as a purchased part that can be substituted for tube and fin heat exchangers with minor production line changes.

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

Regarding the potential investments associated with redesigning CRE to use flammable refrigerants in response to refrigerant regulations such as the December 2022 EPA NOPR, DOE did not consider these investments as conversion costs as they are independent of DOE actions related to any new or amended energy conservation standards. Instead, the refrigerant transition expenses are modeled as an impact to industry cashflow and are incorporated into both the no-new-standards case and standards cases. The refrigerant transition expenses includes redesigning CRE to use flammable refrigerants and retrofitting production facilities to accommodate flammable refrigerants. DOE relied on manufacturer feedback in confidential interviews, a report prepared for EPA,[81] results of the engineering analysis, and investment estimates submitted by NAMA and AHRI in response to the June 2022 Preliminary Analysis to estimate the industry refrigerant transition costs. Based on feedback, DOE assumed that the transition to low-GWP refrigerants would require industry to invest approximately $21.3 million in R&D and $33.3 million in capital expenditures (*e.g.,* investments in new charging equipment, leak detection systems, *etc.*). These costs are included in the no-new-standards case as well as the standards cases. See section V.B.2.e of this document or chapter 12 of the NOPR TSD for additional information.

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 non-production cost markups to the MPCs estimated in the engineering analysis for each equipment class and efficiency level. Modifying these manufacturer markups in the standards case yields different sets of impacts on manufacturers. For the MIA, DOE modeled two standards-case scenarios to represent uncertainty regarding the potential impacts on prices and profitability for manufacturers following the implementation of new and 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 an equipment 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 29 percent for all equipment classes.[82] 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 equipment. Therefore, this scenario represents an upper bound of industry profitability under a new and 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 no-new-standards-case operating profit. DOE implemented

[80] *www.regulations.gov/document/EERE-2017-BT-STD-0007-0050.*

[81] *See* pp. 5–113 of the ''Global Non-CO_2 Greenhouse Gas Emission Projections & Marginal Abatement Cost Analysis: Methodology Documentation'' (2019). Available at *www.epa.gov/sites/default/files/2019-09/documents/nonco2_methodology_report.pdf.*

[82] The gross margin percentage of 29 percent is based on a manufacturer markup of 1.40.

this 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 new and 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.

DOE seeks comment on the use of a 1.40 manufacturer markup for all CRE equipment classes analyzed in this proposed rule. DOE also seeks comment on the estimated manufacturer markups and incremental MSPs that result from the analyzed energy conservation standards.

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

3. Manufacturer Interviews

DOE interviewed manufacturers representing approximately 60 percent of the domestic CRE shipments. Participants included domestic-based and foreign-based OEMs. Participants included manufacturers with a wide range of market shares and variety of equipment offerings, including four manufacturers who offered equipment under the expanded scope.

In interviews, DOE asked manufacturers to describe their major concerns regarding the potential for more stringent energy conservation standards for CRE. The following section highlights manufacturer concerns that helped inform the projected potential impacts of an amended standard on the industry. Manufacturer interviews are conducted under NDAs, so DOE does not document these discussions in the same way that it does public comments in the comment summaries and DOE's responses throughout the rest of this document.

a. Changes to the Cabinet Structure

In interviews, manufacturers expressed numerous concerns about efficiency levels that would necessitate significant changes to the cabinet structure (*i.e.,* increasing insulation thickness or implementing VIPs). Regarding thicker insulation, manufacturers noted that changing the exterior dimensions of equipment would be extremely undesirable for the replacement market because customers expect equipment to fit within the same footprint as the equipment being replaced. A change in exterior dimensions could cause misalignment between existing cases and new cases. As manufacturers typically treat exterior dimensions as fixed, increasing insulation thickness would necessitate reducing interior volume, which could reduce useable, refrigerated volume. Furthermore, manufacturers stated that increasing insulation thickness would require significant capital and product conversion costs. Manufacturers would need to invest in new foam fixtures and tooling. Manufacturers would likely need to update all designs and tooling associated with the interior of the equipment.

Regarding VIPs, manufacturers noted there is very limited industry experience with incorporating VIPs into CRE. Manufacturers emphasized that commercial environments may not be suitable for VIPs as they could be easily punctured, which would erode any efficiency improvements. Manufacturers noted that it would be nearly impossible to do in-field replacements of ineffectual VIPs, meaning that a puncture could require an entirely new CRE unit. Manufacturers also noted that implementing VIPs would require significant investment and redesign to the foaming station, manufacturing facility, and equipment design. Typically, CRE designs require numerous fasteners to secure internal components to the cabinet, which would not be feasible with VIPs. Manufacturers also noted the need to allocate special warehouse space to ensure the VIPs are not jostled or roughly handled in the manufacturing environment.

b. Supply Chain Concerns

Multiple manufacturers expressed concerns about the ongoing supply chain constraints related to sourcing a range of components, such as high-efficiency motors, compressors, and control boards and electronics. Manufacturers noted that limited component availability, increases in raw material prices, and escalating shipping and transportation costs all affect manufacturer production costs. In addition to higher production costs, these manufacturers stated that the evolving nature of these component shortages requires dedicating personnel resources to identify and qualify new suppliers, build prototypes, conduct testing, and update equipment literature. Some manufacturers expressed concern about standard levels that would necessitate numerous component changes, as the manufacturers are already experiencing delays sourcing parts for prototypes. If these supply constraints continue through the end of the conversion period, industry could face capacity constraints. DOE discusses potential supply constraints in section V.B.2.c of this document.

4. Discussion of MIA Comments

In response to the June 2022 Preliminary Analysis, NAMA asserted that the convenience services industry had suffered greatly over the past 3 years due to new DOE energy efficiency regulations, new ENERGY STAR levels, regulations on refrigerants (*e.g.,* California Air Resources Board), the global pandemic, record inflation, and staffing troubles. (NAMA, No. 37 at pp. 2–3) NAMA commented that DOE assumed during the previous rulemaking that the industry would be using natural refrigerants, but industry had not completed these transitions due in part to pandemic shutdowns and the cost of redesigning and manufacturing. (*Id.* at p. 3)

Furthermore, NAMA commented that the costs associated with setting up the production of R–290 machines can easily cost between $0.5 million and $1.0 million per production line depending on the scale and stated that the June 2022 Preliminary TSD does not capture these costs. (*Id.* at pp. 7–8) NAMA commented further that the cost of redesigning equipment for lower GWP chemicals and the associated costs for safety compliance, improvements to factories, changes to service, and training of factory employees and service providers proved a huge burden to smaller manufacturers. (*Id.* at p. 3) NAMA stated that several of its member manufacturing companies qualified as small- and medium-enterprise businesses and requested that DOE pay close attention to the economic impacts of a new set of energy regulations on an industry already under extreme pressure. (*Id.*) NAMA recommended that the environmental impact analysis include the fact that the CRE industry has spent many millions of dollars converting to lower-GWP refrigerant blends and hydrocarbon refrigerants such as R–290, which have a direct and immediate impact on climate change. (*Id.* at p. 8)

AHRI commented similarly on the costs and burdens to transition to alternative refrigerants. (AHRI, No. 46 at pp. 12–13, 17–18) AHRI commented that the AIM Act requires refrigerant manufacturers to phase down the supply of high-GWP HFCs, encouraging CRE manufacturers to switch to low-GWP refrigerants, which often have some degree of flammability. (*Id.* at p. 18) AHRI commented that new low-GWP refrigerants would significantly impact CRE and that new safety standards must address the application of these new flammable refrigerants and subsequent leak mitigation. (*Id.*) AHRI commented that flammable refrigerant sensors would likely be employed, with significant redesign of equipment needed to achieve required mitigation capability, and all equipment would require certification to these new standards, which included a number of additional requirements due to the combination of multiple standards. (*Id.*) AHRI added that all equipment would also need to eliminate potential ignition sources. (*Id.*) AHRI stated that manufacturers estimate the capital investment needed to safely handle and store flammable refrigerants at manufacturing facilities at $0.5 to $1.0 million for small facilities that only manufacture self-contained equipment and $2.0 to $4.0 million for medium and larger facilities. (*Id.* at pp. 12–13) AHRI noted that some companies have made this investment and transitioned products with smaller charges (114 grams in areas of egress, such as hallways) and 150 grams limit in occupied spaces for A3 products (such as propane). (*Id.* at p. 13)

Regarding the comments about new DOE energy efficiency regulations, DOE's cumulative regulatory burden analysis is based on rulemakings that go into effect within a 3-year time frame before or after the expected compliance date of amended CRE energy conservation standards (2028). Section V.B.2.e of this document includes a list of DOE energy conservation standards rulemakings that contribute to cumulative regulatory burden within the 3-year period before or after the expected compliance date of new and amended CRE energy conservation standards, should they be finalized.

Regarding the comments about EPA's new ENERGY STAR levels, DOE notes that participating in ENERGY STAR is voluntary and not considered in DOE's analysis of cumulative regulatory burden.

Regarding the comments about the costs associated with redesigning equipment to make use of lower-GWP refrigerants, DOE understands that manufacturers of CRE using high-GWP refrigerants (*e.g.,* R–404a) will likely need to transition to alternative, lower-GWP refrigerants to comply with anticipated refrigeration regulations, such as the December 2022 EPA NOPR, prior to the expected 2028 compliance date of potential energy conservation standards. *See* 87 FR 76738. DOE did incorporate the estimated expenses associated with redesigning CRE to make use of flammable refrigerants and upgrading production facilities to accommodate flammable refrigerants in the GRIM. DOE relied on a range of sources to estimate the investment required to transition CRE using high-GWP refrigerants to low-GWP refrigerants that satisfy the restrictions outlined in the December 2022 EPA NOPR. These sources included feedback from confidential manufacturer interviews, a report prepared for EPA,[83] results of the engineering analysis, and investment estimates submitted by NAMA and AHRI in response to the June 2022 Preliminary Analysis. DOE also reviewed other public sources, such as retail websites, EPA's ENERGY STAR Product Finder dataset, and equipment literature to estimate the portion of the CRE market that still needs to transition to low-GWP refrigerants (*e.g.,* R–290). The expenses associated with a change in refrigerant are independent on DOE's proposal to amend energy conservation standards and are separate from DOE's estimates of conversion costs to meet amended standards. See section V.B.2.e of this document and chapter 12 of the NOPR TSD for additional discussion on cumulative regulatory burden.

NAMA commented that DOE should not discount the time and resources needed to evaluate and respond to simultaneous proposed test procedures and energy conservation standards for multiple equipment over a short period of time. (NAMA, No. 37 at p. 17) NAMA stated that when rulemakings occur simultaneously, the cumulative burden increases dramatically. (*Id.*) NAMA noted that manufacturers of CRE are in the middle of transitioning from HFC refrigerants to lower-GWP refrigerants and commented that additional requirements from DOE would increase the time necessary for transition. (*Id.*) NAMA commented that the transition to lower-GWP refrigerants is more impactful to the environment than the new energy efficiency requirements shown in the June 2022 Preliminary Analysis. (*Id.*) NAMA requested that DOE incorporate the financial results of the current cumulative regulatory burden analysis directly into the MIA by adding the combined costs of complying with multiple regulations into the product conversion costs in the GRIM. (*Id.* at p. 18) NAMA requested that DOE complete a consolidated analysis for multiple regulations starting from the time of the first regulation. (*Id.*) NAMA stated that DOE has asserted such an analysis would require counting the costs/investments and the revenues/profits for both equipment, which is correct and represents a feature, not a deficiency. (*Id.*) NAMA further commented that if this is not possible, DOE should incorporate a value reduction factor in the first post-regulation year of the analysis that subtracts the value lost from the remaining years of the previous regulation. (*Id.*)

Regarding NAMA's suggestion to account for the financial results of the cumulative regulatory burden analysis into the GRIM, DOE incorporated the estimated refrigerant transition costs that occur in the timeframe of the analysis directly into the GRIM in both the no-new-standards case and the standards-case to reflect the impact of refrigerant regulation on CRE industry cash flow. See section V.B.2.e of this document for additional information.

NAMA requested also that DOE stage its energy efficiency regulations at least 3, and preferably 5, years away from other significant and overlapping governmental regulations. (*Id.*) NAMA commented that changes to State and local building codes are another regulatory burden that should have been factored in the June 2022 Preliminary Analysis.

Regarding NAMA's suggestion to promulgate energy efficiency regulations at least 3, and preferably 5, years away from other significant and overlapping governmental regulations, DOE has statutory requirements under EPCA on the timing of rulemakings. For CRE, EPCA requires that, not later than 6 years after the issuance of any final rule establishing or amending a standard, DOE evaluate the energy conservation standards for each type of covered equipment and publish either a notification of determination that the standards do not need to be amended, or a NOPR that includes new proposed energy conservation standards (proceeding to a final rule, as appropriate). (42 U.S.C. 6316(e)(1)); 42 U.S.C. 6295(m)(1)) The current CRE energy conservation standards were implemented by the March 2014 Final Rule. 79 FR 17725. Under EPCA, any potential new and amended standards would go into effect (1) 3 years after the date on which the final amended standard is published or (2) if the Secretary determines, by rule, that 3 years is inadequate, not later than 5 years after the date on which the final rule is published. (42 U.S.C. 6313(c)(6)(C)). For this NOPR, DOE has proposed a 3-year compliance period after the date on which final amended standard is published. DOE welcomes stakeholder feedback on choice of 3

[83] *See* pp. 5–113 of the ''Global Non-CO_2 Greenhouse Gas Emission Projections & Marginal Abatement Cost Analysis: Methodology Documentation'' (2019). Available at *www.epa.gov/sites/default/files/2019-09/documents/nonco2_methodology_report.pdf.*

years or 5 years between the final rule publication and the compliance date.

NAMA commented that large inaccuracies exist in the tables of design options in the June 2022 TSD and that the June 2022 Preliminary TSD failed to take into account the substantial capital costs caused by these design options, not including recent cost increases due to inflation. (NAMA, No. 37 at pp. 9–10) NAMA stated that it sees no sign DOE has factored into its estimates the cost of capital-intensive design options, such as increased insulation, vacuum panels, heavier doors, and microchannel coils, and that these costs, which would be accrued on top of the millions of dollars being invested to move from high-GWP refrigerants to low-GWP refrigerants, comprise an issue of cumulative burden. (*Id.*)

With respect to NAMA's comment on design options and capital costs, DOE did not estimate capital conversion costs for the June 2022 Preliminary Analysis as DOE does not conduct a full MIA for rulemaking stages prior to the NOPR analysis stage. For this NOPR, DOE accounts for the capital investments required to implement the considered design options in the MIA. See section IV.J.2.c of this document for additional details on conversion costs.

AHRI commented that its members face significant regulatory burdens requiring redesign, retooling, testing, and listing of equipment; new regulations related to the inclusion of special/definite-purpose motors as regulated; state-mandated refrigerant emissions limits, which coincide with a change in the safety standard for CRE; and new regulations requiring elimination of the use of phenyl isopropylated phosphate (PIP 3:1) in components. (AHRI, No. 46 at p. 16) AHRI commented that recent changes to the scope of test procedures for electric motors will increase the burden on manufacturers significantly if all equipment using special and definite-purpose motors were suddenly forced to certify compliance with standards for component parts, including the testing, paperwork, and recordkeeping requirements that accompany certification. (*Id.* at pp. 16–17) AHRI stated that efficient electric motors incorporated into finished equipment are already a major part of the energy equation when OEMs consider what design options to apply to meet new standards, as is evidenced by the June 2022 Preliminary TSD, and urged DOE to account for these costs. (*Id.* at p. 17) AHRI recommended that DOE should consider the impact of new motor designs on CRE and stated that, for equipment yet to be produced, the impact could range from retesting/recertification aligning with safety standards to a full equipment redesign accommodating a new, larger motor. (*Id.*) AHRI commented that the impact could be devastating for equipment already installed in businesses as motors could no longer be available as replacement parts, thereby forcing consumers to prematurely discard equipment that could have otherwise been repaired, imposing significant additional costs on consumers, and generating environmental impacts that would likely entirely offset any marginal gains from the increased scope. (*Id.*) AHRI recommended that DOE should account for the decrease in useful life from this component regulation in the product's LCC calculations. (*Id.*) AHRI stated that the 180-day timeline for motor manufacturers to comply with the electric motor test procedure puts the need to consider the impact of motor test procedures into this analysis. (*Id.*) AHRI calculated and submitted a detailed cost analysis of changing an embedded motor totaling $304,000 for one model of commercial HVAC equipment in response to the electric motor rulemaking. (*Id.*) AHRI stated that CRE will likely face similar costs and that the expanded definition of ''manufacturer'' would redefine OEMs as electric motor manufacturers and they would need to comply with these certification requirements, which is a burden that DOE has not accounted for this burden in its analysis. (*Id.*)

DOE analyzes cumulative regulatory burden pursuant to section 13(g) of the Process Rule. Regarding comments related to the electric motors test procedure final rule published on October 19, 2022 (''October 2022 Final Rule''), DOE tentatively expects that the motors used in the CRE covered by this rulemaking would not be directly impacted by the electric motors rulemaking because the motors used in CRE are typically below 0.25 horsepower, and, thus, are outside the scope of the October 2022 Final Rule. *See* 87 FR 63588, 63601. Regarding comments related to a change in safety standards for CRE, DOE understands that existing safety standards will be replaced by UL 60335–2–89 in 2024 after which all new equipment and certain modifications to existing CRE will require evaluation to the latest edition of UL 60335–2–89. Some manufacturers noted that the latest edition of UL 60335–2–89 is more onerous than existing safety standards for CRE. DOE understood that the product conversion cost feedback from manufacturer interviews reflects the additional time investment associated with testing to UL 60335–2–89.

Regarding comments related to regulations requiring elimination of the use of PIP 3:1 in components, DOE did not consider chemical regulations in its NOPR cumulative regulatory burden analysis as EPA's final rule is not a CRE-specific Federal regulatory action and the required compliance date does not occur within the specified 3-year cumulative regulatory burden timeframe analyzed in this NOPR. *See* 87 FR 12875.

AHRI commented that manufacturers of chef bases, griddle stands, and other equipment for which there is no test procedure would have to spend additional time and funds to determine test efficacy and whether it is possible to meet DOE-designated energy conservation standards. (AHRI, No. 46 at p. 8)

DOE is proposing new and amended conservation standards for chef bases and high-temperature units (*e.g.,* VCT.SC.H, VCS.SC.H, CB.SC.M, CB.SC.L). In its modeling, DOE incorporated the upfront per-unit costs associated with testing to the September 2023 Test Procedure Final Rule for the classes of equipment for which there was no test procedure. DOE incorporated the testing costs into its product conversion cost estimates. See section IV.J.2.c of this document and chapter 12 of the NOPR TSD for additional details.

NAMA commented that the CRE industry has suffered shortages in the supply chain of critical parts during recent years. (NAMA, No. 37 at p. 14) Specifically, NAMA commented regarding difficulties in acquiring fabricated computer chips and other components in the electronics, displays, and electrical area. (*Id.*) NAMA stated that the economic analysis in support of the June 2022 Preliminary Analysis did not account for these disruptions. (*Id.*) NAMA recommended that DOE consider the impact of supply chain issues as part of the new energy efficiency standards levels. (*Id.*) NAMA commented that unavailable components had increased the complexity of equipment design, and further changes based on perceived energy efficiency added additional complexity without benefiting the customer. (*Id.*)

As detailed in section IV.J.3 of this document, DOE received similar comments about the challenges sourcing certain CRE components in recent years during confidential manufacturer interviews. DOE notes that increased costs associated with recent supply chain issues have been implemented in the cost analysis and are presented in the MPCs in this NOPR analysis, specifically by way of 5-year moving averages for materials and the most up-to-date information on purchased part prices for this NOPR analysis.

DOE requests comment on the availability of computer chips and other electronic components used in CREs in the timeframe of 2028, and specifically how availability would affect industry's ability to achieve higher efficiency levels.

NAFEM commented that DOE was evasive in DOE's response to comments regarding negative impacts on a substantial number of small businesses in the July 2021 RFI. (NAFEM, No. 40 at p. 4) NAFEM commented that it continues to work with the Small Business Administration (''SBA'') Office of Advocacy to ensure that small businesses have a direct avenue for input and that DOE properly assesses cumulative regulatory burden and conducts a fair regulatory flexibility analysis. (*Id.*)

DOE notes that there is no regulatory flexibility analysis or manufacturer impact analysis in the preliminary analysis stage of rulemakings. At this NOPR stage, DOE identified 25 small domestic OEMs selling covered CRE in the United States. In support of this NOPR analysis, DOE contractors conducted confidential manufacturer interviews, which included discussions with small, domestic OEMs. DOE incorporated their feedback into the MIA. Additionally, DOE analyzed the impact of the proposed amended standards on small business manufacturers in section VI.B of this document and in chapter 12 of the NOPR TSD.

NAMA commented that no contact between DOE consultants and its manufacturing members was apparent and stated its belief that the information in the June 2022 Preliminary TSD would have been more accurate and reflective of today's market if NAMA's members had been interviewed. (NAMA, No. 37 at p. 6)

DOE did not conduct preliminary manufacturer interviews in support of the June 2022 Preliminary Analysis. However, DOE conducted interviews with a range of manufacturers in support of this NOPR analysis. DOE conducted manufacturer interviews with eight CRE OEMs, representing approximately 60 percent of domestic industry shipments. For additional information on manufacturer interviews, see section IV.J.3 of this document and chapter 12 of the NOPR 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 to 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 factors 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 NOPR 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.[84]

FFC upstream emissions, which include emissions from fuel combustion during extraction, processing, and transportation of fuels, and ''fugitive'' emissions (direct leakage to the atmosphere) of CH_4 and CO_2, are estimated based on the methodology described in chapter 15 of the NOPR 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 the emissions control programs discussed in the following paragraphs, and the Inflation Reduction Act.[85]

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.[86] The *AEO* 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, 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.[87] 77 FR 9304 (Feb. 16, 2012). In the MATS final rule, EPA established a standard for hydrogen chloride as a surrogate for acid gas hazardous air pollutants (''HAP''), and also established a standard for SO_2 (a non-HAP acid gas)

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[84] Available at *www.epa.gov/sites/production/files/2021-04/documents/emission-factors_apr2021.pdf* (last accessed March 9, 2023).

[85] 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 March 30, 2023).

[86] 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 (December 27, 2011) (Supplemental Rule).

[87] 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.

as an alternative equivalent surrogate standard for acid gas HAP. The same controls are used to reduce HAP and non-HAP acid gas; thus, SO_2 emissions are being reduced as a result of the control technologies installed on coal-fired power plants to comply with the MATS requirements for acid gas. 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. 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 would 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 cases, NO_X emissions would remain near the limit even if electricity generation goes down. A different case could possibly result, depending on the configuration of the power sector in the different regions and the need for allowances, such that NO_X emissions might not remain at the limit in the case of lower electricity demand. In this case, energy conservation 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. Energy conservation 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 proposed 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. 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 equipment 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 NOPR.

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'').

In response to the June 2022 Preliminary Analysis, AHRI expressed concern that DOE's social cost of carbon (''SCC'') analysis used to generate the original 2007 and updated 2020 new interim value for the social cost of carbon dioxide extends beyond the statutory authority and the scope contemplated by Congress. (AHRI, No. 46 at p. 9) AHRI stated its belief that DOE should withdraw the SCC values and refrain from using the SCC in any other rulemaking or policymaking until the SCC undergoes a more rigorous notice, review and comment process. (*Id.*) AHRI added that while AHRI agrees that the SCC should be estimated, presented, and made publicly available for every DOE rule, the SCC has not been adequately reviewed before being used as a factor in calculating net benefits. (*Id.*)

As stated in section III.F.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, and considers them important to take into account when considering the need for national energy conservation. (See 42 U.S.C. 6316(e)(1); 42 U.S.C. 6295(o)(2)(B)(i)(IV)) In addition, Executive Order 13563 states 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).'' 76 FR 3821 (Jan. 21, 2011) For these reasons, DOE includes monetized emissions reductions in its evaluation of potential standard levels and reporting of net benefits. As previously stated, however, DOE would reach the same conclusion presented in this proposed rulemaking in the absence of the social cost of greenhouse gases.

AHRI stated that the SCC's time-period for analysis renders its applicability suspect. (AHRI, No. 46 at p. 9) AHRI noted that, in contrast to the timeframe considered for carbon emissions, DOE calculates the present value of the costs to consumers and manufacturers over a 30-year period. (*Id.*) AHRI contends that DOE's comparison of 30 years of cost to hundreds of years of presumed future benefits is inconsistent and improper. (*Id.*)

In response, DOE notes that its analysis considers the costs and benefits associated with 30 years of shipments of a covered product. Because such products continue to operate beyond 30 years, DOE accounts for energy cost savings and reductions in emissions until all products shipped within the 30-year period are retired. In the case of CO_2 emissions, which remain in the atmosphere and contribute to climate change for many decades, the benefits of reductions in emissions likewise occur over a lengthy period. To not include such benefits would be inappropriate. However, because benefits associated with a ton of CO_2 emissions are discounted to derive the SCC value for a given emissions year, and then the benefits from potential standards are discounted to the present, the contribution of climate change benefits in the far future to the total benefits from CO_2 reduction is very small.

AHRI stated that EPCA's focus is exclusively on benefits accruing within this nation, and thus SCC figures reported by DOE at the global level are beyond the scope and authority of DOE. (*Id.* at p. 10) As previously discussed in this section, many climate impacts that affect the welfare of U.S. citizens and residents are better reflected by global measures of the SC–GHG. 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.

AHRI stated that DOE wrongly assumes that SCC values will increase over time. (*Id.*) AHRI contended that the more economic development that occurs, the more adaptation and mitigation efforts are both undertaken by humanity and that a population living in a growing economy can afford to undertake. (*Id.*) In response, DOE notes that there are many reasons why the analysis of the IWG, along with other rigorous assessments, shows SCC values rising over time. Briefly, as concentrations of GHGs increase, so do the impacts on climate and sea level. Growing population in many parts of the world mean more people who would suffer the effects of heat waves and rising sea levels, and continued economic growth means that the overall magnitude of economic damage from climate change is likely to rise. In its February 2021 TSD, the IWG notes that various limitations in the analysis suggest that the range of SC–GHG estimates presented in the TSD likely underestimate societal damages from GHG emissions.[88]

AHRI commented that if DOE still chooses to include the SCC, DOE should consider the benefits of foam blowing and the refrigerant transition in its analysis. (*Id.* at p. 9) In response, DOE notes that the benefits of foam blowing agents and the refrigerant transition is independent of DOE actions related to any new and amended energy conservation standards, therefore such benefits are not accounted for in its monetizing emissions analysis.

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.

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 proposed rulemaking in the absence of the social cost of greenhouse gases. That is, the social costs of greenhouse gases, whether measured using the February 2021 interim estimates presented by the IWG or by another means, did not affect the rule ultimately proposed by DOE.

DOE estimated the global social benefits of CO_2, CH_4, and N_2O emission reductions using SC–GHG values that were based on the interim values 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''). 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. Therefore, the SC–GHG 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 that the interim SC–GHG estimates represent the most appropriate estimate of the SC–GHG until revised estimates have been developed reflecting the latest peer-reviewed science.

The SC–GHG estimates presented here were developed over many years, using a 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, which included 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 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 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.*[89] 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 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.[90] 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

[88] See the February 2021 SC–GHG TSD at p. 4. Available at *www.whitehouse.gov/wp-content/uploads/2021/02/TechnicalSupportDocument_SocialCostofCarbonMethaneNitrousOxide.pdf.*

[89] Marten, A.L., E.A. Kopits, C.W. Griffiths, S.C. Newbold, and A. Wolverton. Incremental CH_4 and N_2O mitigation benefits consistent with the U.S. Government's SC–CO_2 estimates. *Climate Policy.* 2015. 15(2): pp. 272–298.

[90] 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. *nap.nationalacademies.org/catalog/24651/valuing-climate-damages-updating-estimation-of-the-social-cost-of.*

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 proposed rulemaking. 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 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, 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 United States 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 proposed 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 SC–GHG TSD, existing estimates are both incomplete and an underestimate of total damages that accrue to the citizens and residents of the United States 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,[91] and recommended that discount rate uncertainty and relevant 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-percent and 7-percent 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-percent discount rate is not appropriate to apply to value the social cost of greenhouse gases in the analysis presented in this NOPR.

To calculate the present and annualized values of climate benefits, DOE uses the same discount rate as the

[91] 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 March 9, 2023); 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 March 9, 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/201612/documents/sc_co2_tsd_august_2016.pdf* (last accessed March 9, 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 Oxide. August 2016, available at *www.epa.gov/sites/default/files/2016-12/documents/addendum_to_sc-ghg_tsd_august_2016.pdf* (last accessed January 18, 2022).

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 SC–GHG 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, 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, and DOE agrees with this determination. 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.[92] 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 model IAMs, their incomplete treatment of adaptation and technological change, the incomplete way in which inter-regional and intersectoral linkages are modeled, 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–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 proposed rule likely underestimate the damages from GHG emissions. DOE concurs with this assessment.

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 NOPR were based on the values presented for the IWG's February 2021 TSD, which are shown in table IV.12 in five-year increments from 2020 to 2050. shows the updated sets of SC–CO_2 estimates from the IWG's TSD in 5-year increments from 2020 to 2050. The set of annual values that DOE used, which was adapted from estimates published by EPA,[93] is presented in appendix 14–A of the 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 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.10—ANNUAL SC–CO_2 VALUES FROM 2021 INTERAGENCY UPDATE, 2020–2050

[2020$ per metric ton CO_2]

Year	Discount rate and statistic			
	5% Average	3% Average	2.5% Average	3% 95th percentile
2020	14	51	76	152

[92] 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/wp-content/uploads/2021/02/TechnicalSupportDocument_SocialCostofCarbonMethaneNitrousOxide.pdf* (last accessed March 9, 2023).

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

TABLE IV.10—ANNUAL SC–CO_2 VALUES FROM 2021 INTERAGENCY UPDATE, 2020–2050—Continued
[2020$ per metric ton CO_2]

Year	Discount rate and statistic			
	5% Average	3% Average	2.5% Average	3% 95th percentile
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

For 2051 to 2070, DOE used SC–CO_2 estimates published by EPA, adjusted to 2020$.[94] These estimates are based on methods, assumptions, and parameters identical to the 2020–2050 estimates published by the IWG. DOE expects additional climate benefits to accrue for any longer-life CRE 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.

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 2020$ 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 NOPR 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 NOPR 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 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% Average	3% Average	2.5% Average	3% 95th percentile	5% Average	3% Average	2.5% Average	3% 95th percentile
2020	670	1,500	2,000	3,900	5,800	18,000	27,000	48,000
2025	800	1,700	2,200	4,500	6,800	21,000	30,000	54,000
2030	940	2,000	2,500	5,200	7,800	23,000	33,000	60,000
2035	1,100	2,200	2,800	6,000	9,000	25,000	36,000	67,000
2040	1,300	2,500	3,100	6,700	10,000	28,000	39,000	74,000
2045	1,500	2,800	3,500	7,500	10,000	30,000	42,000	81,000
2050	1,700	3,100	3,800	8,200	13,000	33,000	45,000	88,000

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.

2. Monetization of Other Emissions Impacts

For the NOPR, DOE estimated the monetized value of NO_X and SO_2 emissions reductions from electricity generation using the latest benefit per ton estimates for that sector from the EPA's Benefits Mapping and Analysis Program.[95] DOE used EPA's values for $PM_{2.5}$-related benefits associated with NO_X and SO_2 and for ozone-related benefits associated with NO_X for 2025, 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 period; for years beyond 2040 the values are held constant. 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 NOPR TSD).

DOE also estimated the monetized value of NO_X and SO_2 emissions reductions from site use of natural gas

[94] *See* EPA, *Revised 2023 and Later Model Year Light-Duty Vehicle GHG Emissions Standards: Regulatory Impact Analysis,* Washington, DC, December 2021. Available at *www.federalregister.gov/documents/2021/10/30/2021-27854/revised-2023-and-later-model-year-light-duty-vehicle-greenhouse-gas-emissions-standards* (last accessed March 9, 2023).

[95] U.S. Environmental Protection Agency. Estimating the Benefit per Ton of Reducing Directly-Emitted $PM_{2.5}$, $PM_{2.5}$ Precursors and Ozone Precursors from 21 Sectors. *www.epa.gov/benmap/estimating-benefit-ton-reducing-directly-emitted-pm25-pm25-precursors-and-ozone-precursors.*

in CRE using benefit-per-ton estimates from the EPA's Benefits Mapping and Analysis Program. Although none of the sectors covered by EPA refers specifically to residential and commercial buildings, the sector called ''area sources'' would be a reasonable proxy for residential and commercial buildings.[96] The EPA document provides high and low estimates for 2025 and 2030 at 3- and 7-percent discount rates.[97] DOE used the same linear interpolation and extrapolation as it did with the values for electricity generation.

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 NOPR 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 and amended energy conservation standards.

N. Employment Impact Analysis

DOE considers employment impacts in the domestic economy as one factor in selecting a proposed standard. Employment impacts from new and 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 equipment subject to standards, their suppliers, and related service firms. The MIA addresses those impacts. Indirect employment impacts are changes in national employment that occur due to the shift in expenditures and capital investment caused by the purchase and operation of more-efficient appliances. Indirect employment impacts from standards consist of the net jobs created or eliminated in the national economy, other than in the manufacturing sector being regulated, caused by (1) reduced spending by consumers on energy, (2) reduced spending on new energy supply by the utility industry, (3) increased consumer spending on the equipment 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 Bureau of Labor Statistics (''BLS''). BLS regularly publishes its estimates of the number of jobs per million dollars of economic activity in different sectors of the economy, as well as the jobs created elsewhere in the economy by this same economic activity. Data from BLS indicate that expenditures in the utility sector generally create fewer jobs (both directly and indirectly) than expenditures in other sectors of the economy.[98] There are many reasons for these differences, including wage differences and the fact that the utility sector is more capital-intensive and less labor-intensive than other sectors. Energy conservation standards have the effect of reducing consumer utility bills. Because reduced consumer expenditures for energy likely lead to increased expenditures in other sectors of the economy, the general effect of efficiency standards is to shift economic activity from a less labor-intensive sector (*i.e.,* the utility sector) to more labor-intensive sectors (*e.g.,* the retail and service sectors). Thus, 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 NOPR using an input/output model of the U.S. economy called Impact of Sector Energy Technologies version 4 (''ImSET'').[99] 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 there are 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 rulemaking. Therefore, DOE used ImSET only to generate results for near-term timeframes (2028–2032), where these uncertainties are reduced. For more details on the employment impact analysis, see chapter 16 of the NOPR TSD.

V. Analytical Results and Conclusions

The following section addresses the results from DOE's analyses with respect to the considered energy conservation standards for CRE. It addresses the TSLs examined by DOE, the projected impacts of each of these levels if adopted as energy conservation standards for CRE, and the standards levels that DOE is proposing to adopt in this NOPR. Additional details regarding DOE's analyses are contained in the NOPR TSD supporting this document.

A. Trial Standard Levels

In general, DOE typically evaluates potential new or amended standards for 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 equipment classes, to the extent that there are such

[96] ''Area sources'' represents all emission sources for which states do not have exact (point) locations in their emissions inventories. Because exact locations would tend to be associated with larger sources, ''area sources'' would be fairly representative of small dispersed sources like homes and businesses.

[97] ''Area sources'' are a category in the 2018 document from EPA, but are not used in the 2021 document cited above. Available at *www.epa.gov/sites/default/files/2018-02/documents/sourceapportionmentbpttsd_2018.pdf* (last accessed March 9, 2023).

[98] *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 *apps.bea.gov/scb/pdf/regional/perinc/meth/rims2.pdf* (last accessed March 9, 2023).

[99] 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 Guide.* 2015. Pacific Northwest National Laboratory: Richland, WA. PNNL–24563.

interactions, and price elasticity of consumer purchasing decisions that may change when different standard levels are set.

In the analysis conducted for this NOPR, DOE analyzed the benefits and burdens of six TSLs for CRE. DOE developed TSLs that combine efficiency levels for each analyzed equipment class. DOE presents the results for the TSLs in this document, while the results for all efficiency levels that DOE analyzed are in the NOPR TSD.

Table V.1 presents the TSLs and the corresponding efficiency levels that DOE has identified for potential new and amended energy conservation standards for CRE. TSL 6 represents the maximum technologically feasible (''max-tech'') energy efficiency for all equipment classes. TSL 5 represents the highest efficiency level with positive LCC savings, including subgroups, for all equipment classes. TSL 4 represents the highest efficiency level with maximum LCC savings for all equipment classes. TSL 3 represents the highest efficiency level with positive LCC savings and single speed compressor for equipment classes in which this design option was considered. TSL 2 represents the highest efficiency level with maximum LCC savings and single speed compressor for equipment classes with compressors, which also corresponds to the minimum efficiency level between TSL 4 and TSL 3. TSL 1 represents the minimum efficiency level with positive LCC savings.

TABLE V.1—TRIAL STANDARD LEVELS FOR CRE—EFFICIENCY LEVELS

Equipment class	TSL 1	TSL 2	TSL 3	TSL 4	TSL 5	TSL 6
VOP.RC.M	1	2	2	2	2	2
VOP.RC.L	1	2	2	2	2	2
VOP.SC.M	1	2	2	4	5	5
VCT.RC.M	1	1	3	1	3	4
VCT.RC.L	1	2	2	2	2	3
VCT.SC.M	1	1	1	3	3	7
VCT.SC.L	1	3	3	5	6	7
VCT.SC.I	1	2	2	2	2	4
VCT.SC.H	0	0	0	0	0	7
VCS.SC.M	1	3	3	3	4	5
VCS.SC.L	1	4	4	5	6	6
VCS.SC.I	1	4	4	5	6	6
VCS.SC.H	1	1	5	1	6	7
SVO.RC.M	1	1	2	1	2	2
SVO.SC.M	1	4	4	6	7	7
SOC.RC.M	1	1	3	1	3	4
SOC.SC.M	1	3	3	5	7	7
HZO.RC.M	1	1	1	1	1	1
HZO.RC.L	1	1	1	1	1	1
HZO.SC.M	1	2	2	3	5	5
HZO.SC.L	1	2	2	3	5	5
HCT.SC.M	0	0	0	0	0	7
HCT.SC.L	0	0	0	0	0	7
HCT.SC.I	1	0	0	1	2	7
HCS.SC.M	1	1	2	1	2	4
HCS.SC.L	1	1	1	1	1	3
CB.SC.M	1	2	4	2	5	6
CB.SC.L	1	4	4	5	6	6

Table V.2 presents the TSLs and the corresponding percent reduction in energy use below baseline by equipment class. The baseline values for the self-contained equipment classes are presented in table IV.6 in section IV.C.1.a of this document.

TABLE V.2—TRIAL STANDARD LEVELS FOR CRE—% ENERGY REDUCTION BELOW ANALYZED BASELINE

Equipment class	TSL 1 (%)	TSL 2 (%)	TSL 3 (%)	TSL 4 (%)	TSL 5 (%)	TSL 6 (%)
VOP.RC.M	4.5	12.2	12.2	12.2	12.2	12.2
VOP.RC.L	1.6	7.1	7.1	7.1	7.1	7.1
VOP.SC.M	2.6	11.0	11.0	21.9	22.6	22.6
VCT.RC.M	9.5	9.5	10.8	9.5	10.8	11.6
VCT.RC.L	3.4	3.8	3.8	3.8	3.8	6.8
VCT.SC.M	3.0	3.0	3.0	24.8	24.8	27.7
VCT.SC.L	2.9	4.6	4.6	16.7	17.0	20.1
VCT.SC.I	0.6	2.6	2.6	2.6	2.6	8.8
VCT.SC.H	0.0	0.0	0.0	0.0	0.0	41.3
VCS.SC.M	26.7	40.4	40.4	40.4	50.1	51.0
VCS.SC.L	6.6	13.8	13.8	22.6	23.2	23.2
VCS.SC.I	4.8	10.0	10.0	22.0	22.1	22.1
VCS.SC.H	53.9	53.9	69.3	53.9	77.6	78.1
SVO.RC.M	5.0	5.0	12.2	5.0	12.2	12.2
SVO.SC.M	3.4	14.9	14.9	22.6	23.7	23.7

TABLE V.2—TRIAL STANDARD LEVELS FOR CRE—% ENERGY REDUCTION BELOW ANALYZED BASELINE—Continued

Equipment class	TSL 1 (%)	TSL 2 (%)	TSL 3 (%)	TSL 4 (%)	TSL 5 (%)	TSL 6 (%)
SOC.RC.M	10.9	10.9	11.1	10.9	11.1	11.2
SOC.SC.M	13.7	22.9	22.9	38.9	39.8	39.8
HZO.RC.M	2.3	2.3	2.3	2.3	2.3	2.3
HZO.RC.L	1.1	1.1	1.1	1.1	1.1	1.1
HZO.SC.M	3.8	5.2	5.2	14.7	16.9	16.9
HZO.SC.L	2.4	3.1	3.1	17.7	18.4	18.4
HCT.SC.M	0.0	0.0	0.0	0.0	0.0	28.4
HCT.SC.L	0.0	0.0	0.0	0.0	0.0	43.2
HCT.SC.I	30.0	0.0	0.0	30.0	33.4	42.5
HCS.SC.M	36.7	36.7	44.2	36.7	44.2	45.4
HCS.SC.L	7.7	7.7	7.7	7.7	7.7	44.3
CB.SC.M	22.4	50.3	58.2	50.3	60.9	61.2
CB.SC.L	15.6	38.4	38.4	54.1	54.4	54.4

B. Economic Justification and Energy Savings

1. Economic Impacts on Individual Consumers

DOE analyzed the economic impacts on CRE consumers by looking at the effects that potential new and amended standards at each TSL would have on the LCC and PBP. DOE also examined the impacts of potential standards on selected consumer subgroups. These analyses are discussed in the following sections.

a. Life-Cycle Cost and Payback Period

In general, higher-efficiency equipment 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.,* equipment 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 equipment lifetime and a discount rate. Chapter 8 of the NOPR TSD provides detailed information on the LCC and PBP analyses.

Table V.3 through table V.58 show the LCC and PBP results for the TSLs considered for each equipment class. In the first of each pair of tables, the simple payback is measured relative to the baseline equipment. In the second table, impacts are measured relative to the efficiency distribution in the no-new-standards case in the compliance year (see section IV.F.9 of this document). Because some consumers purchase equipment with higher efficiency in the no-new-standards case, the average savings are less than the difference between the average LCC of the baseline equipment 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 an equipment 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.3—LCC AND PBP RESULTS BY EFFICIENCY LEVEL FOR CB.SC.L

TSL	Efficiency level	Average costs (2022F$)				Simple PBP (years)	Average lifetime (years)
		Installed cost	First year's operating cost	Lifetime operating cost	LCC		
	Baseline	2,413.64	275.08	2,506.40	4,780.95		14.0
1	1	2,447.35	239.80	2,212.22	4,518.53	1.0	14.0
	2	2,480.02	195.85	1,840.56	4,177.65	0.8	14.0
	3	2,496.88	192.38	1,814.45	4,167.42	1.0	14.0
2,3	4	2,513.22	188.05	1,780.62	4,148.99	1.1	14.0
4	5	2,654.88	155.98	1,527.83	4,029.69	2.0	14.0
5,6	6	2,675.72	155.68	1,613.81	4,135.31	2.2	14.0

Note: The results for each EL represent the average value if all purchasers in the sample use equipment with that efficiency level. The PBP is measured relative to the baseline equipment.

TABLE V.4—AVERAGE LCC SAVINGS FOR CB.SC.L

TSL	Efficiency level	Average LCC savings* (2022$)	% of consumers that experience net cost
1	1	263.09	0.0
	2	524.57	0.0
	3	534.80	0.0
2,3	4	553.24	0.0
4	5	672.54	0.2
5,6	6	566.92	1.3

* The calculation considers only affected consumers. It excludes purchasers whose purchasing decision would not change under a standard set at the corresponding EL, *i.e.*, those with zero LCC savings.

TABLE V.5—LCC AND PBP RESULTS BY EFFICIENCY LEVEL FOR CB.SC.M

TSL	Efficiency level	Average costs (2022$)				Simple PBP (years)	Average lifetime (years)
		Installed cost	First year's operating cost	Lifetime operating cost	LCC		
	Baseline	1,750.66	86.90	797.20	2,452.05		13.9
1	1	1,767.51	71.40	669.43	2,340.22	1.1	13.9
2,4	2	1,783.85	52.08	507.74	2,193.97	1.0	13.9
	3	1,800.70	49.43	488.95	2,191.11	1.3	13.9
3	4	1,817.04	46.12	464.25	2,181.85	1.6	13.9
5	5	1,958.70	45.03	484.78	2,336.27	5.0	13.9
6	6	1,992.58	44.94	571.95	2,455.47	5.8	13.9

Note: The results for each EL represent the average value if all purchasers in the sample use equipment with that efficiency level. The PBP is measured relative to the baseline equipment.

TABLE V.6—AVERAGE LCC SAVINGS FOR CB.SC.M

TSL	Efficiency level	Average LCC savings* (2022$)	% of consumers that experience net cost
1	1	111.31	0.0
2,4	2	208.70	0.0
	3	190.07	4.1
3	4	199.32	3.3
5	5	44.90	45.9
6	6	(74.29)	73.7

*The calculation considers only affected consumers. It excludes purchasers whose purchasing decision would not change under a standard set at the corresponding EL, *i.e.,* those with zero LCC savings.

TABLE V.7—LCC AND PBP RESULTS BY EFFICIENCY LEVEL FOR HCS.SC.L

TSL	Efficiency level	Average costs (2022$)				Simple PBP (years)	Average lifetime (years)
		Installed cost	First year's operating cost	Lifetime operating cost	LCC		
	Baseline	1,646.86	44.53	428.89	1,984.18		14.0
1–5	1	1,661.72	41.62	407.13	1,976.45	5.1	14.0
	2	1,803.38	28.51	321.35	2,024.44	9.8	14.0
6	3	1,827.70	27.85	404.44	2,130.49	10.8	14.0

Note: The results for each EL represent the average value if all purchasers in the sample use equipment with that efficiency level. The PBP is measured relative to the baseline equipment.

TABLE V.8—AVERAGE LCC SAVINGS FOR HCS.SC.L

TSL	Efficiency level	Average LCC savings* (2022$)	% of consumers that experience net cost
1–5	1	7.77	22.2
	2	(41.22)	72.9
6	3	(147.27)	96.1

*The calculation considers only affected consumers. It excludes purchasers whose purchasing decision would not change under a standard set at the corresponding EL, *i.e.*, those with zero LCC savings.

TABLE V.9—LCC AND PBP RESULTS BY EFFICIENCY LEVEL FOR HCS.SC.M

TSL	Efficiency level	Average costs 2022$				Simple PBP (years)	Average lifetime (years)
		Installed cost	First year's operating cost	Lifetime operating cost	LCC		
	Baseline	1,658.31	37.22	382.20	1,953.10		14.0
1,2,4	1	1,667.94	25.66	279.21	1,859.23	0.8	14.0
3,5	2	1,682.80	23.32	262.46	1,856.56	1.8	14.0
	3	1,707.13	23.02	348.86	1,965.99	3.4	14.0

TABLE V.9—LCC AND PBP RESULTS BY EFFICIENCY LEVEL FOR HCS.SC.M—Continued

TSL	Efficiency level	Average costs 2022$				Simple PBP (years)	Average lifetime (years)
		Installed cost	First year's operating cost	Lifetime operating cost	LCC		
6	4	1,848.81	22.94	379.24	2,130.58	13.3	14.0

Note: The results for each EL represent the average value if all purchasers in the sample use equipment with that efficiency level. The PBP is measured relative to the baseline equipment.

TABLE V.10—AVERAGE LCC SAVINGS FOR HCS.SC.M

TSL	Efficiency level	Average LCC savings* (2022$)	% of consumers that experience net cost
1,2,4	1	94.14	0.0
3,5	2	84.89	4.9
	3	(24.55)	73.5
6	4	(189.13)	99.1

*The calculation considers only affected consumers. It excludes purchasers whose purchasing decision would not change under a standard set at the corresponding EL, *i.e.,* those with zero LCC savings.

TABLE V.11—LCC AND PBP RESULTS BY EFFICIENCY LEVEL FOR HCT.SC.I

TSL	Efficiency level	Average costs (2022$)				Simple PBP (years)	Average lifetime (years)
		Installed cost	First year's operating cost	Lifetime operating cost	LCC		
2,3	Baseline	1,532.98	115.03	1,152.21	2,599.07		14.0
1,4	1	1,674.44	85.83	923.71	2,504.07	4.8	14.0
5	2	1,764.26	82.51	870.76	2,535.89	7.1	14.0
	3	1,795.72	81.94	954.60	2,649.42	7.9	14.0
	4	1,869.93	75.95	901.32	2,666.17	8.6	14.0
	5	1,882.40	74.88	891.73	2,668.35	8.7	14.0
	6	1,885.31	74.52	888.53	2,667.90	8.7	14.0
6	7	2,146.62	73.68	881.07	2,907.06	14.8	14.0

Note: The results for each EL represent the average value if all purchasers in the sample use equipment with that efficiency level. The PBP is measured relative to the baseline equipment.

TABLE V.12—AVERAGE LCC SAVINGS FOR HCT.SC.I

TSL	Efficiency level	Average LCC savings* (2022$)	% of consumers that experience net cost
1,4	1	93.84	15.0
5	2	55.03	32.5
	3	(58.42)	56.4
	4	(68.58)	63.7
	5	(69.11)	65.2
	6	(68.66)	65.0
6	7	(306.51)	85.8

*The calculation considers only affected consumers. It excludes purchasers whose purchasing decision would not change under a standard set at the corresponding EL, *i.e.,* those with zero LCC savings.

TABLE V.13—LCC AND PBP RESULTS BY EFFICIENCY LEVEL FOR HCT.SC.L

TSL	Efficiency level	Average costs (2022$)				Simple PBP (years)	Average lifetime (years)
		Installed cost	First year's operating cost	Lifetime operating cost	LCC		
1–5	Baseline	1,426.49	71.52	740.91	2,089.70		13.9
	1	1,567.94	53.78	614.92	2,097.45	8.0	13.9
	2	1,657.75	50.47	562.23	2,129.67	11.0	13.9
	3	1,689.21	49.85	645.27	2,242.46	12.1	13.9
	4	1,763.42	46.64	616.76	2,284.11	13.5	13.9
	5	1,775.89	46.06	611.63	2,290.76	13.7	13.9

TABLE V.13—LCC AND PBP RESULTS BY EFFICIENCY LEVEL FOR HCT.SC.L—Continued

TSL	Efficiency level	Average costs (2022$)				Simple PBP (years)	Average lifetime (years)
		Installed cost	First year's operating cost	Lifetime operating cost	LCC		
	6	1,778.80	45.87	609.92	2,291.80	13.7	13.9
6	7	2,040.10	45.42	605.93	2,534.87	23.5	13.9

Note: The results for each EL represent the average value if all purchasers in the sample use equipment with that efficiency level. The PBP is measured relative to the baseline equipment.

TABLE V.14—AVERAGE LCC SAVINGS FOR HCT.SC.L

TSL	Efficiency level	Average LCC savings* (2022$)	% of consumers that experience net cost
	1	(8.05)	42.8
	2	(39.67)	57.0
	3	(152.24)	71.5
	4	(178.19)	81.8
	5	(180.80)	83.9
	6	(181.84)	83.8
6	7	(421.60)	90.5

*The calculation considers only affected consumers. It excludes purchasers whose purchasing decision would not change under a standard set at the corresponding EL, *i.e.,* those with zero LCC savings.

TABLE V.15—LCC AND PBP RESULTS BY EFFICIENCY LEVEL FOR HCT.SC.M

TSL	Efficiency level	Average costs (2022$)				Simple PBP (years)	Average lifetime (years)
		Installed cost	First year's operating cost	Lifetime operating cost	LCC		
1–5	Baseline	1,310.11	33.30	378.46	1,617.43		14.0
	1	1,451.54	30.61	386.32	1,759.03	52.6	14.0
	2	1,541.34	27.30	333.51	1,791.13	38.5	14.0
	3	1,572.79	27.05	420.09	1,907.45	42.1	14.0
	4	1,646.98	25.79	408.84	1,966.35	44.9	14.0
	5	1,659.45	25.56	406.81	1,976.12	45.1	14.0
	6	1,662.35	25.48	406.14	1,978.19	45.1	14.0
6	7	1,923.61	25.31	404.56	2,223.67	76.8	14.0

Note: The results for each EL represent the average value if all purchasers in the sample use equipment with that efficiency level. The PBP is measured relative to the baseline equipment.

TABLE V.16—AVERAGE LCC SAVINGS FOR HCT.SC.M

TSL	Efficiency level	Average LCC savings* (2022$)	% of consumers that experience net cost
	1	(141.71)	72.3
	2	(164.18)	76.8
	3	(279.83)	77.8
	4	(307.69)	87.5
	5	(309.50)	89.8
	6	(311.58)	89.8
6	7	(551.40)	91.4

*The calculation considers only affected consumers. It excludes purchasers whose purchasing decision would not change under a standard set at the corresponding EL, *i.e.,* those with zero LCC savings.

TABLE V.17—LCC AND PBP RESULTS BY EFFICIENCY LEVEL FOR HZO.RC.L

TSL	Efficiency level	Average costs (2022$)				Simple PBP (years)	Average lifetime (years)
		Installed cost	First year's operating cost	Lifetime operating cost	LCC		
	Baseline	6,037.15	1,214.59	11,439.53	17,476.68		13.0

TABLE V.17—LCC AND PBP RESULTS BY EFFICIENCY LEVEL FOR HZO.RC.L—Continued

TSL	Efficiency level	Average costs (2022$)				Simple PBP (years)	Average lifetime (years)
		Installed cost	First year's operating cost	Lifetime operating cost	LCC		
1–6	1	6,180.64	1,203.55	11,249.48	17,430.12	13.0	13.0

Note: The results for each EL represent the average value if all purchasers in the sample use equipment with that efficiency level. The PBP is measured relative to the baseline equipment.

TABLE V.18—AVERAGE LCC SAVINGS FOR HZO.RC.L

TSL	Efficiency level	Average LCC savings * (2022$)	% of consumers that experience net cost
1–6	1	46.57	7.8

* The calculation considers only affected consumers. It excludes purchasers whose purchasing decision would not change under a standard set at the corresponding EL, *i.e.,* those with zero LCC savings.

TABLE V.19—LCC AND PBP RESULTS BY EFFICIENCY LEVEL FOR HZO.RC.M

TSL	Efficiency level	Average costs (2022$)				Simple PBP (years)	Average lifetime (years)
		Installed cost	First year's operating cost	Lifetime operating cost	LCC		
	Baseline	6,023.23	543.01	5,247.93	11,271.17		13.0
1–6	1	6,166.77	532.57	5,064.11	11,230.88	13.8	13.0

Note: The results for each EL represent the average value if all purchasers in the sample use equipment with that efficiency level. The PBP is measured relative to the baseline equipment.

TABLE V.20—AVERAGE LCC SAVINGS FOR HZO.RC.M

TSL	Efficiency level	Average LCC savings * (2022$)	% of consumers that experience net cost
1–6	1	40.29	10.8

* The calculation considers only affected consumers. It excludes purchasers whose purchasing decision would not change under a standard set at the corresponding EL, *i.e.,* those with zero LCC savings.

TABLE V.21—LCC AND PBP RESULTS BY EFFICIENCY LEVEL FOR HZO.SC.L

TSL	Efficiency level	Average costs (2022$)				Simple PBP (years)	Average lifetime (years)
		Installed cost	First year's operating cost	Lifetime operating cost	LCC		
	Baseline	3,086.17	1,070.30	9,605.52	12,578.04		13.1
1	1	3,102.46	1,048.99	9,428.65	12,416.86	0.8	13.1
2,3	2	3,117.28	1,042.34	9,374.71	12,377.19	1.1	13.1
4	3	3,399.80	911.71	8,295.65	11,570.22	2.0	13.1
	4	3,425.87	908.91	8,358.49	11,658.16	2.1	13.1
5,6	5	3,542.47	905.58	8,287.58	11,699.54	2.8	13.1

Note: The results for each EL represent the average value if all purchasers in the sample use equipment with that efficiency level. The PBP is measured relative to the baseline equipment.

TABLE V.22—AVERAGE LCC SAVINGS FOR HZO.SC.L

TSL	Efficiency level	Average LCC savings * (2022$)	% of consumers that experience net cost
1	1	160.85	0.0
2,3	2	193.59	0.0
4	3	971.22	0.2
	4	883.28	0.5

TABLE V.22—AVERAGE LCC SAVINGS FOR HZO.SC.L—Continued

TSL	Efficiency level	Average LCC savings* (2022$)	% of consumers that experience net cost
5,6	5	841.89	0.9

* The calculation considers only affected consumers. It excludes purchasers whose purchasing decision would not change under a standard set at the corresponding EL, *i.e.,* those with zero LCC savings.

TABLE V.23—LCC AND PBP RESULTS BY EFFICIENCY LEVEL FOR HZO.SC.M

TSL	Efficiency level	Average costs (2022$)				Simple PBP (years)	Average lifetime (years)
		Installed cost	First year's operating cost	Lifetime operating cost	LCC		
	Baseline	2,397.43	429.17	3,921.92	6,226.78		13.1
1	1	2,412.25	415.60	3,812.49	6,131.59	1.1	13.1
2,3	2	2,427.07	410.44	3,771.80	6,105.15	1.6	13.1
4	3	2,568.36	376.54	3,509.56	5,978.72	3.3	13.1
	4	2,594.43	371.96	3,556.41	6,050.63	3.4	13.1
5,6	5	2,711.05	368.63	3,398.99	6,005.32	5.2	13.1

Note: The results for each EL represent the average value if all purchasers in the sample use equipment with that efficiency level. The PBP is measured relative to the baseline equipment.

TABLE V.24—AVERAGE LCC SAVINGS FOR HZO.SC.M

TSL	Efficiency level	Average LCC savings* (2022$)	% of consumers that experience net cost
1	1	95.03	0.0
2,3	2	117.44	0.2
4	3	226.50	6.8
	4	154.59	19.6
5,6	5	199.91	14.8

* The calculation considers only affected consumers. It excludes purchasers whose purchasing decision would not change under a standard set at the corresponding EL, *i.e.,* those with zero LCC savings.

TABLE V.25—LCC AND PBP RESULTS BY EFFICIENCY LEVEL FOR SOC.RC.M

TSL	Efficiency level	Average costs (2022$)				Simple PBP (years)	Average lifetime (years)
		Installed cost	First year's operating cost	Lifetime operating cost	LCC		
	Baseline	13,455.98	847.97	8,984.53	22,440.51		12.9
1,2,4	1	13,653.31	770.99	7,801.16	21,454.47	2.6	12.9
	2	13,701.42	769.68	7,789.05	21,490.47	3.1	12.9
3,5	3	13,712.64	769.26	7,785.15	21,497.79	3.3	12.9
6	4	14,720.84	768.26	7,775.94	22,496.78	15.9	12.9

Note: The results for each EL represent the average value if all purchasers in the sample use equipment with that efficiency level. The PBP is measured relative to the baseline equipment.

TABLE V.26—AVERAGE LCC SAVINGS FOR SOC.RC.M

TSL	Efficiency level	Average LCC savings* (2022$)	% of consumers that experience net cost
1,2,4	1	986.27	0.0
	2	944.21	0.6
3,5	3	929.51	1.4
6	4	(70.50)	70.9

* The calculation considers only affected consumers. It excludes purchasers whose purchasing decision would not change under a standard set at the corresponding EL, *i.e.,* those with zero LCC savings.

TABLE V.27—LCC AND PBP RESULTS BY EFFICIENCY LEVEL FOR SOC.SC.M

TSL	Efficiency level	Average costs (2022$)				Simple PBP (years)	Average lifetime (years)
		Installed cost	First year's operating cost	Lifetime operating cost	LCC		
	Baseline	15,074.90	1,010.13	10,218.96	24,736.27		13.0
1	1	15,084.50	894.71	9,215.75	23,742.30	0.1	13.0
	2	15,216.87	841.08	8,823.37	23,477.38	0.8	13.0
2,3	3	15,292.93	816.47	8,630.16	23,357.41	1.1	13.0
	4	15,575.42	761.20	8,212.91	23,212.16	2.0	13.0
4	5	15,772.73	681.78	7,036.90	22,226.13	2.1	13.0
	6	15,820.79	676.67	6,992.45	22,227.96	2.2	13.0
5,6	7	16,888.21	673.64	7,052.97	23,316.27	5.4	13.0

Note: The results for each EL represent the average value if all purchasers in the sample use equipment with that efficiency level. The PBP is measured relative to the baseline equipment.

TABLE V.28—AVERAGE LCC SAVINGS FOR SOC.SC.M

TSL	Efficiency level	Average LCC savings* (2022$)	% of consumers that experience net cost
1	1	994.55	0.0
	2	1,085.17	0.4
2,3	3	1,015.54	0.9
	4	1,063.82	3.7
4	5	1,834.72	0.0
	6	1,832.85	0.0
5,6	7	698.37	25.6

*The calculation considers only affected consumers. It excludes purchasers whose purchasing decision would not change under a standard set at the corresponding EL, *i.e.,* those with zero LCC savings.

TABLE V.29—LCC AND PBP RESULTS BY EFFICIENCY LEVEL FOR SVO.RC.M

TSL	Efficiency level	Average costs (2022$)				Simple PBP (years)	Average lifetime (years)
		Installed cost	First year's operating cost	Lifetime operating cost	LCC		
	Baseline	6,998.28	1,115.54	11,064.57	18,062.84		13.0
1,2,4	1	7,222.52	1,068.46	10,317.17	17,539.69	4.8	13.0
3,5,6	2	7,833.88	1,001.65	9,696.11	17,529.99	7.3	13.0

Note: The results for each EL represent the average value if all purchasers in the sample use equipment with that efficiency level. The PBP is measured relative to the baseline equipment.

TABLE V.30—AVERAGE LCC SAVINGS FOR SVO.RC.M

TSL	Efficiency level	Average LCC savings* (2022$)	% of consumers that experience net cost
1,2,4	1	522.85	0.0
3,5,6	2	406.59	18.4

*The calculation considers only affected consumers. It excludes purchasers whose purchasing decision would not change under a standard set at the corresponding EL, *i.e.,* those with zero LCC savings.

TABLE V.31—LCC AND PBP RESULTS BY EFFICIENCY LEVEL FOR SVO.SC.M

TSL	Efficiency level	Average costs (2022$)				Simple PBP (years)	Average lifetime (years)
		Installed cost	First year's operating cost	Lifetime operating cost	LCC		
	Baseline	4,779.96	902.18	8,199.62	12,793.46		13.0
1	1	4,810.58	876.57	7,995.58	12,618.85	1.2	13.0
	2	4,844.20	864.11	7,897.08	12,552.66	1.7	13.0
	3	4,876.77	848.60	7,771.84	12,458.72	1.8	13.0
2,3	4	5,080.56	789.90	7,264.50	12,147.21	2.7	13.0
	5	5,363.08	746.66	6,953.23	12,107.44	3.8	13.0

TABLE V.31—LCC AND PBP RESULTS BY EFFICIENCY LEVEL FOR SVO.SC.M—Continued

TSL	Efficiency level	Average costs (2022$)				Simple PBP (years)	Average lifetime (years)
		Installed cost	First year's operating cost	Lifetime operating cost	LCC		
4	6	5,479.68	731.65	6,718.66	11,984.91	4.1	13.0
5,6	7	5,550.97	723.43	6,733.74	12,068.50	4.3	13.0

Note: The results for each EL represent the average value if all purchasers in the sample use equipment with that efficiency level. The PBP is measured relative to the baseline equipment.

TABLE V.32—AVERAGE LCC SAVINGS FOR SVO.SC.M

TSL	Efficiency level	Average LCC savings* (2022$)	% of consumers that experience net cost
1	1	175.56	0.0
	2	237.26	0.2
	3	324.02	0.1
2,3	4	600.52	0.1
	5	586.37	8.2
4	6	692.32	4.6
5,6	7	602.17	11.0

*The calculation considers only affected consumers. It excludes purchasers whose purchasing decision would not change under a standard set at the corresponding EL, *i.e.,* those with zero LCC savings.

TABLE V.33—LCC AND PBP RESULTS BY EFFICIENCY LEVEL FOR VCS.SC.H

TSL	Efficiency level	Average costs (2022$)				Simple PBP (years)	Average lifetime (years)
		Installed cost	First year's operating cost	Lifetime operating cost	LCC		
	Baseline	3,949.97	101.23	969.24	4,701.69		14.0
1,2,4	1	3,959.60	55.10	558.87	4,300.41	0.2	14.0
	2	3,991.29	50.58	535.86	4,307.35	0.8	14.0
	3	4,021.01	44.95	501.90	4,301.47	1.3	14.0
	4	4,037.86	43.59	494.32	4,309.82	1.5	14.0
3	5	4,054.20	41.89	483.62	4,314.55	1.8	14.0
5	6	4,195.84	34.74	451.10	4,415.86	3.7	14.0
6	7	4,242.12	34.34	536.33	4,544.82	4.4	14.0

Note: The results for each EL represent the average value if all purchasers in the sample use equipment with that efficiency level. The PBP is measured relative to the baseline equipment.

TABLE V.34—AVERAGE LCC SAVINGS FOR VCS.SC.H

TSL	Efficiency level	Average LCC savings* (2022$)	% of consumers that experience net cost
1,2,4	1	399.54	0.0
	2	270.97	17.8
	3	276.86	15.0
	4	268.51	17.4
3	5	263.78	18.4
5	6	162.47	31.6
6	7	33.51	52.8

*The calculation considers only affected consumers. It excludes purchasers whose purchasing decision would not change under a standard set at the corresponding EL, *i.e.,* those with zero LCC savings.

TABLE V.35—LCC AND PBP RESULTS BY EFFICIENCY LEVEL FOR VCS.SC.I

TSL	Efficiency level	Average costs (2022$)				Simple PBP (years)	Average lifetime (years)
		Installed cost	First year's operating cost	Lifetime operating cost	LCC		
	Baseline	4,529.28	627.67	5,752.96	10,031.71		14.1
1	1	4,538.91	602.08	5,524.85	9,812.69	0.4	14.1

TABLE V.35—LCC AND PBP RESULTS BY EFFICIENCY LEVEL FOR VCS.SC.I—Continued

TSL	Efficiency level	Average costs (2022$)				Simple PBP (years)	Average lifetime (years)
		Installed cost	First year's operating cost	Lifetime operating cost	LCC		
	2	4,568.63	584.86	5,387.74	9,703.65	0.9	14.1
	3	4,585.48	580.39	5,352.37	9,684.20	1.2	14.1
2,3	4	4,601.82	574.81	5,307.05	9,654.31	1.4	14.1
4	5	4,885.14	511.08	4,801.64	9,416.52	3.1	14.1
5,6	6	4,931.42	510.61	4,886.41	9,545.00	3.4	14.1

Note: The results for each EL represent the average value if all purchasers in the sample use equipment with that efficiency level. The PBP is measured relative to the baseline equipment.

TABLE V.36—AVERAGE LCC SAVINGS FOR VCS.SC.I

TSL	Efficiency level	Average LCC savings * (2022$)	% of consumers that experience net cost
1	1	219.02	0.0
	2	328.05	0.0
	3	347.51	0.0
2,3	4	377.40	0.0
4	5	615.19	3.6
5,6	6	486.70	8.9

* The calculation considers only affected consumers. It excludes purchasers whose purchasing decision would not change under a standard set at the corresponding EL, *i.e.,* those with zero LCC savings.

TABLE V.37—LCC AND PBP RESULTS BY EFFICIENCY LEVEL FOR VCS.SC.L

TSL	Efficiency level	Average costs (2022$)				Simple PBP (years)	Average lifetime (years)
		Installed cost	First year's operating cost	Lifetime operating cost	LCC		
	Baseline	4,195.10	411.78	3,767.90	7,721.94		14.0
1	1	4,204.73	388.98	3,565.71	7,528.82	0.4	14.0
	2	4,234.45	373.64	3,446.25	7,437.36	1.0	14.0
	3	4,251.30	369.23	3,411.70	7,418.70	1.3	14.0
2,3	4	4,267.64	363.74	3,367.39	7,389.78	1.5	14.0
4	5	4,409.29	332.97	3,125.76	7,281.65	2.7	14.0
5,6	6	4,455.57	331.05	3,197.27	7,396.77	3.2	14.0

Note: The results for each EL represent the average value if all purchasers in the sample use equipment with that efficiency level. The PBP is measured relative to the baseline equipment.

TABLE V.38—AVERAGE LCC SAVINGS FOR VCS.SC.L

TSL	Efficiency level	Average LCC savings * (2022$)	% of consumers that experience net cost
1	1	193.07	0.0
	2	265.56	0.1
	3	284.18	0.2
2,3	4	309.04	0.2
4	5	375.85	4.3
5,6	6	260.73	17.1

* The calculation considers only affected consumers. It excludes purchasers whose purchasing decision would not change under a standard set at the corresponding EL, *i.e.,* those with zero LCC savings.

TABLE V.39—LCC AND PBP RESULTS BY EFFICIENCY LEVEL FOR VCS.SC.M

TSL	Efficiency level	Average costs (2022$)				Simple PBP (years)	Average lifetime (years)
		Installed cost	First year's operating cost	Lifetime operating cost	LCC		
	Baseline	3,956.46	112.72	1,080.77	4,809.78		14.1
1	1	3,966.08	87.24	854.78	4,592.87	0.4	14.1

TABLE V.39—LCC AND PBP RESULTS BY EFFICIENCY LEVEL FOR VCS.SC.M—Continued

TSL	Efficiency level	Average costs (2022$)				Simple PBP (years)	Average lifetime (years)
		Installed cost	First year's operating cost	Lifetime operating cost	LCC		
	2	3,995.80	77.73	786.61	4,552.70	1.1	14.1
2–4	3	4,012.13	74.16	759.47	4,540.95	1.4	14.1
5	4	4,153.76	64.87	709.37	4,624.33	4.1	14.1
6	5	4,200.04	64.02	790.45	4,749.02	5.0	14.1

Note: The results for each EL represent the average value if all purchasers in the sample use equipment with that efficiency level. The PBP is measured relative to the baseline equipment.

TABLE V.40—AVERAGE LCC SAVINGS FOR VCS.SC.M

TSL	Efficiency level	Average LCC savings* (2022$)	% of consumers that experience net cost
1	1	217.33	0.0
	2	235.40	1.3
2–4	3	240.66	1.6
5	4	128.81	27.0
6	5	0.17	56.2

* The calculation considers only affected consumers. It excludes purchasers whose purchasing decision would not change under a standard set at the corresponding EL, *i.e.,* those with zero LCC savings.

TABLE V.41—LCC AND PBP RESULTS BY EFFICIENCY LEVEL FOR VCT.RC.L

TSL	Efficiency level	Average costs (2022$)				Simple PBP (years)	Average lifetime (years)
		Installed cost	First year's operating cost	Lifetime operating cost	LCC		
	Baseline	9,261.69	1,277.59	12,897.96	22,159.65		14.0
1	1	9,486.23	1,241.24	12,349.78	21,836.00	6.2	14.0
2–5	2	9,525.84	1,236.13	12,299.80	21,825.64	6.4	14.0
6	3	13,084.28	1,204.29	11,988.81	25,073.10	52.2	14.0

Note: The results for each EL represent the average value if all purchasers in the sample use equipment with that efficiency level. The PBP is measured relative to the baseline equipment.

TABLE V.42—AVERAGE LCC SAVINGS FOR VCT.RC.L

TSL	Efficiency level	Average LCC savings* (2022$)	% of consumers that experience net cost
1	1	323.67	0.0
2–5	2	331.04	0.4
6	3	(2,934.72)	99.7

* The calculation considers only affected consumers. It excludes purchasers whose purchasing decision would not change under a standard set at the corresponding EL, *i.e.,* those with zero LCC savings.

TABLE V.43—LCC AND PBP RESULTS BY EFFICIENCY LEVEL FOR VCT.RC.M

TSL	Efficiency level	Average costs (2022$)				Simple PBP (years)	Average lifetime (years)
		Installed cost	First year's operating cost	Lifetime operating cost	LCC		
	Baseline	9,052.59	433.39	4,761.74	13,814.33		13.9
1,2,4	1	9,277.06	398.58	4,228.77	13,505.84	6.5	13.9
	2	9,446.82	394.88	4,192.70	13,639.51	10.2	13.9
3,5	3	9,486.42	393.69	4,181.07	13,667.49	10.9	13.9
6	4	13,043.92	390.88	4,153.62	17,197.54	93.9	13.9

Note: The results for each EL represent the average value if all purchasers in the sample use equipment with that efficiency level. The PBP is measured relative to the baseline equipment.

TABLE V.44—AVERAGE LCC SAVINGS FOR VCT.RC.M

TSL	Efficiency level	Average LCC savings* (2022$)	% of Consumers that experience net cost
1,2,4	1	308.65	0.0
	2	171.49	8.1
3,5	3	133.62	24.0
6	4	(3,397.02)	100.0

*The calculation considers only affected consumers. It excludes purchasers whose purchasing decision would not change under a standard set at the corresponding EL, *i.e.,* those with zero LCC savings.

TABLE V.45—LCC AND PBP RESULTS BY EFFICIENCY LEVEL FOR VCT.SC.H

TSL	Efficiency level	Average costs (2022$)				Simple PBP (years)	Average lifetime (years)
		Installed cost	First year's operating cost	Lifetime operating cost	LCC		
1–5	Baseline	4,470.66	126.82	1,370.85	5,586.32		14.0
	1	4,531.98	116.79	1,315.87	5,589.16	6.1	14.0
	2	4,565.12	112.31	1,285.13	5,589.67	6.5	14.0
	3	4,706.57	97.60	1,186.12	5,624.01	8.1	14.0
	4	4,823.32	85.18	1,008.73	5,556.70	8.5	14.0
	5	4,907.08	83.82	996.65	5,623.60	10.2	14.0
	6	4,953.92	83.25	1,080.12	5,751.23	11.1	14.0
6	7	6,377.25	82.48	1,073.29	7,086.37	43.0	14.0

Note: The results for each EL represent the average value if all purchasers in the sample use equipment with that efficiency level. The PBP is measured relative to the baseline equipment.

TABLE V.46—AVERAGE LCC SAVINGS FOR VCT.SC.H

TSL	Efficiency level	Average LCC savings* (2022$)	% of Consumers that experience net cost
	1	(2.49)	30.6
	2	(2.54)	42.4
	3	(36.07)	62.7
	4	33.12	46.7
	5	(33.78)	63.8
	6	(161.50)	79.4
6	7	(1,496.81)	96.9

*The calculation considers only affected consumers. It excludes purchasers whose purchasing decision would not change under a standard set at the corresponding EL, *i.e.,* those with zero LCC savings.

TABLE V.47—LCC AND PBP RESULTS BY EFFICIENCY LEVEL FOR VCT.SC.I

TSL	Efficiency level	Average costs (2022$)				Simple PBP (years)	Average lifetime (years)
		Installed cost	First year's operating cost	Lifetime operating cost	LCC		
	Baseline	6,606.39	717.90	6,723.31	12,967.00		14.0
1	1	6,622.23	714.41	6,692.45	12,951.12	4.6	14.0
2–5	2	6,738.97	701.99	6,515.27	12,884.25	8.3	14.0
	3	7,046.29	690.86	6,505.12	13,164.53	16.3	14.0
6	4	8,469.43	664.72	6,273.60	14,277.88	35.0	14.0

Note: The results for each EL represent the average value if all purchasers in the sample use equipment with that efficiency level. The PBP is measured relative to the baseline equipment.

TABLE V.48—AVERAGE LCC SAVINGS FOR VCT.SC.I

TSL	Efficiency level	Average LCC savings* (2022$)	% of Consumers that experience net cost
1	1	15.76	1.5
2–5	2	77.46	1.1
	3	(226.28)	85.6

TABLE V.48—AVERAGE LCC SAVINGS FOR VCT.SC.I—Continued

TSL	Efficiency level	Average LCC savings* (2022$)	% of Consumers that experience net cost
6	4	(1,318.52)	100.0

*The calculation considers only affected consumers. It excludes purchasers whose purchasing decision would not change under a standard set at the corresponding EL, *i.e.,* those with zero LCC savings.

TABLE V.49—LCC AND PBP RESULTS BY EFFICIENCY LEVEL FOR VCT.SC.L

TSL	Efficiency level	Average costs (2022$)				Simple PBP (years)	Average lifetime (years)
		Installed cost	First year's operating cost	Lifetime operating cost	LCC		
	Baseline	6,441.77	616.41	5,793.30	11,866.44		14.0
1	1	6,471.45	601.18	5,674.48	11,775.59	2.0	14.0
	2	6,487.76	595.37	5,627.26	11,743.75	2.2	14.0
2,3	3	6,503.61	592.42	5,601.15	11,732.58	2.6	14.0
	4	6,786.54	541.91	5,215.01	11,613.15	4.6	14.0
4	5	6,903.32	529.48	5,037.56	11,545.79	5.3	14.0
5	6	6,956.92	527.53	5,108.98	11,667.74	5.8	14.0
6	7	8,380.48	511.74	4,968.73	12,869.46	18.5	14.0

Note: The results for each EL represent the average value if all purchasers in the sample use equipment with that efficiency level. The PBP is measured relative to the baseline equipment.

TABLE V.50—AVERAGE LCC SAVINGS FOR VCT.SC.L

TSL	Efficiency level	Average LCC savings* (2022$)	% of Consumers that experience net cost
1	1	91.06	0.3%
	2	111.65	0.6%
2,3	3	122.78	0.7%
	4	174.92	22.6%
4	5	242.33	18.8%
5	6	120.34	37.5%
6	7	(1,093.50)	98.2%

*The calculation considers only affected consumers. It excludes purchasers whose purchasing decision would not change under a standard set at the corresponding EL, *i.e.,* those with zero LCC savings.

TABLE V.51—LCC AND PBP RESULTS BY EFFICIENCY LEVEL FOR VCT.SC.M

TSL	Efficiency level	Average costs (2022$)				Simple PBP (years)	Average lifetime (years)
		Installed cost	First year's operating cost	Lifetime operating cost	LCC		
	Baseline	4,523.51	173.05	1,797.38	6,066.11		13.9
1–3	1	4,539.82	168.71	1,763.44	6,047.55	3.8	13.9
	2	4,681.25	149.19	1,623.12	6,040.70	6.6	13.9
4,5	3	4,798.00	136.78	1,446.54	5,974.28	7.6	13.9
	4	4,865.91	135.23	1,432.85	6,024.67	9.1	13.9
	5	4,881.76	134.73	1,428.43	6,035.20	9.4	13.9
	6	4,928.59	133.74	1,507.74	6,158.71	10.3	13.9
6	7	6,351.83	132.58	1,497.52	7,491.48	45.2	13.9

Note: The results for each EL represent the average value if all purchasers in the sample use equipment with that efficiency level. The PBP is measured relative to the baseline equipment.

TABLE V.52—AVERAGE LCC SAVINGS FOR VCT.SC.M

TSL	Efficiency level	Average LCC savings* (2022$)	% of Consumers that experience net cost
1–3	1	18.80	5.7%
	2	20.52	29.8
4,5	3	82.53	20.1
	4	30.92	42.4
	5	20.36	45.9

TABLE V.52—AVERAGE LCC SAVINGS FOR VCT.SC.M—Continued

TSL	Efficiency level	Average LCC savings * (2022$)	% of Consumers that experience net cost
	6	(103.42)	64.6
6	7	(1,417.22)	100.0

* The calculation considers only affected consumers. It excludes purchasers whose purchasing decision would not change under a standard set at the corresponding EL, *i.e.,* those with zero LCC savings.

TABLE V.53—LCC AND PBP RESULTS BY EFFICIENCY LEVEL FOR VOP.RC.L

TSL	Efficiency level	Average costs (2022$)				Simple PBP (years)	Average lifetime (years)
		Installed cost	First year's operating cost	Lifetime operating cost	LCC		
	Baseline	9,804.18	3,953.75	37,429.46	47,233.63		13.0
1	1	10,028.41	3,901.88	36,591.13	46,619.55	4.3	13.0
2–6	2	10,639.77	3,719.92	34,905.64	45,545.41	3.6	13.0

Note: The results for each EL represent the average value if all purchasers in the sample use equipment with that efficiency level. The PBP is measured relative to the baseline equipment.

TABLE V.54—AVERAGE LCC SAVINGS FOR VOP.RC.L

TSL	Efficiency level	Average LCC savings * (2022$)	% of Consumers that experience net cost
1	1	615.37	0.0
2–6	2	1,524.52	0.0

* The calculation considers only affected consumers. It excludes purchasers whose purchasing decision would not change under a standard set at the corresponding EL, *i.e.,* those with zero LCC savings.

TABLE V.55—LCC AND PBP RESULTS BY EFFICIENCY LEVEL FOR VOP.RC.M

TSL	Efficiency level	Average costs (2022$)				Simple PBP (years)	Average lifetime (years)
		Installed cost	First year's operating cost	Lifetime operating cost	LCC		
	Baseline	8,943.72	1,436.26	14,170.99	23,114.71		13.0
1	1	9,167.99	1,381.81	13,308.67	22,476.66	4.1	13.0
2–6	2	9,779.42	1,290.04	12,457.83	22,237.25	5.7	13.0

Note: The results for each EL represent the average value if all purchasers in the sample use equipment with that efficiency level. The PBP is measured relative to the baseline equipment.

TABLE V.56—AVERAGE LCC SAVINGS FOR VOP.RC.M

TSL	Efficiency level	Average LCC savings * (2022$)	% of Consumers that experience net cost
1	1	638.01	0.0
2–6	2	707.13	8.2

* The calculation considers only affected consumers. It excludes purchasers whose purchasing decision would not change under a standard set at the corresponding EL, *i.e.,* those with zero LCC savings.

TABLE V.57—LCC AND PBP RESULTS BY EFFICIENCY LEVEL FOR VOP.SC.M

TSL	Efficiency level	Average costs (2022$)				Simple PBP (years)	Average lifetime (years)
		Installed cost	First year's operating cost	Lifetime operating cost	LCC		
	Baseline	6,563.78	1,076.62	9,936.29	16,264.24		13.0
1	1	6,612.64	1,053.03	9,745.17	16,120.22	2.1	13.0
2,3	2	6,816.42	977.96	9,092.80	15,664.28	2.6	13.0
	3	7,098.92	897.61	8,457.71	15,301.52	3.0	13.0
4	4	7,242.43	879.28	8,164.31	15,146.45	3.4	13.0

TABLE V.57—LCC AND PBP RESULTS BY EFFICIENCY LEVEL FOR VOP.SC.M—Continued

TSL	Efficiency level	Average costs (2022$)				Simple PBP (years)	Average lifetime (years)
		Installed cost	First year's operating cost	Lifetime operating cost	LCC		
5,6	5	7,303.09	872.97	8,196.09	15,236.71	3.6	13.0

Note: The results for each EL represent the average value if all purchasers in the sample use equipment with that efficiency level. The PBP is measured relative to the baseline equipment.

TABLE V.58—AVERAGE LCC SAVINGS FOR VOP.SC.M

TSL	Efficiency level	Average LCC savings * (2022$)	% of consumers that experience net cost
1	1	143.30	0.6
2,3	2	590.02	0.0
	3	927.32	1.0
4	4	1,082.34	0.4
5,6	5	992.17	1.0

* The calculation considers only affected consumers. It excludes purchasers whose purchasing decision would not change under a standard set at the corresponding EL, *i.e.,* those with zero LCC savings.

b. Consumer Subgroup Analysis

In the consumer subgroup analysis, DOE estimated the impact of the considered TSLs on small businesses. Table V.59 compares the average LCC savings and PBP at each efficiency level for small businesses with the entire consumer sample for CRE. In most cases, the average LCC savings and PBP for small businesses at the considered efficiency levels are not substantially different from the average for all businesses. Chapter 11 of the NOPR TSD presents the complete LCC and PBP results for the subgroup.

TABLE V.59—AVERAGE LCC AND PBP RESULTS COMPARISON FOR SMALL BUSINESSES FOR CRE

Equipment class	EL	Average LCC savings (2022$)		Simple payback period (years)		Net cost (%)	
		Small business	All purchasers	Small business	All purchasers	Small business	All purchasers
CB.SC.L	1	227.9	263.09	1.0	1.0	0	0
	2	455.5	524.57	0.8	0.8	0	0
	3	462.59	534.80	1.0	1.0	0	0
	4	476.95	553.24	1.1	1.1	0	0
	5	565.61	672.54	2.0	2.0	0	0
	6	473.70	566.92	2.2	2.2	2	1
CB.SC.M	1	96.14	111.31	1.1	1.1	0	0
	2	180.72	208.70	1.0	1.0	0	0
	3	162.71	190.07	1.3	1.3	5	4
	4	168.99	199.32	1.6	1.6	4	3
	5	16.80	44.90	5.0	5.0	53	46
	6	(88.63)	(74.29)	5.8	5.8	79	74
HCS.SC.L	1	5.13	7.77	5.11	5.1	28	22
	2	(54.10)	(41.22)	9.77	9.8	77	73
	3	(146.77)	(147.27)	10.84	10.8	98	96
HCS.SC.M	1	81.56	94.14	0.83	0.8	0	0
	2	71.87	84.89	1.76	1.8	6	5
	3	(23.76)	(24.55)	3.44	3.4	76	74
	4	(184.84)	(189.13)	13.34	13.3	99	99
HCT.SC.I	1	66.18	93.84	4.84	4.8	19	15
	2	21.88	55.03	7.11	7.1	40	33
	3	(78.05)	(58.42)	7.94	7.9	60	56
	4	(93.01)	(68.58)	8.62	8.6	69	64
	5	(94.20)	(69.11)	8.70	8.7	70	65
	6	(94.15)	(68.66)	8.70	8.7	70	65
	7	(334.29)	(306.51)	14.84	14.8	89	86
HCT.SC.L	1	(23.30)	(8.05)	7.97	8.0	49	43
	2	(61.20)	(39.67)	10.99	11.0	61	57
	3	(160.47)	(152.24)	12.13	12.1	75	72
	4	(189.47)	(178.19)	13.54	13.5	85	82
	5	(192.51)	(180.80)	13.72	13.7	87	84
	6	(193.78)	(181.84)	13.73	13.7	87	84
	7	(435.54)	(421.60)	23.51	23.5	91	90

TABLE V.59—AVERAGE LCC AND PBP RESULTS COMPARISON FOR SMALL BUSINESSES FOR CRE—Continued

Equipment class	EL	Average LCC savings (2022$)		Simple payback period (years)		Net cost (%)	
		Small business	All purchasers	Small business	All purchasers	Small business	All purchasers
HCT.SC.M	1	(140.89)	(141.71)	52.63	52.6	72	72
	2	(170.95)	(164.18)	38.53	38.5	77	77
	3	(272.85)	(279.83)	42.07	42.1	78	78
	4	(303.34)	(307.69)	44.85	44.9	87	87
	5	(305.59)	(309.50)	45.14	45.1	90	90
	6	(307.77)	(311.58)	45.07	45.1	90	90
	7	(549.59)	(551.40)	76.76	76.8	91	91
HZO.RC.L	1	20.91	46.57	12.99	13.0	32	8
HZO.RC.M	1	15.27	40.29	13.75	13.8	38	11
HZO.SC.L	1	140.87	160.85	0.76	0.8	0	0
	2	168.35	193.59	1.11	1.1	0	0
	3	826.60	971.22	1.98	2.0	0	0
	4	749.21	883.28	2.10	2.1	1	0
	5	698.01	841.89	2.77	2.8	1	1
HZO.SC.M	1	82.72	95.03	1.09	1.1	0	0
	2	101.05	117.44	1.58	1.6	0	0
	3	182.80	226.50	3.25	3.3	8	7
	4	119.58	154.59	3.44	3.4	24	20
	5	141.74	199.91	5.18	5.2	22	15
SOC.RC.M	1	828.50	986.27	2.56	2.6	0	0
	2	785.91	944.21	3.13	3.1	1	1
	3	771.98	929.51	3.26	3.3	1	1
	4	(229.00)	(70.50)	15.87	15.9	82	71
SOC.SC.M	1	880.09	994.55	0.08	0.1	0	0
	2	947.58	1085.17	0.84	0.8	0	0
	3	880.22	1015.54	1.13	1.1	1	1
	4	894.49	1063.82	2.01	2.0	5	4
	5	1551.11	1834.72	2.13	2.1	0	0
	6	1543.96	1832.85	2.24	2.2	0	0
	7	422.14	698.37	5.39	5.4	32	26
SVO.RC.M	1	422.15	522.85	4.76	4.8	0	0
	2	253.11	406.59	7.34	7.3	26	18
SVO.SC.M	1	152.71	175.56	1.20	1.2	0	0
	2	203.94	237.26	1.69	1.7	0	0
	3	277.65	324.02	1.81	1.8	0	0
	4	500.97	600.52	2.68	2.7	0	0
	5	461.06	586.37	3.75	3.8	11	8
	6	540.59	692.32	4.10	4.1	7	5
	7	456.68	602.17	4.31	4.3	16	11
VCS.SC.H	1	349.72	399.54	0.21	0.2	0	0
	2	233.72	270.97	0.82	0.8	20	18
	3	235.66	276.86	1.26	1.3	17	15
	4	226.40	268.51	1.52	1.5	19	17
	5	220.36	263.78	1.76	1.8	20	18
	6	114.89	162.47	3.70	3.7	36	32
	7	(0.49)	33.51	4.37	4.4	57	53
VCS.SC.I	1	191.10	219.02	0.38	0.4	0	0
	2	283.57	328.05	0.92	0.9	0	0
	3	298.70	347.51	1.19	1.2	0	0
	4	323.05	377.40	1.37	1.4	0	0
	5	498.66	615.19	3.05	3.1	5	4
	6	383.73	486.70	3.44	3.4	11	9
VCS.SC.L	1	168.73	193.07	0.42	0.4	0	0
	2	229.45	265.56	1.03	1.0	0	0
	3	243.92	284.18	1.32	1.3	0	0
	4	264.03	309.04	1.51	1.5	0	0
	5	307.51	375.85	2.72	2.7	5	4
	6	204.16	260.73	3.23	3.2	20	17
VCS.SC.M	1	189.78	217.33	0.38	0.4	0	0
	2	202.56	235.40	1.12	1.1	1	1
	3	205.44	240.66	1.44	1.4	2	2
	4	91.46	128.81	4.12	4.1	31	27
	5	(23.05)	0.17	5.00	5.0	61	56
VCT.RC.L	1	245.49	323.67	6.18	6.2	0	0
	2	246.83	331.04	6.37	6.4	0	0
	3	(3056.29)	(2934.72)	52.15	52.2	100	100
VCT.RC.M	1	233.10	308.65	6.45	6.5	0	0
	2	91.96	171.49	10.24	10.2	26	8

TABLE V.59—AVERAGE LCC AND PBP RESULTS COMPARISON FOR SMALL BUSINESSES FOR CRE—Continued

Equipment class	EL	Average LCC savings (2022$)		Simple payback period (years)		Net cost (%)	
		Small business	All purchasers	Small business	All purchasers	Small business	All purchasers
	3	57.11	133.62	10.93	10.9	45	24
	4	(3476.87)	(3397.02)	93.89	93.9	100	100
VCT.SC.H	1	(8.77)	(2.49)	6.12	6.1	34	31
	2	(11.19)	(2.54)	6.51	6.5	47	42
	3	(55.34)	(36.07)	8.07	8.1	67	63
	4	(8.95)	33.12	8.47	8.5	57	47
	5	(77.88)	(33.78)	10.15	10.2	71	64
	6	(192.35)	(161.50)	11.09	11.1	86	79
	7	(1538.28)	(1496.81)	43.00	43.0	97	97
VCT.SC.I	1	11.97	15.76	4.55	4.6	3	2
	2	51.25	77.46	8.34	8.3	6	1
	3	(244.33)	(226.28)	16.27	16.3	89	86
	4	(1372.20)	(1318.52)	35.04	35.0	100	100
VCT.SC.L	1	76.90	91.06	1.95	2.0	0	0
	2	93.55	111.65	2.19	2.2	1	1
	3	101.44	122.78	2.58	2.6	1	1
	4	118.16	174.92	4.63	4.6	29	23
	5	161.77	242.33	5.31	5.3	26	19
	6	51.55	120.34	5.80	5.8	46	38
	7	(1182.18)	(1093.50)	18.52	18.5	99	98
VCT.SC.M	1	14.68	18.80	3.75	3.8	6	6
	2	0.46	20.52	6.61	6.6	36	30
	3	43.04	82.53	7.57	7.6	29	20
	4	(10.13)	30.92	9.05	9.1	52	42
	5	(21.33)	20.36	9.35	9.4	55	46
	6	(132.37)	(103.42)	10.31	10.3	69	65
	7	(1451.68)	(1417.22)	45.18	45.2	100	100
VOP.RC.L	1	502.94	615.37	4.32	4.3	0	0
	2	1234.55	1524.52	3.57	3.6	0	0
VOP.RC.M	1	522.36	638.01	4.12	4.1	0	0
	2	516.94	707.13	5.72	5.7	13	8
VOP.SC.M	1	121.91	143.30	2.07	2.1	1	1
	2	495.13	590.02	2.56	2.6	0	0
	3	764.98	927.32	2.99	3.0	1	1
	4	882.37	1082.34	3.44	3.4	1	0
	5	798.96	992.17	3.63	3.6	2	1

Notes: The results for each EL are calculated assuming that all consumers use products at that efficiency level. The PBP is measured relative to the baseline product. The savings represent the average LCC savings for affected consumers.

c. Rebuttable Presumption Payback

As discussed in section IV.F.10 of this document, EPCA establishes a rebuttable presumption that an energy conservation standard is economically justified if the increased purchase cost for an equipment 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. 6316(e)(1); 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 CRE. 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.60 presents the rebuttable-presumption payback periods for the considered TSLs for CRE. While DOE examined the rebuttable-presumption criterion, it considered whether the standard levels considered for the NOPR are economically justified through a more detailed analysis of the economic impacts of those levels, pursuant to 42 U.S.C. 6316(e)(1) and 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.60—REBUTTABLE-PRESUMPTION PAYBACK PERIODS

Equipment class	Rebuttable payback period (years)						
	EL 1	EL 2	EL 3	EL 4	EL 5	EL 6	EL 7
CB.SC.L	0.9	0.7	0.9	1.0	1.8	2.0	
CB.SC.M	1.0	0.8	1.2	1.4	4.4	5.1	
HCS.SC.L	4.5	8.7	9.6				

TABLE V.60—REBUTTABLE-PRESUMPTION PAYBACK PERIODS—Continued

Equipment class	Rebuttable payback period (years)						
	EL 1	EL 2	EL 3	EL 4	EL 5	EL 6	EL 7
HCS.SC.M	0.7	1.6	3.0	11.8			
HCT.SC.I	4.3	6.3	7.1	7.7	7.7	7.7	13.2
HCT.SC.L	7.1	9.7	10.7	12.0	12.1	12.1	20.8
HCT.SC.M	46.7	34.2	37.3	39.8	40.0	40.0	68.1
HZO.RC.L	11.6						
HZO.RC.M	12.3						
HZO.SC.L	0.7	1.0	1.8	1.9	2.5		
HZO.SC.M	1.0	1.4	2.9	3.1	4.6		
SOC.RC.M	2.3	2.8	2.9	14.1			
SOC.SC.M	0.1	0.8	1.0	1.8	1.9	2.0	4.8
SVO.RC.M	4.3	6.6					
SVO.SC.M	1.1	1.5	1.6	2.4	3.3	3.7	3.9
VCS.SC.H	0.2	0.7	1.1	1.4	1.6	3.3	3.9
VCS.SC.I	0.3	0.8	1.1	1.2	2.7	3.0	
VCS.SC.L	0.4	0.9	1.2	1.3	2.4	2.9	
VCS.SC.M	0.3	1.0	1.3	3.7	4.5		
VCT.RC.L	5.5	5.7	46.3				
VCT.RC.M	5.7	9.1	9.7	83.3			
VCT.SC.H	5.4	5.8	7.2	7.5	9.0	9.8	38.1
VCT.SC.I	4.0	7.4	14.4	31.1			
VCT.SC.L	1.7	1.9	2.3	4.1	4.7	5.1	16.4
VCT.SC.M	3.3	5.9	6.7	8.0	8.3	9.1	40.0
VOP.RC.L	3.9	3.2					
VOP.RC.M	3.7	5.1					
VOP.SC.M	1.8	2.3	2.7	3.1	3.2		

2. Economic Impacts on Manufacturers

DOE performed an MIA to estimate the impact of new and amended energy conservation standards on manufacturers of CRE. The following section describes the expected impacts on manufacturers at each considered TSL. Chapter 12 of the NOPR 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 new and amended standards. Table V.61 summarizes the estimated financial impacts (represented by changes in INPV) of potential new and amended energy conservation standards on manufacturers of CRE, as well as the conversion costs that DOE estimates manufacturers of CRE would incur at each TSL.

The impact of potential new and 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 29 percent for all equipment classes across all efficiency levels.[100] 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 and 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 required to convert their facilities to produce compliant equipment, operating profit does not change in absolute dollars and decreases as a percentage of revenue. The preservation-of-operating-profit scenario represents the lower (or more severe) bound to industry profitability under potential new and amended energy conservation standards.

Each of the modeled scenarios resulted 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 (2023–2057). The ''change in INPV'' results refer 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 new and 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 equipment designs into compliance with potential new and amended standards. As described in section IV.J.2.c of this document, conversion cost investments occur between the year of publication of the final rule and the year by which manufacturers must comply with the new standards. The conversion costs can have a significant impact on the short-term cash flow on the industry and generally result in lower free cash flow in the period between the publication of the final rule and the compliance date of potential new and amended standards. Conversion costs are independent of the manufacturer markup scenarios and are not presented as a range in this analysis.

[100] The gross margin percentage of 29 percent is based on a manufacturer markup of 1.40.

TABLE V.61—MANUFACTURER IMPACT ANALYSIS RESULTS

	Unit	No-new-standards case	TSL 1	TSL 2	TSL 3	TSL 4	TSL 5	TSL 6
INPV	*2022$ Million.*	3,286.4	3,274.2 to 3,290.8	3,241.9 to 3,279.6.	3,224.4 to 3,271.4.	3,182.5 to 3,269.6.	3,127.0 to 3,255.5.	2,985.9 to 3,529.9.
Change in INPV	*2022$ Million.*		(12.2) to 4.5	(44.4) to (6.7)	(61.9) to (15.0).	(103.8) to (16.7).	(159.3) to (30.9).	(300.4) to 243.6.
	%		(0.4) to 0.1	(1.4) to (0.2)	(1.9) to (0.5)	(3.2) to (0.5)	(4.8) to (0.9)	(9.1) to 7.4.
Free Cash Flow (2027)	*2022$ Million.*	291.2	285.7	268.0	258.3	238.7	210.8	170.9.
Change in Free Cash Flow (2027).	*%*		(1.9)	(8.0)	(11.3)	(18.0)	(27.6)	(41.3).
Product Conversion Costs.	*2022$ Million.*	-	12.6	66.1	94.0	121.5	187.5	299.9.
Capital Conversion Costs.	*2022$ Million.*		2.7	2.2	3.1	26.0	38.9	43.9.
Total Conversion Costs	*2022$ Million.*		15.3	68.3	97.1	147.5	226.4	343.8.

* Parentheses denote negative (-) values.

The following cash flow discussion refers to the equipment classes as detailed in table IV.1 in section IV.A of this document and the TSLs as detailed in section V.A of this document. Table V.62 through table V.66 show the design options analyzed in the engineering analysis for each directly analyzed equipment class by TSL. See section IV.C of this document and chapter 5 of the NOPR TSD for additional information on the engineering analysis.

TABLE V.62—DESIGN OPTIONS ANALYZED AS COMPARED TO BASELINE BY TRIAL STANDARD LEVEL FOR VERTICAL, OPEN EQUIPMENT FAMILIES

Equipment class	TSL 1	TSL 2	TSL 3	TSL 4	TSL 5	TSL 6
VOP.RC.M	Occupancy Sensors	Night Curtains; Occupancy Sensors.				
VOP.RC.L	Occupancy Sensors	Night Curtains; Occupancy Sensors.				
VOP.SC.M	Electronically Commutated ("EC") Cond. Fan Motor.	EC Cond. Fan Motor; Night Curtains		EC Cond. Fan Motor; Night Curtains; variable-speed compressors ("VSCs"); Occupancy Sensors.	EC Cond. Fan Motor; Night Curtains; VSC; Occupancy Sensors; Microchannel Condenser.	

TABLE V.63—DESIGN OPTIONS ANALYZED AS COMPARED TO BASELINE BY TRIAL STANDARD LEVEL FOR VERTICAL, CLOSED EQUIPMENT FAMILIES

Equipment class	TSL 1	TSL 2	TSL 3	TSL 4	TSL 5	TSL 6
VCT.RC.M	Occupancy Sensors		Occupancy Sensors; Triple Pane Door—Krypton Fill.	Occupancy Sensors	Occupancy Sensors; Triple Pane Door—Krypton Fill.	Occupancy Sensors; VIG Door.
VCT.RC.L	Occupancy Sensors.	Occupancy Sensors; Triple Pane Door—Krypton Fill.				Occupancy Sensors; VIG Door.
VCT.SC.H	Baseline.					EC Evap. Fan Motor; EC Cond. Fan Motor; VSC; Occupancy Sensors; Microchannel Condenser; VIG Door.
VCT.SC.M	EC Cond. Fan Motor			EC Cond. Fan Motor; VSC; Occupancy Sensors.		EC Cond. Fan Motor; VSC; Occupancy Sensors; Microchannel Condenser; VIG Door.

TABLE V.63—DESIGN OPTIONS ANALYZED AS COMPARED TO BASELINE BY TRIAL STANDARD LEVEL FOR VERTICAL, CLOSED EQUIPMENT FAMILIES—Continued

Equipment class	TSL 1	TSL 2	TSL 3	TSL 4	TSL 5	TSL 6
VCT.SC.L	EC Evap. Fan Motor.	EC Evap. Fan Motor; EC Cond. Fan Motor; Triple Pane Door—Krypton Fill.		EC Evap. Fan Motor; EC Cond. Fan Motor; Triple Pane Door—Krypton Fill; VSC; Occupancy Sensors.	EC Evap. Fan Motor; EC Cond. Fan Motor; Triple Pane Door—Krypton Fill; VSC; Occupancy Sensors; Microchannel Condenser.	EC Evap. Fan Motor; EC Cond. Fan Motor; VSC; Occupancy Sensors; Microchannel Condenser; VIG Door.
VCT.SC.I	Triple Pane Door—Krypton Fill.	Triple Pane Door—Krypton Fill; Occupancy Sensors				Occupancy Sensors; Microchannel Condenser; VIG Door.
VCS.SC.H	Evap. Fan Control		Evap. Fan Control; EC Evap. Fan Motor; EC Cond. Fan Motor.	Evap. Fan Control	Evap. Fan Control; EC Evap. Fan Motor; EC Cond. Fan Motor; VSC.	Evap. Fan Control; EC Evap. Fan Motor; EC Cond. Fan Motor; VSC; Microchannel Condenser.
VCS.SC.M	Evap. Fan Control.	Evap. Fan Control; EC Evap. Fan Motor; EC Cond. Fan Motor.			Evap. Fan Control; EC Evap. Fan Motor; EC Cond. Fan Motor; VSC.	Evap. Fan Control; EC Evap. Fan Motor; EC Cond. Fan Motor; VSC; Microchannel Condenser.
VCS.SC.L; VCS.SC.I.	Evap. Fan Control.	Evap. Fan Control; EC Evap. Fan Motor; EC Cond. Fan Motor		Evap. Fan Control; EC Evap. Fan Motor; EC Cond. Fan Motor; VSC.	Evap. Fan Control; EC Evap. Fan Motor; EC Cond. Fan Motor; VSC; Microchannel Condenser..	

TABLE V.64—DESIGN OPTIONS ANALYZED AS COMPARED TO BASELINE BY TRIAL STANDARD LEVEL FOR SEMI-VERTICAL, OPEN AND SERVICE OVER-COUNTER EQUIPMENT FAMILIES

Equipment class	TSL 1	TSL 2	TSL 3	TSL 4	TSL 5	TSL 6
SVO.RC.M	Occupancy Sensors.		Occupancy Sensors; Night Curtains.	Occupancy Sensors.	Occupancy Sensors; Night Curtains.	
SVO.SC.M	EC Evap. Fan Motor.	EC Evap. Fan Motor; EC Cond. Fan Motor; Night Curtains		EC Evap. Fan Motor; EC Cond. Fan Motor; Night Curtains; VSC; Occupancy Sensors.	EC Evap. Fan Motor; EC Cond. Fan Motor; Night Curtains; SC; Occupancy Sensors; Microchannel Condenser.	
SOC.RC.M	Occupancy Sensors		Occupancy Sensors; Triple Pane Door—Krypton Fill.	Occupancy Sensors.	Occupancy Sensors; Triple Pane Door—Krypton Fill.	Occupancy Sensors; VIG Door.
SOC.SC.M	Evap. Fan Control	Evap. Fan Control; EC Evap. Fan Motor; EC Cond. Fan Motor		Evap. Fan Control; EC Evap. Fan Motor; EC Cond. Fan Motor; VSC; Occupancy Sensors.	Evap. Fan Control; EC Evap. Fan Motor; EC Cond. Fan Motor; VSC; Occupancy Sensors; Microchannel Condenser; VIG Door.	

TABLE V.65—DESIGN OPTIONS ANALYZED AS COMPARED TO BASELINE BY TRIAL STANDARD LEVEL FOR HORIZONTAL EQUIPMENT FAMILIES

Equipment class	TSL 1	TSL 2	TSL 3	TSL 4	TSL 5	TSL 6
HZO.RC.M; HZO.RC.L.	Occupancy Sensors.					
HZO.SC.M; HZO.SC.L.	EC Evap. Fan Motor.	EC Evap. Fan Motor; EC Cond. Fan Motor		EC Evap. Fan Motor; EC Cond. Fan Motor; VSC.	EC Evap. Fan Motor; EC Cond. Fan Motor; VSC; Microchannel Condenser; Occupancy Sensors..	
HCT.SC.M	Baseline					VSC; Occupancy Sensors; VIG Door.
HCT.SC.L	Baseline					VSC; Occupancy Sensors; Microchannel Condenser; VIG Door.
HCT.SC.I	VSC	Baseline		VSC	VSC; Occupancy Sensors.	VSC; Occupancy Sensors; Microchannel Condenser; VIG Door.
HCS.SC.M	Evap. Fan Control		Evap. Fan Control; EC Cond. Fan Motor.	Evap. Fan Control	Evap. Fan Control; EC Cond. Fan Motor.	Evap. Fan Control; EC Cond. Fan Motor; Microchannel Condenser; VSC.
HCS.SC.L	EC Cond. Fan Motor					EC Cond. Fan Motor; VSC; Microchannel Condenser.

TABLE V.66—DESIGN OPTIONS ANALYZED AS COMPARED TO BASELINE BY TRIAL STANDARD LEVEL FOR CHEF BASE EQUIPMENT CLASSES

Equipment class	TSL 1	TSL 2	TSL 3	TSL 4	TSL 5	TSL 6
CB.SC.M	PSC Evap. Fan Motor.	EC Evap. Fan Motor.	EC Evap. Fan Motor; EC Cond. Fan Motor.	EC Evap. Fan Motor.	EC Evap. Fan Motor; EC Cond. Fan Motor; VSC.	EC Evap. Fan Motor; EC Cond. Fan Motor; VSC; Microchannel Condenser.
CB.SC.L	PSC Evap. Fan Motor.	EC Evap. Fan Motor; EC Cond. Fan Motor		EC Evap. Fan Motor; EC Cond. Fan Motor; VSC.	EC Evap. Fan Motor; EC Cond. Fan Motor; VSC; Microchannel Condenser.	

At TSL 6, the standard represents the max-tech efficiencies for all equipment classes. The change in INPV is expected to range from −$300.4 million to $243.6 million, which represents a change in INPV of –9.1 percent to 7.4 percent, respectively. At this level, free cash flow is estimated to decrease by 41.3 percent compared to the no-new-standards case value of $291.2 million in the year 2027, the year before compliance would be required. In 2027, approximately 2.2 percent of covered CRE shipments are expected to meet the efficiencies required at TSL 6. See table V.67 for the percent of equipment class shipments that would meet or exceed the efficiencies required at each TSL in 2027.

The design options DOE analyzed at TSL 6 included the max-tech technologies for all equipment classes. For all open (*i.e.,* equipment classes without doors) and transparent door equipment classes, DOE expects manufacturers would likely need to incorporate occupancy sensors with dimming capability. Open equipment classes would also likely require the use of night curtains. For equipment classes with transparent doors, DOE expects manufacturers would likely need to incorporate vacuum-insulated glass. For self-contained equipment classes, DOE expects manufacturers would need to incorporate EC evaporator and condenser fan motors, variable-speed compressors, and microchannel condensers. For closed, self-contained equipment classes using forced-air refrigeration systems, DOE expects manufacturers would also need to incorporate evaporator fan control. Of the 28 directly analyzed equipment classes, 5 equipment classes (VCT.RC.M, VCT.SC.M, VCT.SC.L, VCS.SC.M, and VCS.SC.L) account for approximately 81.5 percent of industry shipments. For VCT.RC.M, TSL 6 corresponds to EL 4. For VCT.SC.M and VCT.SC.L, TSL 6 corresponds to EL 7. For VCS.SC.M, TSL 6 corresponds to EL 5. For VCS.SC.L, TSL 6 corresponds to EL 6. See section of this V.A of this document for more information on the efficiency levels analyzed at each TSL.

At max-tech, DOE expects that nearly all manufacturers would need to dedicate notable engineering resources to update equipment designs and source, qualify, and test high-efficiency components across their CRE portfolio. However, most design options analyzed involve more efficient components (*e.g.,* high-efficiency motors) and would not necessitate significant capital investment. Self-contained CRE equipment classes account for 87.1 percent of industry shipments in 2027 and DOE estimates 2.5 percent of self-contained CRE shipments would meet TSL 6 in 2027. Incorporating variable-speed compressors into self-contained CRE designs would likely require additional development and testing time to optimize for different CRE applications to realize maximum efficiency benefits. Capital conversion costs may be necessary for new tooling if additional modifications are required to accommodate a larger compressor system.

CRE equipment classes with transparent doors (*i.e.,* HCT.SC.I, HCT.SC.L, HCT.SC.M, SOC.RC.M, SOC.SC.M, VCT.RC.L, VCT.RC.M, VCT.SC.H, VCT.SC.I, VCT.SC.L, VCT.SC.M) account for approximately 43.8 percent of industry shipments in 2027. For the 71 OEMs that offer directly analyzed CRE with transparent doors, implementing vacuum-insulated glass would require significant engineering resources and testing time to ensure adequate durability of their doors in all commercial settings. Capital conversion costs may be necessary for new fixtures. In interviews, some manufacturers raised concerns about standards requiring a widespread adoption of vacuum-insulated glass as it is still a relatively untested technology in the commercial refrigeration market. There is very little industry experience with implementing vacuum-insulated glass in CRE applications and DOE estimates that approximately 1.7 percent of CRE equipment classes with transparent doors would meet the max-tech efficiencies in 2027. Manufacturers expressed concerns that the 3-year conversion period between the publication of the final rule and the compliance date of the new and amended energy conservation standards might be insufficient to design and test a full portfolio of CRE with vacuum-insulated glass doors that meet the max-tech efficiencies and maintain their internal performance metrics for durability and safety over the equipment lifetime. DOE estimates capital conversion costs of $43.9 million and product conversion costs of $299.9 million. Conversion costs total $343.8 million.

At TSL 6, the shipment-weighted average MPC for all CRE is expected to increase by 25.0 percent relative to the no-new-standards case shipment-weighted average MPC for all CRE in 2028. Given the projected increase in production costs, DOE expects an estimated 2.9 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 large increase in cashflow from the higher MSP outweighs the $343.8 million in conversion costs, causing an increase in INPV at TSL 6 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 2028, the analyzed compliance year. This reduction in the manufacturer markup and the $343.8 million in conversion costs incurred by manufacturers cause a negative change in INPV at TSL 6 under the preservation of operating profit scenario. See section IV.J.2.d of this document for further details on the manufacturer markup scenarios.

At TSL 5, the standard represents the highest efficiency level with positive LCC savings for all equipment classes. The change in INPV is expected to range from −$159.3 million to −$30.9 million, which represents a change in INPV of −4.8 percent to −0.9 percent, respectively. At this level, free cash flow is estimated to decrease by 27.6 percent compared to the no-new-standards case value of $291.2 million in the year 2027, the year before compliance is required. In 2027, approximately 10.8 percent of covered CRE shipments are expected to meet the efficiencies required at TSL 5.

The design options DOE analyzed at TSL 5 are similar to the design options analyzed at TSL 6 except most equipment classes with transparent doors would not need to incorporate vacuum-insulated glass doors. All VCT equipment classes would likely need to incorporate triple pane glass with krypton fill except for VCT.SC.H and VCT.SC.M (together accounting for 26.4 percent of industry shipments), which would likely not require improved door designs. DOE expects that HCT equipment classes would not need to incorporate additional panes of glass to meet TSL 5 levels. At this level, DOE also expects that fewer self-contained equipment classes would need to incorporate microchannel condensers. Additionally, manufacturers of HCS equipment classes may not need to incorporate variable-speed compressors to meet the efficiencies required. For the five highest-volume equipment classes, TSL 5 corresponds to lower efficiency levels for four equipment classes: VCT.RC.M, VCT.SC.M, VCT.SC.L, and VCS.SC.M. For VCT.RC.M and VCT.SC.M, TSL 5 corresponds to EL 3. For VCT.SC.M, TSL 5 corresponds to EL 5. For VCT.SC.L, TSL 5 corresponds to EL 6. For VCS.SC.M, TSL 5 corresponds to EL 4. For VCS.SC.M and VCS.SC.L, the efficiencies required at TSL 5 are the same as TSL 6. At this level, the VCT.RC.M and VCT.SC.L equipment classes would both need to incorporate triple pane glass with krypton fill. Out of the four highest volume self-contained classes, only VCT.SC.L and VCS.SC.L would require the use of microchannel condensers.

Similar to TSL 6, DOE expects manufacturers would spend development time updating equipment designs to incorporate high-efficiency components. However, at this level, DOE expects that most manufacturers of CRE with transparent doors could meet the TSL 5 efficiencies without implementing vacuum-insulated glass doors. Of the 11 directly analyzed transparent door equipment classes, only SOC.SC.M would likely require the use of vacuum-insulated glass doors to meet the efficiencies required. SOC.SC.M accounts for approximately 0.4 percent of analyzed industry shipments in 2027. DOE estimates capital conversion costs of $38.9 million and product conversion costs of $187.5 million. Conversion costs total $226.4 million.

At TSL 5, the shipment-weighted average MPC for all CRE is expected to increase by 6.0 percent relative to the no-new-standards case shipment-weighted average MPC for all CRE in 2028. Given the projected increase in production costs, DOE expects an estimated 0.7 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 $226.4 million in conversion costs, causing a slight decrease in INPV at TSL 5 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 2028, the analyzed compliance year. This reduction in the manufacturer markup and the $226.4 million in conversion costs incurred by manufacturers cause a negative change in INPV at TSL 5 under the preservation of operating profit scenario.

At TSL 4, the standard represents the highest efficiency level with maximum LCC savings for all equipment classes. The change in INPV is expected to range from -$103.8 million to −$16.7 million, which represents a change in INPV of −3.2 percent to −0.5 percent, respectively. At this level, free cash flow is estimated to decrease by 18.0 percent compared to the no-new-standards case value of $291.2 million in the year 2027, the year before compliance is required. In 2027, approximately 15.7 percent of covered CRE shipments are expected to meet the efficiencies required at TSL 4.

At TSL 4, the efficiency levels required for most equipment classes are lower than the efficiency levels required at TSL 5, including for the five highest-volume equipment classes. At this level, no self-contained equipment classes are expected to require the use of microchannel condensers. At TSL 4, none of the highest-volume self-contained equipment classes (VCT.SC.M, VCT.SC.L, VCS.SC.M, VCS.SC.L) would need to incorporate microchannel condensers. Additionally, DOE does not expect VCS.SC.M would require the use of variable-speed compressors to meet TSL 5 efficiencies. For VCT.RC.M and VCT.SC.M, DOE expects manufacturers would not need to implement additional panes of glass to meet the efficiencies required. For VCT.RC.M, TSL 4 corresponds to EL 1. For VCT.SC.M, TSL 4 corresponds to EL 3. For VCT.SC.L, TSL 4 corresponds to EL 5. For VCS.SC.M, TSL 4 corresponds to EL 3. For VCS.SC.L, TSL 4 corresponds to EL 5. At this level, product conversion costs may be necessary to source, qualify, and test high-efficiency components but to a lesser extent than higher TSLs. Some manufacturers of self-contained equipment classes may need to invest in new tooling if incorporating variable-speed compressors require additional modifications to CRE designs. Some manufacturers of transparent door equipment classes may need to invest in new fixtures to accommodate additional panes of glass into CRE designs. DOE estimates capital conversion costs of $26.0 million and product conversion costs of $121.5 million. Conversion costs total $147.5 million.

At TSL 4, the shipment-weighted average MPC for all CRE is expected to increase by 4.1 percent relative to the no-new-standards case shipment-weighted average MPC for all CRE in 2028. Given the projected increase in production costs, DOE expects an estimated 0.4 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 slightly outweighed by the $147.5 million in conversion costs, causing a small decrease in INPV at TSL 4 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 2028, the analyzed compliance year. This reduction in the manufacturer markup and the $147.5 million in conversion costs incurred by manufacturers cause a negative change in INPV at TSL 4 under the preservation of operating profit scenario.

At TSL 3, the standard represents the highest efficiency level with positive LCC savings and the incorporation of single speed compressors for all equipment classes in which this design option was considered. The change in INPV is expected to range from −$ 61.9 million to −$15.0 million, which represents a change in INPV of −1.9 percent to −0.5 percent, respectively. At this level, free cash flow is estimated to decrease by 11.3 percent compared to the no-new-standards case value of $291.2 million in the year 2027, the year before compliance is required. In 2027, approximately 28.8 percent of covered CRE shipments are expected to meet the efficiencies required at TSL 3.

At TSL 3, the efficiency levels required for many equipment classes are lower than the efficiency levels required at TSL 4. However, the efficiency levels required for some equipment classes are the same or are higher (*i.e.,* more stringent) than the TSL 4 efficiencies. At this level, DOE expects that none of the self-contained equipment classes would require the use of variable-speed compressor systems. DOE also expects that fewer equipment classes with transparent doors would need to incorporate additional panes of glass to meet TSL 3. For the five highest-volume equipment classes, the efficiency levels required at TSL 3, as compared to TSL 4, are lower for VCT.SC.M, VCT.SC.L, and VCS.SC.L; higher for VCT.RC.M; and the same for VCT.SC.M. For VCT.RC.M, TSL 3 corresponds to EL 3. For VCT.SC.M, TSL 3 corresponds to EL 1. For VCT.SC.L, TSL 3 corresponds to EL 3. For VCS.SC.L, TSL 3 corresponds to EL 4. At this level, DOE expects industry would incur minimal capital conversion costs. Product conversion costs may be necessary to source, qualify, and test high-efficiency components but to a lesser extent than higher TSLs. DOE estimates capital conversion costs of $3.1 million and product conversion costs of $94.0 million. Conversion costs total $97.1 million.

At TSL 3, the shipment-weighted average MPC for all CRE is expected to increase by 2.2 percent relative to the no-new-standards case shipment-weighted average MPC for all CRE in 2028. 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 $97.1 million in conversion costs, causing a small decrease in INPV at TSL 3 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 2028, the analyzed compliance year. This reduction in the manufacturer markup and the $97.1 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 TSL 2, the standard represents the highest efficiency level with maximum LCC savings and the incorporation of single speed compressors for all equipment classes in which this design option was considered. The change in INPV is expected to range from −$44.4 million to −$6.7 million, which represents a change in INPV of −1.4 percent to −0.2 percent, respectively.

At this level, free cash flow is estimated to decrease by 8.0 percent compared to the no-new-standards case value of $291.2 million in the year 2027, the year before compliance is required. In 2027, approximately 29.9 percent of covered CRE shipments are expected to meet the efficiencies required at TSL 2.

At this level, the efficiency levels required for most equipment classes are the same as TSL 3. For the five highest-volume equipment classes, TSL 2 corresponds to lower efficiency levels for one equipment class: VCT.RC.M. DOE expects manufacturers would likely need to implement occupancy sensors into VCT.RC.M designs. For VCT.SC.M, VCT.SC.L, VCS.SC.M, and VCS.SC.L, the efficiencies at TSL 2 are the same as TSL 3. At this level, DOE expects industry would incur minimal capital conversion costs. The lower efficiency levels required for two equipment classes—VCT.RC.M and SOC.RC.M—drive the drop in product conversion costs at this level. For VCT.RC.M and SOC.RC.M, DOE expects manufacturers could meet TSL 2 efficiencies by incorporating occupancy sensors, which requires minimal development effort. DOE estimates capital conversion costs of $2.2 million and product conversion costs of $66.1 million. Conversion costs total $68.3 million.

At TSL 2, the shipment-weighted average MPC for all CRE is expected to increase by 1.7 percent relative to the no-new-standards case shipment-weighted average MPC for all CRE in 2028. 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 $68.3 million in conversion costs, causing a minor decrease 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 2028, the analyzed compliance year. This reduction in the manufacturer markup and the $68.3 million in conversion costs incurred by manufacturers cause a slightly negative change in INPV at TSL 2 under the preservation of operating profit scenario.

At TSL 1, the standard represents the minimum efficiency level with positive LCC savings. The change in INPV is expected to range from −$12.2 million to $4.5 million, which represents a change in INPV of –0.4 percent to 0.1 percent, respectively. At this level, free cash flow is estimated to decrease by 1.9 percent compared to the no-new-standards case value of $291.2 million in the year 2027, the year before compliance is required. In 2027, approximately 35.6 percent of covered CRE shipments are expected to meet the efficiencies required at TSL 1.

At this level, the efficiency levels correspond to EL 1 for nearly all equipment classes (except for VCT.SC.H, HCT.SC.M, and HCT.SC.L, which are set to baseline or EL 0). DOE expects most self-contained equipment classes would need to incorporate higher-efficiency fan motors (*i.e.,* EC evaporator or condenser fan motors or PSC evaporator fan motors for chef bases). Other self-contained equipment classes may need to incorporate evaporator fan controls in lieu of higher-efficiency motors. DOE expects that HCT.SC.L and HCT.SC.I may require the use of variable-speed compressors to meet TSL 1 efficiencies. At this level, DOE expects that manufacturers of VCT.SC.I may need to incorporate an additional pane of glass. Remote-controlled equipment classes would likely need to incorporate occupancy sensors. Capital conversion costs are driven by tooling costs associated with incorporating variable-speed compressors into HCT.SC.L and HCT.SC.I designs. Product conversion costs are driven by incorporating high-efficiency components into CRE designs. DOE estimates capital conversion costs of $2.7 million and product conversion costs of $12.6 million. Conversion costs total $15.3 million.

At TSL 1, the shipment-weighted average MPC for all CRE is expected to increase by 0.8 percent relative to the no-new-standards case shipment-weighted average MPC for all CRE in 2028. 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 slightly outweighs the $15.3 million in conversion costs, causing a minor increase 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 2028, the analyzed compliance year. This reduction in the manufacturer markup and the $15.3 million in conversion costs incurred by manufacturers cause a slightly negative change in INPV at TSL 1 under the preservation of operating profit scenario.

DOE seeks comments, information, and data on the capital conversion costs and product conversion costs estimated for each TSL.

TABLE V.67—PERCENTAGES OF 2027 NO-NEW-STANDARDS CASE SHIPMENTS THAT MEET EACH TSL BY EQUIPMENT CLASS

Directly analyzed equipment class	TSL 1 (%)	TSL 2 (%)	TSL 3 (%)	TSL 4 (%)	TSL 5 (%)	TSL 6 (%)
CB.SC.L	30.0	0.0	0.0	0.0	0.0	0.0
CB.SC.M	50.0	10.0	0.0	10.0	0.0	0.0
HCS.SC.L	12.4	12.4	12.4	12.4	12.4	0.0
HCS.SC.M	12.4	12.4	0.0	12.4	0.0	0.0
HCT.SC.I	28.3	100.0	100.0	28.3	22.3	8.9
HCT.SC.L	100.0	100.0	100.0	100.0	100.0	8.9
HCT.SC.M	100.0	100.0	100.0	100.0	100.0	8.9
HZO.RC.L	0.0	0.0	0.0	0.0	0.0	0.0
HZO.RC.M	0.0	0.0	0.0	0.0	0.0	0.0
HZO.SC.L	18.9	15.2	15.2	0.0	0.0	0.0
HZO.SC.M	18.9	15.2	15.2	0.0	0.0	0.0
SOC.RC.M	1.6	1.6	0.2	1.6	0.2	0.0
SOC.SC.M	63.7	47.2	47.2	26.7	24.8	24.8
SVO.RC.M	23.8	23.8	0.0	23.8	0.0	0.0

TABLE V.67—PERCENTAGES OF 2027 NO-NEW-STANDARDS CASE SHIPMENTS THAT MEET EACH TSL BY EQUIPMENT CLASS—Continued

Directly analyzed equipment class	TSL 1 (%)	TSL 2 (%)	TSL 3 (%)	TSL 4 (%)	TSL 5 (%)	TSL 6 (%)
SVO.SC.M	34.0	21.5	21.5	11.4	10.5	10.5
VCS.SC.H	30.0	30.0	0.0	30.0	0.0	0.0
VCS.SC.I	0.0	0.0	0.0	0.0	0.0	0.0
VCS.SC.L	23.0	14.0	14.0	0.0	0.0	0.0
VCS.SC.M	29.0	19.0	19.0	19.0	8.0	5.0
VCT.RC.L	7.0	6.0	6.0	6.0	6.0	0.4
VCT.RC.M	7.0	7.0	0.4	7.0	0.4	0.0
VCT.SC.H	100.0	100.0	100.0	100.0	100.0	3.0
VCT.SC.I	55.8	36.5	36.5	36.5	36.5	0.0
VCT.SC.L	65.0	60.0	60.0	10.0	10.0	0.0
VCT.SC.M	52.0	52.0	52.0	18.0	18.0	0.0
VOP.RC.L	26.9	0.0	0.0	0.0	0.0	0.0
VOP.RC.M	26.9	0.0	0.0	0.0	0.0	0.0
VOP.SC.M	14.0	9.0	9.0	5.0	5.0	5.0
Overall Industry	35.6	29.9	28.8	15.7	10.8	2.2

b. Direct Impacts on Employment

To quantitatively assess the potential impacts of new and amended energy conservation standards on direct employment in the CRE 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. DOE calculated these values using statistical data from the 2021 *ASM,*[101] BLS employee compensation data,[102] results of the engineering analysis, and manufacturer interviews.

Labor expenditures related to equipment manufacturing depend on the labor intensity of the equipment, 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 burdened wage ratio factors in paid leave, supplemental pay, insurance, retirement and savings, and legally required benefits.

Total production employees was 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 equipment. This value is derived from manufacturer interviews, equipment database analysis, DOE's shipments analysis, and publicly available information. DOE estimates that approximately 77 percent of currently covered CRE are produced domestically.

The domestic production employees estimate covers production line workers, including line supervisors, who are directly involved in fabricating and assembling equipment 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.[103] DOE's estimates only account for production workers who manufacture the specific equipment covered by this proposed rule.

Non-production workers account for the remainder of the direct employment figure. The non-production employees category covers domestic workers who are not directly involved in the production process, such as sales, engineering, human resources, management, *etc.*[104] Using the number of domestic production workers calculated above, non-production domestic employees are extrapolated by multiplying the ratio of non-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 new energy conservation standards there would be 7,472 domestic workers for CRE in 2028. Table V.68 shows the range of the impacts of energy conservation standards on U.S. manufacturing employment in the CRE industry. The discussion below provides a qualitative evaluation of the range of potential impacts presented in the table.

TABLE V.68—DIRECT EMPLOYMENT IMPACTS FOR DOMESTIC CRE MANUFACTURERS IN 2028 *

	No-new-standards case	TSL 1	TSL 2	TSL 3	TSL 4	TSL 5	TSL 6
Direct Employment in 2028 (Production Workers + Non-Production Workers).	7,472	7,475	7,467	7,464	7,429	7,393	7,234.

[101] 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/data/tables/time-series/econ/asm/2018–2021-asm.html* (last accessed January 20, 2023).

[102] U.S. Bureau of Labor Statistics. *Employer Costs for Employee Compensation.* December 15, 2022. Available at *www.bls.gov/news.release/pdf/ecec.pdf* (last accessed January 20, 2023).

[103] U.S. Census Bureau, "Definitions and Instructions for the Annual Survey of Manufactures, MA–10000." Available at *www2.census.gov/programs-surveys/asm/technical-documentation/questionnaire/2021/instructions/MA_10000_Instructions.pdf* (last accessed January 25, 2023).

[104] *Id.*

TABLE V.68—DIRECT EMPLOYMENT IMPACTS FOR DOMESTIC CRE MANUFACTURERS IN 2028 *—Continued

	No-new-standards case	TSL 1	TSL 2	TSL 3	TSL 4	TSL 5	TSL 6
Potential Changes in Direct Employment in 2028*.	....	(5,484) to 3	(5,484) to (5)	(5,484) to (8)	(5,484) to (43) ..	(5,484) to (79) ..	(5,484) to (238).

* DOE presents a range of potential employee impacts. Numbers in parentheses indicate negative numbers.

The direct employment impacts in table V.68 represent the potential domestic employment changes that could result following the compliance date for CRE in this proposal. The upper bound estimate corresponds to a potential change in the number of domestic workers that would result from new and amended energy conservation standards if manufacturers continue to produce the same scope of covered equipment within the United States after compliance takes effect.

To establish a conservative lower bound, DOE assumes all manufacturers would shift production to foreign countries with lower labor costs. Most of the design options analyzed in the engineering analysis require manufacturers to purchase more-efficient components from suppliers. These components do not require significant additional labor to assemble or significant production line updates. Incorporating vacuum-insulated panels could lead to greater labor requirements, however, as discussed in section IV.B.1 of this document, DOE did not consider vacuum-insulated panels as a design option in its engineering analysis. As a result, DOE believes the likelihood of changes in production location due to new and amended standards are relatively low.

Additional detail on the analysis of direct employment can be found in chapter 12 of the NOPR 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 NOPR TSD.

c. Impacts on Manufacturing Capacity

In interviews, most manufacturers noted potential manufacturing capacity concerns relating to widespread adoption of increased insulation thickness or VIPs. As discussed in section IV.B.1 of this document, DOE excluded these technologies from further consideration in the engineering analysis and, thus, DOE does not expect manufacturers would need to increase insulation thickness or incorporate VIPs to meet any of the efficiency levels analyzed in this NOPR. Therefore, when considering potential new and amended energy conservation standards in isolation, DOE believes manufacturers would be able to maintain manufacturing capacity levels and continue to meet market demand under the proposed new and amended energy conservation standards. However, multiple manufacturers raised concerns about technical and laboratory resource constraints due to overlapping regulations over a short time period. Specifically, these manufacturers mentioned the testing and redesign required for new safety standards and the various regulations necessitating the transition to low-GWP refrigerants. Some manufacturers stated that there are already experiencing testing laboratory shortages, which would further be exacerbated should EPA finalize its proposals in the December 2022 EPA NOPR and DOE set more stringent standards that necessitate the redesign of the majority of basic models. Manufacturers noted that the ongoing supply chain constraints further strain technical and laboratory resources as manufacturers are forced to identify and qualify new component suppliers due to shortages and long lead times.

DOE seeks comment on whether manufacturers expect that manufacturing capacity constraints, engineering resource constraints, or laboratory constraints would limit equipment availability to consumers in the timeframe of the new and amended standards compliance date (2028).

d. Impacts on Subgroups of Manufacturers

Small business, low volume, and niche equipment manufacturers, and manufacturers exhibiting a cost structure substantially different from the industry average could be affected disproportionately. As discussed in section IV.J of this document, using average cost assumptions to develop an industry cash flow estimate is inadequate to assess differential impacts among manufacturer subgroups.

For CRE, DOE identified and evaluated the impact of new and amended conservation standards on one subgroup: small manufacturers. The SBA defines a ''small business'' as having 1,250 employees or less for NAICS 333415, ''Air-Conditioning and Warm Air Heating Equipment and Commercial and Industrial Refrigeration Equipment Manufacturing,'' which includes CRE manufacturing. Based on this definition, DOE identified 25 domestic OEM in the CRE industry that qualify as a ''small business.''

For a discussion of the impacts on the small manufacturer subgroup, see the regulatory flexibility analysis in section VI.B of this document or chapter 12 of the NOPR TSD.

e. Cumulative Regulatory Burden

One aspect of assessing manufacturer burden involves looking at the cumulative impact of multiple DOE standards and the equipment/product-specific regulatory actions of other Federal agencies 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. Assessing the impact of a single regulation may overlook this cumulative regulatory burden. In addition to energy conservation standards, other regulations can significantly affect manufacturers' financial operations. Multiple regulations affecting the same manufacturer can strain profits and lead companies to abandon product lines or markets with lower expected future returns than competing equipment. For these reasons, DOE conducts an analysis of cumulative regulatory burden as part of its rulemakings pertaining to appliance efficiency. DOE evaluates equipment/product-specific regulations that will take effect approximately three years before or after the estimated 2028 compliance date of any new and amended energy conservation standards for CRE. This information is presented in table V.69.

TABLE V.69—COMPLIANCE DATES AND EXPECTED CONVERSION EXPENSES OF FEDERAL ENERGY CONSERVATION STANDARDS AFFECTING COMMERCIAL REFRIGERATION EQUIPMENT OEMS

Federal energy conservation standard	Number of OEMs*	Number of OEMs affected by this rulemaking **	Approx. standards compliance year	Industry conversion costs (Millions $)	Industry conversion costs/ equipment revenue*** (%)
Consumer Furnaces† 87 FR 40590 (July 7, 2022)	15	2	2029	$150.6 (2020$)	1.4
Consumer Clothes Dryers † 87 FR 51734 (August 23, 2022)	15	3	2027	149.7 (2020$)	1.8
Consumer Conventional Cooking Products 88 FR 6818 † (February 1, 2023)	34	4	2027	183.4 (2021$)	1.2
Refrigerators, Freezers, and Refrigerator-Freezers † 88 FR 12452 (February 27, 2023)	49	8	2027	1,323.6 (2021$)	3.8
Residential Clothes Washers † 88 FR 13520 (March 3, 2023)	19	3	2027	690.8 (2021$)	5.2
Room Air Conditioners 88 FR 34298 (May 26, 2023)	8	1	2026	24.8 (2021$)	0.4
Miscellaneous Refrigeration Products † 88 FR 19382 (March 31, 2023)	38	6	2029	126.9 (2021$)	3.1
Dishwashers† 88 FR 32514 (May 19, 2023)	22	5	2027	125.6 (2021$)	2.1
Automatic Commercial Ice Makers † 88 FR 30508 (May 11, 2023)	23	7	2027	15.9 (2022$)	0.6
Refrigerated Bottled or Canned Beverage Vending Machines † 88 FR 33968 May 25, 2023)	5	2	2027	1.5 (2022$)	0.7
Microwave Ovens 88 FR 39912 (June 20, 2023)	18	3	2026	46.1 (2021$)	0.7
Walk-in Coolers and Freezers † 88 FR 60746 (September 5, 2023)	79	5	2027	89.0 (2022$)	0.8

* 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 CRE 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 the 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.

DOE requests information regarding the impact of cumulative regulatory burden on manufacturers of CRE associated with multiple DOE standards or equipment/product-specific regulatory actions of other Federal agencies.

Refrigerant Regulations

The December 2022 EPA NOPR [105] rulemaking proposes to restrict the use of HFCs in specific sectors or subsectors, including use in certain CRE covered by this rulemaking. DOE is considering the impacts of change in refrigerants in its analysis. DOE understands that switching from non-flammable to flammable refrigerants (*e.g.,* R–290) requires time and investment to redesign CRE models and upgrade production facilities to accommodate the additional structural and safety precautions required. As discussed in section IV.C.1 of this document, DOE expects CRE manufacturers will transition most models to R–290 to comply with anticipated refrigeration regulations, such as the December 2022 EPA NOPR, prior to the expected 2028 compliance date of any potential energy conservation standards. Therefore, the engineering analysis assumes the use of R–290 compressors as a baseline design option for select equipment classes. See section IV.C.1 of this document for additional information on refrigerant assumptions in the engineering analysis.

DOE accounted for the costs associated with redesigning CRE to make use of flammable refrigerants and retrofitting production facilities to accommodate flammable refrigerants in the GRIM. DOE considers the expenses associated with the refrigerant transition as independent of DOE actions related to any new and amended energy conservation standards. Therefore, DOE incorporated the refrigerant transition expenses into both the no-new-standards case and standards cases. DOE relied on manufacturer feedback in confidential interviews, a report prepared for EPA,[106] results of the engineering analysis, and investment estimates submitted by NAMA and AHRI in response to the June 2022 Preliminary Analysis to estimate the industry refrigerant transition costs. Based on feedback, DOE assumed that the transition to low-GWP refrigerants would require industry to invest approximately $21.3 million in R&D and $33.3 million in capital expenditures (*e.g.,* investments in new charging equipment, leak detection systems, *etc.*).

DOE requests comments on the magnitude of costs associated with transitioning CRE designs and production facilities to accommodate low-GWP refrigerants that would be incurred between the publication of this NOPR and the proposed compliance date of new and amended standards. Quantification and categorization of

[105] The proposed rule was published on December 15, 2022. 87 FR 76738.

[106] *See* pp. 5–113 of the ''Global Non-CO2 Greenhouse Gas Emission Projections & Marginal Abatement Cost Analysis: Methodology Documentation'' (2019). Available at *www.epa.gov/sites/default/files/2019-09/documents/nonco2_methodology_report.pdf.*

these costs, such as engineering efforts, testing lab time, certification costs, and capital investments (*e.g.,* new charging equipment), would enable DOE to refine its analysis.

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 new and amended standards.

a. Significance of Energy Savings

To estimate the energy savings attributable to potential new and amended standards for CRE, 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 equipment purchased in the 30-year period that begins in the year of anticipated compliance with new and amended standards (2028–2057). Table V.70 presents DOE's projections of the national energy savings for each TSL considered for CRE. The savings were calculated using the approach described in section IV.E of this document.

TABLE V.70—CUMULATIVE NATIONAL ENERGY SAVINGS FOR CRE; 30 YEARS OF SHIPMENTS (2028–2057)

	Trial standard level					
	1	2	3	4	5	6
	(quads)					
Primary energy	1.00	1.70	1.79	2.70	3.02	3.29
FFC energy	1.03	1.75	1.83	2.78	3.11	3.38

OMB Circular A–4 [107] 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 equipment shipments. The choice of a 9-year period is a proxy for the timeline in EPCA for the review of certain energy conservation standards and potential revision of and compliance with such revised standards.[108] The review timeframe established in EPCA is generally not synchronized with the equipment lifetime, equipment manufacturing cycles, or other factors specific to CRE. 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.71. The impacts are counted over the lifetime of CRE purchased in 2028–2036.

TABLE V.71—CUMULATIVE NATIONAL ENERGY SAVINGS FOR CRE; 9 YEARS OF SHIPMENTS (2028–2036)

	Trial standard level					
	1	2	3	4	5	6
	(quads)					
Primary energy	0.28	0.48	0.51	0.77	0.86	0.93
FFC energy	0.29	0.50	0.52	0.79	0.88	0.96

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 CRE. In accordance with OMB's guidelines on regulatory analysis,[109] DOE calculated NPV using both a 7-percent and a 3-percent real discount rate. Table V.72 shows the consumer NPV results with impacts counted over the lifetime of equipment purchased in 2028–2057.

[107] U.S. Office of Management and Budget. *Circular A–4: Regulatory Analysis.* September 17, 2003. *obamawhitehouse.archives.gov/omb/circulars_a004_a-4* (last accessed February 17, 2023).

[108] EPCA requires DOE to review its standards at least once every 6 years, and requires, for certain products, a 3-year period after any new standard is promulgated before compliance is required, except that in no case may any new standards be required within 6 years of the compliance date of the previous standards. (42 U.S.C. 6316(e)(1)); 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.

[109] U.S. Office of Management and Budget. *Circular A–4: Regulatory Analysis.* September 17, 2003. *obamawhitehouse.archives.gov/omb/circulars_a004_a–4* (last accessed February 17, 2023).

TABLE V.72—CUMULATIVE NET PRESENT VALUE OF CONSUMER BENEFITS FOR CRE; 30 YEARS OF SHIPMENTS (2028–2057)

Discount rate	Trial standard level					
	1	2	3	4	5	6
	(billion [2022$])					
3 percent	4.39	6.01	5.87	8.59	7.10	−16.5
7 percent	1.80	2.38	2.27	3.24	2.38	−10.1

The NPV results based on the aforementioned 9-year analytical period are presented in *2022$* table V.73. The impacts are counted over the lifetime of equipment purchased in 2028–2036. 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.

TABL—V.73—CUMULATIVE NET PRESENT VALUE OF CONSUMER BENEFITS FOR CRE; 9 YEARS OF SHIPMENTS (2028–2036)

Discount rate	Trial standard level					
	1	2	3	4	5	6
	(billion [2022$])					
3 percent	1.68	2.30	2.25	3.16	2.50	−6.42
7 percent	0.92	1.21	1.16	1.58	1.09	−5.21

The previous results reflect the use of a default trend to estimate the change in price for CRE over the analysis period (*see* section IV.F.1 of this document). DOE also conducted a sensitivity analysis that considered one scenario with a lower rate of price decline than the reference case and one scenario with a higher rate of price decline than the reference case. The results of these alternative cases are presented in appendix 10C of the NOPR TSD. In the high-price-decline case, the NPV of consumer benefits is higher than in the default case. In the low-price-decline case, the NPV of consumer benefits is lower than in the default case.

c. Indirect Impacts on Employment

DOE estimates that that new and amended energy conservation standards for CRE would reduce energy expenditures for consumers of those equipment, 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 (2028–2032), where these uncertainties are reduced.

The results suggest that the proposed standards would be 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 NOPR TSD presents detailed results regarding anticipated indirect employment impacts.

4. Impact on Utility or Performance of Equipment

As discussed in section IV.C.1.b of this document, DOE has tentatively concluded that the standards proposed in this NOPR would not lessen the utility or performance of the CRE under consideration in this rulemaking. Manufacturers of these equipment currently offer units that meet or exceed the proposed standards.

5. Impact of Any Lessening of Competition

DOE considered any lessening of competition that would be likely to result from new and amended standards. As discussed in section III.F.1 of this document, the Attorney General determines the impact, if any, of any lessening of competition likely to result from a proposed standard, and transmits such determination in writing to the Secretary, together with an analysis of the nature and extent of such impact. To assist the Attorney General in making this determination, DOE has provided DOJ with copies of this NOPR and the accompanying TSD for review. DOE will consider DOJ's comments on the proposed rule in determining whether to proceed to a final rule. DOE will publish and respond to DOJ's comments in that document. DOE invites comment from the public regarding the competitive impacts that are likely to result from this proposed rule. In addition, stakeholders may also provide comments separately to DOJ regarding these potential impacts. See the **ADDRESSES** section for information to send comments to DOJ.

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 NOPR TSD presents the estimated impacts on electricity generating capacity, relative to the no-new-standards case, for the TSLs that DOE considered in this proposed rulemaking.

Energy conservation resulting from potential energy conservation standards for CRE is expected to yield environmental benefits in the form of reduced emissions of certain air pollutants and greenhouse gases. Tabl— V.74 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.L.1 of this document. DOE reports annual emissions reductions for each TSL in chapter 13 of the NOPR TSD.

TABLE V.74—CUMULATIVE EMISSIONS REDUCTION FOR CRE SHIPPED IN 2028–2057

	Trial Standard Level					
	1	2	3	4	5	6
Power Sector and Site Emissions						
CO_2 (*million metric tons*)	16.7	28.5	29.9	45.3	50.7	55.1
CH_4 (*thousand tons*)	1.24	2.11	2.21	3.35	3.75	4.08
N_2O (*thousand tons*)	0.17	0.29	0.31	0.47	0.52	0.57
NO_X (*thousand tons*)	7.89	13.4	14.1	21.3	23.9	26.0
SO_2 (*thousand tons*)	5.53	9.43	9.89	15.0	16.8	18.2
Hg (*tons*)	0.04	0.07	0.07	0.10	0.12	0.13
Upstream Emissions						
CO_2 (*million metric tons*)	1.70	2.90	3.04	4.61	5.15	5.61
CH_4 (*thousand tons*)	155	263	277	419	468	509
N_2O (*thousand tons*)	0.01	0.01	0.01	0.02	0.02	0.03
NO_X (*thousand tons*)	26.5	45.2	47.4	71.8	80.3	87.4
SO_2 (*thousand tons*)	0.10	0.17	0.18	0.28	0.31	0.34
Hg (*tons*)	0.00	0.00	0.00	0.00	0.00	0.00
FFC Emissions						
CO_2 (*million metric tons*)	18.4	31.4	33.0	49.9	55.8	60.7
CH_4 (*thousand tons*)	156	266	279	422	472	514
N_2O (*thousand tons*)	0.18	0.31	0.32	0.49	0.54	0.59
NO_X (*thousand tons*)	34.4	58.6	61.5	93.1	104	113
SO_2 (*thousand tons*)	5.64	9.60	10.1	15.3	17.1	18.6
Hg (*tons*)	0.04	0.07	0.07	0.10	0.12	0.13

As part of the analysis for this rulemaking, DOE estimated monetary benefits likely to result from the reduced emissions of CO_2 that DOE estimated for each of the considered TSLs for CRE. Section IV.L of this document discusses the SC–CO_2 values that DOE used. Table V.75 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 proposed TSL in chapter 14 of the NOPR TSD.

TABLE V.75—PRESENT VALUE OF CO_2 EMISSIONS REDUCTION FOR CRE SHIPPED IN 2028–2057

TSL	SC–CO_2 Case			
	Discount rate and statistics			
	5% Average	3% Average	2.5% Average	3% 95th percentile
	(million 2022$)			
1	183	788	1,233	2,391
2	312	1,342	2,101	4,074
3	327	1,408	2,205	4,276
4	495	2,132	3,337	6,472
5	554	2,384	3,733	7,239
6	602	2,593	4,060	7,872

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 CRE. Table V.76 presents the value of the CH_4 emissions reduction at each TSL, and table V.77 presents the value of the N_2O emissions reduction at each TSL. The time-series of annual values is presented for the proposed TSL in chapter 14 of the NOPR TSD.

The time-series of annual values is presented for the proposed TSL in chapter 14 of the NOPR TSD.

TABLE V.76—PRESENT VALUE OF METHANE EMISSIONS REDUCTION FOR CRE SHIPPED IN 2028–2057

TSL	$SC–CH_4$ Case			
	Discount rate and statistics			
	5% Average	3% Average	2.5% Average	3% 95th percentile
	(Million 2022$)			
1	70.7	213	297	562
2	120	362	506	958
3	126	380	532	1005
4	191	576	805	1522
5	214	644	900	1702
6	233	700	979	1852

TABLE V.77—PRESENT VALUE OF NITROUS OXIDE EMISSIONS REDUCTION FOR CRE SHIPPED IN 2028–2057

TSL	$SC–N_2O$ Case			
	Discount rate and statistics			
	5% Average	3% Average	2.5% Average	3% 95th percentile
	(Million 2022$)			
1	0.69	2.74	4.25	7.30
2	1.17	4.67	7.23	12.4
3	1.23	4.90	7.59	13.0
4	1.85	7.42	11.5	19.8
5	2.07	8.29	12.9	22.1
6	2.25	9.02	14.0	24.0

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 that the proposed standards would be economically justified even without inclusion of monetized benefits of reduced GHG emissions.

DOE also estimated the monetary value of the health benefits associated with NO_X and SO_2 emissions reductions anticipated to result from the considered TSLs for CRE. The dollar-per-ton values that DOE used are discussed in section IV.L of this document. Table V.78 shows the present value for NO_X emissions reduction for each TSL calculated using 7-percent and 3-percent discount rates, and table V.79 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 proposed TSL in chapter 14 of the NOPR TSD.

TABLE V.78—PRESENT VALUE OF NO_X EMISSIONS REDUCTION FOR CRE SHIPPED IN 2028–2057

TSL	3% Discount rate	7% Discount rate
	million [2022$]	
1	1,597	623
2	2,721	1,061
3	2,855	1,114
4	4,322	1,686
5	4,834	1,885
6	5,257	2,048

TABLE V.79—PRESENT VALUE OF SO_2 EMISSIONS REDUCTION FOR CRE SHIPPED IN 2028–2057

TSL	3% Discount rate	7% Discount rate
	million [2022$]	
1	145	366
2	247	624

TABLE V.79—PRESENT VALUE OF SO_2 EMISSIONS REDUCTION FOR CRE SHIPPED IN 2028–2057—Continued

TSL	3% Discount rate	7% Discount rate
3	260	655
4	393	992
5	439	1109
6	478	1206

Not all the public health and environmental benefits from the reduction of greenhouse gases, NO_X, 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. 6316(e)(1); 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.80 presents the NPV values that result from adding the estimates of the potential 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 equipment, and are measured for the lifetime of equipment shipped in 2028–2057. 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 CRE shipped in 2028–2057.

TABLE V.80—CONSUMER NPV COMBINED WITH PRESENT VALUE OF CLIMATE BENEFITS AND HEALTH BENEFITS

Category	TSL 1	TSL 2	TSL 3	TSL 4	TSL 5	TSL 6
Using 3% discount rate for Consumer NPV and Health Benefits (billion 2022$)						
5% Average SC–GHG case	6.6	9.8	9.8	14.6	13.8	−9.2
3% Average SC–GHG case	7.4	11.1	11.2	16.6	16.1	−6.7
2.5% Average SC–GHG case	7.9	12.0	12.1	18.1	17.7	−5.0
3% 95th percentile SC–GHG case	9.3	14.4	14.7	21.9	22.0	−0.3
Using 7% discount rate for Consumer NPV and Health Benefits (billion 2022$)						
5% Average SC–GHG case	2.8	4.1	4.1	6.0	5.5	−6.7
3% Average SC–GHG case	3.6	5.4	5.4	8.0	7.7	−4.2
2.5% Average SC–GHG case	4.1	6.3	6.4	9.5	9.4	−2.5
3% 95th percentile SC–GHG case	5.5	8.7	8.9	13.3	13.7	2.2

C. Conclusion

When considering new or amended energy conservation standards, the standards that DOE adopts for any type (or class) of covered equipment must be designed to achieve the maximum improvement in energy efficiency that the Secretary determines is technologically feasible and economically justified. (42 U.S.C. 6316(e)(1); 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. 6316(e)(1); 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. 6316(e)(1); 42 U.S.C. 6295(o)(3)(B))

For this NOPR, DOE considered the impacts of new and amended standards for CRE 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. There is evidence that consumers undervalue future energy savings as a result of (1) a lack of information; (2) a lack of sufficient salience of the long-term or aggregate benefits; (3) a lack of sufficient savings to warrant delaying or altering purchases; (4) excessive focus on the short term, in the form of inconsistent weighting of future energy cost savings relative to available returns on other investments; (5) computational or other difficulties associated with the evaluation of relevant tradeoffs; and (6) a divergence in incentives (for example, between renters and owners, or builders and purchasers). Having less than perfect foresight and a high degree of uncertainty about the future, consumers may trade off these types of investments at a higher-than-expected rate between current consumption and uncertain future energy cost savings.

1. Benefits and Burdens of TSLs Considered for CRE Standards

Table V.81 and table V.82 summarize the quantitative impacts estimated for each TSL for CRE. The national impacts are measured over the lifetime of CRE purchased in the 30-year period that begins in the anticipated year of compliance with new and amended standards (2028–2057). The energy savings, emissions reductions, and value of emissions reductions refer to full-fuel-cycle results. The efficiency levels contained in each TSL are described in section V.A of this document.

TABLE V.81—SUMMARY OF ANALYTICAL RESULTS FOR CRE TSLS: NATIONAL IMPACTS

Category	TSL 1	TSL 2	TSL 3	TSL 4	TSL 5	TSL 6
Cumulative FFC National Energy Savings						
Quads	1.03	1.75	1.83	2.78	3.11	3.38
Cumulative FFC Emissions Reduction						
CO_2 (*million metric tons*)	18.4	31.4	33.0	49.9	55.8	60.7
CH_4 (*thousand tons*)	156	266	279	422	472	514
N_2O (*thousand tons*)	0.18	0.31	0.32	0.49	0.54	0.59
NO_X (*thousand tons*)	34.4	58.6	61.5	93.1	104	113
SO_2 (*thousand tons*)	5.64	9.60	10.1	15.3	17.1	18.6
Hg (*tons*)	0.04	0.07	0.07	0.10	0.12	0.13
Present Value of Benefits and Costs (3% discount rate, billion 2022$)						
Consumer Operating Cost Savings	5.28	8.03	8.38	12.6	12.8	11.2
Climate Benefits *	1.00	1.71	1.79	2.71	3.04	3.30
Health Benefits **	1.96	3.34	3.51	5.31	5.94	6.46
Total Benefits†	8.25	13.1	13.7	20.7	21.8	21.0
Consumer Incremental Equipment Costs‡	0.89	2.02	2.51	4.05	5.74	27.7
Consumer Net Benefits	4.39	6.01	5.87	8.59	7.10	−16.5
Total Net Benefits	7.36	11.1	11.2	16.6	16.1	−6.72
Present Value of Benefits and Costs (7% discount rate, billion 2022$)						
Consumer Operating Cost Savings	2.28	3.47	3.62	5.46	5.55	4.84
Climate Benefits *	1.00	1.71	1.79	2.71	3.04	3.30
Health Benefits **	0.77	1.31	1.37	2.08	2.32	2.53
Total Benefits†	4.05	6.49	6.79	10.3	10.9	10.7
Consumer Incremental Equipment Costs‡	0.48	1.08	1.35	2.22	3.17	14.9
Consumer Net Benefits	1.80	2.38	2.27	3.24	2.38	−10.1
Total Net Benefits	3.58	5.40	5.44	8.03	7.74	−4.24

Note: This table presents the costs and benefits associated with CRE shipped in 2028—2057. These results include benefits to consumers which accrue after 2057 from the equipment shipped in 2028−2057.

* 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 as well as installation costs.

TABLE V.82—SUMMARY OF ANALYTICAL RESULTS: MANUFACTURER AND CONSUMER IMPACTS

Category	TSL 1 *	TSL 2 *	TSL 3 *	TSL 4 *	TSL 5 *	TSL 6 *
Manufacturer Impacts						
Industry NPV (million 2022$) (No-new-standards case INPV = 3,286.4)	3,274.2 to 3,290.8	3,241.9 to 3,279.6	3,224.4 to 3,271.4	3,182.5 to 3,269.6	3,127.0 to 3,255.5	2,985.9 to 3,529.9
Industry NPV (% change)	(0.4) to 0.1	(1.4) to (0.2)	(1.9) to (0.5)	(3.2) to (0.5)	(4.8) to (0.9)	(9.1) to 7.4

TABLE V.82—SUMMARY OF ANALYTICAL RESULTS: MANUFACTURER AND CONSUMER IMPACTS—Continued

Category	TSL 1*	TSL 2*	TSL 3*	TSL 4*	TSL 5*	TSL 6*
Consumer Average LCC Savings (2022$)						
CB.SC.L	$263.1	$263.1	$553.2	$672.5	$566.9	$566.9
CB.SC.M	111.3	111.3	199.3	208.7	44.9	−74.3
HCS.SC.L	7.8	7.8	7.8	7.8	7.8	−147.3
HCS.SC.M	94.1	94.1	84.9	94.1	84.9	−189.1
HCT.SC.I	93.8	NA	NA	93.8	55.0	−306.5
HCT.SC.L	NA	NA	NA	NA	NA	−421.6
HCT.SC.M	NA	NA	NA	NA	NA	−551.4
HZO.RC.L	46.6	46.6	46.6	46.6	46.6	46.6
HZO.RC.M	40.3	40.3	40.3	40.3	40.3	40.3
HZO.SC.L	160.9	193.6	193.6	971.2	841.9	841.9
HZO.SC.M	95.0	117.4	117.4	226.5	199.9	199.9
SOC.RC.M	986.3	986.3	929.5	986.3	929.5	−70.5
SOC.SC.M	994.6	1,015.5	1,015.5	1,834.7	698.4	698.4
SVO.RC.M	522.8	522.8	406.6	522.8	406.6	406.6
SVO.SC.M	175.6	600.5	600.5	692.3	602.2	602.2
VCS.SC.H	399.5	399.5	263.8	399.5	162.5	33.5
VCS.SC.I	219.0	377.4	377.4	615.2	486.7	486.7
VCS.SC.L	193.1	309.0	309.0	375.8	260.7	260.7
VCS.SC.M	217.3	240.7	240.7	240.7	128.8	0.2
VCT.RC.L	323.7	331.0	331.0	331.0	331.0	−2,934.7
VCT.RC.M	308.7	308.7	133.6	308.7	133.6	−3,397.0
VCT.SC.H	NA	NA	NA	NA	NA	−1,496.8
VCT.SC.I	15.8	77.5	77.5	77.5	77.5	−1,318.5
VCT.SC.L	91.1	122.8	122.8	242.3	120.3	−1,093.5
VCT.SC.M	18.8	18.8	18.8	82.5	82.5	−1,417.2
VOP.RC.L	615.4	1,524.5	1,524.5	1,524.5	1,524.5	1,524.5
VOP.RC.M	638.0	707.1	707.1	707.1	707.1	707.1
VOP.SC.M	143.3	590.0	590.0	1,082.3	992.2	992.2
Shipment-Wtd Average*	169.8	169.8	192.3	242.7	165.5	−649.8
Consumer Simple PBP (years)						
CB.SC.L	1.0	1.0	1.1	2.0	2.2	2.2
CB.SC.M	1.1	1.1	1.6	1.0	5.0	5.8
HCS.SC.L	5.1	5.1	5.1	5.1	5.1	10.8
HCS.SC.M	0.8	0.8	1.8	0.8	1.8	13.3
HCT.SC.I	4.8	NA	NA	4.8	7.1	14.8
HCT.SC.L	NA	NA	NA	NA	NA	23.5
HCT.SC.M	NA	NA	NA	NA	NA	76.8
HZO.RC.L	13.0	13.0	13.0	13.0	13.0	13.0
HZO.RC.M	13.8	13.8	13.8	13.8	13.8	13.8
HZO.SC.L	0.8	1.1	1.1	2.0	2.8	2.8
HZO.SC.M	1.1	1.6	1.6	3.3	5.2	5.2
SOC.RC.M	2.6	2.6	3.3	2.6	3.3	15.9
SOC.SC.M	0.1	1.1	1.1	2.1	5.4	5.4
SVO.RC.M	4.8	4.8	7.3	4.8	7.3	7.3
SVO.SC.M	1.2	2.7	2.7	4.1	4.3	4.3
VCS.SC.H	0.2	0.2	1.8	0.2	3.7	4.4
VCS.SC.I	0.4	1.4	1.4	3.1	3.4	3.4
VCS.SC.L	0.4	1.5	1.5	2.7	3.2	3.2
VCS.SC.M	0.4	1.4	1.4	1.4	4.1	5.0
VCT.RC.L	6.2	6.4	6.4	6.4	6.4	52.2
VCT.RC.M	6.5	6.5	10.9	6.5	10.9	93.9
VCT.SC.H	NA	NA	NA	NA	NA	43.0
VCT.SC.I	4.6	8.3	8.3	8.3	8.3	35.0
VCT.SC.L	2.0	2.6	2.6	5.3	5.8	18.5
VCT.SC.M	3.8	3.8	3.8	7.6	7.6	45.2
VOP.RC.L	4.3	3.6	3.6	3.6	3.6	3.6
VOP.RC.M	4.1	5.7	5.7	5.7	5.7	5.7
VOP.SC.M	2.1	2.6	2.6	3.4	3.6	3.6
Shipment-Wtd Average*	2.2	2.2	3.1	4.1	5.5	23.1
Percent of Consumers that Experience a Net Cost						
CB.SC.L	0.0	0.0	0.0	0.2	1.3	1.3
CB.SC.M	0.0	0.0	3.3	0.0	45.9	73.7
HCS.SC.L	22.2	22.2	22.2	22.2	22.2	96.1
HCS.SC.M	0.0	0.0	4.9	0.0	4.9	99.1
HCT.SC.I	15.0	NA	NA	15.0	32.5	85.8
HCT.SC.L	NA	NA	NA	NA	NA	90.5
HCT.SC.M	NA	NA	NA	NA	NA	91.4
HZO.RC.L	7.8	7.8	7.8	7.8	7.8	7.8
HZO.RC.M	10.8	10.8	10.8	10.8	10.8	10.8
HZO.SC.L	0.0	0.0	0.0	0.2	0.9	0.9
HZO.SC.M	0.0	0.2	0.2	6.8	14.8	14.8
SOC.RC.M	0.0	0.0	1.4	0.0	1.4	70.9
SOC.SC.M	0.0	0.9	0.9	0.0	25.6	25.6
SVO.RC.M	0.0	0.0	18.4	0.0	18.4	18.4
SVO.SC.M	0.0	0.1	0.1	4.6	11.0	11.0
VCS.SC.H	0.0	0.0	18.4	0.0	31.6	52.8

TABLE V.82—SUMMARY OF ANALYTICAL RESULTS: MANUFACTURER AND CONSUMER IMPACTS—Continued

Category	TSL 1*	TSL 2*	TSL 3*	TSL 4*	TSL 5*	TSL 6*
VCS.SC.I	0.0	0.0	0.0	3.6	8.9	8.9
VCS.SC.L	0.0	0.2	0.2	4.3	17.1	17.1
VCS.SC.M	0.0	1.6	1.6	1.6	27.0	56.2
VCT.RC.L	0.0	0.4	0.4	0.4	0.4	99.7
VCT.RC.M	0.0	0.0	24.0	0.0	24.0	100.0
VCT.SC.H	NA	NA	NA	NA	NA	96.9
VCT.SC.I	1.5	1.1	1.1	1.1	1.1	100.0
VCT.SC.L	0.3	0.7	0.7	18.8	37.5	98.2
VCT.SC.M	5.7	5.7	5.7	20.1	20.1	100.0
VOP.RC.L	0.0	0.0	0.0	0.0	0.0	0.0
VOP.RC.M	0.0	8.2	8.2	8.2	8.2	8.2
VOP.SC.M	0.6	0.0	0.0	0.4	1.0	1.0
Shipment-Wtd Average*	2.0	2.0	4.2	8.2	21.9	69.0

Note: The entry "NA" means not applicable because there is no change in the standard at certain TSLs.
*Weighted by shares of each equipment class in total projected shipments in 2022.

DOE first considered TSL 6, which represents the max-tech efficiency levels for all equipment classes. The design options DOE analyzed at this level included the max-tech technologies for all equipment classes. For all open (*i.e.,* equipment classes without doors) and transparent door equipment classes, DOE expects manufacturers would likely need to incorporate occupancy sensors with dimming capability. Open equipment classes would also likely require the use of night curtains. For equipment classes with transparent doors, DOE expects manufacturers would likely need to incorporate vacuum-insulated glass doors. For self-contained equipment classes, DOE expects manufacturers would need to incorporate EC evaporator and condenser fan motors, variable-speed compressors, and microchannel condensers. For closed, self-contained equipment classes using forced-air refrigeration systems, DOE expects manufacturers would also need to incorporate evaporator fan control.

TSL 6 would save an estimated 3.38 quads of FFC energy over 30 years of shipments (2028–2057), an amount DOE considers significant. Under TSL 6, the NPV of consumer benefits would be −$10.1 billion using a discount rate of 7 percent, and −$16.5 billion using a discount rate of 3 percent for the same 30-year period.

The cumulative emissions reductions at TSL 6 are 60.7 Mt of CO_2, 18.6 thousand tons of SO_2, 113 thousand tons of NO_X, 0.13 tons of Hg, 514 thousand tons of CH_4, and 0.59 thousand tons of N_2O for the same 30-year period. 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 6 is $3.30 billion. The estimated monetary value of the health benefits from reduced SO_2 and NO_X emissions at TSL 6 is $2.53 billion using a 7-percent discount rate and $6.46 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 6 is −$4.24 billion. Using a 3−percent discount rate for all benefits and costs, the estimated total NPV at TSL 6 are −$6.72 billion. The estimated total NPV is provided for additional information; however, DOE primarily relies upon the NPV of consumer benefits when determining whether a proposed standard level is economically justified.

At TSL 6, affected purchasers of CRE experience an average LCC savings ranging from −$3,397.0. to $1,524.5 with a payback period ranging from 94 years to 2.1 years. For example, for equipment classes VCS.SC.M, VCT.SC.M, VCS.SC.L, VCT.SC.L, and VCT.RC.M, which account for 82% of annual CRE shipments, there is a net LCC savings of $0.171, −$1,417.24, $260.731, −$1,093.53, and −$3,397.0 and a PBP of 5.04, 4539, 3.2, 18.5, and 94 years, respectively. Overall, a majority of CRE purchasers (69.0 percent) would experience a net cost and the LCC savings would be negative for 13 of 28 analyzed equipment classes, representing 48% of annual shipments. Furthermore, the shipment-weighted-average PBP is estimated at 23 years, which is generally higher than the average CRE lifetime.

At TSL 6, the projected change in INPV ranges from a decrease of $300.4 million to an increase of $243.6 million, which corresponds to a decrease of 9.1 percent and an increase of 7.4 percent, respectively. DOE estimates that industry must invest $343.8 million to update equipment designs and source, qualify, and test high-efficiency components across their entire CRE portfolio. In 2027, a year before compliance is required, DOE estimates that approximately 2.2 percent of CRE shipments would meet the efficiency levels analyzed at TSL 6.

At this level, nearly all manufacturers would need to spend notable development time incorporating the analyzed max-tech design options across their entire CRE portfolio. However, most design options analyzed involve more efficient components (*e.g.,* high-efficiency motors) and would not necessitate significant capital investment. CRE equipment classes with transparent doors (*i.e.,* HCT.SC.I, HCT.SC.L, HCT.SC.M, SOC.RC.M, SOC.SC.M, VCT.RC.L, VCT.RC.M, VCT.SC.H, VCT.SC.I, VCT.SC.L, and VCT.SC.M) account for approximately 43.8 percent of industry shipments in 2027. For the 71 manufacturers that offer CRE with transparent doors, implementing vacuum-insulated glass would require significant engineering resources and testing time to ensure adequate safety and durability of their equipment in all commercial settings. In interviews, most manufacturers raised concerns about standards requiring a widespread adoption of vacuum-insulated glass as it is still a relatively untested technology in the commercial refrigeration market. Manufacturers expressed concerns about the potential for reduced equipment reliability as vacuum-insulated glass can be relatively more fragile than existing glass door designs and there is very little industry experience with implementing vacuum-insulated glass in CRE applications. DOE estimates that less than 2 percent of shipments of CRE equipment classes with transparent doors would meet the max-tech efficiencies in 2027. In interviews, manufacturers emphasized that there are currently a limited number of suppliers of vacuum-insulated glass for CRE applications.

Based on this analysis, the Secretary tentatively concludes that at TSL 6 for CRE, the benefits of energy savings, emission reductions, and the estimated monetary value of the emissions reductions would be outweighed by the negative NPV of consumer benefits, economic burden on many CRE purchasers, and the impacts on manufacturers, including the conversion costs that could result in a reduction in INPV. For the manufacturers of CRE with transparent doors, implementing vacuum-insulated glass would require significant engineering resources and testing time to ensure adequate safety and durability of their equipment in all commercial settings. There is limited industry experience incorporating vacuum-insulated glass into CRE designs. And a majority of CRE purchasers (69.0 percent) would experience a net cost and the average LCC savings would be negative. Consequently, the Secretary has tentatively concluded that TSL 6 is not economically justified.

DOE then considered TSL 5, which represents the highest efficiency level with positive LCC savings for each equipment class. For approximately half of the classes, this TSL represents efficiency levels less than max-tech. For most open (*i.e.,* equipment classes without doors) and transparent door equipment classes, DOE expects manufacturers would likely need to incorporate occupancy sensors with dimming capability. Open equipment classes would also likely require the use of night curtains. For most equipment classes with transparent doors, DOE expects manufacturers would need to incorporate triple-pane, krypton-filled glass doors or vacuum-insulated glass doors. For self-contained equipment classes, DOE expects manufacturers would need to incorporate EC evaporator and condenser fan motors and may require microchannel condensers and variable-speed compressors. For closed, self-contained equipment classes using forced-air refrigeration systems, DOE expects manufacturers would also need to incorporate evaporator fan control.

TSL 5 would save an estimated 3.11 quads of full fuel cycle energy over 30 years of shipments (2028 to 2057), an amount DOE considers significant. Under TSL 5, the NPV of consumer benefit would be $2.38 billion using a discount rate of 7 percent, and $7.10 billion using a discount rate of 3 percent.

The cumulative emissions reductions at TSL 5 are 55.8 Mt of CO_2, 17.1 thousand tons of SO_2, 104 thousand tons of NO_X, 0.12 tons of Hg, 472 thousand tons of CH_4, and 0.54 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 3.04 billion. The estimated monetary value of the health benefits from reduced SO_2 and NO_X emissions at TSL 5 is $2.32 billion using a 7-percent discount rate and $5.94 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 $7.74 billion. Using a 3-percent discount rate for all benefits and costs, the estimated total NPV at TSL 5 is $16.1 billion. The estimated total NPV is provided for additional information, however DOE primarily relies upon the NPV of consumer benefits when determining whether a proposed standard level is economically justified.

At TSL 5, affected purchasers for each CRE equipment class experience an average LCC savings ranging from $7.77 to $1,524.52 with a payback period ranging from 1.765 years to 13.8 years. For example, for equipment classes VCS.SC.M, VCT.SC.M, VCS.SC.L, VCT.SC.L, and VCT.RC.M, which account for 82% of annual CRE shipments, there is a net LCC savings of $128.91, $82.53, $260.73, $120.34,1 and $133.625 and a PBP of 4.1, 7.6, 3.2, 5.8, and 10.9 years, respectively. Overall, approximately 78 percent of affected CRE purchasers would experience a net benefit or not be affected at TSL 5. Furthermore, the estimated shipment-weighted-average LCC savings is $165.52 and PBP is 5.5 years, which is lower than the average CRE lifetime.

At TSL 5, the projected change in INPV ranges from a decrease of $159.3 million to a decrease of $30.9 million, which correspond to decreases of 4.8 percent and 0.9 percent, respectively. DOE estimates that industry must invest $226.4 million to comply with standards set at TSL 5. In 2027, the year before compliance is required, DOE estimates that approximately 10.8 percent of CRE shipments would meet the efficiency levels analyzed at TSL 5. Similar to TSL 6, DOE expects manufacturers would spend development time updating equipment designs to incorporate high-efficiency components. However, at this level, DOE expects that most manufacturers of CRE with transparent doors could meet the TSL 5 efficiencies without implementing vacuum-insulated glass doors. Of the 11 directly analyzed transparent door equipment classes, only the SOC.SC.M equipment class would likely require vacuum-insulated glass doors to meet the TSL 5 efficiency levels. SOC.SC.M accounts for approximately 0.4 percent of analyzed industry shipments in 2027.

After considering the analysis and weighing the benefits and burdens, the Secretary has tentatively concluded that at a standard set at TSL 5 for CRE would be economically justified. At this TSL, the average LCC savings for all affected purchasers is positive. An estimated 67.1 percent of purchasers experience a net benefit, while 21.9 percent of purchasers experience a net LCC cost. 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. Notably, the benefits to consumers vastly outweigh the cost to manufacturers. At TSL 5, the NPV of consumer benefits, even measured at the more conservative discount rate of 7 percent is over 14 times higher than the maximum estimated manufacturers' loss in INPV. The standard levels at TSL 5 are economically justified even without weighing the estimated monetary value of emissions reductions. When those emissions reductions are included—representing $3.04 billion in climate benefits (associated with the average SC–GHG at a 3-percent discount rate), and $5.94 billion (using a 3-percent discount rate) or $2.32 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. 86 FR 70892, 70908. Although DOE has not conducted a comparative analysis to select the proposed energy conservation standards, DOE notes that TSL 5 represents the highest efficiency level for each equipment class with positive LCC savings for each equipment class, and a considerably lower reduction in INPV, and positive consumer NPV compared to TSL 6.

Although DOE considered proposed new and amended standard levels for CRE by grouping the efficiency levels for each equipment class into TSLs, DOE evaluates all analyzed efficiency levels in its analysis. For all equipment classes, the proposed standard level represents the maximum energy savings that does not result in negative LCC savings. The ELs at the proposed standard level result in positive LCC savings for all equipment classes, significantly reduce the number of purchasers experiencing a net cost, and reduce the decrease in INPV and conversion costs to the point where DOE has tentatively concluded they are economically justified, as discussed for TSL 5 in the preceding paragraphs. As previously discussed, setting standards at max-tech (TSL 6) would result in negative LCC savings for 13 of the analyzed equipment classes, representing 48 percent of the estimated CRE shipments.

Therefore, based on the previous considerations, DOE proposes to adopt the energy conservation standards for CRE at TSL 5. The proposed new and amended energy conservation standards for CRE, which are expressed as kWh/day, are shown in table V.83.

TABLE V.83—PROPOSED NEW OR AMENDED ENERGY CONSERVATION STANDARDS FOR CRE

Equipment class	Maximum daily energy consumption (kWh/day)
VOP.RC.H	0.31 × TDA + 1.99.
VOP.RC.M	0.56 × TDA + 3.57.
VOP.RC.L	2.04 × TDA + 6.36.
VOP.RC.I	2.59 × TDA + 8.08.
SVO.RC.H	0.32 × TDA + 1.55.
SVO.RC.M	0.58 × TDA + 2.79.
SVO.RC.L	2.04 × TDA + 6.36.
SVO.RC.I	2.59 × TDA + 8.08.
HZO.RC.H	0.19 × TDA + 1.56.
HZO.RC.M	0.34 × TDA + 2.81.
HZO.RC.L	0.54 × TDA + 6.81.
HZO.RC.I	0.69 × TDA + 8.64.
VCT.RC.H	0.07 × TDA + 0.97.
VCT.RC.M	0.134 × TDA + 1.74.
VCT.RC.L	0.47 × TDA + 2.51.
VCT.RC.I	0.56 × TDA + 2.97.
HCT.RC.M	0.16 × TDA + 0.13.
HCT.RC.L	0.34 × TDA + 0.26.
HCT.RC.I	0.38 × TDA + 0.29.
VCS.RC.H	0.06 × V + 0.14.
VCS.RC.M	0.1 × V + 0.26.
VCS.RC.L	0.21 × V + 0.54.
VCS.RC.I	0.25 × V + 0.63.
HCS.RC.M	0.1 × V + 0.26.
HCS.RC.L	0.21 × V + 0.54.
HCS.RC.I	0.25 × V + 0.63.
SOC.RC.H	0.22 × TDA + 0.05.
SOC.RC.M	0.39 × TDA + 0.1.
SOC.RC.L	0.83 × TDA + 0.2.
SOC.RC.I	1.04 × TDA + 0.25.
CB.RC.M	0.03 × V + 0.39.
CB.RC.L	0.13 × V + 1.37.
VOP.SC.H	0.69 × TDA + 1.94.
VOP.SC.M	1.25 × TDA + 3.48.
VOP.SC.L	3.29 × TDA + 9.15.
VOP.SC.I	4.18 × TDA + 11.63.
SVO.SC.H	0.65 × TDA + 1.77.
SVO.SC.M	1.18 × TDA + 3.18.
SVO.SC.L	3.25 × TDA + 8.78.
SVO.SC.I	4.13 × TDA + 11.16.
HZO.SC.H	0.27 × TDA + 2.06.
HZO.SC.M	0.48 × TDA + 3.71.
HZO.SC.L	1.48 × TDA + 5.5.
HZO.SC.I	1.97 × TDA + 7.34.
VCT.SC.H	0.053 × V + 0.85.
VCT.SC.M	0.054 × V + 0.86.
VCT.SC.L	0.234 × V + 2.38.
VCT.SC.I	0.6 × TDA + 3.2.
HCT.SC.M	0.06 × V + 0.37.
HCT.SC.L	0.08 × V + 1.23.
HCT.SC.I	0.34 × TDA + 0.43.
VCS.SC.H	0.0082 × V + 0.21.
VCS.SC.M	0.02 × V + 0.54.
VCS.SC.L	0.155 × V + 0.97.
VCS.SC.I	0.25 × V + 0.88.
HCS.SC.M	0.022 × V + 0.41.
HCS.SC.L	0.043 × V + 0.81.
HCS.SC.I	0.31 × V + 0.81.
SOC.SC.H	0.17 × TDA + 0.33.
SOC.SC.M	0.304 × TDA + 0.59.
SOC.SC.L	1.1 × TDA + 2.1.
SOC.SC.I	1.53 × TDA + 0.36.
CB.SC.M	0.049 × V + 0.54.
CB.SC.L	0.180 × V + 1.92.
PD.SC.M	0.11 × V + 0.81.
VCT.RC.M.PT	0.139 × TDA + 1.81.
VCT.SC.M.PT	0.056 × V + 0.86.
VCT.SC.L.PT	0.243 × V + 2.47.
VCS.SC.M.PT	0.02 × V + 0.56.
VCS.SC.L.PT	0.161 × V + 1.01.
VCT.RC.M.SD	0.143 × TDA + 1.86.
VCT.SC.M.SD	0.058 × V + 0.86.
VCT.RC.M.SDPT	0.149 × TDA + 1.93.
VCT.SC.M.SDPT	0.060 × V + 0.86.
VCT.RC.M.RI	0.140 × TDA + 1.83.
VCT.SC.M.RI	0.057 × V + 0.86.
VCS.SC.M.RI	0.02 × V + 0.57.
VCS.SC.L.RI	0.162 × V + 1.02.
VCT.RC.M.RT	0.146 × TDA + 1.9.
VCT.SC.M.RT	0.059 × V + 0.86.
VCS.SC.M.RT	0.02 × V + 0.59.
VCS.SC.L.RT	0.169 × V + 1.06.
HCS.SC.L.FA	0.052 × V + 0.97.

Unique design characteristic	Abbreviation
Pass-through Door	PT.
Sliding Door	SD.
Sliding and Pass-through Doors.	SDPT.
Roll-in Door	RI.
Roll-through Door	RT.
Forced Air Evaporator	FA.

2. Annualized Benefits and Costs of the Proposed Standards

The benefits and costs of the proposed 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 equipment that meet the proposed standards (consisting primarily of operating cost savings from using less energy, minus increases in equipment purchase costs), and (2) the annualized monetary value of the climate and health benefits from emission reductions.

Table V.84 shows the annualized values for CRE under TSL 5, expressed in 2022$. The results under the primary estimate are as follows.

Using a 7-percent discount rate for consumer benefits and costs and NO_X and SO_2 reduction benefits, and a 3-percent discount rate case for GHG social costs, the estimated cost of the proposed standards for CRE is $335 million per year in increased equipment costs, while the estimated annual benefits are $586 million from reduced equipment operating costs, $174 million from climate benefits, and $246 million from health benefits. In this case, the net benefit amounts to $671 million per year.

Using a 3-percent discount rate for all benefits and costs, the estimated cost of the proposed standards for CRE is $330 million per year in increased equipment costs, while the estimated annual benefits are $738 million in reduced operating costs, $174 million from climate benefits, and $341 million from health benefits. In this case, the net benefit amounts to $923 million per year.

TABLE V.84—ANNUALIZED BENEFITS AND COSTS OF PROPOSED ENERGY CONSERVATION STANDARDS FOR CRE (TSL 5)

	Million 2022$/year		
	Primary estimate	Low-net-benefits estimate	High-net-benefits estimate
3% discount rate			
Consumer Operating Cost Savings	738	714	774

TABLE V.84—ANNUALIZED BENEFITS AND COSTS OF PROPOSED ENERGY CONSERVATION STANDARDS FOR CRE (TSL 5)—Continued

	Million 2022$/year		
	Primary estimate	Low-net-benefits estimate	High-net-benefits estimate
Climate Benefits *	174	173	179
Health Benefits **	341	340	350
Total Benefits †	1253	1227	1302
Consumer Incremental Equipment Costs	330	338	328
Net Benefits	923	890	974
Change in Producer Cashflow (INPV ‡‡)	(17)–(3)	(17)–(3)	(17)–(3)
7% discount rate			
Consumer Operating Cost Savings	586	569	613
Climate Benefits * (3% discount rate)	174	173	179
Health Benefits **	246	245	251
Total Benefits †	1006	987	1043
Consumer Incremental Equipment Costs	335	342	334
Net Benefits	671	646	709
Change in Producer Cashflow (INPV‡‡)	(17)–(3)	(17)–(3)	(17)–(3)

Note: This table presents the costs and benefits associated with CRE shipped in 2028 − 2057. These include consumer, climate, and health benefits that accrue after 2057 from the equipment shipped in 2028 − 2057. 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 sections IV.F.1 and 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.

‡‡ 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 NIA includes all impacts (both costs and benefits) along the distribution chain beginning with the increased costs to the manufacturer to manufacture the equipment and ending with the increase in price experienced by the consumer. DOE also separately conducts a detailed analysis on the impacts on manufacturers (the 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 10.0 percent that is estimated in the MIA (see chapter 12 of the NOPR TSD for a complete description of the industry weighted average cost of capital). For commercial refrigeration equipment, those values are −$16.65 million to −$3.23 million. DOE accounts for that range of likely impacts in analyzing whether a TSL 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 annualized 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 proposal 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 proposed rule, the annualized net benefits would range from $907 million to $920 million at 3-percent discount rate and would range from $655 million to $668 million at 7-percent discount rate. Parentheses () indicate negative values.

D. Reporting, Certification, and Sampling Plan

Manufacturers, including importers, must use equipment-specific certification templates to certify compliance to DOE. For CRE, the certification template reflects the general certification requirements specified at 10 CFR 429.12 and the equipment-specific requirements specified at 10 CFR 429.42 DOE is not proposing to amend the equipment-specific certification requirements for this equipment.

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 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 the preamble, this proposed 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 proposed regulatory action constitutes a ''significant regulatory action'' within the scope of section 3(f)(1) of E.O. 12866. Accordingly, pursuant to section 6(a)(3)(C) of E.O. 12866, DOE has provided to OIRA an assessment, including the underlying analysis, of benefits and costs anticipated from the proposed 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 as to 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'') 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 has prepared the following IRFA for the equipment that are the subject of this proposed rulemaking.

For manufacturers of CRE, the SBA has set a size threshold, which defines those entities classified as ''small businesses'' for the purposes of the statute. DOE used the SBA's small business size standards to determine whether any small entities would be subject to the requirements of the rule. (*See* 13 CFR part 121.) The size standards are listed by North American Industry Classification System (''NAICS'') code and industry description and are available at *www.sba.gov/document/support--table-size-standards.* Manufacturing of CRE is classified under NAICS 333415, ''Air-Conditioning and Warm Air Heating Equipment and Commercial and Industrial Refrigeration Equipment Manufacturing.'' The SBA sets a threshold of 1,250 employees or fewer for an entity to be considered as a small business for this category.

1. Description of Reasons Why Action Is Being Considered

DOE is proposing new and amended energy conservation standards for CRE. EPCA authorizes DOE to regulate the energy efficiency of a number of consumer products and certain industrial equipment. Title III, part C of EPCA, added by Public Law 95–619, title IV, section 441(a) (42 U.S.C. 6311–6317, as codified), established the Energy Conservation Program for Certain Industrial Equipment, which sets forth a variety of provisions designed to improve energy efficiency. This equipment includes CRE, the subject of this document. (42 U.S.C. 6311(1)(E)) EPCA established standards for certain categories of CRE (42 U.S.C. 6313(c)(2)–(4)) and directs DOE to conduct future rulemakings to determine whether to amend these standards. (42 U.S.C. 6313(c)(6)(B)) On March 28, 2014, DOE published a final rule that prescribed the current energy conservation standards for CRE manufactured on and after March 27, 2017. 79 FR 17725. EPCA 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 equipment 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. 6316(e)(1); 42 U.S.C. 6295(m)(1)) This proposed rulemaking is in accordance with DOE's obligations under EPCA.

2. Objectives of, and Legal Basis for, Rule

EPCA authorizes DOE to regulate the energy efficiency of a number of consumer products and certain industrial equipment. Title III, part C of EPCA, added by Public Law 95–619, title IV, section 441(a) (42 U.S.C. 6311–6317, as codified), established the Energy Conservation Program for Certain Industrial Equipment, which sets forth a variety of provisions designed to improve energy efficiency. EPCA established standards for certain categories of CRE (42 U.S.C. 6313(c)(2)–(4)) and directs DOE to conduct future rulemakings to determine whether to amend these standards. (42 U.S.C. 6313(c)(6)(B))

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 equipment 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. 6316(e)(1); 42 U.S.C. 6295(m)(1))

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 EPCA include definitions (42 U.S.C.

6311), test procedures (42 U.S.C. 6314), labeling provisions (42 U.S.C. 6315), energy conservation standards (42 U.S.C. 6313), and the authority to require information and reports from manufacturers (42 U.S.C. 6316; 42 U.S.C. 6296).

3. Description on Estimated Number of Small Entities Regulated

DOE reviewed this proposed rule under the provisions of the Regulatory Flexibility Act and the procedures and policies published on February 19, 2003. 68 FR 7990. DOE conducted a market assessment to identify potential small manufacturers of CRE. DOE began its assessment by compiling an equipment database of CRE models available in the United States. To develop a comprehensive equipment database of CRE basic models, DOE reviewed its Compliance Certification Database (''CCD'')[110] supplemented by information from California Energy Commission's Modernized Appliance Efficiency Database System,[111] individual company websites, and prior CRE rulemakings. To identify chef bases, griddle stands, and high-temperature units, DOE reviewed publicly available data from web scraping retail websites. DOE then reviewed the comprehensive equipment database to identify the OEMs of the CRE models identified. DOE consulted publicly available data, such as manufacturer websites, manufacturer specifications and equipment literature, import/export logs (*e.g.,* bills of lading from Panjiva[112]), and basic model numbers, to identify OEMs of CRE. DOE further relied on public data and subscription-based market research tools (*e.g.,* Dun & Bradstreet reports[113]) to determine company, location, headcount, and annual revenue. DOE also asked industry representatives if they were aware of any small manufacturers during manufacturer interviews. DOE screened out companies that do not offer equipment covered by this rulemaking, do not meet the SBA's definition of a ''small business,'' or are foreign-owned and operated.

DOE initially identified 83 OEMs that sell CRE in the United States. Of the 83 OEMs identified, DOE tentatively determined that 25 companies qualify as small businesses and are not foreign-owned and operated.

4. Description and Estimate of Compliance Requirements Including Differences in Cost, if Any, for Different Groups of Small Entities

Of the 25 small, domestic CRE OEMs, 24 OEMs manufacture vertical equipment classes (*i.e.,* vertical open (''VOP''), vertical closed transparent (''VCT''), or vertical closed solid (''VCS'')), 8 OEMs manufacture semi-vertical open (''SVO'') equipment classes (*i.e.,* medium temperature remote condensing (''RC''; ''SVO.RC.M'') or medium temperature self-contained (''SC''; ''SVO.SC.M'')), 7 OEMs manufacture service-over-counter (''SOC'') equipment classes (*i.e.,* SOC.RC.M or SOC.SC.M), 10 OEMs manufacture horizontal equipment classes (*i.e.,* horizontal open (''HZO''), horizontal closed transparent (''HCT''), or horizontal closed solid (''HCS'')), and 3 OEMs manufacture chef bases.

For the purposes of this IRFA, DOE assumed that the industry capital conversion costs would be evenly distributed across the OEMs that manufacture each equipment class to avoid underestimating the potential capital investments small manufacturers may incur as a result of the proposed standard. As discussed in section IV.J.2.c of this document, DOE scaled the industry capital conversion costs by the number of OEMs offering models of the respective equipment class. For product conversion costs, DOE assumed all small businesses would choose to redesign or replace models that do not meet the proposed TSL 5 efficiency levels. DOE used basic model counts to scale the industry product conversion costs, as discussed in section IV.J.2.c of this document. DOE expects manufacturers would have to incorporate various high-efficiency components to meet the TSL 5 efficiencies across their CRE offerings. For certain transparent door equipment classes, capital conversion costs may be necessary to incorporate improved door designs. For self-contained equipment classes, many manufacturers would likely have to incorporate VSCs into CRE designs. To incorporate VSCs, which could be larger than existing single-speed compressors, manufacturers may need new tools for the baseplate. Product conversion costs may be necessary to qualify, source, and test new high-efficiency components (*e.g.,* electronically commutated motors).

Out of the 24 small OEMs of vertical equipment classes, DOE expects 23 OEMs would incur some conversion costs to redesign models that do not currently the proposed efficiency levels. The remaining small OEM would likely not incur conversion costs as a direct result of the proposed standard as all of their vertical CRE models currently meet or exceed the proposed levels. Vertical equipment classes account for approximately 90.1 percent of industry shipments in 2027. All the VOP and VCT equipment classes would likely require manufacturers to incorporate occupancy sensors to meet TSL 5. DOE further expects VOP equipment classes would also need to incorporate night curtains. DOE expects manufacturers of VOP.SC.M would likely also need to incorporate EC condenser fan motors, VSCs, and microchannel condensers. Some VCT equipment classes would likely need to incorporate triple pane glass with krypton fill. VCT.SC.M, and VCT.SC.L likely would further need to incorporate EC condenser fan motors and VSCs. For most VCS equipment classes, manufacturers would likely need to incorporate evaporator fan controls, EC evaporator fan motors, EC condenser fan motors, VSCs, and microchannel condensers.

DOE expects all 8 small OEMs of semi-vertical equipment classes would incur some conversion costs to redesign models that do not currently meet the proposed efficiency levels. Semi-vertical equipment classes account for approximately 2.1 percent of industry shipments in 2027. All semi-vertical equipment classes would likely need to incorporate occupancy sensors and night curtains. SVO.SC.M would also likely require EC evaporator fan motors, EC condenser fan motors, VSCs, and microchannel condensers.

Out of the 7 small OEMs of service-over-counter equipment classes, DOE expects 6 OEMs would incur some conversion costs to redesign models that do not currently the proposed efficiency levels. The remaining small OEM would likely not incur conversion costs as a direct result of the proposed standard as all of their service-over-counter CRE models currently meet or exceed the proposed levels. Service-over-counter equipment classes account for approximately 0.5 percent of industry shipments in 2027. SOC.RC.M and SOC.SC.M would likely incorporate occupancy sensors. SOC.RC.M would also likely require triple pane glass doors with krypton fill. SOC.SC.M would also likely require VIG doors,

[110] 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 April 13, 2023.)

[111] California Energy Commission's Modernized Appliance Efficiency Database is available at: *https://cacertappliances.energy.ca.gov/Pages/Search/AdvancedSearch.aspx.* (last accessed February 2, 2022.)

[112] S&P Global. Panjiva Market Intelligence. *panjiva.com/import-export/United-States.* (last accessed April 13, 2023.)

[113] D&B Hoover's subscription login is accessible at: *app.dnbhoovers.com.* (last accessed April 13, 2023.)

evaporator fan controls, EC evaporator fan motors, EC condenser fan motors, VSCs, and microchannel condensers.

Out of the 10 small OEMs of horizontal equipment classes, DOE expects 9 OEMs would incur some conversion costs to redesign models that do not currently the proposed efficiency levels. The remaining small OEM would likely not incur conversion costs as a direct result of the proposed standard as all of their horizontal CRE models currently meet or exceed the proposed levels. Horizontal equipment classes account for approximately 5.9 percent of industry shipments in 2027. For HZO equipment classes, manufacturers would likely incorporate occupancy sensors. For HZO.SC.M and HZO.SC.L equipment classes, manufacturers would likely incorporate EC evaporator fan motors, EC condenser fan motors, VSCs, and microchannel condensers. DOE expects that HCT.SC.I would likely need to incorporate VSCs and occupancy sensors to meet TSL 5 levels. For HCS equipment classes, manufacturers would likely incorporate EC condenser fan motors. HCS.SC.M would also likely require evaporator fan controls and EC condenser fan motors.

DOE expects all 3 small OEMs offering chef base equipment classes to incur some conversion costs to redesign models that do not meet efficiency levels at TSL 5. Chef base equipment classes account for approximately 1.4 percent of industry shipments in 2027. Manufacturers would likely incorporate EC evaporator fan motors, EC condenser fan motors, and VSCs for CB.SC.M. None of the small businesses offer CB.SC.L.

Based on annual revenue estimates from market research tools (*e.g.,* Dun & Bradstreet reports), the annual revenue of the small, domestic OEMs identified range from approximately $2.8 million to $448.6 million, with an average annual revenue of approximately $112.9 million. DOE estimates that conversion costs could range from $0.0 million to $15.3 million, with the average per OEM conversion costs of $2.8 million. The estimated total conversion costs as a percent of company revenue over the 3-year conversion period range from approximately 0.0 percent to 9.6 percent, with an average of 1.7 percent. See table VI.1 for additional details.

TABLE VI.1—POTENTIAL SMALL BUSINESS IMPACTS (TSL 5)

Company	Est. conversion costs ($ millions)	Est. annual revenue ($ millions)	Conversion costs as a % of conversion period revenue** (%)	Vertical	Semi-vertical	Service-over-counter	Horizontal	Chef base
A	0.25	2.8	3.0	X				
B	0.21	4.1	1.7	X				
C	1.58	5.5	9.6	X	X	X		
D	0.00	6.3	0.0				X	
E	2.41	10.8	7.4	X	X	X		
F	0.88	13.6	2.2	X			X	
G	0.05	25.4	0.1	X				
H	0.22	26.9	0.3	X				
I	1.42	28.6	1.7	X	X			
J	1.78	58.1	1.0	X				
K	0.77	71.9	0.4	X			X	
L	0.26	74.9	0.1	X				
M	5.46	85.3	2.1	X			X	
N	2.15	96.8	0.7	X				
O	7.35	110.3	2.2	X	X	X	X	X
P	15.31	131.1	3.9	X	X	X	X	
Q	5.70	142.3	1.3	X	X	X	X	
R	0.24	143.1	0.1	X				
S	14.29	156.1	3.1	X			X	X
T	2.35	156.3	0.5	X			X	X
U	0.48	193.7	0.1	X				
V	0.63	212.5	0.1	X				
W	4.86	269.3	0.6	X	X	X	X	
X	0.28	307.9	0.0	X				
Y	0.56	488.6	0.0	X	X	X		

* The "X" indicates that the manufacturer offers CRE models of the respective equipment family.
** This column is calculated by dividing the estimated conversion costs by the revenue during the three year the conversion period: (Est. Conversion Costs) ÷ [(Est. Annual Revenue) × 3 years].
*** All models of directly analyzed CRE equipment classes meet or exceed the proposed efficiency levels. Therefore, DOE tentatively does not expect this manufacturer would incur conversion costs as direct result of the rule, if the standards were finalized as proposed.

DOE seeks comments, information, and data on the number of small businesses in the industry, the names of those small businesses, and their market shares by equipment class. DOE also requests comment on the potential impacts of the proposed standards on small manufacturers.

5. Duplication, Overlap, and Conflict With Other Rules and Regulations

DOE is not aware of any rules or regulations that duplicate, overlap, or conflict with the proposed rule.

6. Significant Alternatives to the Rule

The discussion in the previous section analyzes impacts on small businesses that would result from DOE's proposed rule, represented by TSL 5. In reviewing alternatives to the proposed rule, DOE examined energy conservation standards set at lower efficiency levels. While TSL 1, TSL 2, TSL 3, and TSL 4 would reduce the impacts on small business manufacturers, it would come at the expense of a reduction in energy savings. TSL 1 achieves 67.0 percent lower energy savings compared to the energy savings at TSL 5. TSL 2 achieves 43.7 percent lower energy savings compared to the energy savings at TSL 5. TSL 3 achieves 41.0 percent lower energy savings compared to the energy savings at TSL 5. TSL 4 achieves 10.6 percent lower energy savings as compared to the energy savings at TSL 5.

Based on the presented discussion, establishing standards at TSL 5 balances the benefits of the energy savings at TSL 5 with the potential burdens placed on

CRE manufacturers, including small business manufacturers. Accordingly, DOE does not propose one of the other TSLs considered in the analysis, or the other policy alternatives examined as part of the regulatory impact analysis and included in chapter 17 of the NOPR TSD.

Additional compliance flexibilities may be available through other means. Manufacturers subject to DOE's energy efficiency standards may apply to DOE's Office of Hearings and Appeals for exception relief under certain circumstances. Manufacturers should refer to 10 CFR part 430, subpart E, and 10 CFR part 1003 for additional details.

C. Review Under the Paperwork Reduction Act

Manufacturers of CRE must certify to DOE that their equipment comply with any applicable energy conservation standards. In certifying compliance, manufacturers must test their equipment according to the DOE test procedures for CRE, including any amendments adopted for those test procedures. DOE has established regulations for the certification and recordkeeping requirements for all covered consumer equipment and commercial equipment, including CRE. (*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

DOE is analyzing this proposed regulation in accordance with the National Environmental Policy Act of 1969 (''NEPA'') and DOE's NEPA implementing regulations (10 CFR part 1021). DOE's regulations include a categorical exclusion for rulemakings that establish energy conservation standards for consumer products or industrial equipment. 10 CFR part 1021, subpart D, appendix B5.1. DOE anticipates that this proposed rulemaking qualifies for categorical exclusion B5.1 because it is a rulemaking that establishes energy conservation standards for consumer products or industrial equipment, none of the exceptions identified in categorical exclusion B5.1(b) apply, no extraordinary circumstances exist that require further environmental analysis, and it otherwise meets the requirements for application of a categorical exclusion. *See* 10 CFR 1021.410. DOE will complete its NEPA review before issuing the final rule.

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 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 proposed rule and has tentatively determined that it would not have a substantial direct effect on the States, on the relationship between the national government and the States, or on the distribution of power and responsibilities among the various levels of government. EPCA governs and prescribes Federal preemption of State regulations as to energy conservation for the equipment that are the subject of this proposed rule. States can petition DOE for exemption from such preemption to the extent, and based on criteria, set forth in EPCA. (*See* 42 U.S.C. 6316(a) and (b); 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 Executive Order 12988 requires Executive agencies to review regulations in light of applicable standards in section 3(a) and section 3(b) to determine whether they are met or it is unreasonable to meet one or more of them. DOE has completed the required review and determined that, to the extent permitted by law, this proposed rule meets the relevant standards of 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, section 201 (codified at 2 U.S.C. 1531). For a proposed regulatory action likely to result in a rule that may cause the expenditure by State, local, and Tribal governments, in the aggregate, or by the private sector of $100 million or more in any one year (adjusted annually for inflation), section 202 of UMRA requires a Federal agency to publish a written statement that estimates the resulting costs, benefits, and other effects on the national economy. (2 U.S.C. 1532(a), (b)) The UMRA also requires a Federal agency to develop an effective process to permit timely input by elected officers of State, local, and Tribal governments on a proposed ''significant intergovernmental mandate,'' and requires an agency plan for giving notice and opportunity for timely input to potentially affected small governments before establishing any requirements that might significantly or uniquely affect 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.*

Although this proposed rule does not contain a Federal intergovernmental mandate, it 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 CRE manufacturers in the years between the final rule and the compliance date for the new standards and (2) incremental additional expenditures by consumers to purchase higher-efficiency CRE, starting at the compliance date for the applicable standard.

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

Under section 205 of UMRA, DOE is obligated to identify and consider a reasonable number of regulatory alternatives before promulgating a rule for which a written statement under section 202 is required. (2 U.S.C. 1535(a)) DOE is required to select from those alternatives the most cost effective and least burdensome alternative that achieves the objectives of the proposed rule unless DOE publishes an explanation for doing otherwise, or the selection of such an alternative is inconsistent with law. As required by 42 U.S.C. 6316(e)(1) and 42 U.S.C. 6295(m), this proposed rule would establish new and amended energy conservation standards for CRE 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 42 U.S.C. 6316(e)(1) and 42 U.S.C. 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 proposed rule.

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

Section 654 of the Treasury and General Government Appropriations Act, 1999 (Pub. L. 105–277) requires Federal agencies to issue a Family Policymaking Assessment for any rule that may affect family well-being. This proposed rule would not have any impact on the autonomy or integrity of the family as an institution. Accordingly, DOE has concluded that it is not necessary to prepare a Family Policymaking Assessment.

I. Review Under Executive Order 12630

Pursuant to E.O. 12630, "Governmental Actions and Interference with Constitutionally Protected Property Rights," 53 FR 8859 (Mar. 15, 1988), DOE has determined that this proposed 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 NOPR under the OMB and DOE guidelines and has concluded that it is consistent with applicable policies in those guidelines.

K. Review Under Executive Order 13211

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 proposed significant energy action. A "significant energy action" is defined as any action by an agency that promulgates or is expected to lead to promulgation of a final rule, and that (1) is a significant regulatory action under Executive Order 12866, or any successor order; and (2) is likely to have a significant adverse effect on the supply, distribution, or use of energy, or (3) is designated by the Administrator of OIRA as a significant energy action. For any proposed significant energy action, the agency must give a detailed statement of any adverse effects on energy supply, distribution, or use should the proposal be implemented, and of reasonable alternatives to the action and their expected benefits on energy supply, distribution, and use.

DOE has tentatively concluded that this regulatory action, which proposes new and amended energy conservation standards for CRE, is not a significant energy action because the proposed standards are not likely to have a significant adverse effect on the supply, distribution, or use of energy, nor has it been designated as such by the Administrator at OIRA. Accordingly, DOE has not prepared a Statement of Energy Effects on this proposed 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 has prepared a report describing that peer review.[114] 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

[114] The 2007 "Energy Conservation Standards Rulemaking Peer Review Report" is available at *energy.gov/eere/buildings/downloads/energy-conservation-standards-rulemaking-peer-review-report-0* (last accessed May 22, 2023).

with the National Academy of Sciences to review DOE's analytical methodologies to ascertain whether modifications are needed to improve the Department's analyses. DOE is in the process of evaluating the resulting report.[115]

VII. Public Participation

In response to the June 2022 Preliminary Analysis, DOE received a comment from NAMA requesting the Department to conduct an in person public meeting. NAMA commented that it is requesting an in person public meeting due to the webinar held on August 8, 2022, feeling rushed and to allow time for full dialogue on these important subjects. (NAMA, No. 37, p. 4)

After carefully considering NAMA's request, the Department has decided to grant the request for an in-person public meeting. Consequently, DOE will be hosting an in-person public meeting in addition to the webinar. Please note that attendance will be limited for the in-person public meeting due to room size capacity limits.

A. Participation in the Public Meeting and Webinar

The time, date, and location of the public meeting are listed in the **DATES** and **ADDRESSES** sections at the beginning of this document. If you plan to attend the public meeting, you must notify the Appliance and Equipment Standards Program staff no later than November 1, 2023, either by phone at (202) 287–1445 or by email: *ApplianceStandards Questions@ee.doe.gov.* Please note advance registration is required and capacity in the meeting room will be limited.

Please note that foreign nationals participating in the public meeting are subject to advance security screening procedures which require advance notice prior to attendance at the public meeting. If a foreign national wishes to participate in the public meeting, please inform DOE as soon as possible by contacting Ms. Regina Washington at (202) 586–1214 or by email: *Regina.Washington@ee.doe.gov* so that the necessary procedures can be completed.

DOE requires visitors to have laptops and other devices, such as tablets, checked upon entry into the building. Any person wishing to bring these devices into the building will be required to obtain a property pass. Visitors should avoid bringing these devices, or allow an extra 45 minutes to check in. Please report to the visitor's desk to have devices checked before proceeding through security.

Due to the REAL ID Act implemented by the Department of Homeland Security (''DHS''), there have been recent changes regarding ID requirements for individuals wishing to enter Federal buildings from specific States and U.S. territories. DHS maintains an updated website identifying the State and territory driver's licenses that currently are acceptable for entry into DOE facilities at *www.dhs.gov/real-id-enforcement-brief.* A driver's licenses from a State or territory identified as not compliant by DHS will not be accepted for building entry and one of the alternate forms of ID listed below will be required. Acceptable alternate forms of Photo-ID include U.S. Passport or Passport Card; an Enhanced Driver's License or Enhanced ID-Card issued by States and territories as identified on the DHS website (Enhanced licenses issued by these States and territories are clearly marked Enhanced or Enhanced Driver's License); a military ID or other Federal Government-issued Photo-ID card.

In addition, you can attend the public meeting via webinar. Webinar registration information, participant instructions, and information about the capabilities available to webinar participants will be published on DOE's website at *www.energy.gov/eere/buildings/public-meetings-and-comment-deadlines.* Participants are responsible for ensuring their systems are compatible with the webinar software.

B. Procedure for Submitting Prepared General Statements for Distribution

Any person who has plans to present a prepared general statement may request that copies of his or her statement be made available at the public meeting. Such persons may submit requests, along with an advance electronic copy of their statement in PDF (preferred), Microsoft Word or Excel, WordPerfect, or text (ASCII) file format, to the appropriate address shown in the **ADDRESSES** section at the beginning of this document. The request and advance copy of statements must be received at least one week before the public meeting and are to be emailed. Please include a telephone number to enable DOE staff to make follow-up contact, if needed.

C. Conduct of the Public Meeting

DOE will designate a DOE official to preside at the public meeting and may also use a professional facilitator to aid discussion. The meeting will not be a judicial or evidentiary-type public hearing, but DOE will conduct it in accordance with section 336 of EPCA (42 U.S.C. 6306). A court reporter will be present to record the proceedings and prepare a transcript. DOE reserves the right to schedule the order of presentations and to establish the procedures governing the conduct of the public meeting. There shall not be discussion of proprietary information, costs or prices, market share, or other commercial matters regulated by U.S. anti-trust laws. After the public meeting and until the end of the comment period, interested parties may submit further comments on the proceedings and any aspect of the rulemaking.

The public meeting will be conducted in an informal, conference style. DOE will a general overview of the topics addressed in this proposed rulemaking, allow time for prepared general statements by participants, and encourage all interested parties to share their views on issues affecting this proposed rulemaking. Each participant will be allowed to make a general statement (within time limits determined by DOE), before the discussion of specific topics. DOE will permit, as time permits, other participants to comment briefly on any general statements.

At the end of all prepared statements on a topic, DOE will permit participants to clarify their statements briefly. Participants should be prepared to answer questions by DOE and by other participants concerning these issues. DOE representatives may also ask questions of participants concerning other matters relevant to this rulemaking. The official conducting the public meeting will accept additional comments or questions from those attending, as time permits. The presiding official will announce any further procedural rules or modification of the above procedures that may be needed for the proper conduct of the public meeting.

A transcript of the public meeting will be included in the docket, which can be viewed as described in the *Docket* section at the beginning of this document. In addition, any person may buy a copy of the transcript from the transcribing reporter.

D. Submission of Comments

DOE will accept comments, data, and information regarding this proposed rule before or after the public meeting, but no later than the date provided in the **DATES** section at the beginning of this proposed rule. Interested parties may submit comments, data, and other

[115] The report is available at *www.nationalacademies.org/our-work/review-of-methods-for-setting-building-and-equipment-performance-standards.*

information using any of the methods described in the **ADDRESSES** section at the beginning of this document.

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

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

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

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

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

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

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

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

Confidential Business Information. Pursuant to 10 CFR 1004.11, any person submitting information that he or she believes to be confidential and exempt by law from public disclosure should submit via email two well-marked copies: one copy of the document marked ''confidential'' including all the information believed to be confidential, and one copy of the document marked ''non-confidential'' with the information believed to be confidential deleted. DOE will make its own determination about the confidential status of the information and treat it according to its determination.

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

E. Issues on Which DOE Seeks Comment

Although DOE welcomes comments on any aspect of this proposal, DOE is particularly interested in receiving comments and views of interested parties concerning the following issues:

(1) DOE requests comments on its proposal to require that the proposed standards, if adopted, would apply to all CRE listed in table I.1 manufactured in, or imported into, the United States on or after the date that is 3 years after the date on which the final new and amended standards are published. More generally, DOE requests comment on whether it would be beneficial to CRE manufacturers to align the compliance date of any DOE amended or established standards as closely as possible with the refrigerant prohibition dates proposed by the December 2022 EPA NOPR.

(2) DOE requests comment on the impacts to CRE manufacturers and consumers from the Inflation Reduction Act (IRA) and the Infrastructure Investment and Jobs Act (IIJA).

(3) DOE requests comment on the proposed definitions for ''cold-wall evaporator,'' ''forced-air evaporator,'' ''pass-through doors,'' ''roll-in door,'' ''roll-through doors,'' ''sliding door,'' and ''rating temperature.''

(4) DOE requests comment on blast chiller or freezer design options, design specifications, and energy consumption data tested per the DOE test procedure located in appendix D of 10 CFR 431.64.

(5) DOE requests comment on refrigerated buffet/preparation table design options, design specifications, and energy consumption data tested per the DOE test procedure located in appendix C of 10 CFR 431.64.

(6) DOE requests comment on publicly available market data on CRE manufacturers or identification of any CRE manufacturers with large market shares not identified in Chapter 3 of the TSD NOPR.

(7) DOE requests comment on the decision to screen out increased insulation thickness, vacuum-insulated panels, linear compressors, and air curtain design as design options for improving the energy efficiency of CRE.

(8) DOE requests comment on its proposal to use baseline levels for CRE equipment based upon the anticipated design changes that will be made by manufacturers in response to the December 2022 EPA NOPR.

(9) DOE further requests comment on its estimates of energy-use reduction associated with the design changes made by manufacturers in response to the December 2022 EPA NOPR.

(10) DOE requests comment on its proposal to apply an energy use multiplier to certain equipment classes that contain CRE with unique utility and energy use characteristics. DOE additionally requests comment on the proposed multiplier values and equipment classes for which these multipliers would be applied.

(11) DOE seeks comment on the method for estimating manufacturing production costs.

(12) DOE requests comment on the CRE distribution channels and overall on the markups analysis.

(13) DOE requests comment on its approach for the energy use analysis.

(14) DOE requests comment on its price learning assumptions and methodology.

(15) DOE requests comment and data to inform how any of the analyzed design options would require additional installation time, training, or other related skills compared to the baseline equipment.

(16) DOE requests comment and data on its assumptions and approach regarding consideration of repair and maintenance costs in the LCC and PBP analyses. Specifically, DOE requests data on the expected lifetimes and repair and maintenance frequencies of the considered design options in this NOPR.

(17) DOE requests comment and data regarding the CRE lifetime assumptions and methodology.

(18) DOE requests comment and data on the assumed business types and the corresponding CRE lifetimes at which refurbishment may occur.

(19) DOE requests comment on its methodology and data to better inform the no-standards-case efficiency distribution for CRE.

(20) DOE requests comment on the price elasticity assumptions for the CRE shipments analysis as they relates to the overall CRE market and the market for refurbished CRE.

(21) DOE requests comment on its assumption of no efficiency trend for CRE and seeks historical CRE efficiency data, ideally by equipment class or alternatively by equipment family, or overall for the CRE market as a whole.

(22) DOE seeks comment on the use of a 1.40 manufacturer markup for all CRE equipment classes analyzed in this proposed rule. DOE also seeks comment on the estimated manufacturer markups and incremental MSPs that result from the analyzed energy conservation standards.

(23) DOE requests detailed comment and information on the capital investments associated with each analyzed design option. In particular, DOE requests detailed comment and feedback on the specific changes in equipment and tooling required to incorporate microchannel heat exchangers, as DOE currently models microchannel heat exchangers as a purchased part that can be substituted for tube and fin heat exchangers with minor production line changes.

(24) DOE requests comment on the availability of computer chips and other electrical components used in CREs and specifically if these components are used to achieve higher efficiency levels.

(25) DOE seeks comments, information, and data on the capital conversion costs and product conversion costs estimated for each TSL.

(26) DOE seeks comment on whether manufacturers expect that manufacturing capacity constraints, engineering resource constraints, or laboratory constraints would limit equipment availability to consumers in the timeframe of the new and amended standards compliance date (2028).

(27) DOE requests information regarding the impact of cumulative regulatory burden on manufacturers of CRE associated with multiple DOE standards or equipment/product-specific regulatory actions of other Federal agencies.

(28) DOE requests comments on the magnitude of costs associated with transitioning CRE designs and production facilities to accommodate low-GWP refrigerants that would be incurred between the publication of this NOPR and the proposed compliance date of new and amended standards. Quantification and categorization of these costs, such as engineering efforts, testing lab time, certification costs, and capital investments (*e.g.,* new charging equipment), would enable DOE to refine its analysis.

(29) DOE seeks comments, information, and data on the number of small businesses in the industry, the names of those small businesses, and their market shares by equipment class. DOE also requests comment on the potential impacts of the proposed standards on small manufacturers.

(30) Additionally, DOE welcomes comments on other issues relevant to the conduct of this rulemaking that may not specifically be identified in this document.

VIII. Approval of the Office of the Secretary

The Secretary of Energy has approved publication of this notice of proposed rulemaking and announcement of public meeting.

List of Subjects in 10 CFR Part 431

Administrative practice and procedure, Confidential business information, Energy conservation test procedures, and Reporting and recordkeeping requirements.

Signing Authority

This document of the Department of Energy was signed on September 28, 2023, 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 September 29, 2023.

Treena V. Garrett,

Federal Register Liaison Officer, U.S. Department of Energy.

For the reasons set forth in the preamble, DOE proposes to amend part 431 of chapter II of title 10 of the Code of Federal Regulations, as set forth below:

PART 431—ENERGY EFFICIENCY PROGRAM FOR CERTAIN COMMERCIAL AND INDUSTRIAL EQUIPMENT

■ 1. The authority citation for part 431 continues to read as follows:

Authority: 42 U.S.C. 6291–6317; 28 U.S.C. 2461 note.

■ 2. Amend § 431.62 by:

■ a. Adding, in alphabetical order, definitions for ''Cold-wall evaporator'', ''Forced-air evaporator'', and ''Pass-through doors'';

■ b. Revising the definition of ''Rating temperature''; and

■ c. Adding, in alphabetical order, definitions for ''Roll-in door'', ''Roll-through doors'', and ''Sliding door''.

The additions and revision read as follows:

§ 431.62 Definitions concerning commercial refrigerators, freezers and refrigerator-freezers.

* * * * *

Cold-wall evaporator means an evaporator that comprises a portion or all of the commercial refrigerator, freezer, and refrigerator freezer cabinet's interior surface that transfers heat through means other than fan-forced convection.

* * * * *

Forced-air evaporator means an evaporator that employs the use of fan-forced convection to transfer heat within the commercial refrigerator, freezer, and refrigerator freezer cabinet.

* * * * *

Pass-through doors means doors located on both the front and rear of the commercial refrigerator, freezer, and refrigerator freezer.

* * * * *

Rating temperature means the integrated average temperature a unit must maintain during testing, as determined in accordance with section 2.1. or section 2.2. of appendix B to subpart C of this part, as applicable.

* * * * *

Roll-in door means a door that includes a door sweep to seal the bottom of the door and may include a ramp that allows wheeled racks of product to be rolled into the commercial refrigerator, freezer, and refrigerator freezer.

Roll-through doors means doors located on both the front and rear of the commercial refrigerator, freezer, and refrigerator freezer, that includes a door sweep to seal the bottom of the door and may include a ramp that allows wheeled racks of product to be rolled into and through the commercial refrigerator, freezer, and refrigerator freezer.

* * * * *

Sliding door means a door that opens when a portion of the door moves in a direction generally parallel to its surface.

* * * * *

■ 3. Revise § 431.66 to read as follows:

§ 431.66 Energy conservation standards and their effective dates.

(a) In this section—

(1) The term ''V'' means the volume of a commercial refrigerator, freezer, and refrigerator-freezer, as determined in accordance with section 3.1. of appendix B to subpart C of this part.

(2) The term ''TDA'' means the total display area of a commercial refrigerator, freezer, and refrigerator-freezer, as determined in accordance with section 3.2. of appendix B to subpart C of this part.

(b) Each commercial refrigerator, freezer, and refrigerator-freezer, except as specified in paragraph (d) of this section, manufactured on or after March 27, 2017 and before [*Date 3 Years after publication of the final rule in the* **Federal Register**], shall have a daily energy consumption (in kilowatt-hours per day or ''kWh/day''), when measured in accordance with the DOE test procedure at § 431.64, that does not exceed the following:

(1) For commercial refrigerators, freezers, and refrigerator-freezers other than commercial hybrids, commercial refrigerator-freezers, or wedge cases:

Condensing unit configuration	Equipment family	Rating temperature (°F)	Operating temperature (°F)	Equipment class designation *	Maximum daily energy consumption (kWh/day)
Remote Condensing (RC)	Vertical Open (VOP)	38.0 (M)	≥32.0	VOP.RC.M	0.64 × TDA + 4.07.
		0.0 (L)	<32.0	VOP.RC.L	2.2 × TDA + 6.85.
		− 15.0 (I)	≤ − 5.0	VOP.RC.I	2.79 × TDA + 8.7.
	Semivertical Open (SVO)	38.0 (M)	≥32.0	SVO.RC.M	0.66 × TDA + 3.18.
		0.0 (L)	<32.0	SVO.RC.L	2.2 × TDA + 6.85.
		− 15.0 (I)	≤ − 5.0	SVO.RC.I	2.79 × TDA + 8.7.
	Horizontal Open (HZO)	38.0 (M)	≥32.0	HZO.RC.M	0.35 × TDA + 2.88.
		0.0 (L)	<32.0	HZO.RC.L	0.55 × TDA + 6.88.
		− 15.0 (I)	≤ − 5.0	HZO.RC.I	0.7 × TDA + 8.74.
	Vertical Closed Transparent (VCT).	38.0 (M)	≥32.0	VCT.RC.M	0.15 × TDA + 1.95.
		0.0 (L)	<32.0	VCT.RC.L	0.49 × TDA + 2.61.
		− 15.0 (I)	≤ − 5.0	VCT.RC.I	0.58 × TDA + 3.05.
	Horizontal Closed Transparent (HCT).	38.0 (M)	≥32.0	HCT.RC.M	0.16 × TDA + 0.13.
		0.0 (L)	<32.0	HCT.RC.L	0.34 × TDA + 0.26.
		− 15.0 (I)	≤ − 5.0	HCT.RC.I	0.4 × TDA + 0.31.
	Vertical Closed Solid (VCS)	38.0 (M)	≥32.0	VCS.RC.M	0.1 × V + 0.26.
		0.0 (L)	<32.0	VCS.RC.L	0.21 × V + 0.54.
		− 15.0 (I)	≤ − 5.0	VCS.RC.I	0.25 × V + 0.63.
	Horizontal Closed Solid (HCS)	38.0 (M)	≥32.0	HCS.RC.M	0.1 × V + 0.26.
		0.0 (L)	<32.0	HCS.RC.L	0.21 × V + 0.54.
		− 15.0 (I)	≤ − 5.0	HCS.RC.I	0.25 × V + 0.63.
	Service Over Counter (SOC)	38.0 (M)	≥32.0	SOC.RC.M	0.44 × TDA + 0.11.
		0.0 (L)	<32.0	SOC.RC.L	0.93 × TDA + 0.22.
		− 15.0 (I)	≤ − 5.0	SOC.RC.I	1.09 × TDA + 0.26.
Self-Contained (SC)	Vertical Open (VOP)	38.0 (M)	≥32.0	VOP.SC.M	1.69 × TDA + 4.71.
		0.0 (L)	<32.0	VOP.SC.L	4.25 × TDA + 11.82.
		− 15.0 (I)	≤ − 5.0	VOP.SC.I	5.4 × TDA + 15.02.
	Semivertical Open (SVO)	38.0 (M)	≥32.0	SVO.SC.M	1.7 × TDA + 4.59.
		0.0 (L)	<32.0	SVO.SC.L	4.26 × TDA + 11.51.
		− 15.0 (I)	≤ − 5.0	SVO.SC.I	5.41 × TDA + 14.63.
	Horizontal Open (HZO)	38.0 (M)	≥32.0	HZO.SC.M	0.72 × TDA + 5.55.
		0.0 (L)	<32.0	HZO.SC.L	1.9 × TDA + 7.08.
		− 15.0 (I)	≤ − 5.0	HZO.SC.I	2.42 × TDA + 9.
	Vertical Closed Transparent (VCT).	38.0 (M)	≥32.0	VCT.SC.M	0.1 × V + 0.86.
		0.0 (L)	<32.0	VCT.SC.L	0.29 × V + 2.95.
		− 15.0 (I)	≤ − 5.0	VCT.SC.I	0.62 × TDA + 3.29.
	Vertical Closed Solid (VCS)	38.0 (M)	≥32.0	VCS.SC.M	0.05 × V + 1.36.
		0.0 (L)	<32.0	VCS.SC.L	0.22 × V + 1.38.
		− 15.0 (I)	≤ − 5.0	VCS.SC.I	0.34 × V + 0.88.
	Horizontal Closed Transparent (HCT).	38.0 (M)	≥32.0	HCT.SC.M	0.06 × V + 0.37.
		0.0 (L)	<32.0	HCT.SC.L	0.08 × V + 1.23.
		− 15.0 (I)	≤ − 5.0	HCT.SC.I	0.56 × TDA + 0.43.

Condensing unit configuration	Equipment family	Rating temperature (°F)	Operating temperature (°F)	Equipment class designation *	Maximum daily energy consumption (kWh/day)
	Horizontal Closed Solid (HCS)	38.0 (M)	≥32.0	HCS.SC.M ...	0.05 × V + 0.91.
		0.0 (L)	<32.0	HCS.SC.L	0.06 × V + 1.12.
		− 15.0 (I)	≤ − 5.0	HCS.SC.I	0.34 × V + 0.88.
	Service Over Counter (SOC)	38.0 (M)	≥32.0	SOC.SC.M ..	0.52 × TDA + 1.
		0.0 (L)	<32.0	SOC.SC.L ...	1.1 × TDA + 2.1.
		− 15.0 (I)	≤ − 5.0	SOC.SC.I	1.53 × TDA + 0.36.
	Pull-Down (PD)	38.0 (M)	≥32.0	PD.SC.M	0.11 × V + 0.81.

* The meaning of the letters in this column is indicated in the columns to the left.

(2) For commercial hybrids and commercial refrigerator-freezers, the maximum daily energy consumption (MDEC) for each model shall be the sum of the MDEC values for all of its compartments. For each compartment, measure the TDA or volume of that compartment, and determine the appropriate equipment class based on that compartment's equipment family, condensing unit configuration, and designed operating temperature. The MDEC limit for each compartment shall be the calculated value obtained by entering that compartment's TDA or volume into the standard equation in paragraph (b)(1) of this section for that compartment's equipment class. Measure the calculated daily energy consumption (CDEC) or total daily energy consumption (TDEC) for the model:

(i) For commercial hybrids and commercial refrigerator-freezers where two or more independent remote condensing units are each connected to separate, individual compartments, measure the total refrigeration load of each compartment separately according to appendix B to subpart C of this part. The CDEC for the model shall be the sum of the compressor energy consumption (CEC) for each compartment, fan energy consumption (FEC), lighting energy consumption (LEC), anti-condensate energy consumption (AEC), defrost energy consumption (DEC), condensate evaporator pan energy consumption (PEC), and other applicable energy consumption (OEC).

(ii) For commercial hybrids and commercial refrigerator-freezers where two or more compartments are connected to one remote condensing unit, measure the total refrigeration load of the model according to appendix B to subpart C of this part.

(A) Calculate a weighted adjusted dew point temperature for the model by:

(1) Multiplying the adjusted dew point temperature of each compartment by the volume of that compartment,

(2) Summing the resulting values for all compartments; and

(3) Dividing the resulting total by the total volume of all compartments.

(B) Calculate the CEC for the model using the total refrigeration load and the weighted average adjusted dew point temperature. The CDEC for the model shall be the sum of the CEC, FEC, LEC, AEC, DEC, PEC, and OEC.

(iii) For commercial hybrids and commercial refrigerator-freezers connected to a self-contained condensing unit, measure the TDEC for the model according to appendix B to subpart C of this part.

(3) For wedge cases, measure the CDEC or TDEC according to appendix B to subpart C of this part. For wedge cases in equipment classes for which a volume metric is used, the MDEC shall be the amount derived from the appropriate standards equation in paragraph (b)(1) of this section. For wedge cases of equipment classes for which a TDA metric is used, the MDEC shall be the amount derived from the appropriate standards equation in paragraph (b)(1) of this section incorporating a value for the TDA that is the product of:

(i) The vertical height of the air-curtain (or glass in a transparent door) and

(ii) The largest overall width of the case, when viewed from the front.

(c) Each commercial refrigerator, freezer, and refrigerator-freezer, except as specified in paragraph (d) of this section, manufactured on or after [*Date 3 years after publication of the final rule in the* **Federal Register**], shall have a daily energy consumption (in kilowatt-hours per day or ''kWh/day''), when measured in accordance with the DOE test procedure at § 431.64, that does not exceed the following:

(1) For commercial refrigerators, freezers, and refrigerator-freezers other than commercial hybrids, commercial refrigerator-freezers, or wedge cases:

Condensing unit configuration	Equipment family	Rating temperature (°F)	Operating temperature (°F)	Equipment class designation*	Maximum daily energy consumption (kWh/day)
Remote Condensing (RC) ..	Vertical Open (VOP)	55.0 (H)	>40.0	VOP.RC.H	0.31 × TDA + 1.99
		38.0 (M)	40.0≥ × ≥32.0	VOP.RC.M	0.56 × TDA + 3.57
		0.0 (L)	<32.0	VOP.RC.L	2.04 × TDA + 6.36
		− 15.0 (I)	≤ − 13.0	VOP.RC.I	2.59 × TDA + 8.08
	Semivertical Open (SVO)	55.0 (H)	>40.0	SVO.RC.H	0.32 × TDA + 1.55
		38.0 (M)	40.0≥ × ≥32.0	SVO.RC.M	0.58 × TDA + 2.79
		0.0 (L)	<32.0	SVO.RC.L	2.04 × TDA + 6.36
		− 15.0 (I)	≤ − 13.0	SVO.RC.I	2.59 × TDA + 8.08
	Horizontal Open (HZO)	55.0 (H)	>40.0	HZO.RC.H	0.19 × TDA + 1.56
		38.0 (M)	40.0≥ × ≥32.0	HZO.RC.M	0.34 × TDA + 2.81
		0.0 (L)	<32.0	HZO.RC.L	0.54 × TDA + 6.81
		− 15.0 (I)	≤ − 13.0	HZO.RC.I	0.69 × TDA + 8.64
	Vertical Closed Transparent (VCT)	55.0 (H)	>40.0	VCT.RC.H	0.07 × TDA + 0.97
		38.0 (M)	40.0≥ × ≥32.0	VCT.RC.M	0.134 × TDA + 1.74
				VCT.RC.M.PT	0.139 × TDA + 1.81
				VCT.RC.M.SD	0.143 × TDA + 1.86
				VCT.RC.M.SDPT	0.149 × TDA + 1.93
				VCT.RC.M.RI	0.140 × TDA + 1.83

Condensing unit configuration	Equipment family	Rating temperature (°F)	Operating temperature (°F)	Equipment class designation*	Maximum daily energy consumption (kWh/day)
				VCT.RC.M.RT	0.146 × TDA + 1.9
		0.0 (L)	<32.0	VCT.RC.L	0.47 × TDA + 2.51
		−15.0 (I)	≤−13.0	VCT.RC.I	0.56 × TDA + 2.97
	Horizontal Closed Transparent (HCT)	38.0 (M)	≥32.0	HCT.RC.M	0.16 × TDA + 0.13
		0.0 (L)	<32.0	HCT.RC.L	0.34 × TDA + 0.26
		−15.0 (I)	≤−13.0	HCT.RC.I	0.38 × TDA + 0.29
	Vertical Closed Solid (VCS)	55.0 (H)	>40.0	VCS.RC.H	0.06 × V + 0.14
		38.0 (M)	40.0≥ × ≥32.0	VCS.RC.M	0.1 × V + 0.26
		0.0 (L)	<32.0	VCS.RC.L	0.21 × V + 0.54
		−15.0 (I)	≤−13.0	VCS.RC.I	0.25 × V + 0.63
	Horizontal Closed Solid (HCS)	38.0 (M)	≥32.0	HCS.RC.M	0.1 × V + 0.26
		0.0 (L)	<32.0	HCS.RC.L	0.21 × V + 0.54
		−15.0 (I)	≤−13.0	HCS.RC.I	0.25 × V + 0.63
	Service Over Counter (SOC)	55.0 (H)	>40.0	SOC.RC.H	0.22 × TDA + 0.05
		38.0 (M)	40.0≥ × ≥32.0	SOC.RC.M	0.39 × TDA + 0.1
		0.0 (L)	<32.0	SOC.RC.L	0.83 × TDA + 0.2
		−15.0 (I)	≤−13.0	SOC.RC.I	1.04 × TDA + 0.25
	Chef Base (CB)	38.0 (M)	≥32.0	CB.RC.M	0.03 × V + 0.39
		0.0 (L)	<32.0	CB.RC.L	0.13 × V + 1.37
Self-Contained (SC)	Vertical Open (VOP)	55.0 (H)	>40.0	VOP.SC.H	0.69 × TDA + 1.94
		38.0 (M)	40.0≥ × ≥32.0	VOP.SC.M	1.25 × TDA + 3.48
		0.0 (L)	<32.0	VOP.SC.L	3.29 × TDA + 9.15
		−15.0 (I)	≤−13.0	VOP.SC.I	4.18 × TDA + 11.63
	Semivertical Open (SVO)	55.0 (H)	>40.0	SVO.SC.H	0.65 × TDA + 1.77
		38.0 (M)	40.0≥ × ≥32.0	SVO.SC.M	1.18 × TDA + 3.18
		0.0 (L)	<32.0	SVO.SC.L	3.25 × TDA + 8.78
		−15.0 (I)	≤−13.0	SVO.SC.I	4.13 × TDA + 11.16
	Horizontal Open (HZO)	55.0 (H)	>40.0	HZO.SC.H	0.27 × TDA + 2.06
		38.0 (M)	40.0≥ × ≥32.0	HZO.SC.M	0.48 × TDA + 3.71
		0.0 (L)	<32.0	HZO.SC.L	1.48 × TDA + 5.5
		−15.0 (I)	≤−13.0	HZO.SC.I	1.97 × TDA + 7.34
	Vertical Closed Transparent (VCT)	55.0 (H)	>40.0	VCT.SC.H	0.053 × V + 0.85
		38.0 (M)	40.0≥ × ≥32.0	VCT.SC.M	0.054 × V + 0.86
				VCT.SC.M.PT	0.056 × V + 0.86
				VCT.SC.M.SD	0.058 × V + 0.86
				VCT.SC.M.SDPT	0.060 × V + 0.86
				VCT.SC.M.RI	0.057 × V + 0.86
				VCT.SC.M.RT	0.059 × V + 0.86
		0.0 (L)	<32.0	VCT.SC.L	0.234 × V + 2.38
				VCT.SC.L.PT	0.243 × V + 2.47
		−15.0 (I)	≤−13.0	VCT.SC.I	0.6 × TDA + 3.2
	Vertical Closed Solid (VCS)	55.0 (H)	>40.0	VCS.SC.H	0.0082 × V + 0.21
		38.0 (M)	40.0≥ × ≥32.0	VCS.SC.M	0.02 × V + 0.54
				VCS.SC.M.PT	0.02 × V + 0.56
				VCS.SC.M.RI	0.02 × V + 0.57
				VCS.SC.M.RT	0.02 × V + 0.59
		0.0 (L)	<32.0	VCS.SC.L	0.155 × V + 0.97
				VCS.SC.L.PT	0.161 × V + 1.01
				VCS.SC.L.RI	0.162 × V + 1.02
				VCS.SC.L.RT	0.169 × V + 1.06
		−15.0 (I)	≤−13.0	VCS.SC.I	0.25 × V + 0.88
	Horizontal Closed Transparent (HCT)	38.0 (M)	≥32.0	HCT.SC.M	0.06 × V + 0.37
		0.0 (L)	<32.0	HCT.SC.L	0.08 × V + 1.23
		−15.0 (I)	≤−13.0	HCT.SC.I	0.34 × TDA + 0.43
	Horizontal Closed Solid (HCS)	38.0 (M)	≥32.0	HCS.SC.M	0.022 × V + 0.41
		0.0 (L)	<32.0	HCS.SC.L	0.043 × V + 0.81
				HCS.SC.L.FA	0.052 × V + 0.97
		−15.0 (I)	≤−13.0	HCS.SC.I	0.31 × V + 0.81
	Service Over Counter (SOC)	55.0 (H)	>40.0	SOC.SC.H	0.17 × TDA + 0.33
		38.0 (M)	40.0≥ × ≥32.0	SOC.SC.M	0.304 × TDA + 0.59
		0.0 (L)	<32.0	SOC.SC.L	1.1 × TDA + 2.1
		−15.0 (I)	≤−13.0	SOC.SC.I	1.53 × TDA + 0.36
	Chef Base (CB)	38.0 (M)	≥32.0	CB.SC.M	0.049 × V + 0.54
		0.0 (L)	<32.0	CB.SC.L	0.180 × V + 1.92
	Pull-Down (PD)	38.0 (M)	≥32.0	PD.SC.M	0.11 × V + 0.81

*The meaning of the letters in this column are indicated in the columns to the left or as follows: ".PT" represents pass-through doors; ".SD" represents sliding doors; ".SDPT" represents sliding and pass-through doors; ".RI" represents roll-in doors; ".RT" represents roll-through doors; and ".FA" represents forced air evaporators.

(2) For commercial hybrids and commercial refrigerator-freezers, the MDEC for each model shall be the sum of the MDEC values for all of its compartments. For each compartment, measure the TDA or volume of that compartment, and determine the appropriate equipment class based on that compartment's equipment family, condensing unit configuration, and designed operating temperature. The MDEC limit for each compartment shall be the calculated value obtained by entering that compartment's TDA or volume into the standard equation in paragraph (c)(1) of this section for that compartment's equipment class. Measure the CDEC or TDEC for the model:

(i) For commercial hybrids and commercial refrigerator-freezers where two or more independent remote condensing units are each connected to separate, individual compartments, measure the total refrigeration load of each compartment separately according to appendix B to subpart C of this part. The CDEC for the model shall be the sum of the CEC for each compartment, FEC, LEC, AEC, DEC, PEC, and OEC.

(ii) For commercial hybrids and commercial refrigerator-freezers where two or more compartments are connected to one remote condensing unit, measure the total refrigeration load of the model according to appendix B to subpart C of this part.

(A) Calculate a weighted adjusted dew point temperature for the model by:

(1) Multiplying the adjusted dew point temperature of each compartment by the volume of that compartment,

(2) Summing the resulting values for all compartments, and

(3) Dividing the resulting total by the total volume of all compartments.

(B) Calculate the CEC for the model using the total refrigeration load and the weighted average adjusted dew point temperature. The CDEC for the model shall be the sum of the CEC, FEC, LEC, AEC, DEC, PEC, and OEC.

(iii) For commercial hybrids and commercial refrigerator-freezers connected to a self-contained condensing unit, measure the TDEC for the model according to appendix B to subpart C of this part.

(3) For wedge cases, measure the CDEC or TDEC according to appendix B to subpart C of this part. For wedge cases in equipment classes for which a volume metric is used, the MDEC shall be the amount derived from the appropriate standards equation in paragraph (c)(1) of this section. For wedge cases of equipment classes for which a TDA metric is used, the MDEC shall be the amount derived from the appropriate standards equation in paragraph (c)(1) of this section incorporating a value for the TDA that is the product of:

(i) The vertical height of the air-curtain (or glass in a transparent door) and

(ii) The largest overall width of the case, when viewed from the front.

(d) The energy conservation standards in paragraph (b) of this section do not apply to chef bases or griddle stands. The energy conservation standards in paragraphs (b) through (c) of this section do not apply to buffet tables or preparation tables, blast chillers, blast freezers, or mobile refrigerated cabinets.

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