refurbishments. AHRI commented that energy efficiency gains are lost when consumers refurbish CRE and argued that refurbished CRE could cost up to 45 percent less than new CRE, causing the refurbished market to grow. (AHRI, No. 81 at pp. 8, 11–12) According to AHRI, their surveyed suppliers of refurbished equipment reported double-digit growth in the past few years. (*Id.* at p. 12) Hussmann emphasized the growth of the refurbishment market due to increased costs and payback periods and commented that the compound annual growth rate (''CAGR'') of the refurbishment industry in FY20, FY21, FY22 was 23 percent, 25 percent, and 11 percent, respectively. (Hussmann, No. 80 at p. 9) Further, Hussmann estimated a 10 percent annual growth in this market since 2015. (*Id.* at pp. 9–10) Hillphoenix commented that the cost of refurbished equipment is usually 50 percent less than the cost of new CRE, and that two large U.S. retailers are currently considering establishing their own in-house refurbishment program. (Hillphoenix, No. 77 at p. 2) Hillphoenix emphasized the growth of the refurbished market due to supply chain shortage and component cost increases, and stated there are at least 20 companies that refurbish CRE and suggested DOE reach out to those companies. (*Id.*) NAFEM commented that increased equipment prices are leading to refurbishment in all business sizes. (NAFEM, No. 83 at pp. 18, 23) NAMA also requested that DOE evaluate the energy use of refurbished machines and estimate the impact that equipment price increases associated with new standards may have on delaying purchase of new CRE or incentivizing purchase of refurbished CRE. (NAMA, No. 85 at pp. 16–17) NAMA added that any changes in the design options will cause significant increases in the cost of the machines, which will cause the purchaser to consider other alternatives including delaying the purchase of new equipment, purchasing refurbished machines, and importing machines from overseas, all of which will delay energy savings from being realized. (NAMA, No. 85 at p. 19) Furthermore, Storemasters commented that increased equipment prices would lead to fewer independent retailers opening new branches or remodeling existing ones. (Storemasters, No. 68 at p. 1)

In response to the August 2024 NODA, several stakeholders reiterated their concern about the growth of the refurbishment market, and its impact on energy savings as an unregulated industry. Hillphoenix commented that the lower cost of refurbished CRE drives the growth of the refurbishment market and suggested that DOE reach out to the more than 20 retailers dealing in refurbished equipment for data on the size and growth of the refurbishment industry. (Hillphoenix, No. 110 at p. 2) NAMA commented that the design options analyzed would significantly increase equipment costs, which could result in consumers purchasing refurbished CRE or delaying the purchase of new CRE. (NAMA, No. 112 at p. 6) AHRI restated their concern that the new standards will increase CRE costs, causing customers to buy less energy efficient, refurbished CRE. (AHRI, No. 104 at p. 8)

To account for the effect of a potential increase in refurbished CRE as a result of increased prices from CRE standards, in the October 2023 NOPR, DOE had assumed a price elasticity effect for a small fraction of CRE shipments, which was limited to small-sized buildings. 88 FR 70196, 70242. In response to the stakeholder comments on refurbished CRE, in the August 2024 NODA, DOE modified its price elasticity approach based on the premise that if the refurbishment market offers a favorable economic opportunity, it could be utilized by all businesses. Accordingly, for the August 2024 NODA DOE applied price elasticity to all self-contained units, regardless of the building size where those units are installed. DOE notes that the price elasticity effect and a resulting reduction in CRE shipments is dependent on the price difference between the price consumers pay in the no-new-standards case and the standards case. DOE applied an elasticity constant of -0.5 to shipments for self-contained CRE and scaled this constant down to -0.15 over a period of 20 years (then constant thereafter) from the current year of calculations. DOE also acknowledges that, while a CRE refurbishment market may well exist and its magnitude may have recently increased due to supply chain and equipment price increases, this phenomenon applies to the CRE market overall and is not a result of energy efficiency standards on CRE. With regard to self-contained units, DOE estimates that their market share is approximately 86 percent of the new (*i.e.,* not refurbished) CRE market within the scope of this final rule. DOE notes that decision makers consider many other factors aside CRE purchase price when evaluating business openings or expansions, including the operating cost of CRE over the lifetime of the equipment, as well as other business factors. Nonetheless, because more efficient CRE would actually lead to *increased* shipments in the standards cases if DOE were to account for efficiency elasticity, DOE followed a conservative approach and did not account for efficiency elasticity in its shipments analysis. In response to the comment from NAMA regarding importing machines from overseas, DOE notes that 10 CFR 429.5(a) states that any person importing any covered product or covered equipment into the United States shall comply with the provisions of this part, and parts 430 and 431, and is subject to the remedies of this part.

As discussed in section IV.F.7, following the August 2024 NODA, AHRI, Hillphoenix and Hussmann commented that, in addition to self-contained CRE, remote-condensing CRE are also subject to refurbishments when stores close or undergo remodeling. (AHRI, No. 104 at p. 8; Hillphoenix, No. 110 at p. 11; Hussmann, No. 108 at p. 2)

In response to these comments, DOE acknowledges that remote-condensing CRE may also be subject to refurbishments when stores close or undergo remodeling, potentially rendering such CRE subject to price elasticity, in addition to self-contained CRE. To account for the potential impact in the NIA and MIA of all CRE being subject to refurbishments, DOE applied price elasticity to all CRE shipments as part of a sensitivity analysis. The results of this analysis show that at the selected TSL (TSL 3), there is a 0.39 percent decrease in the cumulative shipments compared to the no-new standards case, in the first 5 years after the rulemaking compliance year (2029). See appendix 10C of the final rule TSD for more details. The MIA results of the sensitivity analysis indicate a minimal impact in the change in INPV at TSL 3 as compared to the change in INPV at TSL 3 for the reference scenario. See chapter 12 of the final rule TSD for the MIA results of the price elasticity sensitivity analysis. Consistent with the August 2024 NODA, in this final rule, DOE continues to apply price elasticity to all-self-contained CRE as its reference scenario. At the selected TSL for the reference scenario, there is a 0.37 percent decrease in the cumulative shipments compared to the no-new standards case, in the first 5 years after the rulemaking compliance year (2029).

In response to the October 2023 NOPR and the August 2024 NODA, Hillphoenix commented that the proposed standards for many of the closed equipment classes (*e.g.,* HCT, VCT, and VCS) are concerning, as the industry continues to transition to closed cases for additional energy savings. (Hillphoenix, No. 77 at p. 1; Hillphoenix, No. 110 at p. 1) Hillphoenix commented that the cost increase of closed cases required to implement the design changes necessary will slow the transition from open cases to more energy-efficient closed-door models. (*Id.*) Hillphoenix stated that any CRE with lids or doors saves approximately 60-percent energy over their open-display counterparts. (*Id.*) Hillphoenix stated that many retailers have converted their VOP/HZO open cases to VCT/HCT classes by retrofitting doors in existing installations to capture the aforementioned energy savings, but requirements for further energy reduction will lead to many closed products being discontinued from the market, which is counter to the goal of reducing energy consumption. (*Id.*)

Regarding the transition from open to closed cases and how standards may affect this transition, DOE reviewed the first cost increase of open cases (VOP and HZO equipment families) relative to corresponding door cases (VCT and HCT equipment families, respectively) between the no-new-standards case and the standards-cases evaluated by DOE and determined that, overall, the increase in first cost for door case equipment classes is smaller than that for open case equipment classes at the considered standard levels. Therefore, DOE concludes that the transition from open to closed cases will not be affected by standards.

In response to the October 2023 NOPR, NAMA commented that DOE's shipments estimates are incorrect and may be off by as much as 50 percent and added that there is no specific information on shipments by category in the October 2023 NOPR TSD. (NAMA, No. 85 at p. 3) Furthermore, NAMA commented that while most of the projections on cost, capital, and utility concerns in the October 2023 NOPR TSD refer to CRE connected to a refrigerant supply system, the impact on self-contained units is much greater and stated that this is not acknowledged in the October 2023 NOPR TSD or the October 2023 NOPR. (*Id.* at p. 10) NAMA recommended that DOE review data from ENERGY STAR regarding shipments with which to modify the percentages according to sales-weighted numbers, which would likely result in a significant effect on the equipment within NAMA's scope. (*Id.*) NAMA also requested that DOE use shipment data of new rather than a collection of new and refurbished units. (*Id.* at p. 20)

In response to the August 2024 NODA, NAMA reiterated the claim that DOE's shipments estimates are off by as much as 50 percent, and that refurbished units have not been accounted for in this data. (NAMA, No. 112 at p. 5) NAMA also repeated their request for information on shipments. (*Id.* at p. 6–7)

In response to the comments from NAMA, DOE notes that shipment estimates by equipment class are available in chapter 9 of the October 2023 NOPR TSD, as well as chapter 9 of this final rule TSD. In this final rule, total CRE shipments in 2029 are estimated to be 1.42 million units. DOE clarifies that all data inputs for shipments estimates are associated with new units. Also, as discussed earlier in this section, DOE reviewed historical CRE ENERGY STAR shipments data to estimate CRE shipments and self-contained units specifically. For self-contained units, DOE used estimates based on manufacturer interviews in 2022 to determine that their market share is approximately 86 percent of the CRE market covered by this final rule.

Chapter 9 of the final rule 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 or amended standards at specific efficiency levels.[114] ("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 2029 through 2058.

DOE evaluates the impacts of new or amended standards by comparing a case without such standards with standards-case projections. The no-new-standards case characterizes energy use and consumer costs for each equipment class in the absence of new or amended energy conservation standards. For this projection, DOE considers historical trends in efficiency and various forces that are likely to affect the mix of efficiencies over time. DOE compares the no-new-standards case with projections characterizing the market for each equipment class if DOE adopted new or amended standards at specific energy efficiency levels (*i.e.,* the TSLs or standards cases) for that class. For the standards cases, DOE considers how a given standard would likely affect the market shares of equipment with efficiencies greater than the standard.

DOE utilized the Python programming language for its NIA to calculate the energy savings and the national consumer costs and savings for each TSL. The final results of this analysis are available in the NIA spreadsheet, 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. summarizes the inputs and methods DOE used for the NIA analysis for this final rule. Discussion of these inputs and methods follows table IV. See chapter 10 of the final rule TSD for further details.

[114] The NIA accounts for impacts in the United States and U.S. territories.

Table IV.20 Summary of Inputs and Methods for the National Impact Analysis

Inputs	Method
Shipments	Annual shipments from shipments model.
Compliance Date of Standard	2029
Efficiency Trends	N/A (No efficiency trends were applied)
Annual Energy Consumption per Unit	Annual weighted-average values are a function of energy use at each TSL.
Total Installed Cost per Unit	Annual weighted-average values are a function of cost at each TSL. Incorporates projection of future equipment prices based on historical data.
Annual Energy Cost per Unit	Annual weighted-average values as a function of the annual energy consumption per unit and energy prices.
Repair and Maintenance Cost per Unit	Annual, weighted-average values from the LCC model.
Energy Price Trends	Prices from LCC analysis and *AEO2023* projections (to 2050) and extrapolation after 2050.
Energy Site-to-Primary and FFC Conversion	Time-series conversion factors based on *AEO2023*.
Discount Rate	3 percent and 7 percent
Present Year	2024

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 year of anticipated compliance with an amended or new standard.

For the standards cases, DOE used a ''roll-up'' scenario to establish the shipment-weighted efficiency for the year that standards are assumed to become effective (2029). In this scenario, the market shares of 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 October 2023 NOPR, due to an 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. 88 FR 70196, 70244. For a given equipment class, market shares by efficiency level were held fixed to their estimated distribution in 2029.[115] *Id.*

In response to the October 2023 NOPR, AHRI recommended that DOE review its CCD for efficiency data and trends. (AHRI, No. 81 at p. 12) Hussmann provided data on the efficiency improvement of one of its highest volume cases in the VOP.RC.M equipment class and showed a 46-percent reduction in energy use between 1985 and 2023. (Hussmann, No. 80 at p. 11–12) Hussmann further stated that other equipment classes, such as VCT.RC.L, have shown similar trends. (*Id.*) DOE appreciates the comments and data provided by AHRI and Hussmann. DOE reviewed CCD data between 2017 and 2024 and did not identify a significant pattern in CRE efficiency trends. Furthermore, DOE notes that the energy efficiency improvement from the March 2014 Final rule and the energy efficiency improvement reported by Hussmann for the VOP.RC.M class between 2012 and 2023 are similar. Therefore, the efficiency improvement provided by Hussmann in recent years may be a result of the March 2014 Final Rule, and not an efficiency improvement trend in the absence of standards. Hence, for this final rule, DOE continued to assume no trend in efficiency in the no-new-standards and the standards cases.

2. National Energy Savings

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

Use of higher-efficiency equipment is sometimes associated with a direct rebound effect, which refers to an increase in utilization of the equipment due to the increase in efficiency and reduction in operating cost. DOE did not find any data on the rebound effect specific to CRE that would indicate 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 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 GHG and other emissions in the NIA and emissions analyses included in future energy conservation standards

[115] 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 the compliance year (2029).

rulemakings. 76 FR 51281 (August 18, 2011). After evaluating the approaches discussed in the August 18, 2011 notice, DOE published a statement of amended policy in which DOE explained its determination that EIA's National Energy Modeling System (''NEMS'') is the most appropriate tool for its FFC analysis and its intention to use NEMS for that purpose. 77 FR 49701 (August 17, 2012). NEMS is a public domain, multi-sector, partial equilibrium model of the U.S. energy sector [116] 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 final rule TSD.

At the November 2023 Public Meeting, EEI suggested that DOE consider modifying its analysis to account for the captured energy approach that EIA is now using and/or the zero emissions approach by ASHRAE for noncombustible renewables as alternative FFC factors. (November 2023 Public Meeting Transcript, No. 64 at p. 149) EEI also requested that DOE review the NREL Cambium databases [117] and conduct a sensitivity analysis using alternative FFC factors. (*Id.* at pp. 149–150) With respect to the comment from EEI, it has been DOE's practice for many years to rely on EIA's *AEO* for deriving site-to-primary and FFC energy factors. DOE is aware that, starting with the September 2023 Monthly Energy Review, EIA began converting electricity generation from noncombustible renewables into primary energy using the captured energy approach rather than the fossil fuel equivalency approach that it had previously used. However, the *AEO2023* that DOE used for this final rule still reflects the fossil fuel equivalency approach. DOE will consider conducting a sensitivity analysis using the captured energy approach, as well as a sensitivity analysis using a scenario with a high level of renewable energy market share for any future rulemakings.

In response to the August 2024 NODA, NAMA commented that DOE addressed their request to separate some equipment classes into two categories based on size being above or below 30 cubic feet. (NAMA, No. 112 at pp. 4–5) However, NAMA stated that this change is not reflected in DOE's national impacts analysis to show lesser projected energy savings for smaller units. *Id.* In response, DOE notes that the energy savings shown in the NIA depend not only on the energy savings of a single unit, but also on its market share and shipment numbers over the analysis period. A unit with lesser energy savings might register higher savings on a national level due to its larger volume of shipments. For example, VCT.SC.M (non-large) is shown to have 0.09 quads of FFC savings while VCT.SC.M (large) is shown to have 0.02 quads of FFC savings at max EL (EL 6) in the August NODA. While the average daily energy consumption of the large representative unit is more than three times higher than that of the non-large representative unit, the ratio of their market shares (shipments) is approximately 1:9.

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 (which include 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 equipment shipped during the projection period.

As discussed in section IV.F.1 of this document, DOE developed price trends for CRE of each equipment class containing variable-speed compressors and/or LED lighting. By 2058, 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 decrease by approximately 85 percent, relative to projected 2029 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 4.0 percent by 2058 relative to 2029. 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 final rule TSD.

The operating cost savings are energy cost savings, which are calculated using the estimated energy savings in each year and the projected price of 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, as discussed in section IV.F.5 of this document, 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 compared to the Reference case. In addition, the low economic benefits scenario reflects a no-price-learning approach to calculate the equipment costs. NIA results based on these cases are presented in appendix 10C of the final rule TSD.

In calculating the NPV, DOE multiplies the net savings in future years by a discount factor to determine their present value. For this final rule, DOE estimated the NPV of consumer benefits using both a 3-percent and a 7-percent real discount rate. DOE uses these discount rates in accordance with guidance provided by the Office of Management and Budget (''OMB'') to Federal agencies on the development of regulatory analysis.[118] The discount rates for the determination of NPV are in contrast to the discount rates used in the LCC analysis, which are designed to reflect a consumer's perspective. The 7-percent real value is an estimate of the average before-tax rate of return to private capital in the U.S. economy. The 3-percent real value represents the ''social rate of time preference,'' which is the rate at which society discounts future consumption flows to their present value.

[116] For more information on NEMS, refer to *The National Energy Modeling System: An Overview 2018,* DOE/EIA–0581(2019), April 2019. Available at *www.eia.gov/outlooks/aeo/nems/overview/pdf/0581(2018).pdf* (last accessed July 22, 2024).

[117] See *www.nrel.gov/docs/fy23osti/84916.pdf* for more information (last accessed July 22, 2024). The Cambium datasets include alternative projections on the U.S. electric sector under different scenarios.

[118] U.S. Office of Management and Budget. *Circular A–4: Regulatory Analysis*. Available at *www.whitehouse.gov/omb/information-for-agencies/circulars* (last accessed Aug. 19, 2024). DOE used the prior version of Circular A–4 (September 17, 2003) in accordance with the effective date of the November 9, 2023 version. Available at *www.whitehouse.gov/wp-content/uploads/legacy_drupal_files/omb/circulars/A4/a-4.pdf* (last accessed Aug. 19, 2024).

a. Sensitivity Analysis for Equipment With Unique Energy Use Characteristics

As discussed in section IV.C.1.c of this document, to account for CRE with certain features (*e.g.,* pass-through, sliding door, sliding-door pass-through, roll-in, roll-through, forced-air evaporator, and drawers), DOE applied a single multiplier of 1.07 to the energy use of CRE with these features. To evaluate the impact of such CRE on the NIA, DOE conducted a sensitivity analysis in this final rule and estimated the NES and NPV by applying a 1.07 energy use multiplier to CRE with these features.

Given a lack of market data regarding CRE with these unique energy use characteristics, DOE modeled two sensitivities, each with a different approach to assumptions regarding market shares. In the first approach, DOE relied on CCD model counts to estimate market shares of CRE with unique energy use characteristics. In the second approach, DOE assumed that these CRE hold a flat 5 percent market share within their equipment class.

To model this sensitivity, DOE assumed that the efficiency distribution of the equipment with unique features is the same as that of the overall equipment class. DOE assumed an increased energy consumption for the affected equipment by a factor of 7 percent. The results of these sensitivity analyses are shown in Appendix 10C of the final rule TSD.

I. Consumer Subgroup Analysis

In analyzing the potential impact of new or amended energy conservation standards on consumers, DOE evaluates the impact on identifiable subgroups of consumers that may be disproportionately affected by a new or amended national standard. The purpose of a subgroup analysis is to determine the extent of any such 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 October 2023 NOPR, an individual commenter submitted a confidential comment that expressed support for the proposed rule but also stated concern that the standards could impose a significant financial burden on small and medium-sized businesses. (Individual Commenter, No. 58 at pp. 1–2) Kirby commented that the proposed purchase prices will limit the growth of small and midsize companies. (Kirby, No. 66 at p. 2) NAMA stated that the cost of the new and amended standards will be significantly higher, with lower energy savings than DOE's estimates, and added that this will affect NAMA's members in ''food deserts.'' (NAMA, No. 85 at p. 2)

For this final rule, DOE analyzed the impacts of the considered standard levels on small businesses. Regarding the comment from NAMA on this rulemaking's impact on ''food deserts'' (*i.e.,* areas where consumers have limited access to healthy and affordable food options), DOE does not have specific data on the businesses that operate in such areas but assumes that most of them are small businesses. For this subgroup, DOE applied discount rates and electricity prices specific to small businesses to the same consumer sample that was used in the standard LCC analysis. DOE used the LCC and PBP spreadsheet model to estimate the impacts of the considered efficiency levels on these subgroups. Chapter 11 in the final rule TSD describes the consumer subgroup analysis and provides detailed results. See also section V.B.1.b of this document for a summary of the subgroup analysis results.

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, unit 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 new and amended standards, the GRIM estimates a range of possible impacts under different manufacturer markup scenarios.

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

DOE conducted the MIA for this rulemaking in three phases. In Phase 1 of the MIA, DOE prepared a profile of the 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,[119] corporate annual reports, the U.S. Census Bureau's *Annual Survey of Manufactures* (''*ASM*''),[120] the U.S. Census Bureau's *Economic Census,*[121] the U.S. Census Bureau's *Quarterly*

[119] U.S. Securities and Exchange Commission. *Electronic Data Gathering, Analysis, and Retrieval system.* Available at *www.sec.gov/edgar/searchedgar/companysearch* (last accessed April 11, 2024).

[120] U.S. Census Bureau. *Annual Survey of Manufactures.* (2012–2021). Available at *www.census.gov/programs-surveys/asm/data.html* (last accessed April 11, 2024).

[121] U.S. Census Bureau. *Economic Census.* (2012 and 2017). Available at *www.census.gov/programs-surveys/economic-census.html* (last accessed April 15, 2024).

Survey of Plant Capacity Utilization,[122] and reports from Dun & Bradstreet.[123]

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 product and capital conversion costs, and to gather additional information on the anticipated effects of energy conservation standards on revenues, direct employment, capital assets, industry competitiveness, and subgroup impacts.

In Phase 3 of the MIA, DOE conducted structured, detailed interviews with representative manufacturers. During these interviews, DOE discussed engineering, manufacturing, procurement, and financial topics to validate assumptions used in the GRIM and to identify key issues or concerns. As part of Phase 3, DOE also evaluated subgroups of manufacturers that may be disproportionately impacted by 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 final rule TSD.

2. Government Regulatory Impact Model and Key Inputs

DOE uses the GRIM to quantify the changes in cash flow due to new or amended standards that result in a higher or lower industry value. The GRIM uses a standard, annual discounted cash-flow analysis that incorporates manufacturer costs, manufacturer 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 a new or amended energy conservation standard. The GRIM spreadsheet uses the inputs to arrive at a series of annual cash flows, beginning in 2024 (the base year of the analysis) and continuing to 2058. DOE calculated INPVs by summing the stream of annual discounted cash flows during this period. For manufacturers of 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 and public comments in response to the October 2023 NOPR. 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 final rule 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 final rule, DOE relied on a design-option approach, supported with testing and reverse engineering of directly analyzed CRE, similar to the approach in the August 2024 NODA and October 2023 NOPR. 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 final rule TSD.

b. Shipments Projections

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

c. Product and Capital Conversion Costs

New or amended energy conservation standards could cause manufacturers to incur conversion costs to bring their production facilities and 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 the product development effort—including engineer, laboratory technician, and marketing resources—associated with each design option and scaled the costs based on the number of basic models (or model

[122] 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 April 11, 2024).

[123] Dun & Bradstreet Hoovers. Subscription login accessible at *app.dnbhoovers.com/*(last accessed March 15, 2024).

platforms, depending on the nature of the design option). The 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 that an 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 equipment platforms that would require redesign. DOE used its CCD [124] and CEC's MAEDbS [125] to identify CRE models covered by this rulemaking. To identify chef bases or griddle stands and high-temperature CRE models, DOE further relied on publicly available data aggregated from the web scraping of retail websites. DOE used the no-new-standards case efficiency distribution from the shipments analysis to estimate the model efficiency distribution for chef bases, griddle stands, and high-temperature CRE. DOE also included the estimated cost of testing to the DOE test procedure for chef bases, griddle stands, 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.

For this final rule, DOE used its product conversion cost methodology from the October 2023 NOPR and updated data sources from the August 2024 NODA. Specifically, DOE incorporated the most recent Department of Labor's BLS Occupational Employment and Wage Statistics wage data [126] into its product conversion cost estimates and refreshed its equipment database to reflect current model listings. Furthermore, in response to stakeholder comments to the October 2023 NOPR regarding the increase in testing and certification costs associated with new safety standards (*i.e.,* UL 60335–2–89) and industry test standards (see Hoshizaki, No. 76 at p. 2), DOE doubled product conversion costs associated with UL testing and industry certification for this final rule, consistent with the August 2024 NODA.

In addition to the sources used to derive product conversion costs, DOE relied on additional sources of information such as the Trade Associations Survey,[127] submitted in advance of the October 2023 NOPR, 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 tooling changes required by the considered design options. 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 CRE that achieve higher efficiency levels through component swaps, which are typically associated with lower efficiency levels). 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. (Trade Association Survey, No. 50 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 condensers, additional panes of glass, and variable-speed compressors. Although DOE analyzed microchannel condensers as a design option to improve efficiency in the October 2023 NOPR, DOE notes that it did not analyze microchannel condensers as a design option in the August 2024 NODA or this final rule analysis. DOE compared feedback from the Trade Associations Survey with information from the equipment teardown analysis and manufacturer interviews and incorporated the feedback where applicable.

Consistent with the August 2024 NODA, DOE adjusted its capital conversion cost estimates from 2022$ to 2023$ for this final rule but otherwise maintained its capital conversion cost methodology from the October 2023 NOPR.

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 V.B.2.a of this document. For additional information on the estimated capital and product conversion costs, see chapter 12 of the final rule TSD.

d. Manufacturer Markup Scenarios

MSPs include direct manufacturing production costs (*i.e.,* labor, materials, and overhead estimated in DOE's MPCs) and all non-production costs (*i.e.,* SG&A, R&D, and interest), along with profit. To calculate the MSPs in the GRIM, DOE applied manufacturer markups to the MPCs estimated in the engineering analysis for each equipment class and efficiency level. Modifying these manufacturer markups in the standards case yields different sets of impacts on manufacturers. For the MIA, DOE modeled two standards-case scenarios to represent uncertainty regarding the potential impacts on prices and profitability for

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[124] 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 Jan. 31, 2024).

[125] California Energy Commission's Modernized Appliance Efficiency Database System is available at *cacertappliances.energy.ca.gov/Pages/Search/AdvancedSearch.aspx* (last accessed Jan. 31, 2024).

[126] U.S. Department of Labor, ''Occupational Employment and Wage Statistics,'' (May 2023). Available at *www.bls.gov/oes/2023/may/oes_nat.htm#17-0000* (last accessed May 22, 2024). See National median annual wages for ''17–2071 Electrical Engineers,'' ''17–2141 Mechanical Engineers,'' ''17–3027 Mechanical Engineering Technologists and Technicians,'' and ''13–1082 Project Management Specialists.''

[127] *See* Trade Associations Survey, No. 50 at pp. 16–18. Available at *www.regulations.gov/document/EERE-2017-BT-STD-0007-0050.*

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'' across all efficiency levels and equipment classes, 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. In the October 2023 NOPR, DOE used a gross-margin percentage of 29 percent for all equipment classes.[128] 88 FR 70196, 70247. In the August 2024 NODA and this final rule, DOE used a gross-margin percentage of 28 percent for all equipment classes based on comments in response to the October 2023 NOPR and market share weights.[129] 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 a high bound of industry profitability under new and amended energy conservation standards. To address manufacturer concerns about reduced margins and profitability under potential amended standards, DOE also analyzes a preservation-of-operating-profit scenario.

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

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

3. Discussion of MIA Comments

a. Conversion Costs

In response to the October 2023 NOPR, NAMA commented the industry would incur hundreds of thousands to millions in capital costs when incorporating increased insulation, VIPs, heavier doors, and microchannel coils, which will take place in an environment with rising interest rates. (NAMA, No. 85 at p. 10) NAMA requested that DOE consider fully burdened conversion costs for the following areas: mold cost for plastic parts; production of the molds in molding machines; fixtures for production of metal parts; fixtures to hold the components in place; engineering design changes; manufacturing changes; building of prototypes to test internally; testing of prototypes; building of pre-production units from production parts and fixtures (sometimes called a pilot lot); safety certification for pre-production units; safety certification costs from U.S. Department of Labor Occupational Safety and Health Administration (''OSHA'') nationally recognized test laboratories (''NRTLs''); internal costs for performance testing; external costs for performance testing; internal energy testing; energy testing from outside laboratories for confirmation; training of production employees; training of service personnel; equipment for service personnel; and capital costs amortized over 3 to 5 years. (*Id.* at p. 22)

NAFEM stated some CRE models can be redesigned to achieve a lower energy limit within the 3-year timeline, while others (primarily self-contained products) have unknown design challenges and variable-speed evaporators and/or condenser fan motors and variable-speed compressors and all the extra electronic controls required for these variable-speed components will require extensive testing to accommodate the proposed limits to increase energy efficiency. (NAFEM, No. 83 at p. 12)

AHRI commented that microchannel condensers should include supplier tooling costs, existing and potential tariffs, laboratory testing, field testing, product line changeovers, refrigerant charge, and air flow analysis. (AHRI, No. 81 at p. 12) Hoshizaki commented that changing condensers requires manufacturers to purchase new jigs for brazing patterns where the cost of the jigs depends on the size and complexity. (Hoshizaki, No. 76 at p. 5) Hoshizaki stated jigs for brazing can cost thousands and costs for new condensing units are amortized over the first 3 years of purchase. (*Id.*) Hoshizaki commented that there are increased labor costs for variable-speed compressors because they require fine-tuning of design controls for optimum energy use. (*Id.*)

NAFEM commented that each foam fixture can cost between $250,000 and $750,000 depending on size and complexity, so new foam fixtures are multi-million-dollar investments. (NAFEM, No. 83 at p. 19) NAFEM also stated complex control systems require wiring, sensors, and additional assembly. (*Id.*)

In response to these comments, DOE notes that it incorporates investments in research, development, testing and certification, marketing, and other non-capitalized costs necessary to make equipment designs comply with standards (*i.e.,* product conversion costs) and investments in property, plant, and equipment necessary to adapt or change existing production facilities (*i.e.,* capital conversion costs) into its MIA. For the October 2023 NOPR, DOE analyzed incorporating a range of design options, including microchannel condensers, variable-speed compressors, and improved door designs (*i.e.,* moving to double-pane, triple-pane, or vacuum-insulated glass for CRE equipment classes with transparent doors). However, DOE did not consider increased insulation thickness or VIPs as design options in its engineering analysis as DOE had tentatively screened out those technology options due to ''impacts on product utility''. See section IV.B of this document for additional information.

For this final rule, DOE maintains the approach used in the August 2024 NODA. Specifically, based on stakeholder comments to the October 2023 NOPR, DOE revised its baseline component assumptions and revised its assessment of representative insulation thickness for the August 2024 NODA and this final rule to align with the insulation thickness assumptions used in the March 2014 Final Rule.[130] As such, DOE did not incorporate estimates associated with increasing insulation

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

[129] The gross-margin percentage of 28 percent is based on a manufacturer markup of 1.38.

[130] See Table 5A.2.2 Baseline Specifications in the March 2014 Final Rule TSD at *www.regulations.gov/document/EERE-2010-BT-STD-0003-0102.* DOE updated the following insulation thicknesses: 1.5 in. for medium- and high-temperature equipment, 2.0 in. for low-temperature equipment, and 2.5 in. for ice-cream temperature equipment. Table IV.11 in this document.

thickness or VIPs in its conversion costs for this final rule. As discussed in section IV.B.1.g of this document, DOE screened out the use of microchannel condensers as a design option to improve efficiency in this final rule analysis. Thus, consistent with the August 2024 NODA, DOE does not consider investments associated with implementing microchannel condensers in its MIA for this final rule. Consistent with both the August 2024 NODA and 2023 October NOPR, DOE assumed that implementing variable-speed compressors takes an additional level of engineering effort and testing time compared to other design options based on manufacturer feedback from confidential interviews. See chapter 12 of the final rule TSD for industry conversion costs by efficiency level for each directly analyzed equipment class.

Hussmann commented that design changes may lead to incorporating additional components (*e.g.,* EEVs, case controllers, lighting controls, anti-sweat heater controllers), which would negatively impact production rates and plant capacity if equipment becomes more difficult to assemble. (Hussmann, No. 80 at p. 8) Hussmann and AHRI commented that manufacturers would also have to develop new training materials and programs to educate existing technicians on the integration of these additional electronic components. (*Id.* at p. 8; AHRI, No. 81 at p. 10)

DOE understands that incorporating additional components could require additional sub-assembly stations and increase per-unit production time, potentially impacting plant capacity. DOE clarifies that EEVs, case controllers, and anti-sweat heater controls are not design options analyzed in this final rule, although DOE understands that manufacturers can choose to meet the adopted standards using a variety of different technologies. Furthermore, DOE does not expect that TSL 3 efficiencies would necessitate the use of occupancy sensors with dimming capability. Additionally, DOE notes that manufacturers have 4 years after this final rule publishes in the **Federal Register** to update CRE designs and production facilities to comply with the adopted standards. As such, DOE does not expect the CRE industry would face long-term capacity constraints as a direct result of the standards adopted in this final rule. As discussed in section V.B.2.c of this document, DOE assesses potential impacts of standards on manufacturing capacity. Manufacturers primary concern was about the dual development needed to comply with both new and amended energy conservation standards and EPA refrigerant regulations over a similar timeframe, however, DOE expects that extending the compliance period from the 3-years analyzed in the October 2023 NOPR to 4-years in this final rule will help mitigate these concerns about laboratory and engineering resource constraints. Regarding developing new training material for technicians, DOE's product conversion costs are intended to encompass investments in marketing and other non-capitalized expenses that directly result from meeting new or amended standards.

NAMA commented that DOE's consultants did not account for the enormous capital costs of most design options or the enormous cumulative burden that results from the transition from high-GWP refrigerants to low-GWP refrigerants. (NAMA, No. 85 at p. 10) NAMA also commented that the practice of burying capital costs in a separate category and not accounting for them in the true cost of design options is unrealistic. (*Id.* at p. 11)

In response to the comment from NAMA, DOE notes that it accounts for the capital investments required to implement the design options analyzed in the engineering analysis in its industry cash flow model, the GRIM. DOE also notes that it does not expect manufacturers would incur significant capital conversion costs as a result of the standards in this final rule as DOE is not analyzing capital-intensive design options such as increasing insulation thickness or implementing VIPs in its analysis. See section IV.J.2.c of this document for a discussion of conversion cost methodology and section V.B.2.a of this document for estimated capital conversion costs required to meet each TSL.

Regarding DOE's accounting of the investments required to transition to low-GWP refrigerants in response to Federal and State regulations, DOE accounts for the investments required to transition to low-GWP refrigerants in its GRIM in the no-new-standards case and standards case. DOE did not consider these investments as ''conversion costs'' as they are considered as part of the analytical baseline. In other words, the CRE industry would incur refrigerant transition expenses to comply with the October 2023 EPA Final Rule regardless of whether DOE amends energy conservation standards for CRE. Although refrigerant transition costs are not attributable to this DOE rulemaking, DOE incorporates these expenses into its GRIM to better reflect the state of industry finances and annual cash flow.

For the October 2023 NOPR, DOE relied on manufacturer feedback in confidential interviews, a report prepared for EPA,[131] 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. 88 FR 70196, 70284. 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.*) from 2023 to 2025.[132] *Id.* DOE estimates industry would incur approximately $13.6 million in R&D and $17.7 million in capital expenditures from 2024 to 2027 for this final rule.[133] These values reflect the estimated refrigerant transition expenses incurred during the period analyzed in this final rule (*i.e.,* 2024–2058), and not the cumulative industry investments associated with transitioning to low-GWP refrigerants. DOE addresses stakeholder comments about the costs associated with the refrigerant transition in section IV.J.3.f of this document. These stakeholder comments relate to concerns about underestimating the costs associated with the refrigerant transition. For more detailed information on how DOE accounts for the refrigerant transition in its MIA, see section V.B.2.e of this document.

NAFEM asserted that DOE did not account for the substantial and unprecedented inflation and cost-of-capital issues that are plaguing all private enterprise at this time, including the CRE industry, in its October 2023 NOPR. (NAFEM, No. 83 at p. 14) NAFEM emphasized that the current macroeconomic environment makes short-term or long-term borrowing for capital improvements impossible. (*Id.* at p. 17) NAMA similarly commented that high interest rates make large investments—such as the expenses required to transition to low-GWP refrigerants in response to Federal and State refrigerant regulation—very expensive. (NAMA, No. 85 at p. 3)

[131] 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.*

[132] At the time of the October 2023 NOPR analysis, the December 2022 EPA NOPR proposed a compliance date of January 1, 2025 for all subsectors relevant to CRE covered by this rulemaking.

[133] The October 2023 EPA Final rule maintained a January 1, 2025 compliance date for stand-alone units but delayed compliance to January 1, 2026 or January 1, 2027 for other subsectors relevant to CRE covered by this rulemaking.

For the October 2023 NOPR, DOE used the discount rate (*i.e.,* the weighted average cost of capital) from the March 2014 Final Rule as a starting point for the MIA. The March 2014 Final Rule financial parameters were vetted by multiple manufacturers in confidential interviews and went through public notice and comment. DOE then compared the discount rate developed for the prior CRE rulemaking to recent financial data from four publicly traded CRE manufacturers to ensure relevance. DOE presented the discount rate and other financial parameters to manufacturers during confidential interviews conducted in January 2023 in advance of the October 2023 NOPR. See chapter 12 of the October 2023 NOPR TSD.[134] Based on feedback, DOE used a discount rate of 10.0 percent in its MIA conducted for the October 2023 NOPR. 88 FR 70196, 70246. As DOE did not receive quantitative feedback from manufacturers on the discount rate in response to the October 2023 NOPR, DOE maintained a discount rate of 10.0 percent for the August 2024 NODA and for this final rule. Regarding DOE's accounting of inflation, for this final rule, DOE updated its engineering analysis to incorporate up-to-date cost estimates by way of 5-year moving averages for materials and the most up-to-date costs for purchased parts.

In response to the October 2023 NOPR, Hillphoenix commented that the standards proposed in the October 2023 NOPR, if adopted, would force OEMs to discontinue equipment, noting that the March 2014 Final Rule standards (which went into effect in 2017) eliminated less-efficient models that were offered as part of tiered efficiency-based pricing. (Hillphoenix, No. 77 at p. 1) In response to the October 2023 NOPR and August 2024 NODA, Hillphoenix commented that proposed standards may lead to equipment commoditization where equipment can only compete on price rather than value-added options and features. (Hillphoenix, No. 77 at p. 1; Hillphoenix, No. 110 at p. 1) In response to August 2024 NODA, Hillphoenix similarly commented that the proposed standards would force OEMs to discontinue models, which would have negative business impacts, stifle innovation, lead to commoditization, and lead to a disadvantage selling in foreign markets. (Hillphoenix, No. 110 at p. 1)

With respect to the comment from Hillphoenix, DOE acknowledges that not all models on the market would meet the efficiency levels proposed in the October 2023 NOPR or the efficiency levels adopted in this final rule. As discussed in section IV.J.2.c of this document, DOE used its CCD as a key input to its conversion cost methodology to estimate the number of unique basic models that would require redesign for each directly analyzed equipment class at each efficiency level. To avoid underestimating the potential investments, DOE assumed manufacturers would redesign all models that would not currently meet each analyzed efficiency level. As such, industry conversion costs reflect the redesign effort required to update the portion of CRE models that do not meet each efficiency level.

In the October 2023 NOPR, DOE estimated that approximately 11 percent of shipments would meet the proposed levels by the analyzed compliance year. However, DOE estimates that approximately 49 percent of shipments would meet the levels adopted in this final rule (*i.e.,* TSL 3). Therefore, compared to the October 2023 NOPR, fewer models would require redesign to meet the adopted TSL in this final rule. Furthermore, compared to the October 2023 NOPR, manufacturers will have an additional year to redesign CRE to meet new and amended standards. Based on stakeholder feedback, DOE is extending the compliance period from the 3 years analyzed in the October 2023 NOPR to 4 years. DOE also notes that in the October 2023 NOPR, DOE proposed energy use multipliers for certain features (*e.g.,* pass-through doors, sliding doors, roll-in doors, roll-through doors, and forced air evaporators). 88 FR 70196, 70231. As presented in the August 2024 NODA, in this final rule, DOE is adopting a simplified multiplier of 1.07 to the eligible equipment classes discussed in the October 2023 NOPR. See section IV.C.1.a of this document for a discussion of equipment classes with unique energy use characteristics. As such, DOE expects that these types of features and others would remain prevalent in the market and could offer means for equipment differentiation, minimizing the risk of equipment commoditization. Additionally, DOE notes that it is not adopting the max-tech efficiency level for most directly analyzed equipment classes. Out of the 28 directly analyzed equipment classes, DOE is adopting efficiency levels below max-tech for 18 classes, which account for approximately 84 percent of industry shipments covered by this rulemaking. DOE expects that manufacturers would still be able to differentiate their models and product lines by various factors (*e.g.,* price, technologies, consumer features, energy efficiency) rather than just price as Hillphoenix contended in its comment. Furthermore, as discussed in section IV.C.1.b of this document, there are a range of models on the market and certified in DOE's CCD that exceed the analyzed max-tech efficiency levels. Possible explanations for the variability in energy usage could be due to a range of lighting powers, differences in insulation thickness, and use of evaporator fan controls, among other reasons.

b. Impacts on Direct Employment

In response to the October 2023 NOPR, Continental commented it may discontinue equipment, potentially affecting Continental employees, if the standards proposed in the October 2023 NOPR were implemented. (Continental, No. 86 at p. 6) AHRI commented that proposed standards in the October 2023 NOPR would force domestic manufacturers to exit the market, effectively lessening consumer choice. (AHRI, No. 81 at p. 15) NAMA commented that a large CRE manufacturer recently closed a factory and reduced company output, resulting in job loss. (NAMA, No. 85 at p. 4)

NAFEM added that the costs and complexity of adopting technology like variable-speed compressors would lead to cost and price increases, which in turn would impede the ability to compete against other equipment, particularly from foreign manufacturers who benefit from government subsidies. (NAFEM, No. 83 at p. 18) NAFEM commented its members continue to share their concerns about the substantial manufacturing costs and investments necessary to comply with the October 2023 NOPR. (*Id.* at p. 19)

In response to the August 2024 NODA, Delfield commented that if standards reduce equipment offerings, manufacturers may reduce their workforce, negatively impacting local communities where manufacturers are major employers. (Delfield, No. 99 at p. 1)

With respect to these comments, DOE notes that it analyzes the potential impacts to domestic manufacturing employment in section V.B.2.b of this document. DOE's direct employment analysis explores the potential reduction in employment under the standards cases (*i.e.,* each TSL) relative to the estimated employment absent standards (*i.e.,* the no-new-standards case). As discussed in section V.B.2.b of this document, DOE estimates that the potential change in domestic direct employment could range from −4,404 to −93 in 2029 at TSL 3. The upper

[134] Available at *www.regulations.gov/document/EERE-2017-BT-STD-0007-0051.*

bound of domestic employment represents the potential change in domestic production and non-production workers if manufacturers continue to produce the same scope of CRE in the United States after compliance. The lower bound estimate conservatively assumes that some domestic manufacturing either is eliminated or moves abroad at more stringent efficiency levels. DOE estimates that approximately 77 percent of CRE covered by this rulemaking are produced domestically. DOE notes that, compared to the October 2023 NOPR, the levels adopted are less stringent (in terms of percent energy use reduction from the analyzed baseline) for 22 out of the 28 directly analyzed equipment classes. These 22 equipment classes account for approximately 96 percent of industry shipments covered by this final rule. In the October 2023 NOPR, DOE estimated that approximately 11 percent of CRE shipments would meet the proposed standards by 2028, a year before the analyzed compliance year. Comparatively, DOE estimates that approximately 49 percent of CRE shipments would meet the standards adopted in this final rule by the analyzed compliance date. Based on a review of its CCD and market research conducted in support of its direct employment analysis, DOE understands that a range of OEMs with domestic CRE manufacturing facilities already offer models that meet the efficiency levels adopted in this final rule. Specifically, DOE identified 30 OEMs with domestic manufacturing facilities that sell the five highest shipments volume equipment classes (VCS.SC.L, VCS.SC.M, VCT.RC.M, VCT.SC.L, and VCT.SC.M). Of those 30 OEMs, only 3 manufacturers do not have any models that meet TSL 3. Approximately half of these 30 OEMs, including the largest CRE manufacturer (in terms of sales volume), currently make CRE exclusively in domestic production facilities.

c. Laboratory Resource Constraints

In response to the October 2023 NOPR, NAFEM, Hoshizaki, SCC, Hillphoenix, Hussmann, and AHRI all expressed concerns that third-party laboratories already have backlogs and are experiencing delays, meaning that new and amended standards for CRE could exacerbate the issue and require more internal testing and third-party testing. (NAFEM, No. 83 at pp. 12–13; Hoshizaki, No. 76 at p. 2; SCC, No. 74 at p. 1; Hillphoenix, No. 77 at p. 3; Hussmann, No. 80 at p. 1; AHRI, No. 81 at p. 2) SCC stated that there is a 3-to-6-month backlog at NRTLs from the October 2023 EPA Final Rule and UL safety standards. (SCC, No. 74 at p. 1) SCC commented that estimates are up to several years just for certification of a manufacturer's full catalog, and testing for UL 60335–2–89 will extend the time needed to test and comply for each CRE model family using new refrigerants. (*Id.* at pp. 1, 2)

In response to the August 2024 NODA, Hussmann commented amendments to UL/CSA 60335–1 and 60335–2–89 requires critical resources, laboratory space, and time. Hussmann stated that these amendments would potentially extend UL approval time by up to 14 weeks. (Hussmann, No. 108 at p. 2) In response to the October 2023 NOPR and August 2024 NODA, Hussmann commented that the backlog at NRTLs will lead to certification delays both for its equipment and components from its suppliers. (Hussmann, No. 80 at p. 1; Hussmann, No. 108 at p. 1) Hillphoenix stated that changes to CRE designs require OEMs to retest to standards from DOE, UL, NSF, ASHRAE, and AHRI. (Hillphoenix, No. 77 at p. 3) In response to the August 2024 NODA, Hillphoenix commented the industry is concerned with the availability of NRTLs to meet proposed standard, regulations from EPA AIM Act, and safety standard UL 60335–2–89, and manufacturers are using significant portions of engineering, supply chain resources, manufacturing, and marketing to meet regulations. (Hillphoenix, No. 110 at p. 2) In response to the October 2023 NOPR, Hoshizaki commented that the refrigerant changes required by 2026, energy conservation standards for ACIMs and CRE by 2027–2028, the new UL safety standard, and NSF sanitation testing for new ice-making systems will push its testing laboratories to capacity, requiring Hoshizaki to rely on third-party laboratories for safety testing. (Hoshizaki, No. 76 at p. 6)

AHRI stated that manufacturers are currently switching to low-GWP refrigerants, and DOE rulemakings increase pressure on laboratory availability, testing capacity, and component availability. (AHRI, No. 81 at p. 2) AHRI stated manufacturers are facing regulatory burdens of DOE rulemakings for ACIMs and WICFs, the October 2023 EPA Final Rule, UL 60335–89–2 and UL 60335–4–40 safety standards, and PFAS regulations, all of which constrain manufacturers' engineering resources, testing validation, verification time, and sourcing components, and constrain independent laboratory testing from low-GWP refrigerants. (*Id.* at pp. 2, 5) AHRI further asserted that EPA and DOE rulemakings regulations pose a high risk for manufacturers to be unable to meet all requirements in the required timeframes. (*Id.* p. 2) AHRI commented that conversion of CRE to larger refrigerant charges over 150 grams is a significant, design-intensive process spanning multiple years and requiring project management, product management, industrial engineering, maintenance, quality, finance, marketing, design engineering, and compliance. (*Id.* at p. 14) AHRI commented that, as of September 29, 2024, new CRE can only be certified to UL 60335–2–89 and any significant equipment modifications for each model family must be certified to UL 60335–2–89—including to CRE using A2L refrigerant or an A3 refrigerant with charge larger than 150 grams. (*Id.* at pp. 2, 5) AHRI stated that manufacturers' third-party national laboratories for UL 60335–2–89 require special sensory equipment that will further limit laboratory capabilities and double the testing time of larger units. (*Id.* at p. 14) Specifically, AHRI commented that laboratory testing time for larger-charged units will double from less than 1 week to nearly 2 weeks, with additional testing required, including end-use lower-flammability limit component testing, annex CC testing, and vibration testing. (*Id.* pp. 14–15)

Hoshizaki commented that UL safety standard 60335–2–89 requires extensive review of refrigeration equipment, which will increase testing and approval time for each model. (Hoshizaki, No. 76 at p. 2) Hoshizaki elaborated that manufacturers will need more testing equipment, testing time, and training for engineers. (*Id.*) Hoshizaki commented that changes to safety and energy testing have more than doubled the testing time for each model family as a result of UL safety standards, Intertek safety certification, and ASHRAE 29 and 72 standards. (*Id.* at p. 6) Hoshizaki requested that DOE investigate if NRTLs are expanding to meet the higher testing demand for the use of flammable refrigerants. (*Id.*) Hoshizaki commented that manufacturers will need additional time to complete all the necessary testing involved for CRE that require redesign as a result of new and amended standards due to the existing ''backlog'' of third-party laboratories. (*Id.* at pp. 1–2) Hoshizaki commented that more than 100 of its CRE models will be affected by the energy conservation standards proposed in the October 2023 NOPR, and corresponding UL safety and NSF sanitation testing will be difficult or impossible to complete within the 3-year compliance period. (*Id.* at pp. 6–7)

In response to the August 2024 NODA, NAMA acknowledged DOE's assessment of the increased testing costs associated with new UL safety standards. (NAMA, No. 112 at p. 5) NAMA asserted that the cost of DOE testing for energy efficiency will increase noting that 2 units need to be tested. (*Id* at p. 6).

Hussmann commented that compliance to UL 60335–2–89 uses critical resources, laboratory space, and time for new components and design modifications. (Hussmann, No. 80 at p. 2) Hussmann asserted that its testing laboratories and personnel are at capacity. (*Id.* at p. 1) In the October 2023 NOPR and August 2024 NODA, Hussmann commented manufacturers will commit 1 to 3 years of laboratory time and significant resource investment to test to UL standards when evaluating the performance of new A3 or A2L components from the October 2023 EPA Final Rule. (*Id.* at p. 2; Hussmann, No. 108 at p. 1) Hillphoenix commented that UL 60335–2–89 requires all new CRE to be certified if using most end-uses of A2Ls and larger charges or R–290, which requires more testing, equipment markings, instructions, and modifications to meet the safety requirements. (Hillphoenix, No. 77 at p. 3) Hillphoenix commented that UL 60335–2–89 requires significantly more testing potentially and substantial modifications to meet the safety requirements. (*Id.*) Hillphoenix commented that each time equipment changes, OEMs must retest to all of these regulations and specific test standards, and there is substantial industry concern over the availability of NRTLs to meet the evolving regulatory landscape. (*Id.*) Hillphoenix stated that a significant portion of engineering, supply chain, manufacturing, and marketing resources are being consumed just to meet these evolving regulations. (*Id.*)

NAFEM commented that the standards proposed in the October 2023 NOPR would require extensive testing for the CRE industry, which is problematic due to bottlenecks related to changing safety and environmental regulations at third-party testing laboratories. (NAFEM, No. 83 at p. 12)

With respect to these comments, DOE understands that complying with concurrent EPA and DOE regulations, compounded by changes to UL safety standards and industry test standards, requires a significant amount of engineering and laboratory resources for CRE manufacturers. Regarding the redesign, testing, and certification required to develop CRE designs that comply with the October 2023 EPA Final Rule, DOE accounts for those refrigerant transition expenses incurred during the analysis period (2024 to 2058) in its MIA. DOE recognizes that many CRE manufacturers also manufacture WICFs and ACIMs, as shown in table V. in section V.B.2.e of this document. DOE notes that the compliance dates in the October 2023 EPA Final Rule are staggered for these equipment categories across multiple years, rather than having a single January 1, 2025 compliance date as proposed in the December 2022 EPA NOPR. Staggering compliance dates could lessen potential bottlenecks in the transition to manufacture new equipment, such as testing and certification of equipment by an NRTL. See 88 FR 73098, 73133. For WICFs, the October 2023 EPA Final Rule established GWP restrictions for refrigeration systems with remote condensing units in retail food refrigeration systems and cold storage warehouses with less than 200 pounds (''lbs'') of charge, effective January 1, 2026. See *id.* at 88 FR 73209. The October 2023 EPA Final Rule established GWP restrictions for ACIMs effective January 1, 2026 or January 1, 2027, depending on the ACIM equipment category. See *id.* at 88 FR 73165. Regarding potential DOE standards for WICFs and ACIMs, DOE notes that it issued a final rule amending standards for WICFs on November 29, 2024, with compliance required for WICF refrigeration systems starting December 31, 2028 (approximately 1 year later than what was proposed, see 88 FR 60746).[135] At this time, DOE has proposed but has not finalized new and amended standards for ACIMs. See 88 FR 30508. In this final rule, DOE is adopting a 4-year compliance period (modeled as a 2029 compliance year), providing manufacturers an additional year compared to the October 2023 NOPR to complete the necessary testing and redesign needed to meet the adopted standards. As such, DOE expects that any energy conservation standards compliance dates for CRE, WICFs, and ACIMs (should DOE adopt more stringent standards) will be staggered.

Regarding stakeholders' comments on the increase in per-unit testing burden as a result of the transition to UL 60335–2–89, DOE updated its product conversion costs to reflect the increase in testing burden. As discussed in section IV.J.2.c of this document, DOE doubled the costs associated with testing and certifying to the new UL safety standard in response to written comments and secondary research.

d. Supply Chain

In response to the October 2023 NOPR, NAMA asserted that DOE has not addressed the lack of available components in the supply chain. (NAMA, No. 85 at p. 15) Hoshizaki, Hussmann, and AHRI commented that manufacturers experience long lead times and shortages of components, including electronic controls, fan motors, compressors, sheet metal, and plastic resin. (Hoshizaki, No. 76 at pp. 5–6; Hussmann, No. 80 at p. 13; AHRI, No. 81 at pp. 12–13) Hussmann and AHRI commented that COVID–19 impacted the supply chain for computer chips and, while the situation is improving, shortages and long lead times for electrical components, materials, and parts remain. (Hussmann, No. 80 at p. 13; AHRI, No. 81 at pp. 12–13) In response to the August 2024 NODA, Hussmann commented that the industry faces supply chain issues related to A2L components, standard supply chain issues prevalent since COVID–19, time constraints, resource constraints, and laboratory capacity limitations, and a learning curve to understand new baseline energy usage. (Hussmann, No. 108 at p. 2) In response to the October 2023 NOPR, AHRI commented that supply chain issues for electrical components requires that CRE OEMs continually redesign equipment to adapt to new electronic controls. (AHRI, No. 81 at p. 13) AHRI added that manufacturers experience high component prices; uncertainty around PFAS regulations; long lead times for variable-speed compressors, variable-speed fans, variable-speed drives, system controllers, and ECMs; electronic component redesign; backlogs for components to certify to both UL 60335–2–40 and UL 60335–2–89; time for sourcing alternative components; and additional reliability testing of new components. (*Id.*)

Hussmann commented that electronic component shortages forced a supplier to discontinue several fan motors and assemblies, abandon adjustable-speed motors in ''Insight Merchandisers'',[136] and source EEVs and case controllers, taking several months, which constrains engineering resources. (Hussmann, No. 80 at p. 13) Hussmann also commented that computer chips and controller shortages have resulted in $10,000 in

[135] At the time of issuance of this final rule, the WICFs final rule has been issued and is pending publication in the **Federal Register**. Once published, the final rule pertaining to WICFs will be available at: *www.regulations.gov/docket/EERE-2017-BT-STD-0009.*

[136] *www.hussmann.com/en/products/display-cases/insight-merchandisers#p=48.* (Last accessed October 8, 2024).

laboratory costs to conduct reliability testing, performance validation testing on CRE cases, and UL and NSF testing and validation. (*Id.* at pp. 1, 13) Hussmann stated that more shortages may occur if more controllers or computer chips are required to meet proposed standards, particularly if the United States imposes a ban on semi-conductors from China (Section 5949 of the National Defense Authorization Act). (*Id.* at p. 13)

In response to the August 2024 NODA, Delfield commented the proposed standards would have a significant impact on manufacturers in terms of testing, development, and overall business resources, which may negatively impact equipment availability. (Delfield, No. 99 at p. 1) Delfield stated that if the supply chain is not equipped for all most manufacturers to move to new tooling and components, it could result in production delays. (*Id.*)

In response to comments about supply chain issues, DOE notes that for the August 2024 NODA and this final rule, DOE updated its engineering analysis to incorporate up-to-date cost estimates. Increased costs associated with recent supply chain challenges stemming from the COVID–19 pandemic have been incorporated into the cost analysis by way of 5-year moving averages for materials and up-to-date costs for purchased parts. DOE expects manufacturers would most likely incorporate design options that require more electronic components (*e.g.,* ECMs, variable-speed compressors) to meet the standards adopted in this final rule. However, based on the engineering and teardown analyses as well as comments from manufacturers (see AHRI, No. 81 at pp. 4–5; Delfield, No. 71 at p. 1; Hussmann, No. 80 at p. 10), DOE understands that the use of advanced electronics (*e.g.,* EC fan motors and controls for fans) is already prevalent in the CRE industry. For this final rule, DOE expects that 10 directly analyzed equipment classes, which account for 50 percent of self-contained CRE shipments (approximately 43 percent of total industry shipments), would likely need to incorporate variable-speed compressors to meet TSL 3. However, for those 10 equipment classes, 30 percent of shipments already meet TSL 3 efficiencies. Additionally, as discussed in section III.A.2.a of this document, DOE is extending the compliance period from 3-years analyzed in the October 2023 NOPR to 4-years for this final rule. The 4-year compliance period provides some economic and regulatory certainty to component suppliers and manufacturers, which eases supply constraints on components that manufacturers may need in order to meet the new and amended standards.

e. Cumulative Regulatory Burden

In response to the October 2023 NOPR, AHRI appreciated that DOE recognizes the cumulative regulatory burden associated with regulatory initiatives of multiple Federal agencies and standards-setting bodies, which includes DOE energy conservation standards for CRE, WICF, and ACIM rulemakings occurring simultaneously with refrigerant regulation such as the October 2023 EPA Final Rule, and changes to UL safety standards, State regulations, *etc.* (AHRI, No. 81 at pp. 13–14) AHRI commented that all these regulatory actions entail costs, engineering design time, testing validation and verification time, establishment of new supply chains, and independent laboratory testing. (*Id.* at p. 14) AHRI commented also that DOE's proposed changes to medium electric motors and expanded-scope electric motors (''ESEMs'')—formerly named small non-small electric motors—in 2027 would also have an impact on CRE manufacturers and may require equipment changes to account for larger motors, additional testing, safety agency approval, backward compatibility for the replacement market, and cost increases for higher-efficiency motors. (*Id.*) AHRI stated that these factors make DOE's 3-year compliance period analyzed in the October 2023 NOPR infeasible, as meeting the standards would require substantial investment, resources, and innovation by manufacturers. (*Id.*) Hussmann commented that it incorporated by reference AHRI's comment that there is a cumulative regulatory burden associated with the October 2023 NOPR. (Hussmann, No. 80 at p. 14) Hussmann similarly emphasized that the motors rulemakings could also impact CRE manufacturers. (*Id.*)

Hoshizaki commented that ACIM and CRE regulations have converging compliance dates for new safety regulations, the refrigerant transition, and DOE energy conservation standards. (Hoshizaki, No. 76 at p. 6) Hoshizaki added that industry is still trying to understand the scope of change needed for the transition to UL 60335–2–89, which is required for most commercial refrigeration categories starting in September 2024. (*Id.*) Hoshizaki commented that it is also tracking the development of chemical (*e.g.,* PFAS) regulations. (*Id.* at p. 7)

SCC similarly commented that the cumulative regulatory burden from EPA refrigerant regulations, new safety standards, DOE's ACIM and WICF energy conservation standards rulemakings, and PFAS reporting make it challenging to analyze and comply with these regulations within the required timeframes. (SCC, No. 74 at pp. 1, 4) SCC emphasized that each rulemaking requires significant engineering time, capital costs, testing validation, and independent laboratory certification. (*Id.* at p. 4) SCC commented that 3 years is an insufficient amount of time to comply with the standards proposed in the October 2023 NOPR, given the cumulative regulatory burden from overlapping rulemakings. (*Id.*)

Hussmann highlighted that many State and local building codes prohibit the use of A2Ls and must be updated outside of the normal cycle of building code revisions, which commonly take 2 to 5 years to complete. (Hussmann, No. 80 at p. 2) Hussmann commented only eight States have updated their codes to allow A2L refrigerants in CRE, and more than 20 States and all U.S. territories have not yet passed legislation authorizing the use of A2L refrigerants for CRE. (*Id.*) Hussmann commented that manufacturers currently face uncertainty around the use of A2L but stated that AHRI is dedicating resources to allow A2Ls in CRE in all States and territories to allow A2Ls in building codes by mid-2024. (*Id.; see also* AHRI, No. 81 at p. 2) In response to the August 2024 NODA, NAMA requested that DOE consider the regulatory burden associated with changing State and local building codes. NAMA commented that National, State, and local building codes may not be finalized before the proposed compliance date for CRE. (NAMA, No. 112 at pp. 4, 9) If building codes are not updated, NAMA asserted that manufacturers may build two versions of models with either R–290 refrigerants or a blend of low-GWP refrigerants and higher-GWP refrigerants. (*Id.* at p. 4)

In response to the October 2023 NOPR and August 2024 NODA, Hussmann commented that it faces simultaneous UL 60335–2–89, NSF, FDA, EPA, and DOE rulemakings, as well as issues related to A2L supply chain, other supply chain issues, time constraints, resource constraints, retooling costs, investments for R&D for CRE and walk-in refrigerators and freezers, and laboratory and capacity limitations. (Hussmann, No. 80 at p. 2 and Hussmann, No. 108 at p. 1) NAFEM commented that its members face overlapping regulations from Federal, State, local, and industrial authorities: the October 2023 EPA Final Rule will have an impact on energy efficiency, UL 60335–2–89 will have a multi-year impact, equipment must meet NSF sanitation requirements, and all equipment must comply with ASHRAE safety requirements. (NAFEM, No. 83 at p. 16) NAFEM commented that many CRE manufacturers must also accommodate changes in ACIMs during a similar timeframe. (*Id.* at p. 13) NAMA commented the industry has experienced regulatory pressure for 5 years, citing DOE's March 2014 Final Rule with compliance in 2017, new ENERGY STAR levels, State-level refrigerant regulations, COVID–19, inflation, and labor shortages for skilled workers. (NAMA, No. 85 at pp. 3–4) In response to the October 2023 NOPR and August 2024 NODA, NAMA commented that cumulative regulatory burden should include changes necessary to adhere to local and State building codes. (NAMA, No. 85 at p. 18 and NAMA, No. 112 at p. 7) NAMA stated California, Oregon, Washington, and other States have changed refrigerant regulations, including retiring HFC refrigerants. (NAMA, No. 85 at p. 17)

With respect to comments regarding the regulatory burden, DOE recognizes that the CRE industry faces overlapping regulations from Federal, State, local, and industrial entities. DOE analyzes and considers the impact on manufacturers of multiple product/equipment-specific Federal regulatory actions. DOE analyzes cumulative regulatory burden pursuant to section 13(g) of the Process Rule. 10 CFR 431.4; 10 CFR 430, subpart C, appendix A, section 13(g). DOE notes that regulations not yet finalized (*e.g.,* DOE energy conservation standards for ACIMs and BVMs) are not considered as cumulative regulatory burden, as the timing, cost, and impacts of unfinalized rules are speculative. However, to aid stakeholders in identifying potential cumulative regulatory burden, DOE does list rulemakings that have proposed rules with tentative compliance dates, compliance levels, and compliance cost estimates. The results of this analysis can be found in section V.B.2.e of this document. As shown in table V.67 in section V.B.2.e of this document, DOE considers the potential cumulative regulatory burden from other DOE energy conservation standards rulemakings for a range of DOE rulemakings, including WICFs, in this final rule analysis. DOE also considers the cost to comply with the October 2023 EPA Final Rule in its analysis. DOE estimates industry will need to invest $13.6 million in R&D and $17.7 million in capital expenditures to transition to low-GWP refrigerants over the next 2 years.

Regarding the comments about EPA's 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 updates to State and local building codes allowing A2L refrigerants in CRE, DOE understands that building codes can limit refrigerants available for use in certain end-uses, including CRE, based on their flammability, the charge size of the equipment, and other relevant safety factors. Building codes are established at the subnational level and can differ greatly across jurisdictions. DOE understands that, in some cases, jurisdictions still need to update their building codes for some substitutes to be available for certain uses. Subsection (i)(4)(B) of the AIM Act, codified at 42 U.S.C. 7675, directs EPA, to the extent practicable, to take building codes into account in its consideration of availability of substitutes when establishing refrigerant restrictions. As such, the October 2023 EPA Final Rule considered whether current building codes permit the installation and use of equipment and systems using substitutes, particularly with respect to setting compliance dates for refrigerant restrictions. As discussed in the October 2023 EPA Final Rule, EPA found it reasonable to consider that jurisdictions will prioritize completing the necessary updates with the October 2023 EPA Final Rule compliance dates in mind. 88 FR 73098, 73135–73136. For many subsectors, including remote condensing CRE equipment classes, the October 2023 EPA Final Rule provided additional time to comply with refrigerant restrictions as compared to the December 2022 EPA NOPR to enable jurisdictions to update their building codes or legislation accordingly. *Id.* at 88 FR 73136. DOE notes that the compliance dates detailed in the October 2023 EPA Final Rule for categories relevant to CRE are 2 to 4 years earlier than the compliance date for new and amended CRE energy conservation standards. As such, DOE anticipates that building codes should not impact a manufacturer's ability to transition to A2L refrigerants by the DOE compliance year. See section IV.C.1.a of this document for additional discussion on building codes.

Regarding the ESEM proposed rule published on December 15, 2023, DOE expects that CRE covered by the ESEM rulemaking would not be directly impacted because the motors used in CRE are typically below 0.25 horsepower, and, thus, are outside the scope of the ESEM rulemaking. See 88 FR 87062. Furthermore, as DOE did not identify any CRE manufacturers that also manufacture ESEMs, DOE did not include CRE manufacturers in the ESEM proposed rule in its cumulative regulatory burden analysis. Regarding potential PFAS regulations restricting the use of certain A2L refrigerants, DOE notes that EPA has not yet proposed any regulations concerning the use of PFAS in refrigerants. DOE notes that EPA's ''PFAS Strategic Roadmap'' sets timelines for specific actions and outlines EPA's commitments to new policies to safeguard public health, protect the environment, and hold polluters accountable.[137]

Regarding State refrigerant regulations, those transition costs are reflected in the refrigerant transition costs estimated in this final rule (see section V.B.2.e of this document). DOE notes that two States have established GWP limits for certain remote-condensing CRE that are lower (*i.e.,* more restrictive) than the October 2023 EPA Final Rule for some CRE categories. Specifically, California and Washington prohibited refrigerants with a GWP of 150 or greater for new retail food refrigeration equipment containing more than 50 lbs refrigerant, which includes certain self-contained and remote-condensing CRE, as of January 1, 2022 in California[138] and as of January 1, 2025 in the State of Washington.[139] Because CRE connected to a remote condensing unit can be connected to multiple types of remote condensing systems with varying refrigerant charge sizes (*e.g.,* dedicated condensing unit or compressor rack system), and State regulations align with the most restrictive GWP limit in the October 2023 EPA Final Rule for CRE, DOE does not expect that individual State refrigerant regulations would further contribute to refrigerant transition costs beyond what was assessed for the October 2023 EPA Final Rule for the equipment covered by this final rule. DOE is already basing its engineering analysis on the most restrictive GWP

[137] U.S. Environmental Protection Agency, ''Per- and Polyfluoroalkyl Substances (PFAS).'' Available at: *www.epa.gov/pfas* (last accessed October 23, 2024).

[138] California Air Resource Board, ''California Significant New Alternatives Policy (SNAP).'' Available at *ww2.arb.ca.gov/our-work/programs/california-significant-new-alternatives-policy-snap/retail-food-refrigeration* (last accessed May 23, 2024).

[139] State of Washington Department of Ecology, WAC 173–443–040. Available at *app.leg.wa.gov/WAC/default.aspx?cite=173-443-040* (last accessed May 23, 2024).

limit (*i.e.,* 150 GWP) to account for the potential variation in remote condensing system refrigerant charge sizes.

In response to the October 2023 NOPR and August 2024 NODA, NAMA commented that DOE should investigate the cumulative burden of the ongoing BVM rulemaking and combine the costs of compliance with multiple regulations into the product conversion costs and GRIM spreadsheets to reflect the costs of responding to and monitoring regulations. (NAMA, No. 85 at pp. 17–18; NAMA, No. 112 at p. 8) NAMA added the GRIM does not show recoupment of investments from multiple product regulations within the six-year lock-in period and recommends DOE consolidate analysis for multiple regulations. (NAMA, No. 112 at p. 8)

Regarding incorporating the combined product conversion costs from the BVM rulemaking into the CRE GRIM (and vice versa), DOE is concerned that combined results would make it more difficult to discern the direct impact of a new or amended standard on covered manufacturers, particularly for rulemakings where there is only partial overlap of manufacturers, which is the case for BVMs and CRE. The GRIM prepared for this rulemaking is specific to the CRE industry. Inputs to the GRIM such as annual shipments, production costs, conversion costs, cost structure, discount rate, *etc.,* reflect the CRE industry. As such, MIA results only encompass industry revenue and annual cash flow associated with shipments of CRE covered by this specific rulemaking. If DOE were to combine the conversion costs from multiple regulations into the CRE GRIM, as requested, it would be appropriate to also include the combined revenues of the relevant regulated products or equipment. For rulemakings with only a partial overlap of manufacturers, conversion costs would be spread over a larger revenue base and result in less severe INPV impacts when evaluated on a percent change basis. For instance, of the 5 BVM manufacturers and of the 103 CRE manufacturers, only 1 manufacturer makes both BVMs and CRE.

In response to the October 2023 NOPR, Zero Zone expressed concern about the third segment of the AIM Act, which regards managing HFC use and reuse. (Zero Zone, No. 75 at p. 1) Zero Zone commented that this proposed regulation has requirements for leak detection and repair that would increase the purchase and operating cost of refrigerating equipment, and the phasedown of HFC refrigerant will increase the cost of equipment for stores. (*Id.*) Zero Zone commented that those cost changes in addition to the costs of design changes to meet the proposed energy conservation standard will reduce overall industry sales volume, which would be detrimental to manufacturers. (*Id.*)

On October 19, 2023, EPA published a proposed rule in the **Federal Register** to address and control certain activities regarding the servicing, repair, disposal, or installation of equipment that involves HFCs or their substitutes. 88 FR 72216. On October 11, 2024, EPA finalized its proposed rule. 89 FR 82682. DOE anticipates that EPA's rule may necessitate additional components or design changes (*e.g.,* automatic leak detection) in certain CRE covered by this rulemaking. Zero Zone's comment did not quantify the increase in cost to CRE within the scope of this final rule. However, DOE expects that any costs associated with complying with EPA's rule would apply to relevant CRE models at all efficiency levels regardless of the energy conservation standard adopted in this final rule. Because the cost impacts from EPA's rule are not efficiency-related costs but rather would be incurred due to EPA requirements that are applicable at all efficiency levels, DOE has not considered the impacts of these changes on MPCs in this final rule. See section IV.C.2 of this document for additional information on DOE's cost analysis.

f. Refrigerant Transition

In response to the October 2023 NOPR, NAFEM commented that the October 2023 NOPR fundamentally ignores the context of other significant changes impacting the CRE industry at this time. (NAFEM, No. 83 at p. 16) NAFEM commented that DOE is not accounting for the significant capital and other investments that were made, and continue to be made, in the shift to new refrigerants under the AIM Act. (*Id.* at p. 15) NAFEM asserted that DOE's analysis does not account for manufacturers trying to recover the costs of these substantial investments made to comply with the October 2023 EPA Final Rule. (*Id.*) NAFEM commented that, contrary to the information in the October 2023 NOPR, the changeover to natural refrigerants is underway but not complete in the CRE industry, mostly because necessary capital improvements are extremely expensive, far more than those listed in the October 2023 NOPR TSD. (*Id.*)

AHRI commented that manufacturers have delayed their refrigerant transition due to COVID–19, component shortages, and long lead times. (AHRI, No. 81 at p. 8) AHRI stated that equipment designs will be impacted by the October 2023 EPA Final rule, which will go into effect in 2025 for self-contained equipment classes and 2026 or 2027 for remote condensing equipment classes. (*Id.*) AHRI commented that DOE did not include any increase in capital costs for the conversion from R–404A to R–290 refrigerant in the baseline assessment. (AHRI, No. 81 at p. 7)

In response to both the October 2023 NOPR and August 2024 NODA, NAMA commented that the CRE industry is burdened by the ongoing transition to low-GWP refrigerants and new safety standards, which require capital improvements to factories, changes to service, and training of factory employees. (NAMA, No. 85 at p. 4; NAMA, No. 112 at p. 5) In particular, NAMA commented that DOE underestimated the capital costs associated with transitioning to low-GWP refrigerants. (*Id.* at pp. 4, 8) NAMA commented also that while the October 2023 NOPR TSD acknowledges the need to change multiple components, the product and capital costs shown are far below what manufacturers must incur to fully implement the use of A3 refrigerants. (NAMA, No. 85 at pp. 7–8)

NAMA stated that the costs of converting to alternative, low-GWP refrigerants has cost millions of dollars for its members, which has been particularly challenging since sales have been down and labor and materials costs have increased. (NAMA, No. 85 at p. 35) NAMA stated its belief that the cost of the refrigerant transition has diverted business resources. (*Id.* at p. 3) NAMA asserted that the cost of the refrigerant transition is higher than the estimated amount in the October 2023 NOPR TSD, especially due to current interest rates, which increase the cost of short-term and long-term borrowing. (*Id.*) NAMA commented that new or amended energy conservation standards from DOE would increase the time to transition CRE to low-GWP refrigerants due to supply chain issues and limited staffing for some manufacturers. (*Id.* at p. 8)

In response to the October 2023 NOPR and August 2024 NODA, Hussmann commented that complying with the October 2023 EPA Final rule necessitates changes to its manufacturing processes, retooling of equipment, and R&D investment. (Hussmann, No. 80 at p. 1; Hussmann No. 108 at p. 1) Hussmann commented that there are supply chain constraints surrounding sourcing components for CRE using A2L refrigerants since components are pending third-party regulatory compliance. (*Id.*) Hussmann stated that because A2L components are new, components must be purchased, designed, installed in models, and undergo performance and safety validation. (*Id.*) Hussmann stated A2L components also require UL certification. (Hussmann, No. 108 at p. 1) Hussmann commented that its costs of transitioning one factory to low-GWP refrigerants included: $700,000 for engineering resources, $500,000 in testing, $600,000 in laboratory equipment, $10,000 in certification costs, $300,000 in manufacturing efforts for self-contained equipment, and $500,000 for manufacturing equipment for self-contained equipment. (Hussmann, No. 80 at p. 15) In response to the August 2024 NODA, the CA IOUs agreed with DOE's analysis that manufacturer R&D costs will increase due to the revised compliance dates for CRE from the October 2023 EPA final rule. (CA IOUs, No. 113 at p. 2)

In response to the comments from NAFEM, AHRI, NAMA, the CA IOUs and Hussmann, DOE recognizes that redesigning CRE models to comply with EPA's refrigerant regulation and DOE's new and amended energy conservation standards requires significant engineering resources and capital investment. DOE analyzed the potential impacts of the December 2022 EPA NOPR in its October 2023 NOPR. Based on the December 2022 EPA NOPR, DOE modeled the CRE industry transitioning to low-GWP refrigerants prior to EPA's proposed January 1, 2025 compliance date. However, EPA has since finalized refrigerant restrictions affecting CRE (*i.e.,* the October 2023 EPA Final rule). The October 2023 EPA Final rule prohibits the manufacture or import of self-contained CRE with HFCs and HFC blends with GWPs of 150 or greater starting January 1, 2025 (for the CRE covered by this rulemaking). For other CRE covered by this rulemaking, the October 2023 EPA Final rule adopted later compliance dates of January 1, 2026 or January 1, 2027 based on equipment type.

DOE notes that it accounts for industry refrigerant transition expenses in its GRIM in the no-new-standards case and standards cases because investments required to transition to low-GWP refrigerants in response to the October 2023 EPA Final Rule likely necessitates a level of investment beyond typical annual R&D and capital expenditures. DOE incorporates these expenses into its GRIM as part of the analytical baseline to better reflect the state of industry finances and annual cash flow. For the October 2023 NOPR, DOE relied on a range of sources, including feedback gathered during confidential manufacturer interviews and investment estimates submitted by NAMA and AHRI in response to the June 2022 Preliminary Analysis. In response to written comments to the October 2023 NOPR, DOE revised its refrigerant transition R&D estimates (see Hussmann, No. 80 at p. 15). DOE did not revise its estimates of refrigerant transition capital expenditures as stakeholder feedback aligned with the methodology used in the October 2023 NOPR. Based on these sources, DOE modeled the transition to low-GWP refrigerants would require industry to invest approximately $13.6 million in R&D and $17.7 million in capital expenditures (*e.g.,* investments in new charging equipment, leak detection systems, *etc.*) from 2024 (the final rule reference year) and 2027 (the latest EPA compliance date for CRE covered by this rulemaking). However, DOE acknowledges that many manufacturers have made significant investments to transition to low-GWP refrigerants prior to 2024, which would not reflected in the GRIM as those costs were incurred outside of the analysis period for this rulemaking (2024–2058). See section V.B.2.e of this document for additional discussion of how DOE accounts for cumulative regulatory burden in its analysis. DOE incorporated the potential redesign costs (*i.e.,* product conversion costs) and capital investment (*i.e.,* capital conversion costs) needed to meet various standard levels in its MIA. See section IV.J.2.c of this document for additional discussion of conversion costs.

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 GHG, CH_4 and N_2O, as well as the reductions in emissions of other gases due to ''upstream'' activities in the fuel production chain. These upstream activities comprise extraction, processing, and transporting fuels to the site of combustion.

The analysis of electric power sector emissions of CO_2, NO_X, SO_2, and Hg uses emissions intended to represent the marginal impacts of the change in electricity consumption associated with amended or new standards. The methodology is based on results published for the *AEO,* including a set of side cases that implement a variety of efficiency-related policies. The methodology is described in appendix 13A in the final rule TSD. The analysis presented in this document uses projections from *AEO2023.* Power sector emissions of CH_4 and N_2O from fuel combustion are estimated using Emission Factors for Greenhouse Gas Inventories published by EPA.[140]

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 final rule TSD.

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

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.[141]

SO_2 emissions from affected electric generating units (''EGUs'') are subject to nationwide and regional emissions cap-and-trade programs. Title IV of the Clean Air Act sets an annual emissions cap on SO_2 for affected EGUs in the 48 contiguous States and the District of Columbia (''DC''). (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.[142] The *AEO*

[140] Available at *www.epa.gov/sites/production/files/2021-04/documents/emission-factors_apr2021.pdf* (last accessed July 22, 2024).

[141] 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 July 20, 2024).

[142] CSAPR requires States to address annual emissions of SO_2 and NO_X, precursors to the formation of fine particulate matter (''$PM_{2.5}$'')

incorporates implementation of CSAPR, including the update to the CSAPR ozone season program emission budgets and target dates issued in 2016. 81 FR 74504 (Oct. 26, 2016). Compliance with CSAPR is flexible among EGUs and is enforced through the use of tradable emissions allowances. Under existing EPA regulations, for States subject to SO_2 emissions limits under CSAPR, any excess SO_2 emissions allowances resulting from the lower electricity demand caused by the adoption of an efficiency standard could be used to permit offsetting increases in SO_2 emissions by another regulated EGU.

However, beginning in 2016, SO_2 emissions began to fall as a result of the Mercury and Air Toxics Standards (''MATS'') for power plants.[143] 77 FR 9304 (Feb. 16, 2012). The final rule establishes power plant emission standards for mercury, acid gases, and non-mercury metallic toxic pollutants. Because of the emissions reductions under the MATS, it is unlikely that excess SO_2 emissions allowances resulting from the lower electricity demand would be needed or used to permit offsetting increases in SO_2 emissions by another regulated EGU. Therefore, energy conservation standards that decrease electricity generation will generally reduce SO_2 emissions. DOE estimated SO_2 emissions reduction using emissions factors based on *AEO2023.*

CSAPR also established limits on NO_X emissions for numerous States in the eastern half of the United States. Energy conservation standards would have little effect on NO_X emissions in those States covered by CSAPR emissions limits if excess NO_X emissions allowances resulting from the lower electricity demand could be used to permit offsetting increases in NO_X emissions from other EGUs. In such cases, NO_X emissions would remain near the limit even if electricity generation goes down. Depending on the configuration of the power sector in the different regions and the need for allowances, however, NO_X emissions might not remain at the limit in the case of lower electricity demand. That would mean that standards might reduce NO_X emissions in covered States. Despite this possibility, DOE has chosen to be conservative in its analysis and has maintained the assumption that standards will not reduce NO_X emissions in States covered by CSAPR. Standards would be expected to reduce NO_X emissions in the States not covered by CSAPR. DOE used *AEO2023* data to derive NO_X emissions factors for the group of States not covered by CSAPR.

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

L. Monetizing Emissions Impacts

As part of the development of this final rule, for the purpose of complying with the requirements of Executive Order 12866, DOE considered the estimated monetary benefits from the reduced emissions of CO_2, CH_4, N_2O, NO_X, and SO_2 that are expected to result from each of the TSLs considered. In order to make this calculation analogous to the calculation of the NPV of consumer benefit, DOE considered the reduced emissions expected to result over the lifetime of equipment shipped during 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 final rule.

1. Monetization of Greenhouse Gas Emissions

To monetize the climate benefits of reducing GHG emissions, the October 2023 NOPR used the interim social cost of greenhouse gases (''SC–GHG'') 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 Interagency Working Group on the SC–GHG (''IWG'') (''2021 Interim SC–GHG estimates''). As a member of the IWG involved in the development of the February 2021 SC–GHG TSD, DOE agreed that the 2021 interim SC–GHG estimates represented the most appropriate estimate of the SC–GHG until revised estimates were developed reflecting the latest, peer-reviewed science. See 87 FR 78382, (Dec. 21, 2022) 78406–78408 for discussion of the development and details of the 2021 interim SC–GHG estimates. The IWG has continued working on updating the interim estimates but has not published final estimates.

Accordingly, in the regulatory analysis of its December 2023 Final Rule, ''Standards of Performance for New, Reconstructed, and Modified Sources and Emissions Guidelines for Existing Sources: Oil and Natural Gas Sector Climate Review,'' the Environmental Protection Agency (''EPA'') estimated climate benefits using a new, updated set of SC–GHG estimates (''2023 SC–GHG estimates''). EPA documented the methodology underlying the new estimates in the RIA for the December 2023 Final Rule and in greater detail in a technical report entitled ''Report on the Social Cost of Greenhouse Gases: Estimates Incorporating Recent Scientific Advances'' (''Final Report'') that was presented as Supplementary Material to the RIA. The 2023 SC–GHG estimates address the recommendations of the National Academies of Science, Engineering, and Medicine (National Academies) by incorporating recent research and responses to public comments. The public comments include those on an earlier sensitivity analysis contained in EPA's December 2022 proposal in the oil and natural gas sector standards of performance rulemaking along with comments on a 2023 external peer review of the accompanying technical report.

On December 22, 2023, the IWG issued a memorandum directing that when agencies ''consider applying the SC–GHG in various contexts . . . agencies should use their professional judgment to determine which estimates of the SC–GHG reflect the best available evidence, are most appropriate for particular analytical contexts, and best facilitate sound decision-making'' consistent with OMB Circular A–4 and applicable law.

DOE has been extensively involved in the IWG process and related work on the SC–GHGs for over a decade. This involvement includes DOE's role as the Federal technical monitor for the seminal 2017 report on the SC–GHG issued by the National Academies, which provided extensive recommendations on how to strengthen and update the SC–GHG estimates. DOE has also participated in the IWG's work since 2021. DOE technical experts involved in this work reviewed the 2023 SC–GHG methodology and report in light of the National Academies' recommendations and DOE's

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

[143] 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.

understanding of the state of the science.

Based on this review, in the August 2024 NODA, DOE proposed for public comment its preliminary determination that the updated 2023 SC–GHG estimates, including the approach to discounting, represent a significant improvement in estimating the SC–GHG through incorporating the most recent advancements in the scientific literature and by addressing recommendations on prior methodologies. That NODA presented climate benefits using both the 2023 SC–GHG estimates and the 2021 interim SC–GHG estimates. In this final rule, DOE has not made a final decision regarding that preliminary assessment or adoption of the updated 2023 SC–GHG estimates, as such a decision is not necessary for purposes of this rule. In this final rule, DOE is presenting estimates using both the updated 2023 SC–GHG values and the 2021 interim SC–GHG estimates, as DOE believes it is appropriate to give the public more complete information regarding the benefits of this rule. DOE notes, however, that the adopted standards would be economically justified using either set of SC–GHG values, and even without inclusion of the estimated monetized benefits of reduced GHG emissions. In future rulemakings, DOE will continue to evaluate the applicability in context and use our professional judgment to apply the SC–GHG estimates that are most appropriate to use at that time.

The 2023 EPA technical report presents SC–GHG values for emissions years through 2080; therefore, DOE did not monetize the climate benefits of GHG emissions reductions occurring after 2080 when using the 2023 estimates for the SC–GHG. DOE expects additional climate impacts to accrue from GHG emissions changes post 2080, but due to a lack of readily available SC–GHG estimates for emissions years beyond 2080 and the relatively small emission effects expected from those years, DOE has not monetized these additional impacts in this analysis. Similarly, the 2021 interim SC–GHG estimates include values through 2070. DOE expects additional climate benefits to accrue for products still operating after 2070, but a lack of available SC–GHG estimates published by the IWG for emissions years beyond 2070 prevents DOE from monetizing these potential benefits in this analysis.

The overall climate benefits are generally greater when using the higher, updated 2023 SC–GHG estimates, compared to the climate benefits using the older 2021 interim SC–GHG estimates, which were used in the July 2023 NOPR. The net benefits of the rule are positive, however, under either SC–GHG calculation methodology; in fact, the net benefits of the rule are positive without including any monetized climate benefits at all. The adopted standards would be economically justified even without inclusion of the estimated monetized benefits of reduced GHG emissions using either methodology, therefore the conclusions of the analysis (as presented in section V.C of this document) are not dependent on which set of estimates of the SC–GHG are used in the analysis or on the use of the SC–GHG at all. The adopted standard level would remain the same under either SC–GHG calculation methodology (or without using the SC–GHG at all).

DOE received several comments regarding its preliminary determination on the use of the 2023 SC–GHG methodologies in the August 2024 NODA. As noted above, DOE is not making a final determination regarding which of the two sets of SC–GHG is most appropriate to apply here. Accordingly, DOE is not addressing in this rule comments regarding such a final determination. Because DOE is presenting results using both sets of estimates, however, to the extent that commenters raised concerns about any reference to the 2023 SC–GHG methodologies, DOE is responding to that limited set of comments here.

Commenter Pacific Gas & Electric (PG&E) et al. expressed support for the 2023 update on SC–GHG methodologies and for use of these estimates in DOE policy analysis. (PG&E et al., No. 113 at p. 2). PG&E et al. stated that the use of the 2023 SC–GHG methodologies is consistent with the Office of Management and Budget (OMB) recommendations to use the best and most recent available estimates for calculating the social cost of carbon. (PG&E et al., No. 113 at p. 2).

Commenters Hussman Corporation, American Lighting Association (ALA) et al., Competitive Enterprise Institute (CEI), and National Association of Home Builders (NAHB) expressed general opposition to the use of a metric that monetizes carbon emissions, and they criticized especially the use of the 2023 SC–GHG methodologies. (Hussman Corporation, No. 108 at p. 3; ALA et al., No. 109 at p. 2; NAHB, No. 103 at p. 4). NAHB stated that, ‘‘the monetized value of [SC–GHG] is highly esoteric, is not tied to tangible outcomes, and will not lead to real change intended in the EERE mission and priorities.’’ NAHB further requested that DOE limits its use of SC–GHG in the future and not use it as a metric for setting minimum efficiency criteria. (NAHB, No. 103 at p. 4) Commenter (CEI) stated that SC–GHG is not a valid approach to monetizing impacts from emissions.

DOE acknowledges the comments expressing general opposition to the 2023 SC–GHG methodologies and their use in these policy analyses. In this final rule, DOE is presenting SC–GHG results using both the interim 2021 SC–GHG estimates and the updated 2023 SC–GHG estimates. DOE notes again that it would promulgate the same standards in these final rules even in the absence of the benefits of the GHG reductions achieved by the rule.

Some commenters (NAHB, ALA, et al., and the U.S. Chamber of Commerce et al.) argued that there is a significant lack of clarity as to how the methodology was applied and how the results were produced. Overall, commenters requested more transparency within the modeling process. Commenter (ALA et al.) affirmed that it may be appropriate for DOE to examine the SC–GHG and monetization of other emissions reductions benefits as informational if the underlying analysis is transparent and vigorous and reviewed by properly qualified peer reviewers. However, ALA maintained that the benefits calculated with the SC–GHG should not be used to justify a rule given the uncertain and ever-evolving nature of those estimates. (ALA et al., No. 109 at pp. 3–4)

Commenter (U.S. Chamber of Commerce et al.) stated that the December 22, 2023, IWG memo ‘‘lacked any discussion of the methodologies, assumptions, or models used by the EPA in revising the estimates.’’ U.S. Chamber of Commerce further criticized that while EPA provided some technical documentation in support of its new SG–GHG estimates, the overall lack of transparency within the decision-making process undermines the credibility of the estimates. The group also stated that the IWG memo does not direct agencies which values to use, allowing agencies to use any estimate, which would lead to inconsistent use of the SC–GHG estimates across the government. (U.S. Chamber of Commerce et al., No. 115 at p. 3)

Because DOE is presenting climate benefits using both the 2021 interim SC–GHG estimates and the 2023 SC–GHG estimates without relying on either set of values to justify its standards, we do not address the substance of these comments insofar as they assess the relative merits of the two sets of estimates. Insofar as these comments object to DOE even referring to the 2023 SC–GHG estimates and using them for informational purposes, DOE notes that

EPA made documentation available in support of the draft updated 2023 SC–GHG estimates used in the sensitivity analysis in EPA's December 2022 Regulatory Impact Analysis, as well as in support of the final updated SC–GHG estimates used in EPA's Dec. 2023 Final Rule. This includes the final technical report explaining the methodology underlying the new set of SC–GHG estimates, files to support independent replication of the SC–GHG estimates, a workbook to support members of the public in applying the SC–GHG estimates in their own analyses, public comments relating to SC–GHG estimates as part of the December 2022 RIA, EPA responses to those public comments, and extensive documentation on the peer review process, including information about the public input opportunities in the peer review panel selection process, the selected peer reviewers, a recording of the peer review meeting, the peer reviewers' report, and EPA's responses to the peer reviewers' report. EPA additionally provided copies of all studies and reports cited in the analysis in the public docket. (EPA RTC A–7–4).

Regarding commenter's concerns regarding IWG's lack of discussion of the 2023 SC–GHG methodologies, insofar as this comment objects to DOE even referring to the 2023 SC–GHG estimates and using them for informational purposes, DOE notes that the methodologies were not introduced in the IWG memo, but rather in an EPA proposed and final rule and a Final Report. The IWG's lack of discussion does not appear to be relevant.

With respect to the commenter's concern about the potential for different agencies to use different and therefore inconsistent estimates of the SC–GHG, this comment is not directly relevant because DOE is presenting both the 2021 interim SC–GHG estimates and the 2023 SC–GHG estimates for this rule.

Several commenters (CEI, AHRI, and U.S. Chamber of Commerce et al.) questioned the accuracy of the estimates produced by the 2023 SC–GHG methodologies and called attention to uncertainties in the calculation process. Commenters argue that due to what they view as substantial inaccuracies and uncertainties in the methodologies, they should not be used to justify new and more stringent energy conservation standards. Commenter (CEI) criticizes the 2023 SC–GHG methodologies as ''too speculative, too prone to user manipulation, and too reliant on dubious assumptions to either justify regulatory decisions or estimate their net benefits to the public.'' (CEI1, No. 100 at p. 2; CEI2, No. 102 at p. 10)

Commenter (AHRI) stated that the methodology fails to acknowledge uncertainties and extrapolations regarding the climate modeling and interaction of the four modules. Additionally, AHRI criticized the quantification of the benefits claimed by DOE as ''speculative and tangential at best.'' (AHRI, No. 104 at p. 2)

Commenter (U.S. Chamber of Commerce et al.) identified the scientific underpinnings of the methodologies as a key area of concern. The U.S. Chamber of Commerce claimed that the SC–GHG values are ''inherently uncertain because they depend on complex modeling of future economic and environmental impacts—and not just near-term forecasts, but forecasts that project hundreds of years into the future.'' (U.S. Chamber of Commerce et al., No. 115 at p. 4)

Because DOE is presenting climate benefits using both the 2021 interim SC–GHG estimates and the 2023 SC–GHG estimates without relying on either set of values to justify its standards, we do not address comments on the uncertainty in the 2023 SC–GHG estimates insofar as they assess the relative merits of the two sets of estimates. Insofar as these comments object to DOE even referring to the 2023 SC–GHG estimates and using them for informational purposes, DOE notes that some measure of uncertainty is inherent in all complex cost estimates that quantify physical impacts and translate them into dollar values. Moreover, DOE notes that EPA discussed the uncertainty in various aspects of the 2023 SC–GHG estimates, including how it is directly accounted for in each of the modules, in the Final SC–GHG Report, and pointed to discussions of uncertainty in the supporting academic literature. (See, *e.g.,* EPA Report at p. 77; EPA RTC A–1–7). EPA discussed factors not accounted for in the SC–GHG, such as those represented in table 3.2.1, explicitly acknowledged that there are limits on which damages and impacts the analysis can capture due to data and modeling limitations, and analyzed the omitted damages and modeling limitations, including the net directional changes of the omitted impacts.

Commenter (CEI) criticized the EPA report's lack of ''table, chart, or paragraph explaining which factors contribute what percentage of the more than threefold increase in social cost—despite the more than two-thirds reduction in emission baselines.'' CEI noted that the reduced discount rate is one factor, but not the entire explanation for the increase in SC–GHG values. (CEI2, No. 102 at p. 8)

Because DOE is presenting climate benefits using both the 2021 interim SC–GHG estimates and the 2023 SC–GHG estimates without relying on either set of values to justify its standards, we do not address the substance of this comment insofar as it calls for a comparison of the relative merits between the two sets of estimates. For informational purposes, DOE notes that EPA stated in the Final Report that the increases in the 2023 SC–GHG estimates are due to the combined effect of multiple methodological updates, and because some of these updates are integrated, a complete decomposition of the incremental contribution of each change is difficult for all three damage functions used in the damage module. (EPA Report at p. 102; EPA RTC A–5–25).

Multiple commenters (National Automatic Merchandising Association (NAMA) and U.S. Chamber of Commerce et al.) raised concerns about whether the new methodologies were sufficiently peer-reviewed by independent experts before DOE utilized them in its analyses. Commenter (NAMA) argued that the updated SC–GHG methodologies deserve an ''open discussion'' with increased transparency before they are used in regulatory action. NAMA specifically claimed that ''the updated IWG report'' that the DOE cites in its analyses was never fully peer-reviewed and was not part of an open process. (NAMA, No. 112 at p. 4) Commenter (U.S. Chamber of Commerce et al.) similarly criticized the IWG's lack of transparency and stated that it undermined the credibility of the updated methodologies and raised questions as to whether the estimates were subject to appropriate scrutiny and review. (U.S. Chamber of Commerce et al., No. 115 at pp. 2–3)

Insofar as commenters were referring to the EPA report—and further insofar as this comment objects to DOE even referring to the 2023 SC–GHG estimates and using them for informational purposes—DOE notes that these commenters referred to the SC–GHG methodologies ''in the IWG report,'' but DOE is not aware of any report by the IWG concerning the 2023 SC–GHG estimates. There is a December 2023 IWG memo referencing developments in the scientific literature, as well as a February 2021 IWG Technical Support Document that provided Interim SC–GHG estimates, but the December 2023 memo does not introduce any new methodologies. The 2023 SC–GHG estimates were not introduced in the IWG memo but rather in an EPA rule and Final Report.

EPA stated that the 2023 SC–GHG methodologies were subjected to independent peer review in line with EPA's Peer Review Handbook 4th Edition, 2015 and described the process. (EPA RTC A–7–10).

Several commenters (CEI, NAHB, AHRI, U.S. Chamber of Commerce et al., and American Enterprise Institute (AEI)) raised concerns with the discount rates employed in the 2023 SC–GHG methodologies and the substantial consequences of utilizing such rates. Commenters (CEI, NAHB, and AEI) criticized the disproportionate impact that the choice of a lower discount rate had on the end SC–GHG estimates. Commenter (AEI) specifically denounced the ''artificially low'' rates and maintained that the rates are a result of prioritizing only climate effects and not wealth aggregation, which would more realistically reflect the objectives of each generation. (CEI2, No. 102 at p. 9; NAHB, No. 103 at p. 4; AEI at pp. 8–9) Commenters (AHRI and U.S. Chamber of Commerce et al.) further criticized the rate choices in the methodologies as inconsistent throughout the cost-benefit analysis. Commenters also questioned why such rates were chosen for each context, especially with such significant impact. (AHRI, No. 104 at p. 4; U.S. Chamber of Commerce et al., No. 115 at p. 4)

Because DOE is presenting climate benefits using both the 2021 interim SC–GHG estimates and the 2023 SC–GHG estimates without relying on either set of values to justify its standards, we do not address comments on the discounting approach used in the 2023 SC–GHG estimates insofar as they assess the relative merits of the two sets of estimates. Insofar as these comments object to DOE even referring to the 2023 SC–GHG estimates and using them for informational purposes, DOE notes that EPA stated that the introduction of a Ramsey approach rather than a constant interest rate ensures internal consistency within the modeling between the socio-economic scenarios and the discount rate and allows for a more complete accounting of uncertainty. (EPA Report at pp. 63–64; EPA RTC A–5–13). EPA further stated that it selected the rates based on multiple lines of evidence: historical real rates of returns, empirical studies of equilibrium real interest rates, future projections of real interest rates, and surveys of economists and technical experts. (EPA Report at p. 2; EPA RTC A–5–24).

Commenter (CEI2) offered support for the updates to the emissions baseline utilized in the 2023 SC–GHG methodologies. Commenter noted that the new baseline of reduced carbon emissions is more realistic for climate modeling and the SC–GHG metric (CEI2, No. 102 at p. 3)

Multiple commenters (CEI and AEI) stated that the 2023 SC–GHG methodologies improperly continue to rely on Representative Concentration Pathway 8.5 (RCP 8.5) for climate models, despite EPA's switch to more realistic emissions baselines elsewhere in the analysis. Commenter (CEI) specifically stated that the 2023 SC–GHG updates rely on three damage functions based on RCP 8.5 and thus assume substantially greater warming and damage despite otherwise utilizing a lower emissions baseline. (CEI2, No. 102 at p. 9) Commenter (CEI) also noted concerns with the use of SSP3 and SSP5 as ''wildly implausible''. Commenter (AEI) similarly opposed the continued use of RCP 8.5 for damage functions and climate models and further criticized the inaccuracy of RCP 8.5 in general. Commenter stated that calculations relying on RCP 8.5 are so extreme, they are realistically impossible. (AEI, No. 97 at p. 4)

Because DOE is presenting climate benefits using both the 2021 interim SC–GHG estimates and the 2023 SC–GHG estimates without relying on either set of values to justify its standards, we do not address the substance of these comments on the emissions baseline insofar as they assess the relative merits of the two sets of estimates. Insofar as these comments object to DOE even referring to the 2023 SC–GHG estimates and using them for informational purposes, DOE notes that EPA's Final Report states that the updated 2023 SC–GHG estimates use a new methodology (not RCPs or SSPs (Shared Socio-economic Pathways)), to project future emissions scenarios. Per EPA, the new methodology is an internally consistent set of probabilistic projections of population, GDP, and GHG emissions to 2300, developed by expert elicitation (Rennert et al., ''The social cost of carbon: Advances in long-term probabilistic projections of population, GDP, emissions, and discount rates,'' 2022).

Commenters (Gas Analytics and Advocacy Services (GAAS) and AEI) stated that the 2023 SC–GHG methodologies fail to incorporate the environmental benefits of carbon emissions into the analyses. Commenters include planetary greening, increased agricultural productivity, increased water use efficiency, and reduced mortality from cold as potential benefits from increased GHG emissions. (GAAS, No. 96 at p. 6; AEI, No. 97 at pp. 7–8)

Because DOE is presenting climate benefits using both the 2021 interim SC–GHG estimates and the 2023 SC–GHG estimates without relying on either set of values to justify its standards, we do not address this comment insofar as it assesses the relative merits of the two sets of estimates. Insofar as this comment objects to DOE even referring to the 2023 SC–GHG estimates and using them for informational purposes, DOE notes that the Final Report states that carbon fertilization and changes to both heat and cold mortality are represented in the updated 2023 SC–GHG estimates (see EPA Report, table 3.2.1 at p. 87). EPA acknowledged that the analysis is not able to capture all impacts of GHG emissions (both positive and negative) due to data and modeling limitations.

Commenter (CEI) criticized the 2023 SC–GHG methodologies' integration of the mortality effects of climate change through metrics such as ''Value of Statistical Life'' (VSL). Commenter specifically took issue with the fact that VSL does not account for intergenerational externalities and instead focused on individuals as opposed to society as a whole. As a result, Commenter stated that the use of the metric encourages consumption at the expense of productive investment. (CEI1, No. 100 at pp. 2–3)

Because DOE is presenting climate benefits using both the 2021 interim SC–GHG estimates and the 2023 SC–GHG estimates without relying on either set of values to justify its standards, we do not address this comment insofar as it assesses the relative merits of the two sets of estimates. Insofar as this comment objects to DOE even referring to the 2023 SC–GHG estimates and using them for informational purposes, we note that in its cost-benefit guidance for Federal agencies, OMB endorses VSL as an approach to monetizing reductions in fatality risks, notes that for decades Federal agencies have consistently used VSL estimates, and cites EPA's VSL guidelines as an example. (OMB, Circular No. A–4, 49–50 (Nov. 9, 2023)). EPA's VSL methodology was also peer reviewed by its Science Advisory Board (EPA Report at pp. 1633–167; EPA RTC A–4–11). As an additional point of reference, DOE's methodology for determining the monetized benefits of reductions in SO_X and SO_2 emissions, as described in the TSDs accompanying the rule, are also based upon the EPA's benefit-per-ton (BPT) analysis of emissions reduction benefits that in turn are based upon the VSL approach. DOE also notes that the commenter incorrectly asserted that the incorporation of mortality effects is new to the 2023 SC–GHG estimates. Previous estimates of SC–GHG also reflect willingness to pay to reduce mortality risk and in some cases also use VSL specifically.

A commenter (CEI1) stated that the characterization of SC–GHG estimates as monetized is misleading. Commenter asserted that calculations are measured in ''welfare'' rather than money and cannot be compared with other dollar values. Commenter also stated that SC–GHG estimates are ordinal rather than cardinal and therefore don't express degree of relative benefit. (CEI1, No. 100 at p. 4)

This comment goes to any SC–GHG estimates, not the 2023 SC–GHG estimates specifically. SC–GHG is a measure of aggregate willingness to pay, rather than utility as the commenter suggests. It does not measure how much utility changes as a result of additional emissions. Instead, SC–GHG measures how much income society could forgo today with a given emission reduction and be as well off as it would have been without such a reduction (EPA Report at p. 5, 94, and 163). This is a standard economic method for valuing nonmarket goods, and the calculations yield a dollar value, correctly labeled in dollars, for the benefits of emission reductions. This is a cardinal measure that can be compared with any other dollar value as part of a cost benefit analysis.

Commenter (CEI1) stated that because SC–GHG estimates were developed using a normative approach, specifically optimizing utility using a social welfare function, with a social planner framework, to determine how intergenerational impacts should be weighted, they are inconsistent with economic efficiency. (CEI1, No. 100 at p. 4)

This comment goes to all SC–GHG estimates, not the 2023 SC–GHG estimates. specifically.. DOE acknowledges that there are inherent uncertainties in capturing trade-offs over extended time periods. Both the interim 2021 SC–GHG estimates and the 2023 SC–GHG estimates are based on empirical evidence as described by the peer-reviewed literature (EPA Report at pp. 19–76), and both rely on a descriptive, rather than normative, approach to inform discount rate choices, which the IWG has found to be the most defensible and transparent (IWG, February 2010 Technical Support Document at p. 19; see EPA Report at pp. 62–64 for further discussion). This allows for discount rates to be chosen that are consistent with empirical evidence.

Commenter (AEI) stated that the Biden administration mischaracterizes the GDP effects of rising GHG concentrations in its 2023 SC–GHG methodologies. Commenter instead maintains that GDP data supports the contention that the prospective financial risks of anthropogenic climate change, at least in the aggregate, are much smaller than the SC–GHG estimates suggest. (AEI, No. 97 at p. 9)

As DOE is presenting climate benefits using both the interim 2021 SC–GHG estimates and the 2023 SC–GHG estimates without relying on either set of values to justify its standards, DOE does not address this comment insofar as it assesses the relative merits of the two sets of estimates. Insofar as this comment objects to DOE even referring to the 2023 SC–GHG estimates and using them for informational purposes, we note that Figure 2.1.2 in the EPA Final Report shows the projections of per capita GDP growth rate over the period 2020–2300, with the RFF–SP projections used in the 2023 SC–GHG estimates remaining at rates under 2 percent and the other scenarios ranging to just over 4 percent (EPA Report at p. 30). DOE further notes that GDP projections are not equivalent to total social cost, as they only measure economic output, while social cost aims to measure well-being, including many non-market factors that are impacted by climate change, such as human health. Commenters (AHRI and ALA et al.) cited the requirement in EPCA section 6295(o)(2)(B) for DOE to consider seven separate factors when evaluating whether a new or amended energy conservation standard is economically justified. Commenters stated that DOE's use of the SC–GHG metric dominated the economic justification analysis of the rule, effectively disregarding the other factors in violation of the statute. Commenter (AHRI) stated that the statutory text provides no indication one factor should be given more weight than others. (AHRI, No. 104 at p. 3) Commenter (ALA et al.) objected to DOE's ''reliance'' on the economic benefits produced by the 2023 SC–GHG methodologies and reiterated that DOE is required to balance EPCA's seven factors together. (ALA et al., No. 109 at pp. 3–4)

These comments largely go to use of any estimate of SC–GHG in this rulemaking. DOE has long included SC–GHG estimates in its economic justification analyses pursuant to section 6295(o)(2)(B)(i) of EPCA. In deciding if an energy conservation standard is economically justified under EPCA, DOE must consider, to the greatest extent practicable, seven statutory factors, including the need for national energy and water conservation. (42 U.S.C. 6295(o)(2)(B)(i)(I)–(VII)). Under that requirement, DOE estimates environmental and public health benefits associated with the more efficient use of energy. The adopted standards are likely to result in environmental benefits in the form of reduced emissions of air pollutants and greenhouse gases associated with energy production and use. DOE conducts an emissions analysis to estimate how potential standards may affect these emissions and estimates the economic value of emissions reductions. DOE disagrees with commenters' assertion that the agency failed to adequately balance the other six factors in its analysis or that the SC–GHG metric (under either estimate) overpowers the other factors. DOE found that the standards would be economically justified—*i.e.,* meet the section 6295(o)(2)(B)(i) criteria—without taking any of the benefits of GHG emissions reductions (as calculated by either the 2023 SC–GHG estimates or the interim 2021 SC–GHG estimates) into account. DOE reiterates that the SC–GHG values are not determinative in this rulemaking as DOE would promulgate the same standards even in the absence of the estimated climate benefits (using either the 2021 or the 2023 calculation methodology).

Multiple commenters (NAHB, AHRI, and AEI) highlighted the global nature of the impacts and benefits represented in the 2023 SC–GHG estimates and deemed this inappropriate in the context of U.S. domestic policy and rulemaking.

Commenters (NAHB and AEI) criticized conflation of global and domestic metrics in the 2023 SC–GHG methodologies and stated that the inclusion of global metrics will incorrectly incentivize international and domestic climate measures. Commenters further predicted that the inclusion of global metrics will impose unnecessary costs on U.S. consumers and the domestic economy. Commenter (NAHB) asserted that this is a disproportional distribution of costs and benefits and is effectively a tax through regulation. (NAHB, No. 103 at p. 3; AEI, No. 97 at p. 7). Commenter (AHRI) stated that EPCA has a domestic focus and argued that to reframe EPCA into a globally oriented statute would ignore its legislative history and contradict its focus on benefits accruing solely within the United States. (AHRI, No. 104 at p. 2)

These comments go to both the interim 2021 SC–GHG estimates and the 2023 SC–GHG estimates. Both sets of

SC–GHG estimates reflect the global cost of climate change impacts given the distinctive global nature of the climate change problem. Numerous impacts of global climate change occur outside of U.S. territories that directly affect U.S. residents, U.S. companies, the U.S. economy, and U.S. national security and geopolitical interests. Also, if each country were to design emissions policies accounting for only the burdens inflicted on their own citizens and residents, none of the ''foreign'' impacts of emissions would be accounted for by any country and so all countries would under-regulate GHG emissions. This would, in turn, cause significant harm to U.S. citizens and residents.

DOE disagrees with commenter's contention that EPCA restricts DOE's estimates of the benefits of avoiding GHG emissions only to direct domestic benefits. The economic justification analysis under EPCA contains no such limiting language regarding consideration of global or domestic emissions benefits and burdens. (42 U.S.C. 6295(o)(2)(B)(i)(I)–(VII)). Also see *Zero Zone, Inc.* v. *United States DOE,* 832 F.3d 654, 678–79 (7th Cir. 2016) in which the Seventh Circuit Court of Appeals rejected a petitioner's challenge to DOE's use of a global social cost of carbon in setting an efficiency standard under EPCA and upheld DOE's consideration of global impacts in its climate analysis. In any event, comments on DOE's consideration of transboundary climate impacts are not ultimately relevant because, as stated above, the SC–GHG values are not determinative in this rulemaking and DOE would promulgate the same standards even in the absence of any climate benefits (domestic or global).

Commenter (AHRI) argued that DOE's use of the SC–GHG violates the Major Questions Doctrine. The commenter asserts that as the impact for the SC–GHG resulting from the proposed commercial refrigeration equipment rule was estimated at $671.4 million, the rule asserts a claim of authority concerning vast economic significance that Congress has not provided to it. AHRI maintained that EPCA did not provide DOE with clear authority to regulate emissions when evaluating new or amended standards and thus the inclusion of such analysis in the rulemaking violates the Major Questions Doctrine. (AHRI, No. 104 at p. 4)

Commenter (GAAS) similarly incorporated a ''Science Matters'' article into its comment citing a 2022 court case challenging the Federal government's use of SC–GHG as a violation of the Major Questions Doctrine. (GAAS, No. 96 at p. 4)

These comments go to any estimate of SC–GHG in the rule. DOE disagrees with commenters' assertion that the use of SC–GHG methodologies violates the Major Questions Doctrine. First, DOE reiterates that the rule does not rely on the monetized climate benefits and would be economically justified regardless of the inclusion of the climate benefits that DOE projects would result from the standards. Second, through EPCA, Congress has directed DOE to set energy conservation standards applicable to covered products and has explicitly required DOE to determine whether a standard is economically justified by determining ''whether the benefits of the standard exceed its burdens'' based on listed considerations. (42 U.S.C. 6295(o)) The economic benefit of pollution reductions is a standard metric in cost benefit analysis of actions that significantly affect emissions, as appliance efficiency standards typically do due to their statutory focus on energy conservation (and both grid electricity and natural gas combustion have associated emissions of GHGs and other air pollutants). All presidential administrations since the Reagan Administration have required agencies to conduct cost benefit analyses in their rulemakings and have strongly encouraged the monetization of impacts where possible. The interagency working group developed Federal SC–GHG estimates in 2010, and SC–GHG estimates have been used in Federal agencies rulemakings for over a decade. DOE itself has used SC–GHG estimates in its rulemakings and other analyses since 2009. It is, in fact, difficult to see how DOE could justify not calculating such benefits where possible. DOE's use of SC–GHG estimates to provide a monetary estimate of the benefits of the GHG emissions reductions that are projected to result from the adoption of these efficiency standards is consistent with the statutory requirements, best economic practices, government-wide cost benefit analysis guidance, longstanding Federal agency practices, data quality requirements, and current science. Additionally, it does not in any way assert a claim of authority concerning vast economic significance.

Regarding the comment about $671.4 million in SC–GHG benefits, the commenter appears to have misinterpreted this value as the benefits of SC–GHGs reductions of the proposed rule. In the proposed rule, at a 3% discount rate, the total benefits were estimated to be $1.25 billion, of which $174.4 million was attributed to climate benefits (calculated using the 2021 interim SC–GHG), $738 million was from consumer operating cost savings, and the remainder was health benefits of other emissions reductions. At a 7% discount rate, the total benefits were estimated to be $1 billion, of which $174.4 million was attributed to climate benefits (calculated using the 2021 interim SC–GHG),, $586 million was from consumer operating cost savings, and the remainder was health benefits from other emissions. The climate benefits were thus not even the rule's largest monetized impact, and this rulemaking would be economically justified regardless of the inclusion of either set of estimates of the GHG emissions reductions.

Several commenters (Hussman Corporation, ALA et al., NAMA, and GAAS) criticized DOE's decision to first include the 2023 SC–GHG estimates in a NODA for an individual rule. Commenters criticized DOE for not dedicating a separate and comprehensive rulemaking to the use of the new methodologies in future agency analyses. Commenter (Hussman Corporation) opposed the metric being added in a NODA with a final rule due in four months and advocated that any SC–GHG considerations ''should be handled by DOE as a discussion item for all appliances and not simply added during a proposed rulemaking for one product category.'' (Hussman Corporation, No. 108 at p. 3)

Commenter (ALA et al.) also urged DOE to evaluate its use of the 2023 SC–GHG methodologies in the anticipated rulemaking dedicated to reviewing and updating DOE's analytical methodology. ALA reiterated that vetting analytical method changes on issues as complex as SC–GHG is better done in a focused rulemaking rather than as part of a product-specific rulemaking on standards. (ALA et al., No. 109 at p. 2) Commenter (NAMA) stated that the new methodologies deserve an open and transparent discussion on how they will be applied before they are utilized in regulatory action. (NAMA, No. 112 at p. 4).

Commenter (GAAS) claimed that DOE's introduction of the SC–GHG within an electric appliance docket was an attempt to implement it without wide recognition or objection from other stakeholders that may be adversely impacted by the new methodologies. GAAS further deemed this decision, along with alleged policies of forced societal electrification, the ''energy equivalent of ethnic cleansing.'' (GAAS, No. 96 at p. 6) Commenter (NAHB) stated that the DOE should increase transparency with regards to the process used to develop the new metric, stating that the process used to develop these estimates only involved parties invited to participate and that the choices made by these participants heavily affect the results. (NAHB, No. 103 at p. 4)

While DOE proposed in the August 2024 NODA to shift to the updated estimates, in this final rule, DOE is presenting climate benefits using both the 2021 interim SC–GHG estimates and the 2023 SC–GHG estimates without relying on either set of values to justify its standards. By presenting both sets of estimates, DOE is simply providing additional information to the public regarding the estimated benefits of the final rule. Furthermore, DOE uses modeled estimates of values based on data inputs and analytical assumptions in its analyses all the time, from EIA projections of future energy supplies and prices, to estimates of costs of technologies over time. Here, DOE determined that public notice and comment is appropriate given the substantial interest in this topic, differences of opinion around various methodological choices, and the importance of the methodological updates underlying the new estimates. Multiple commenters did in fact comment on the August NODA solely on this topic, indicating that the public received notice of and had opportunity to comment on DOE's proposed preliminary decision to use the updated 2023 SC–GHG estimates.

Commenter (AEI) stated that the 2023 SC–GHG methodologies incorporate the co-benefits of regulating criteria and hazardous air pollutants in its calculations despite those pollutants being regulated independently under the Clean Air Act. Commenter raised concerns that accounting for the benefits of regulating these pollutants when they are already regulated improperly inflates the health benefits of GHG policies. (AEI, No. 97 at p. 8)

Both the 2021 interim SC–GHG estimates and the 2023 SC–GHG estimates account for the avoided harms of GHG emissions. Neither of the SC–GHG estimates incorporate the co-benefits of regulating fine particulates, other criteria air pollutants, or hazardous air pollutants. In its energy conservation rules, DOE separately estimates the resulting air pollution emissions reductions. DOE calculates the benefits from the reductions in sulfur dioxide, nitrogen oxides, nitrous oxide, and mercury, as well as greenhouse gases that result from the final rule. The benefits for each air pollutant are calculated separately, and none of the calculations include co-benefits from reducing the other pollutants.

Commenter (U.S. Chamber of Commerce et al.) stated that the significantly higher 2023 SC–GHG values could lead to overly stringent regulations and increased compliance costs for industries. Commenter further asserted that higher SC–GHG values could have a chilling effect on economic activity and that the change in methodologies could produce uncertainty that challenges businesses and investors. Commenter noted concerns with the 2021 interim SC–GHG estimates also, but ultimately recommended applying those values as opposed to the 2023 SC–GHG estimates. (U.S. Chamber of Commerce et al., No. 115 at pp. 5–6)

As stated previously, the standards in this rule do not rely on the monetized climate benefits and would be economically justified regardless of their use. Further, these standards would be economically justified using either the 2023 SC–GHG estimates or the 2021 interim SC–GHG estimates. As such, compliance costs for industries would be the same regardless of which SC–GHG metric is utilized and even if SC–GHG were not accounted for at all.

V.CDOE's derivations of the SC–CO2, SC–N2O, and SC–CH4 values used for this final rule are discussed in the following sections, and the results of DOE's analyses estimating the benefits of the reductions in emissions of these GHGs are presented in section V.B.6 of this document.

a. Social Cost of Carbon

The SC–CO_2 values used for this final rule are presented using two sets of SC–GHG estimates. One set is the 2023 SC–GHG estimates published by the EPA, which are shown in table IV.21 in 5-year increments from 2020 to 2050. The full set of annual values that DOE used is presented in appendix 14A of the final rule TSD. These estimates include values out to 2080. DOE expects additional climate benefits to accrue for equipment still operating after 2080, but a lack of available SC–CO_2 estimates for emissions years beyond 2080 prevents DOE from monetizing these potential benefits in this analysis.

Table IV.21 Annual SC-CO_2 Values Based on 2023 SC-GHG Estimates, 2020–2050 (2020$ per Metric Ton CO_2)

Emissions Year	Near-term Ramsey Discount Rate		
	2.5%	2.0%	1.5%
2020	117	193	337
2025	130	212	360
2030	144	230	384
2035	158	248	408
2040	173	267	431
2045	189	287	456
2050	205	308	482

DOE also presents results using interim SC-CO_2 values based on the values developed for the February 2021 SC-GHG TSD, which are shown in table IV. in 5-year increments from 2020 to 2050. The set of annual values that DOE used, which was adapted from estimates published by EPA in 2021,[144] is presented in appendix 14A of the final rule TSD. These estimates are based on

[144] *See* EPA, *Revised 2023 and Later Model Year Light-Duty Vehicle GHG Emissions Standards: Regulatory Impact Analysis,* Washington, DC, December 2021. Available at *https://nepis.epa.gov/Exe/ZyPDF.cgi?Dockey=P1013ORN.pdf* (last accessed Dec. 3, 2024).

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.

Table IV.22. Annual SC-CO_2 Values Based on 2021 Interim SC-GHG Estimates, 2020–2050 (2020$ per Metric Ton CO_2)

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

DOE multiplied the CO_2 emissions reduction estimated for each year by the SC-CO_2 value for that year in all cases. DOE adjusted the values to 2023$ 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 all 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 final rule are presented using two sets of SC-GHG estimates. One set is the 2023 SC-GHG estimates published by the EPA. Table IV.23 shows the updated sets of SC-CH_4 and SC-N_2O estimates in 5-year increments from 2020 to 2050. The full set of annual values used is presented in appendix 14A of the final rule TSD. These estimates include values out to 2080.

Table IV.23 Annual SC-CH_4 and SC-N_2O Values Based on the 2023 SC-GHG estimates, 2020–2080 (2020$ per Metric Ton)

Emissions Year	SC-CH_4			SC-N_2O		
	Near-term Ramsey Discount Rate			Near-term Ramsey Discount Rate		
	2.5%	2.0%	1.5%	2.5%	2.0%	1.5%
2020	1,257	1,648	2,305	35,232	54,139	87,284
2025	1,590	2,025	2,737	39,972	60,267	95,210
2030	1,924	2,403	3,169	44,712	66,395	103,137
2035	2,313	2,842	3,673	49,617	72,644	111,085
2040	2,702	3,280	4,177	54,521	78,894	119,032
2045	3,124	3,756	4,718	60,078	85,945	127,916
2050	3,547	4,231	5,260	65,635	92,996	136,799

DOE also presents results using interim SC-CH_4 and SC-N_2O values based on the values developed for the February 2021 SC-GHG TSD. Table IV.24 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 unrounded values used in the calculations is presented in appendix 14A of the final rule TSD. These estimates include values out to 2070.

Table IV.24 Annual SC-CH_4 and SC-N_2O Values Based on 2021 Interim SC-GHG Estimates, 2020–2050 (2020$ per Metric Ton)

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

DOE multiplied the CH_4 and N_2O emissions reduction estimated for each year by the SC-CH_4 and SC-N_2O estimates for that year in each of the cases. DOE adjusted the values to 2023$ 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 final rule, DOE estimated the monetized value of NO_X and SO_2 emissions reductions from electricity generation using benefit-per-ton estimates for that sector from EPA's Benefits Mapping and Analysis Program.[145] Table 5 of the EPA TSD provides a summary of the health impact endpoints quantified in the analysis. 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, 2035, 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 (rather than extrapolated) to be conservative. 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 final rule TSD).

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

M. Utility Impact Analysis

The utility impact analysis estimates the changes in installed electrical capacity and generation projected to result for each considered TSL. The analysis is based on published output from the NEMS associated with *AEO2023*. NEMS produces the *AEO* Reference case, as well as a number of side cases that estimate the economy-wide impacts of changes to energy supply and demand. For the current analysis, impacts are quantified by comparing the levels of electricity sector generation, installed capacity, fuel consumption, and emissions in the *AEO2023* Reference case and various side cases. Details of the methodology are provided in the appendices to chapter 15 of the final rule TSD.

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

N. Employment Impact Analysis

DOE considers employment impacts in the domestic economy as one factor in selecting a standard. Employment impacts from new or amended energy conservation standards include both direct and indirect impacts. Direct employment impacts are any changes in the number of employees of manufacturers of the 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

[145] 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. Available at *www.epa.gov/benmap/estimating-benefit-ton-reducing-directly-emitted-pm25-pm25-precursors-and-ozone-precursors.* (last accessed August 29, 2024).

sector generally create fewer jobs (both directly and indirectly) than expenditures in other sectors of the economy.[146] Bureau of Economic Analysis input-output multipliers also show a lower labor intensity per million dollars of activity for utilities as compared to other industries.[147] 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, these 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 final rule using an input/output model of the U.S. economy called Impact of Sector Energy Technologies version 4 (''ImSET'').[148] 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 overestimate actual job impacts over the long run for this rule. Therefore, DOE used ImSET only to generate results for near-term timeframes (2029–2033), where these uncertainties are reduced.

For more details on the employment impact analysis, see chapter 16 of the final rule TSD.

V. Analytical Results and Conclusions

The following section addresses the results from DOE's analyses with respect to the considered energy conservation standards for 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 adopting in this final rule. Additional details regarding DOE's analyses are contained in the final rule 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 interactions, and price elasticity of consumer purchasing decisions that may change when different standard levels are set.

In the analysis conducted for this final rule, DOE analyzed the benefits and burdens of five 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 final rule TSD. Table V.1 presents the TSLs and the corresponding efficiency levels that DOE has identified for potential amended energy conservation standards for CRE. TSL 5 represents the maximum technologically feasible (''max-tech'') energy efficiency for all equipment classes. TSL 4 represents an intermediate TSL representing less stringent efficiency levels for approximately one-third of the equipment classes analyzed compared to TSL 5. TSL 3 represents less stringent efficiency levels for 12 equipment classes compared to TSL 4. TSL 2 represents another intermediate TSL, representing less stringent efficiency levels for 11 equipment classes, compared to TSL 3. TSL 1 represents the minimum efficiency level for most analyzed equipment classes. DOE considered all efficiency levels as part of its analysis.[149] Analytical results broken down by EL and equipment class are presented in chapters 8 and 10 of the final rule TSD.

[146] *See* U.S. Bureau of Labor Statistics. Industry Output and Employment. Available at *www.bls.gov/emp/data/industry-out-and-emp.htm* (last accessed Aug. 19, 2024).

[147] *See Regional Input-Output Modeling System (RIMS II) User's Guide.* U.S. Department of Commerce—Bureau of Economic Analysis. Available at *bea.gov/resources/methodologies/RIMSII-user-guide* (last accessed Aug. 19, 2024).

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

[149] Efficiency levels that were analyzed for this final rule are discussed in section IV.C.1 of this document. Results by efficiency level are presented in chapters 8 and 10 of the final rule TSD.

Table V.1 Trial Standard Levels for CRE

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

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 final rule TSD provides detailed information on the LCC and PBP analyses.

Table V.2 through table V.57 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, the 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 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.

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Table V.2 Average LCC and PBP Results for CB.SC.L

TSL	Efficiency Level	Average Costs *2023$*				Simple Payback *years*	Average Lifetime *years*
		Installed Cost	First Year's Operating Cost	Lifetime Operating Cost	LCC		
---	0	2,981.6	273.0	2,636.7	5,540.9	0.0	13.4
1	1	2,987.9	267.6	2,586.6	5,497.0	1.2	13.4
2	2	3,003.0	260.8	2,526.2	5,451.3	1.8	13.4
3-5	3	3,142.7	232.2	2,282.9	5,344.1	4.0	13.4

Note: The results for each TSL are calculated assuming that all consumers use equipment at that efficiency level. The PBP is measured relative to the baseline product.

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

TSL	Efficiency Level	Life-Cycle Cost Savings	
		Average LCC Savings* *2023$*	Percent of Consumers that Experience Net Cost
1	1	44.3	0%
2	2	75.4	0.3%
3-5	3	163.6	8.8%

* The savings represent the average LCC for affected consumers.

Table V.4 Average LCC and PBP Results for CB.SC.M

TSL	Efficiency Level	Average Costs *2023$*				Simple Payback *years*	Average Lifetime *years*
		Installed Cost	First Year's Operating Cost	Lifetime Operating Cost	LCC		
---	0	2,335.2	106.0	1,042.1	3,317.1	0.0	13.3
1	1	2,341.6	102.6	1,011.6	3,292.7	1.9	13.3
2	2	2,356.7	98.4	975.5	3,271.4	2.8	13.3
3-5	3	2,496.4	82.4	854.6	3,286.6	6.8	13.3

Note: The results for each TSL are calculated assuming that all consumers use equipment at that efficiency level. The PBP is measured relative to the baseline product.

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

TSL	Efficiency Level	Life-Cycle Cost Savings	
		Average LCC Savings* *2023$*	Percent of Consumers that Experience Net Cost
1	1	24.6	0.1%
2	2	46.4	1.0%
3-5	3	8.1	26.2%

* The savings represent the average LCC for affected consumers.

Table V.6 Average LCC and PBP Results for HCS.SC.L

TSL	Efficiency Level	Average Costs *2023$*				Simple Payback *years*	Average Lifetime *years*
		Installed Cost	First Year's Operating Cost	Lifetime Operating Cost	LCC		
--	0	1,674.1	64.4	627.5	2,256.4	0.0	13.4
1-5	1	1,687.8	60.1	590.3	2,232.5	3.2	13.4

Note: The results for each TSL are calculated assuming that all consumers use equipment at that efficiency level. The PBP is measured relative to the baseline product.

Table V.7 Average LCC Savings Relative to the No-New-Standards Case for HCS.SC.L

TSL	Efficiency Level	Life-Cycle Cost Savings	
		Average LCC Savings* *2023$*	Percent of Consumers that Experience Net Cost
1-5	1	24.1	3.5%

* The savings represent the average LCC for affected consumers.

Table V.8 Average LCC and PBP Results for HCS.SC.M

TSL	Efficiency Level	Average Costs *2023$*				Simple Payback *years*	Average Lifetime *years*
		Installed Cost	First Year's Operating Cost	Lifetime Operating Cost	LCC		
--	0	1,667.0	45.8	464.8	2,086.1	0.0	13.3
1	1	1,677.3	43.2	442.5	2,073.9	3.9	13.3
2-5	2	1,691.0	39.9	415.0	2,059.6	4.0	13.3

Note: The results for each TSL are calculated assuming that all consumers use equipment at that efficiency level. The PBP is measured relative to the baseline product.

Table V.9 Average LCC Savings Relative to the No-New-Standards Case for HCS.SC.M

TSL	Efficiency Level	Life-Cycle Cost Savings	
		Average LCC Savings* *2023$*	Percent of Consumers that Experience Net Cost
1	1	12.4	3.0%
2-5	2	18.9	9.1%

* The savings represent the average LCC for affected consumers.

Table V.10 Average LCC and PBP Results for HCT.SC.I

TSL	Efficiency Level	Average Costs *2023$*				Simple Payback *years*	Average Lifetime *years*
		Installed Cost	First Year's Operating Cost	Lifetime Operating Cost	LCC		
--	0	1,536.5	129.5	1,308.4	2,807.6	0.0	13.5
1	1	1,609.7	119.2	1,209.9	2,780.5	7.1	13.5
2-4	2	1,622.0	117.3	1,192.1	2,774.7	7.0	13.5
--	3	1,761.5	104.3	1,097.5	2,816.2	8.9	13.5
--	4	1,850.0	103.2	1,074.2	2,879.3	11.9	13.5
--	5	1,870.1	102.7	1,069.1	2,893.8	12.5	13.5
5	6	2,110.6	101.4	1,057.2	3,116.5	20.5	13.5

Note: The results for each TSL are calculated assuming that all consumers use equipment at that efficiency level. The PBP is measured relative to the baseline product.

Table V.11 Average LCC Savings Relative to the No-New-Standards Case for HCT.SC.I

TSL	Efficiency Level	Life-Cycle Cost Savings	
		Average LCC Savings* *2023$*	Percent of Consumers that Experience Net Cost
1	1	26.7	9.6%
2-4	2	29.3	10.4%
--	3	(24.9)	34.6%
--	4	(87.6)	41.2%
--	5	(99.9)	43.4%
5	6	(309.8)	58.8%

* The savings represent the average LCC for affected consumers.

Table V.12 Average LCC and PBP Results for HCT.SC.L

TSL	Efficiency Level	Average Costs *2023$*				Simple Payback *years*	Average Lifetime *years*
		Installed Cost	First Year's Operating Cost	Lifetime Operating Cost	LCC		
1-4	0	1,443.6	80.6	823.4	2,230.4	0.0	13.4
--	1	1,516.8	74.4	764.9	2,243.1	11.9	13.4
--	2	1,529.1	73.4	755.0	2,245.2	11.9	13.4
--	3	1,617.7	72.3	731.7	2,308.3	21.1	13.4
--	4	1,637.8	72.0	728.4	2,324.6	22.5	13.4
--	5	1,777.2	70.4	744.8	2,476.9	32.9	13.4
5	6	2,017.6	69.6	737.3	2,703.7	52.6	13.4

Note: The results for each TSL are calculated assuming that all consumers use equipment at that efficiency level. The PBP is measured relative to the baseline product.

Table V.13 Average LCC Savings Relative to the No-New-Standards Case for HCT.SC.L

TSL	Efficiency Level	Life-Cycle Cost Savings	
		Average LCC Savings* *2023$*	Percent of Consumers that Experience Net Cost
--	1	(12.4)	18.3%
--	2	(13.0)	20.9%
--	3	(70.6)	48.5%
--	4	(86.1)	49.7%
--	5	(235.8)	52.3%
5	6	(430.4)	60.5%

* The savings represent the average LCC for affected consumers.

Table V.14 Average LCC and PBP Results for HCT.SC.M

TSL	Efficiency Level	Average Costs *2023$*				Simple Payback *years*	Average Lifetime *years*
		Installed Cost	First Year's Operating Cost	Lifetime Operating Cost	LCC		
1-4	0	1,372.5	37.5	407.5	1,741.6	0.0	13.3
--	1	1,445.6	35.6	389.6	1,794.8	38.6	13.3
--	2	1,457.9	35.2	385.9	1,803.1	37.4	13.3
--	3	1,546.4	34.2	362.8	1,866.0	52.0	13.3
--	4	1,566.5	34.0	361.5	1,884.3	55.8	13.3
5	5	1,806.9	33.7	358.7	2,115.1	114.9	13.3

Note: The results for each TSL are calculated assuming that all consumers use equipment at that efficiency level. The PBP is measured relative to the baseline product.

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

TSL	Efficiency Level	Life-Cycle Cost Savings	
		Average LCC Savings* *2023$*	Percent of Consumers that Experience Net Cost
--	1	(53.4)	42.9%
--	2	(55.8)	48.3%
--	3	(95.4)	83.1%
--	4	(112.5)	84.3%
5	5	(340.7)	86.4%

* The savings represent the average LCC for affected consumers.

Table V.16 Average LCC and PBP Results for HZO.RC.L

TSL	Efficiency Level	Average Costs *2023$*				Simple Payback *years*	Average Lifetime *years*
		Installed Cost	First Year's Operating Cost	Lifetime Operating Cost	LCC		
1-5	0	5,912.4	1,383.8	12,889.5	18,801.9	0.0	13.0

Note: The results for each TSL are calculated assuming that all consumers use equipment at that efficiency level. The PBP is measured relative to the baseline product.

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

TSL	Efficiency Level	Life-Cycle Cost Savings	
		Average LCC Savings* *2023$*	Percent of Consumers that Experience Net Cost
1-5	0	0.00	0.0%

* The savings represent the average LCC for affected consumers.

Table V.18 Average LCC and PBP Results for HZO.RC.M

TSL	Efficiency Level	Average Costs *2023$*				Simple Payback *years*	Average Lifetime *years*
		Installed Cost	First Year's Operating Cost	Lifetime Operating Cost	LCC		
1-5	0	5,914.4	616.9	5,803.3	11,717.7	0.0	13.0

Note: The results for each TSL are calculated assuming that all consumers use equipment at that efficiency level. The PBP is measured relative to the baseline product.

Table V.19 Average LCC Savings Relative to the No-New-Standards Case for HZO.RC.M

TSL	Efficiency Level	Life-Cycle Cost Savings	
		Average LCC Savings* *2023$*	Percent of Consumers that Experience Net Cost
1-5	0	0.00	0.0%

* The savings represent the average LCC for affected consumers.

Table V.20 Average LCC and PBP Results for HZO.SC.L

TSL	Efficiency Level	Average Costs *2023$*				Simple Payback *years*	Average Lifetime *years*
		Installed Cost	First Year's Operating Cost	Lifetime Operating Cost	LCC		
---	0	3,110.6	1,244.7	11,366.8	14,409.0	0.0	12.6
1-2	1	3,124.2	1,236.9	11,299.7	14,355.2	1.8	12.6
3-5	2	3,600.1	1,039.1	9,594.3	13,115.3	2.4	12.6

Note: The results for each TSL are calculated assuming that all consumers use equipment at that efficiency level. The PBP is measured relative to the baseline product.

Table V.21 Average LCC Savings Relative to the No-New-Standards Case for HZO.SC.L

TSL	Efficiency Level	Life-Cycle Cost Savings	
		Average LCC Savings* *2023$*	Percent of Consumers that Experience Net Cost
1-2	1	54.0	0.03%
3-5	2	1,243.6	0.3%

* The savings represent the average LCC for affected consumers.

Table V.22 Average LCC and PBP Results for HZO.SC.M

TSL	Efficiency Level	Average Costs *2023$*				Simple Payback *years*	Average Lifetime *years*
		Installed Cost	First Year's Operating Cost	Lifetime Operating Cost	LCC		
--	0	2,336.9	517.3	4,721.0	7,006.0	0.0	12.5
1-2	1	2,350.5	511.2	4,670.0	6,968.3	2.3	12.5
3-5	2	2,489.8	458.4	4,224.4	6,658.8	2.6	12.5

Note: The results for each TSL are calculated assuming that all consumers use equipment at that efficiency level. The PBP is measured relative to the baseline product.

Table V.23 Average LCC Savings Relative to the No-New-Standards Case for HZO.SC.M

TSL	Efficiency Level	Life-Cycle Cost Savings	
		Average LCC Savings* *2023$*	Percent of Consumers that Experience Net Cost
1-2	1	39.2	0.1%
3-5	2	312.9	1.0%

* The savings represent the average LCC for affected consumers.

Table V.24 Average LCC and PBP Results for SOC.RC.M

TSL	Efficiency Level	Average Costs *2023$*				Simple Payback *years*	Average Lifetime *years*
		Installed Cost	First Year's Operating Cost	Lifetime Operating Cost	LCC		
1-3	0	13,558.3	965.0	10,107.1	23,665.3	0.0	13.0
--	1	13,605.7	964.0	10,097.6	23,703.3	46.7	13.0
--	2	13,800.2	898.3	9,079.0	22,879.3	3.6	13.0
4	3	13,877.8	897.8	9,074.5	22,952.3	4.8	13.0
5	4	14,805.4	896.6	9,063.7	23,869.1	18.3	13.0

Note: The results for each TSL are calculated assuming that all consumers use equipment at that efficiency level. The PBP is measured relative to the baseline product.

Table V.25 Average LCC Savings Relative to the No-New-Standards Case for SOC.RC.M

TSL	Efficiency Level	Life-Cycle Cost Savings	
		Average LCC Savings* *2023$*	Percent of Consumers that Experience Net Cost
--	1	(37.9)	11.8%
--	2	816.4	16.1%
4	3	743.4	16.1%
5	4	(181.4)	36.7%

* The savings represent the average LCC for affected consumers.

Table V.26 Average LCC and PBP Results for SOC.SC.M

TSL	Efficiency Level	Average Costs *2023$*				Simple Payback *years*	Average Lifetime *years*
		Installed Cost	First Year's Operating Cost	Lifetime Operating Cost	LCC		
--	0	7,798.4	436.0	4,382.6	12,014.9	0.0	12.5
1	1	7,822.4	382.8	3,914.1	11,569.8	0.5	12.5
--	2	7,839.4	377.8	3,873.5	11,545.8	0.7	12.5
2	3	7,846.4	371.6	3,818.9	11,498.2	0.7	12.5
--	4	7,985.6	351.0	3,662.7	11,478.2	2.2	12.5
3	5	8,001.5	350.4	3,657.1	11,488.1	2.4	12.5
--	6	8,196.0	332.4	3,348.5	11,369.9	3.8	12.5
4-5	7	8,531.0	331.7	3,342.4	11,691.6	7.0	12.5

Note: The results for each TSL are calculated assuming that all consumers use equipment at that efficiency level. The PBP is measured relative to the baseline product.

Table V.27 Average LCC Savings Relative to the No-New-Standards Case for SOC.SC.M

TSL	Efficiency Level	Life-Cycle Cost Savings	
		Average LCC Savings* *2023$*	Percent of Consumers that Experience Net Cost
1	1	441.5	0.0%
--	2	448.3	0.2%
2	3	481.5	0.0%
--	4	453.4	3.1%
3	5	443.5	3.7%
--	6	504.8	5.0%
4-5	7	183.2	22.8%

* The savings represent the average LCC for affected consumers.

Table V.28 Average LCC and PBP Results for SVO.RC.M

TSL	Efficiency Level	Average Costs *2023$*				Simple Payback *years*	Average Lifetime *years*
		Installed Cost	First Year's Operating Cost	Lifetime Operating Cost	LCC		
--	0	6,955.4	1,267.3	12,496.0	19,451.3	0.0	13.1
1-3	1	7,145.5	1,187.6	12,211.7	19,357.3	2.4	13.1
4-5	2	7,366.6	1,149.6	11,596.2	18,962.8	3.5	13.1

Note: The results for each TSL are calculated assuming that all consumers use equipment at that efficiency level. The PBP is measured relative to the baseline product.

Table V.29 Average LCC Savings Relative to the No-New-Standards Case for SVO.RC.M

TSL	Efficiency Level	Life-Cycle Cost Savings	
		Average LCC Savings* *2023$*	Percent of Consumers that Experience Net Cost
1-3	1	97.1	25.6%
4-5	2	473.0	14.6%

* The savings represent the average LCC for affected consumers.

Table V.30 Average LCC and PBP Results for SVO.SC.M

TSL	Efficiency Level	Average Costs *2023$*				Simple Payback *years*	Average Lifetime *years*
		Installed Cost	First Year's Operating Cost	Lifetime Operating Cost	LCC		
--	0	4,229.1	1,020.4	9,486.6	13,624.4	0.0	12.5
1	1	4,292.4	946.4	8,994.5	13,194.3	0.9	12.5
--	2	4,305.1	933.1	8,878.1	13,090.3	0.9	12.5
2	3	4,335.3	916.6	8,737.1	12,978.8	1.0	12.5
3	4	4,981.2	835.2	8,032.2	12,905.9	4.1	12.5
4-5	5	5,096.1	823.5	7,844.0	12,830.1	4.4	12.5

Note: The results for each TSL are calculated assuming that all consumers use equipment at that efficiency level. The PBP is measured relative to the baseline product.

Table V.31 Average LCC Savings Relative to the No-New-Standards Case for SVO.SC.M

TSL	Efficiency Level	Life-Cycle Cost Savings	
		Average LCC Savings* *2023$*	Percent of Consumers that Experience Net Cost
1	1	430.2	0.0%
--	2	493.8	0.0%
2	3	576.1	0.03%
3	4	578.9	11.8%
4-5	5	642.4	10.1%

* The savings represent the average LCC for affected consumers.

Table V.32 Average LCC and PBP Results for VCS.SC.H

TSL	Efficiency Level	Average Costs *2023$*				Simple Payback *years*	Average Lifetime *years*
		Installed Cost	First Year's Operating Cost	Lifetime Operating Cost	LCC		
--	0	4,216.4	82.5	853.1	4,963.1	0.0	13.5
--	1	4,222.8	80.0	831.9	4,948.1	2.6	13.5
1-4	2	4,237.9	77.1	807.5	4,938.5	4.0	13.5
5	3	4,377.6	66.0	732.2	4,999.3	9.8	13.5

Note: The results for each TSL are calculated assuming that all consumers use equipment at that efficiency level. The PBP is measured relative to the baseline product.

Table V.33 Average LCC Savings Relative to the No-New-Standards Case for VCS.SC.H

TSL	Efficiency Level	Life-Cycle Cost Savings	
		Average LCC Savings* *2023$*	Percent of Consumers that Experience Net Cost
--	1	0.0	0.0%
1-4	2	9.8	5.6%
5	3	(57.7)	58.9%

* The savings represent the average LCC for affected consumers.

Table V.34 Average LCC and PBP Results for VCS.SC.I

TSL	Efficiency Level	Average Costs *2023$*				Simple Payback *years*	Average Lifetime *years*
		Installed Cost	First Year's Operating Cost	Lifetime Operating Cost	LCC		
--	0	4,875.2	679.7	6,528.2	11,270.1	0.0	13.4
1	1	4,881.6	674.3	6,478.4	11,226.5	1.2	13.4
2	2	4,896.7	667.6	6,418.4	11,181.2	1.8	13.4
3-5	3	5,176.0	583.0	5,676.1	10,710.6	3.1	13.4

Note: The results for each TSL are calculated assuming that all consumers use equipment at that efficiency level. The PBP is measured relative to the baseline product.

Table V.35 Average LCC Savings Relative to the No-New-Standards Case for VCS.SC.I

TSL	Efficiency Level	Life-Cycle Cost Savings	
		Average LCC Savings* *2023$*	Percent of Consumers that Experience Net Cost
1	1	45.1	0.0%
2	2	70.8	0.1%
3-5	3	488.2	3.9%

* The savings represent the average LCC for affected consumers.

Table V.36 Average LCC and PBP Results for VCS.SC.L

TSL	Efficiency Level	Average Costs *2023$*				Simple Payback *years*	Average Lifetime *years*
		Installed Cost	First Year's Operating Cost	Lifetime Operating Cost	LCC		
--	0	4,441.3	475.8	4,560.5	8,879.8	0.0	13.3
1	1	4,447.6	470.4	4,510.8	8,836.2	1.2	13.3
2	2	4,462.7	463.6	4,450.8	8,791.0	1.8	13.3
3-5	3	4,602.4	401.5	3,892.7	8,368.7	2.2	13.3

Note: The results for each TSL are calculated assuming that all consumers use equipment at that efficiency level. The PBP is measured relative to the baseline product.

Table V.37 Average LCC Savings Relative to the No-New-Standards Case for VCS.SC.L

TSL	Efficiency Level	Life-Cycle Cost Savings	
		Average LCC Savings* *2023$*	Percent of Consumers that Experience Net Cost
1	1	43.3	0.0%
2	2	88.0	0.1%
3-5	3	470.5	0.4%

* The savings represent the average LCC for affected consumers.

Table V.38 Average LCC and PBP Results for VCS.SC.M

TSL	Efficiency Level	Average Costs *2023$*				Simple Payback *years*	Average Lifetime *years*
		Installed Cost	First Year's Operating Cost	Lifetime Operating Cost	LCC		
--	0	4,222.3	127.8	1,285.2	5,395.9	0.0	13.5
1-3	1	4,237.4	122.8	1,241.6	5,367.1	3.0	13.5
4-5	2	4,377.0	111.7	1,166.3	5,427.7	9.6	13.5

Note: The results for each TSL are calculated assuming that all consumers use equipment at that efficiency level. The PBP is measured relative to the baseline product.

Table V.39 Average LCC Savings Relative to the No-New-Standards Case for VCS.SC.M

TSL	Efficiency Level	Life-Cycle Cost Savings	
		Average LCC Savings* *2023$*	Percent of Consumers that Experience Net Cost
1-3	1	29.1	3.1%
4-5	2	(42.0)	51.8%

* The savings represent the average LCC for affected consumers.

Table V.40 Average LCC and PBP Results for VCT.RC.L

TSL	Efficiency Level	Average Costs *2023$*				Simple Payback *years*	Average Lifetime *years*
		Installed Cost	First Year's Operating Cost	Lifetime Operating Cost	LCC		
1-3	0	9,220.4	1,438.3	14,513.2	23,733.5	0.0	14.0
--	1	9,441.7	1,414.5	14,122.1	23,563.9	9.3	14.0
4	2	9,715.5	1,408.7	14,064.8	23,780.3	16.8	14.0
5	3	12,989.5	1,372.5	13,708.1	26,697.6	57.3	14.0

Note: The results for each TSL are calculated assuming that all consumers use equipment at that efficiency level. The PBP is measured relative to the baseline product.

Table V.41 Average LCC Savings Relative to the No-New-Standards Case for VCT.RC.L

TSL	Efficiency Level	Life-Cycle Cost Savings	
		Average LCC Savings* *2023$*	Percent of Consumers that Experience Net Cost
--	1	174.2	3.5%
4	2	(182.9)	69.8%
5	3	(3,080.4)	85.6%

* The savings represent the average LCC for affected consumers.

Table V.42 Average LCC and PBP Results for VCT.RC.M

TSL	Efficiency Level	Average Costs *2023$*				Simple Payback *years*	Average Lifetime *years*
		Installed Cost	First Year's Operating Cost	Lifetime Operating Cost	LCC		
1-3	0	9,014.1	488.0	5,268.2	14,282.3	0.0	14.0
--	1	9,181.5	482.0	5,209.0	14,390.5	27.8	14.0
--	2	9,402.9	455.9	4,795.9	14,198.7	12.1	14.0
4	3	9,676.6	454.6	4,782.5	14,459.1	19.8	14.0
5	4	12,949.6	451.3	4,751.0	17,700.6	107.3	14.0

Note: The results for each TSL are calculated assuming that all consumers use equipment at that efficiency level. The PBP is measured relative to the baseline product.

Table V.43 Average LCC Savings Relative to the No-New-Standards Case for VCT.RC.M

TSL	Efficiency Level	Life-Cycle Cost Savings	
		Average LCC Savings* *2023$*	Percent of Consumers that Experience Net Cost
--	1	(108.5)	8.7%
--	2	170.3	10.6%
4	3	(108.3)	31.6%
5	4	(3,333.3)	55.9%

* The savings represent the average LCC for affected consumers.

Table V.44 Average LCC and PBP Results for VCT.SC.H

TSL	Efficiency Level	Average Costs *2023$*				Simple Payback *years*	Average Lifetime *years*
		Installed Cost	First Year's Operating Cost	Lifetime Operating Cost	LCC		
--	0	4,570.0	122.2	1,310.6	5,763.6	0.0	13.4
1	1	4,576.3	119.8	1,289.6	5,748.7	2.7	13.4
2-4	2	4,591.4	116.9	1,265.3	5,739.2	4.0	13.4
--	3	4,730.9	102.6	1,158.7	5,768.5	8.2	13.4
--	4	4,797.8	101.1	1,145.2	5,820.2	10.8	13.4
--	5	4,913.0	98.3	1,088.9	5,876.1	14.3	13.4
--	6	5,022.5	97.8	1,084.5	5,978.4	18.6	13.4
5	7	6,332.0	96.8	1,074.2	7,244.1	69.2	13.4

Note: The results for each TSL are calculated assuming that all consumers use equipment at that efficiency level. The PBP is measured relative to the baseline product.

Table V.45 Average LCC Savings Relative to the No-New-Standards Case for VCT.SC.H

TSL	Efficiency Level	Life-Cycle Cost Savings	
		Average LCC Savings* *2023$*	Percent of Consumers that Experience Net Cost
1	1	14.6	1.0%
2-4	2	19.3	7.0%
--	3	(16.1)	35.8%
--	4	(67.8)	41.4%
--	5	(113.4)	54.2%
--	6	(201.5)	69.3%
5	7	(1,467.3)	72.7%

* The savings represent the average LCC for affected consumers.

Table V.46 Average LCC and PBP Results for VCT.SC.I

TSL	Efficiency Level	Average Costs *2023$*				Simple Payback *years*	Average Lifetime *years*
		Installed Cost	First Year's Operating Cost	Lifetime Operating Cost	LCC		
1-2	0	6,919.6	808.7	7,881.5	14,631.6	0.0	13.4
3	1	7,034.7	806.5	7,825.6	14,688.0	51.7	13.4
--	2	7,144.2	801.3	7,777.1	14,746.3	30.5	13.4
4	3	8,453.6	769.4	7,475.0	15,721.5	39.0	13.4

Note: The results for each TSL are calculated assuming that all consumers use equipment at that efficiency level. The PBP is measured relative to the baseline product.

Table V.47 Average LCC Savings Relative to the No-New-Standards Case for VCT.SC.I

TSL	Efficiency Level	Life-Cycle Cost Savings	
		Average LCC Savings* *2023$*	Percent of Consumers that Experience Net Cost
3	1	(57.0)	2.0%
--	2	(68.7)	11.2%
4	3	(990.6)	48.0%

* The savings represent the average LCC for affected consumers.

Table V.48 Average LCC and PBP Results for VCT.SC.L

TSL	Efficiency Level	Average Costs *2023$*				Simple Payback *years*	Average Lifetime *years*
		Installed Cost	First Year's Operating Cost	Lifetime Operating Cost	LCC		
--	0	6,788.8	673.4	6,539.3	13,137.6	0.0	13.4
1-2	1	6,803.9	666.7	6,479.3	13,092.3	2.2	13.4
3	2	7,082.9	588.1	5,793.8	12,677.9	3.5	13.4
--	3	7,198.1	585.3	5,737.9	12,733.9	4.6	13.4
--	4	7,307.6	582.5	5,711.7	12,814.2	5.7	13.4
4-5	5	8,617.3	565.4	5,548.8	13,924.3	16.9	13.4

Note: The results for each TSL are calculated assuming that all consumers use equipment at that efficiency level. The PBP is measured relative to the baseline product.

Table V.49 Average LCC Savings Relative to the No-New-Standards Case for VCT.SC.L

TSL	Efficiency Level	Life-Cycle Cost Savings	
		Average LCC Savings* *2023$*	Percent of Consumers that Experience Net Cost
1-2	1	45.2	0.4%
3	2	436.9	7.2%
--	3	380.6	11.0%
--	4	300.3	20.5%
4-5	5	(809.8)	82.7%

* The savings represent the average LCC for affected consumers.

Table V.50 Average LCC and PBP Results for VCT.SC.M

TSL	Efficiency Level	Average Costs *2023$*				Simple Payback *years*	Average Lifetime *years*
		Installed Cost	First Year's Operating Cost	Lifetime Operating Cost	LCC		
--	0	4,580.6	203.7	2,069.4	6,540.2	0.0	13.3
1-2	1	4,595.7	198.7	2,026.6	6,512.2	3.1	13.3
3	2	4,735.2	179.9	1,879.5	6,501.1	6.5	13.3
--	3	4,802.1	177.5	1,856.9	6,543.9	8.5	13.3
4	4	4,917.2	174.7	1,801.0	6,600.4	11.6	13.3
--	5	5,026.7	173.9	1,793.7	6,700.0	15.0	13.3
5	6	6,336.2	172.1	1,776.6	7,960.8	55.6	13.3

Note: The results for each TSL are calculated assuming that all consumers use equipment at that efficiency level. The PBP is measured relative to the baseline product.

Table V.51 Average LCC Savings Relative to the No-New-Standards Case for VCT.SC.M

TSL	Efficiency Level	Life-Cycle Cost Savings	
		Average LCC Savings* *2023$*	Percent of Consumers that Experience Net Cost
1-2	1	28.0	2.7%
3	2	33.2	25.3%
--	3	(9.9)	38.2%
4	4	(66.0)	44.6%
--	5	(165.4)	51.5%
5	6	(1,421.6)	61.3%

* The savings represent the average LCC for affected consumers.

Table V.52 Average LCC and PBP Results for VOP.RC.L

TSL	Efficiency Level	Average Costs *2023$*				Simple Payback *years*	Average Lifetime *years*
		Installed Cost	First Year's Operating Cost	Lifetime Operating Cost	LCC		
--	0	9,692.4	4,493.8	42,696.1	52,388.5	0.0	13.0
1-3	1	9,882.5	4,283.3	41,193.3	51,075.8	0.9	13.0
4-5	2	10,103.6	4,235.7	40,431.7	50,535.3	1.6	13.0

Note: The results for each TSL are calculated assuming that all consumers use equipment at that efficiency level. The PBP is measured relative to the baseline product.

Table V.53 Average LCC Savings Relative to the No-New-Standards Case for VOP.RC.L

TSL	Efficiency Level	Life-Cycle Cost Savings	
		Average LCC Savings* *2023$*	Percent of Consumers that Experience Net Cost
1-3	1	1,300.4	0.00%
4-5	2	1,529.7	3.1%

* The savings represent the average LCC for affected consumers.

Table V.54 Average LCC and PBP Results for VOP.RC.M

TSL	Efficiency Level	Average Costs *2023$*				Simple Payback *years*	Average Lifetime *years*
		Installed Cost	First Year's Operating Cost	Lifetime Operating Cost	LCC		
--	0	8,838.5	1,632.2	16,060.5	24,898.9	0.0	13.0
1-3	1	9,028.7	1,525.8	15,526.0	24,554.7	1.8	13.0
4-5	2	9,249.8	1,478.2	14,764.8	24,014.6	2.7	13.0

Note: The results for each TSL are calculated assuming that all consumers use equipment at that efficiency level. The PBP is measured relative to the baseline product.

Table V.55 Average LCC Savings Relative to the No-New-Standards Case for VOP.RC.M

TSL	Efficiency Level	Life-Cycle Cost Savings	
		Average LCC Savings* *2023$*	Percent of Consumers that Experience Net Cost
1-3	1	337.4	4.1%
4-5	2	798.0	7.5%

* The savings represent the average LCC for affected consumers.

Table V.56 Average LCC and PBP Results for VOP.SC.M

TSL	Efficiency Level	Average Costs *2023$*				Simple Payback *years*	Average Lifetime *years*
		Installed Cost	First Year's Operating Cost	Lifetime Operating Cost	LCC		
--	0	6,623.6	1,264.5	11,857.3	18,337.8	0.0	12.6
1	1	6,687.0	1,171.3	11,189.4	17,731.8	0.7	12.6
--	2	6,705.9	1,151.5	11,014.4	17,575.4	0.7	12.6
2	3	6,751.2	1,126.8	10,802.6	17,407.8	0.9	12.6
3	4	7,029.7	981.9	9,545.7	16,423.4	1.4	12.6
4-5	5	7,171.2	967.5	9,306.7	16,322.9	1.8	12.6

Note: The results for each TSL are calculated assuming that all consumers use equipment at that efficiency level. The PBP is measured relative to the baseline product.

Table V.57 Average LCC Savings Relative to the No-New-Standards Case for VOP.SC.M

TSL	Efficiency Level	Life-Cycle Cost Savings	
		Average LCC Savings* *2023$*	Percent of Consumers that Experience Net Cost
1	1	604.6	0.0%
--	2	760.5	0.0%
2	3	915.5	0.0%
3	4	1,867.5	0.0%
4-5	5	1,945.9	0.3%

* The savings represent the average LCC for affected consumers.

b. Consumer Subgroup Analysis

In the consumer subgroup analysis, DOE estimated the impact of the considered TSLs on small businesses. Table V.58 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 final rule TSD presents the complete LCC and PBP results for the subgroup.

Table V.58 Average LCC and PBP Results Comparison for Small Businesses for CRE

Equipment Class		EL	Average LCC Savings		Simple Payback Period		Net Cost	
			2023$		*years*		*%*	
			Small Business	Ref. Case	Small Business	Ref. Case	Small Business	Ref. Case
CB.SC.L	1	1	46.7	44.3	1.0	1.2	0%	0%
	2	2	80.3	75.4	1.4	1.8	0%	0%
	3-5	3	182.7	163.6	3.2	4.0	3%	9%
CB.SC.M	1	1	26.4	24.6	1.5	1.9	0%	0%
	2	2	50.7	46.4	2.3	2.8	0%	1%
	3-5	3	21.9	8.1	5.5	6.8	17%	26%
HCS.SC.L	1-5	1	26.3	24.1	2.6	3.2	0%	4%
HCS.SC.M	1	1	14.1	12.4	3.2	3.9	1%	3%
	2-5	2	21.7	18.9	3.3	4.0	4%	9%
HCT.SC.I	1	1	31.1	26.7	5.8	7.1	2%	10%
	2-4	2	34.0	29.3	5.7	7.0	2%	10%
	--	3	(12.6)	(24.9)	7.3	8.9	31%	35%
	--	4	(77.2)	(87.6)	9.7	11.9	44%	41%
	--	5	(89.6)	(99.9)	10.2	12.5	46%	43%
	5	6	(301.0)	(309.8)	16.7	20.5	59%	59%
HCT.SC.L	--	1	(9.8)	(12.4)	9.6	11.9	20%	18%
	--	2	(10.3)	(13.0)	9.6	11.9	22%	21%
	--	3	(70.8)	(70.6)	17.1	21.1	50%	49%
	--	4	(86.2)	(86.1)	18.3	22.5	51%	50%
	--	5	(231.0)	(235.8)	26.7	32.9	52%	52%
	5	6	(426.6)	(430.4)	42.7	52.6	61%	61%
HCT.SC.M	--	1	(52.7)	(53.4)	31.4	38.6	43%	43%
	--	2	(55.0)	(55.8)	30.4	37.4	48%	48%
	--	3	(96.7)	(95.4)	42.3	52.0	83%	83%
	--	4	(113.8)	(112.5)	45.5	55.8	84%	84%
	5	5	(342.6)	(340.7)	93.6	114.9	86%	86%
HZO.SC.L	1-2	1	59.4	54.0	1.4	1.8	0%	0%
	3-5	2	1,384.4	1,243.6	1.9	2.4	0%	0%
HZO.SC.M	1-2	1	43.2	39.2	1.8	2.3	0%	0%
	3-5	2	353.3	312.9	2.1	2.6	0%	1%
SOC.RC.M	--	1	(37.3)	(37.9)	37.8	46.7	12%	12%
	--	2	798.4	816.4	2.9	3.6	16%	16%
	4	3	725.7	743.4	3.8	4.8	16%	16%
	5	4	(198.1)	(181.4)	14.8	18.3	31%	37%
SOC.SC.M	1	1	477.3	441.5	0.4	0.5	0%	0%
	--	2	486.6	448.3	0.6	0.7	0%	0%
	2	3	522.8	481.5	0.6	0.7	0%	0%
	--	4	507.8	453.4	1.8	2.2	1%	3%
	3	5	498.3	443.5	1.9	2.4	2%	4%

	--	6	542.9	504.8	3.1	3.8	4%	5%
	4-5	7	220.9	183.2	5.7	7.0	18%	23%
SVO.RC.M	1-3	1	218.7	97.1	1.9	2.4	3%	26%
	4-5	2	557.2	473.0	2.8	3.5	12%	15%
SVO.SC.M	1	1	507.5	430.2	0.7	0.9	0%	0%
	--	2	573.0	493.8	0.7	0.9	0%	0%
	2	3	662.7	576.1	0.8	1.0	0%	0%
	3	4	710.4	578.9	3.3	4.1	4%	12%
	4-5	5	766.1	642.4	3.6	4.4	3%	10%
VCS.SC.H	--	1	0.0	0.0	2.2	2.6	0%	0%
	1-4	2	11.5	9.8	3.2	4.0	4%	6%
	5	3	(48.4)	(57.7)	8.0	9.8	62%	59%
VCS.SC.I	1	1	47.7	45.1	1.0	1.2	0%	0%
	2	2	75.6	70.8	1.4	1.8	0%	0%
	3-5	3	533.8	488.2	2.5	3.1	0%	4%
VCS.SC.L	1	1	46.1	43.3	1.0	1.2	0%	0%
	2	2	94.6	88.0	1.4	1.8	0%	0%
	3-5	3	506.3	470.5	1.8	2.2	0%	0%
VCS.SC.M	1-3	1	31.4	29.1	2.5	3.0	0%	3%
	4-5	2	(32.2)	(42.0)	7.9	9.6	51%	52%
VCT.RC.L	--	1	157.3	174.2	7.6	9.3	4%	4%
	4	2	(183.9)	(182.9)	13.6	16.8	69%	70%
	5	3	(3,067.5)	(3,080.4)	46.6	57.3	86%	86%
VCT.RC.M	--	1	(106.0)	(108.5)	22.6	27.8	9%	9%
	--	2	157.8	170.3	9.8	12.1	11%	11%
	4	3	(118.9)	(108.3)	16.1	19.8	29%	32%
	5	4	(3,340.9)	(3,333.3)	87.2	107.3	56%	56%
VCT.SC.H	1	1	16.0	14.6	2.2	2.7	0%	1%
	2-4	2	22.0	19.3	3.3	4.0	3%	7%
	--	3	(3.7)	(16.1)	6.7	8.2	29%	36%
	--	4	(55.0)	(67.8)	8.8	10.8	43%	41%
	--	5	(106.1)	(113.4)	11.7	14.3	58%	54%
	--	6	(195.3)	(201.5)	15.1	18.6	72%	69%
	5	7	(1,464.5)	(1,467.3)	56.3	69.2	73%	73%
VCT.SC.I	--	1	(61.6)	(57.0)	42.2	51.7	2%	2%
	--	2	(67.5)	(68.7)	24.9	30.5	11%	11%
	5	3	(979.4)	(990.6)	31.8	39.0	48%	48%
VCT.SC.L	1-2	1	48.9	45.2	1.8	2.2	0%	0%
	3	2	480.3	436.9	2.8	3.5	1%	7%
	--	3	420.4	380.6	3.8	4.6	3%	11%
	--	4	340.9	300.3	4.6	5.7	7%	21%
	4-5	5	(766.2)	(809.8)	13.8	16.9	88%	83%
VCT.SC.M	1-2	1	31.0	28.0	2.5	3.1	0%	3%
	3	2	48.0	33.2	5.3	6.5	14%	25%
	--	3	5.5	(9.9)	6.9	8.5	30%	38%
	4	4	(54.4)	(66.0)	9.4	11.6	45%	45%
	--	5	(153.7)	(165.4)	12.2	15.0	56%	51%
	5	6	(1,413.1)	(1,421.6)	45.1	55.6	61%	61%
VOP.RC.L	1-3	1	1,515.0	1,300.4	0.7	0.9	0%	0%
	4-5	2	1,677.7	1,529.7	1.3	1.6	3%	3%

VOP.RC.M	1-3	1	480.8	337.4	1.4	1.8	0%	4%
	4-5	2	890.5	798.0	2.2	2.7	3%	7%
VOP.SC.M	1	1	691.4	604.6	0.6	0.7	0%	0%
	--	2	860.6	760.5	0.6	0.7	0%	0%
	2	3	1,031.3	915.5	0.8	0.9	0%	0%
	3	4	2,077.3	1,867.5	1.2	1.4	0%	0%
	4-5	5	2,146.3	1,945.9	1.5	1.8	0%	0%

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.

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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 CRE that meets the standard is less than three times the value of the first-year energy savings resulting from the standard. In calculating a rebuttable presumption payback period for each of the considered TSLs, DOE used discrete values, and, as required by EPCA, based the energy use calculation on the DOE test procedures for 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.59 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 this rule 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.59 Rebuttable-Presumption Payback Periods

	Rebuttable Payback Period years						
Equipment Class	EL 1	EL 2	EL 3	EL 4	EL 5	EL 6	EL 7
CB.SC.L	1.1	1.6	3.6				
CB.SC.M	1.6	2.5	6.2				
HCS.SC.L	2.9						
HCS.SC.M	3.7	3.8					
HCT.SC.I	6.4	6.4	8.0	10.7	11.3	18.4	
HCT.SC.L	10.3	10.3	18.4	19.7	29.1	46.9	
HCT.SC.M	37.0	36.0	48.9	49.1	100.0		
HZO.SC.L	1.6	2.2					
HZO.SC.M	2.0	2.4					
SOC.RC.M	40.0	3.3	4.4	16.8			
SOC.SC.M	0.4	0.6	0.7	2.0	2.2	3.5	6.5
SVO.RC.M	2.2	3.2					
SVO.SC.M	0.8	0.8	0.9	3.7	4.1		
VCS.SC.H	2.3	3.6	8.9				
VCS.SC.I	1.0	1.6	2.8				
VCS.SC.L	1.1	1.6	2.0				
VCS.SC.M	2.7	8.7					
VCT.RC.L	8.5	15.1	51.9				
VCT.RC.M	24.9	10.9	17.8	96.7			
VCT.SC.H	2.3	3.6	7.4	9.8	13.0	16.6	61.9
VCT.SC.I	48.6	27.1	35.3				
VCT.SC.L	2.0	3.1	4.2	5.1	15.2		
VCT.SC.M	2.7	5.8	7.6	10.4	13.4	49.9	
VOP.RC.L	0.8	1.5					
VOP.RC.M	1.6	2.5					
VOP.SC.M	0.6	0.7	0.9	1.3	1.7		

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 next section describes the expected impacts on manufacturers at each considered TSL. Chapter 12 of the final rule TSD explains the analysis in further detail.

a. Industry Cash Flow Analysis Results

In this section, DOE provides GRIM results from the analysis, which examines changes in the industry that would result from a standard. Table V.60 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 scenario; and (2) the preservation-of-operating-profit scenario, as discussed in section IV.J.2.d of this document. The preservation-of-gross-margin percentage scenario applies a ''gross-margin percentage'' of 28 percent for all equipment classes across all efficiency levels.[150] 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 or 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

[150] The gross-margin percentage of 28 percent is based on a manufacturer markup of 1.38.

through the end of the analysis period (2024–2058). 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 and amended standards. The conversion costs can have a significant impact on the short-term cash flow in the industry and generally result in lower free cash flow in the period between 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.

Table V.60 Manufacturer Impact Analysis Results

	Unit	No-New-Standards Case	TSL 1	TSL 2	TSL 3	TSL 4	TSL 5
INPV	*2023$ Million*	3,022.3	2,997.6 to 3,001.5	2,994.8 to 2,999.2	2,943.6 to 2,971.0	2,862.2 to 2,958.8	2,800.6 to 3,077.5
Change in INPV*	*2023$ Million*	-	(24.7) to (20.8)	(27.5) to (23.1)	(78.7) to (51.3)	(160.1) to (63.5)	(221.7) to 55.2
	%	-	(0.8) to (0.7)	(0.9) to (0.8)	(2.6) to (1.7)	(5.3) to (2.1)	(7.3) to 1.8
Free Cash flow (2028)	*2023$ Million*	262.6	248.6	246.9	221.0	184.4	173.9
Change in Free Cash flow (2028)*	*%*	-	(5.4)	(6.0)	(15.9)	(29.8)	(33.8)
Product Conversion Costs	*2023$ Million*	-	42.0	46.4	98.5	196.4	223.5
Capital Conversion Costs	*2023$ Million*	-	0.0	0.3	19.1	27.5	30.6
Total Conversion Costs	*2023$ Million*	-	42.0	46.7	117.7	233.9	254.1

*Parentheses denote negative (-) values.

The following cash flow discussion refers to the TSLs as detailed in section V.A of this document. Table V. table V.61 through table V.64 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 final rule TSD for additional information on the engineering analysis.

Table V.61 Incremental Design Options Analyzed as Compared to Baseline by Trial Standard Level for Vertical Equipment Families

Equipment Class	TSL 1	TSL 2	TSL 3	TSL 4	TSL 5
VOP.RC.M	Night curtains			Occupancy Sensors with Dimming	
VOP.RC.L	Night curtains			Occupancy Sensors with Dimming	
VOP.SC.M	Night Curtains	Brushless Direct Current ("BLDC") Condenser Fan Motor	VSC	Occupancy Sensors with Dimming	
VCT.RC.M	Baseline			Occupancy Sensors with Dimming; Triple Pane Krypton-Fill Door	Vacuum Insulated Glass Door ("VIG")
VCT.RC.L	Baseline			Occupancy Sensors with Dimming; Triple Pane Krypton-Fill Door	VIG
VCT.SC.H	Permanent Split Capacitator ("PSC") Condenser Fan Motor	BLDC Condenser Fan Motor			VSC; Occupancy Sensors with Dimming; VIG
VCT.SC.M	BLDC Condenser Fan Motor		VSC	Triple Pane Argon-Fill Door; Occupancy Sensors with Dimming	VIG
VCT.SC.L	BLDC Condenser Fan Motor		VSC	Occupancy Sensors with Dimming; VIG	
VCT.SC.I	Baseline				Occupancy Sensors with Dimming; VIG
VCS.SC.H	BLDC Condenser Fan Motor				VSC
VCS.SC.M	BLDC Condenser Fan Motor			VSC	
VCS.SC.L	PSC Condenser Fan Motor	BLDC Condenser Fan Motor	VSC		

Equipment Class	TSL 1	TSL 2	TSL 3	TSL 4	TSL 5
VCS.SC.I	PSC Condenser Fan Motor	BLDC Condenser Fan Motor	VSC		

Note: Design options are cumulative (*i.e.*, added as TSLs increase), except for component replacements of a design option at a lower TSL (*i.e.*, switching from a double pane door to a triple pane door, a triple-pane door to a VIG door, single-speed compressor to a variable speed compressor, or a PSC motor to a BLDC motor).

Table V.62 Incremental 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
SVO.RC.M	Night Curtains			Occupancy Sensors with Dimming	
SVO.SC.M	Night Curtains	BLDC Condenser Fan Motor	VSC	Occupancy Sensors with Dimming	
SOC.RC.M	Baseline			Occupancy Sensors with Dimming; Triple Pane, Krypton-Fill Door	VIG
SOC.SC.M	BLDC Evaporator Fan Motor	BLDC Condenser Fan Motor	VSC; Triple Pane, Argon-Fill Door	Occupancy Sensors with Dimming; VIG	

Note: Design options are cumulative (*i.e.*, added as TSLs increase), except for component replacements of a design option at a lower TSL (*i.e.*, switching from double pane door to triple pane door, a triple-pane door to a VIG door, a single-speed compressor to a variable-speed compressor, a PSC motor to a BLDC motor).

Table V.63 Incremental Design Options Analyzed as Compared to Baseline by Trial Standard Level for Horizontal Equipment Families

<table>
<tr><th>Equipment Class</th><th>TSL 1</th><th>TSL 2</th><th>TSL 3</th><th>TSL 4</th><th>TSL 5</th></tr>
<tr><td>HZO.RC.M</td><td colspan="5">Baseline</td></tr>
<tr><td>HZO.RC.L</td><td colspan="5">Baseline</td></tr>
<tr><td>HZO.SC.M</td><td colspan="2">BLDC Condenser Fan Motor</td><td colspan="3">VSC</td></tr>
<tr><td>HZO.SC.L</td><td colspan="2">BLDC Condenser Fan Motor</td><td colspan="3">VSC</td></tr>
<tr><td>HCT.SC.M</td><td colspan="4">Baseline</td><td>Occupancy Sensors with Dimming; VIG</td></tr>
<tr><td>HCT.SC.L</td><td colspan="4">Baseline</td><td>Occupancy Sensors with Dimming; VSC; VIG</td></tr>
<tr><td>HCT.SC.I</td><td>Double Pane, Argon-Fill Door</td><td colspan="3">Triple Pane, Argon-Fill Door</td><td>VSC; Occupancy Sensors with Dimming; VIG</td></tr>
<tr><td>HCS.SC.M</td><td>PSC Condenser Fan Motor</td><td colspan="4">BLDC Condenser Fan Motor</td></tr>
<tr><td>HCS.SC.L</td><td colspan="5">BLDC Condenser Fan Motor</td></tr>
</table>

Note: Design options are cumulative (*i.e.*, added as TSLs increase), except for component replacements of design option(s) at lower TSLs (*i.e.*, switching from a double pane door to a triple pane door, a triple-pane door to a VIG door, a single-speed compressor to a variable speed compressor, or a PSC motor to a BLDC motor).

Table V.64 Incremental Design Options Analyzed as Compared to Baseline by Trial Standard Level for Chef Base or Griddle Stand Equipment Classes

<table>
<tr><th>Equipment Class</th><th>TSL 1</th><th>TSL 2</th><th>TSL 3</th><th>TSL 4</th><th>TSL 5</th></tr>
<tr><td>CB.SC.M</td><td>PSC Condenser Fan Motor</td><td>BLDC Condenser Fan Motor</td><td colspan="3">VSC</td></tr>
<tr><td>CB.SC.L</td><td>PSC Condenser Fan Motor</td><td>BLDC Condenser Fan Motor</td><td colspan="3">VSC</td></tr>
</table>

Note: Design options are cumulative (*i.e.*, added as TSLs increase), except for component replacements of a design options at a lower TSL (*i.e.*, switching from a PSC motor to a BLDC motor or a single-speed compressor to a variable speed compressor).

At TSL 5, the standard represents the max-tech efficiencies for all equipment classes. The change in INPV is expected to range from −$221.7 million to $55.2 million, which represents a change in INPV of −7.3 percent to 1.8 percent, respectively. At this level, free cash flow is estimated to decrease by 33.8 percent compared to the no-new-standards case value of $262.6 million in the year 2028, the year before compliance would be required. In 2028, approximately 30.5 percent of covered CRE shipments are expected to meet the efficiencies required at TSL 5. See table V. for the percent of equipment class shipments that would meet or exceed the efficiencies required at each TSL in 2028 (a year before the modeled compliance year).

The design options DOE analyzed at TSL 5 included the max-tech technologies for all equipment classes. For all semi-vertical and vertical open and transparent door equipment classes, DOE expects manufacturers would likely incorporate occupancy sensors with dimming capability. Open equipment classes would also likely necessitate the use of night curtains. For equipment classes with transparent doors, DOE expects manufacturers would likely need to incorporate vacuum-insulated glass doors. For most self-contained equipment classes, DOE expects manufacturers would need to incorporate BLDC condenser fan motors and variable-speed compressors. Of the 28 directly analyzed equipment classes, 5 equipment classes (VSC.SC.L, VCS.SC.M, VCT.RC.M, VCT.SC.L, and VCT.SC.M) account for approximately 81.5 percent of industry shipments covered by this final rule. For VCS.SC.L, TSL 5 corresponds to EL 3. For VCS.SC.M, TSL 5 corresponds to EL 2. For VCT.RC.M, TSL 5 corresponds to EL 4. For VCT.SC.L, TSL 5 corresponds to EL 5 and VCT.SC.M, TSL 5 corresponds to EL 6. See section 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. At this level, DOE estimates that approximately 55 percent of analyzed equipment class model listings (10,957 out of 19,902 unique basic models) do not meet the efficiency levels required.[151] Self-contained CRE equipment classes account for approximately 86 percent of industry shipments covered by this final rule. 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 baseplate 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, and VCT.SC.M) account for approximately 41 percent of model listings. For the 84 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 and public comments, some manufacturers raised concerns about standards requiring a widespread adoption of vacuum-insulated glass as it is still a relatively new technology in the commercial refrigeration market. Manufacturers pointed to the very limited industry experience with implementing vacuum-insulated glass in CRE applications. Manufacturers expressed concerns about their ability 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 within the required compliance period (*i.e.,* between the publication of the final rule and the compliance date of the new and amended energy conservation standards). DOE estimates capital conversion costs of $30.6 million and product conversion costs of $223.5 million. Conversion costs total $254.1 million.

DOE acknowledges that most CRE manufacturers offer an exhaustive range of model offerings to appeal to the unique requirements of each CRE consumer. Within a model family, manufacturers offer numerous options to customize CRE to the specifications of restaurant, supermarket, and retail chains and other bulk purchasers of CRE (*e.g.,* Coca-Cola, Pepsi). In interviews, many manufacturers noted that offering a wide-range of models with a high-level of customization and optionality (*e.g.,* different evaporator setups, different lighting arrangements, different door configurations, *etc.*) is critical to succeed in the CRE market. Many manufacturers prioritize offering a breadth of model offerings and specialty CRE, even if sales of each individual model are low. As such, manufacturers still offer hundreds of basic models for equipment classes with low annual shipments. For example, SOC.RC.M accounts for approximately 5 percent of model listings (over 1,000 unique basic models certified in DOE's CCD) even though SOC.RC.M only accounts for 0.1 percent of industry shipments (less than 2,000 units sold in 2024). As discussed in section IV.J.2.c of this document, to avoid underestimating the potential industry investment, DOE's conversion cost model assumes manufacturers would redesign models that do not meet each considered TSL. However, if manufacturers do not have sufficient resources to redesign models within the compliance period, manufacturers would likely discontinue low-volume equipment designs and prioritize redesigning high-volume model offerings.

At TSL 5, the shipment-weighted average MPC for all CRE is expected to increase by 14.2 percent relative to the no-new-standards case shipment-weighted average MPC for all CRE in 2029. Given the projected increase in production costs, DOE expects an estimated 4.1-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 cash flow from the higher MSP outweighs the $254.1 million in conversion costs, causing a small increase 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 2029, the analyzed compliance year. This reduction in the manufacturer markup and the $254.1 million in conversion costs incurred by manufacturers cause a negative change in INPV at TSL 5 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 4, the standard represents an intermediate level with less stringent efficiencies required for 10 directly analyzed equipment classes compared to max-tech. The change in INPV is expected to range from −$160.1 million to −$63.5 million, which represents a change in INPV of −5.3 percent to −2.1 percent, respectively. At this level, free cash flow is estimated to decrease by 28.9 percent compared to the no-new-standards case value of $262.6 million in the year 2028, the year before compliance is required. In 2028, approximately 33.4 percent of covered CRE shipments are expected to meet the efficiencies required at TSL 4.

The design options DOE analyzed at TSL 4 are similar to the design options analyzed at TSL 5 except fewer equipment classes with transparent doors would need to incorporate improved door designs and fewer self-contained equipment classes would necessitate the use of variable-speed compressors. DOE estimates that a similar portion of models would require redesign at TSL 4 and TSL 5. DOE estimates that approximately 53 percent of analyzed equipment class model listings (10,574 out of a total of 19,902

[151] DOE's Compliance Certification Database, ''Refrigeration Equipment—Commercial, Single Compartment'' is available at: *www.regulations.doe.gov/certification-data/#q=Product_Group_s%3A**. Model count estimates discussed throughout section V.B.2.a and section V.C of this document refer to unique basic models of the directly analyzed equipment classes only. (Last accessed Jan. 31, 2024).

unique basic models) do not meet the TSL 4 efficiency levels. Self-contained equipment classes that may incorporate variable-speed compressors represent approximately 90 percent of self-contained CRE model listings. For the five highest-volume equipment classes, TSL 4 corresponds to lower efficiency levels for 2 equipment classes: VCT.RC.M and VCT.SC.M. For VCS.SC.M, VCS.SC.L, and VCT.SC.L, the efficiencies required at TSL 4 are the same as TSL 5. For VCT.RC.M, TSL 4 corresponds to EL 3. For VCT.SC.M, TSL 4 corresponds to EL 4. At this level, DOE expects that VCT.RC.M and VCT.SC.M would incorporate triple-pane glass with krypton fill and argon fill, respectively. The 4 self-contained equipment classes with the highest-volume shipments (VCS.SC.L, VCS.SC.M, VCT.SC.L, and VCT.SC.M) would likely necessitate the use of variable-speed compressors.

Similar to TSL 5, DOE expects manufacturers would spend development time updating equipment designs to incorporate high-efficiency components. Manufacturers of CRE with transparent doors may need to invest in new fixtures to accommodate additional panes of glass into CRE designs. Unlike at TSL 5 where DOE expects all transparent door CRE equipment classes would incorporate vacuum-insulated glass doors to meet the efficiency levels required, only two directly analyzed equipment classes, SOC.SC.M and VCT.SC.L, (which represent approximately 9 percent of transparent door CRE model listings) would likely necessitate vacuum-insulated glass doors to meet at TSL 4. However, DOE expects that manufacturers of VCT.RC.L, VCT.RC.M, and SOC.RC.M (which represent approximately 63 percent of transparent door CRE model listings) would likely incorporate triple-pane glass doors with krypton fill and manufacturers of HCT.SC.I and VCT.SC.M (which represent approximately 25 percent of transparent door CRE model listings) would incorporate triple-pane glass doors with argon fill. As previously discussed, many manufacturers raised concerns about the widespread adoption of vacuum-insulated glass because the industry does not have widescale experience integrating this technology into their designs. In interviews and public comments, some manufacturers also raised concerns about the limited supply of krypton gas available to the market. Currently, few CRE designs have triple-pane glass doors with krypton fill as nearly all CRE with double-pane or triple-pane doors are manufactured with argon fill, and single-pane doors do not have an inert gas fill. DOE estimates capital conversion costs of $27.5 million and product conversion costs of $196.4 million. Conversion costs total $223.9 million.

As previously discussed with TSL 5, if manufacturers do not have sufficient resources to redesign models within the compliance period, manufacturers would likely discontinue low-volume equipment designs and prioritize redesigning high-volume model offerings.

At TSL 4, the shipment-weighted average MPC for all CRE is expected to increase by 4.8 percent relative to the no-new-standards case shipment-weighted average MPC for all CRE in 2029. Given the projected increase in production costs, DOE expects an estimated 1.8-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 cash flow from the higher MSP is outweighed by the $223.9 million in conversion costs, causing a 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 2029, the analyzed compliance year. This reduction in the manufacturer markup and the $223.9 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 an intermediate level with less stringent efficiencies required for 12 directly analyzed equipment classes compared to TSL 4. The change in INPV is expected to range from −$78.7 million to −$51.3 million, which represents a change in INPV of −2.6 percent to −1.7 percent, respectively. At this level, free cash flow is estimated to decrease by 15.9 percent compared to the no-new-standards case value of $262.6 million in the year 2028, the year before compliance is required. In 2028, approximately 49.0 percent of covered CRE shipments are expected to meet the efficiencies required at TSL 3.

At TSL 3, the efficiency levels required for most open (*i.e.,* equipment classes without doors) and transparent door equipment classes are lower than the efficiency levels required at TSL 4. DOE estimates that notably fewer models would require redesign at TSL 3 compared to TSL 4 and TSL 5. At this level, approximately 37 percent of analyzed equipment class model listings (7,306 out of 19,902 unique basic models) do not meet the efficiency levels required. DOE expects manufacturers could meet TSL 3 without implementing occupancy sensors with dimming capability, triple-pane doors with krypton fill, or vacuum-insulated glass doors, alleviating industry concerns about the availability and supply of krypton gas and vacuum-insulated glass. At this level, the same equipment classes as TSL 4—except for VSC.SC.M, which represents 37 percent of self-contained CRE model listings–would likely incorporate variable-speed compressors. At this level, only 2 equipment classes, HCT.SC.I and SOC.SC.M (together representing 7 percent of transparent door CRE model listings), would likely incorporate improved door designs compared to 7 equipment classes that would likely incorporate improved door designs at TSL 4 (together representing 97 percent of transparent door CRE model listings). For the 5 highest-volume equipment classes, TSL 3 corresponds to lower efficiency levels for 4 equipment classes: VCS.SC.M, VCT.RC.M, VCT.SC.L, and VCT.SC.M. For VCS.SC.M, TSL 3 corresponds to EL 1. For VCT.RC.M, TSL 3 corresponds to baseline efficiency (*i.e.,* EL 0). For VCT.SC.L, TSL 3 corresponds to EL 2. For VCT.SC.M, TSL 3 corresponds to EL 2. For VCS.SC.L, the efficiencies required at TSL 3 are the same as TSL 4. At this level, product conversion costs may be necessary to source, qualify, and test high-efficiency components—but to a lesser extent than at higher TSLs. Some manufacturers of self-contained equipment classes may need to invest in new baseplate tooling if incorporating variable-speed compressors requires additional modifications to CRE designs. Manufacturers of CRE with transparent doors may need to invest in new fixtures to accommodate additional panes of glass into CRE designs. DOE estimates capital conversion costs of $19.1 million and product conversion costs of $98.5 million. Conversion costs total $117.7 million.

At TSL 3, the shipment-weighted average MPC for all CRE is expected to increase by 1.4 percent relative to the no-new-standards case shipment-weighted average MPC for all CRE in 2029. Given the relatively small projected 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 increase in cash flow from the higher MSP is slightly outweighed by the $117.7 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 2029, the analyzed compliance year. This reduction in the manufacturer markup and the $117.7 million in conversion costs incurred by manufacturers cause a small negative change in INPV at TSL 3 under the preservation-of-operating-profit scenario.

At TSL 2, the standard represents an intermediate level with less stringent efficiencies required for 11 directly analyzed equipment classes compared to TSL 3. The change in INPV is expected to range from −$27.5 million to −$23.1 million, which represents a change in INPV of −0.9 percent to −0.8 percent, respectively. At this level, free cash flow is estimated to decrease by 6.0 percent compared to the no-new-standards case value of $262.6 million in the year 2028, the year before compliance is required. In 2028, approximately 60.7 percent of covered CRE shipments are expected to meet the efficiencies required at TSL 2.

At this level, the efficiency levels required are lower than TSL 3 for less than half of the directly analyzed equipment classes, which represent approximately 19 percent of industry shipments. DOE estimates that a similar portion of models would require redesign at TSL 2 and TSL 3. At this level, approximately 33 percent of analyzed equipment class model listings (6,631 out of 19,902 unique basic models) do not meet the efficiency levels required. DOE does not expect manufacturers would incorporate variable-speed compressors to meet efficiencies at TSL 2. At this level, DOE expects manufacturers would implement BLDC condenser fan motors for all self-contained equipment classes. Only HCT.SC.I would likely need to incorporate improved door designs. Open equipment classes would likely necessitate the use of night curtains. For the five highest-volume equipment classes, TSL 2 corresponds to lower efficiency levels for 3 equipment classes: VCS.SC.L, VCT.SC.L, and VCT.SC.M. For VCS.SC.L, TSL 2 corresponds to EL 2. For VCT.SC.L and VCT.SC.M, the TSL 2 corresponds to EL 1. For VSC.SC.M and VCT.RC.M, 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 2 equipment classes—VCS.SC.L and VCT.SC.M—drive the drop in product conversion costs at this level. For VCS.SC.L and VCT.SC.M, DOE believes manufacturers could meet TSL 2 efficiencies by incorporating more efficient condenser fan motors with minimal development effort, unlike at TSL 3, which may necessitate implementing variable-speed compressors. DOE estimates capital conversion costs of $0.3 million and product conversion costs of $46.4 million. Conversion costs total $46.7 million.

At TSL 2, the shipment-weighted average MPC for all CRE is expected to increase by 0.2 percent relative to the no-new-standards case shipment-weighted average MPC for all CRE in 2029. Given the relatively small projected 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 increase in cash flow from the higher MSP is slightly outweighed by the $46.7 million in conversion costs, causing a slight 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 $46.7 million in conversion costs incurred by manufacturers cause a small 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 −$24.7 million to −$20.8 million, which represents a change in INPV of −0.8 percent to −0.7 percent, respectively. At this level, free cash flow is estimated to decrease by 5.4 percent compared to the no-new-standards case value of $262.6 million in the year 2028, the year before compliance is required. In 2028, approximately 64.1 percent of covered CRE shipments are expected to meet the efficiencies required at TSL 1.

At this level, the efficiency levels correspond to baseline for 8 directly analyzed equipment classes, EL 1 for 19 equipment classes, and EL 2 for 1 equipment class (VCS.SC.H). DOE estimates that a similar portion of models would require redesign at TSL 1, TSL 2, and TSL 3. At this level, approximately 33 percent of analyzed equipment class model listings (6,504 out of 19,902 unique basic models) do not meet the efficiency levels required. DOE expects most self-contained equipment classes would need to incorporate higher-efficiency fan motors (*i.e.,* BLDC evaporator or condenser fan motors or PSC evaporator fan motors for chef bases). HCT.SC.I may necessitate the use of double-pane argon-fill doors to meet TSL 1 efficiencies. DOE expects manufacturers could TSL 1 efficiencies without investing in new tooling or equipment. Product conversion costs are driven by incorporating high-efficiency components into CRE designs. DOE estimates product conversion costs of $42.0 million.

At TSL 1, the shipment-weighted average MPC for all CRE is expected to increase by 0.2 percent relative to the no-new-standards case shipment-weighted average MPC for all CRE in 2029. Given the relatively small projected 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 cash flow from the higher MSP slightly outweighs the $42.0 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 2029, the analyzed compliance year. This reduction in manufacturer markup and the $42.0 million in conversion costs incurred by manufacturers cause a minor negative change in INPV at TSL 1 under the preservation-of-operating-profit scenario.

Table V.65 Percentages of 2028 No-New-Standards Case Shipments that Meet Each TSL by Directly Analyzed Equipment Class

Equipment Family	Equipment Class	TSL 1	TSL 2	TSL 3	TSL 4	TSL 5
Vertical Equipment	VOP.RC.M	63.5%	63.5%	63.5%	52.6%	52.6%
	VOP.RC.L	63.5%	63.5%	63.5%	52.6%	52.6%
	VOP.SC.M	10.1%	8.6%	4.9%	3.7%	3.7%
	VCT.RC.M	100.0%	100.0%	100.0%	51.6%	43.3%
	VCT.RC.L	100.0%	100.0%	100.0%	23.6%	14.6%
	VCT.SC.H	72.7%	59.1%	59.1%	59.1%	27.3%
	VCT.SC.M	57.4%	57.4%	41.8%	39.8%	38.8%
	VCT.SC.L	59.8%	59.8%	10.0%	9.9%	9.9%
	VCT.SC.I	100.0%	100.0%	100.0%	100.0%	51.9%
	VCS.SC.H	75.0%	75.0%	75.0%	75.0%	25.0%
	VCS.SC.M	55.4%	55.4%	55.4%	29.7%	29.7%
	VCS.SC.L	47.8%	47.6%	3.8%	3.8%	3.8%
	VCS.SC.I	92.1%	85.3%	32.5%	32.5%	32.5%
Semi-Vertical Equipment	SVO.RC.M	42.2%	42.2%	42.2%	30.6%	30.6%
	SVO.SC.M	48.9%	40.3%	32.2%	30.5%	30.5%
Service-Over-Counter Equipment	SOC.RC.M	100.0%	100.0%	100.0%	37.9%	37.2%
	SOC.SC.M	58.9%	56.0%	51.2%	44.3%	44.3%
Horizontal Equipment	HZO.RC.M	100.0%	100.0%	100.0%	100.0%	100.0%
	HZO.RC.L	100.0%	100.0%	100.0%	100.0%	100.0%
	HZO.SC.M	92.8%	92.8%	45.1%	45.1%	45.1%
	HZO.SC.L	92.8%	92.8%	45.1%	45.1%	45.1%
	HCT.SC.M	100.0%	100.0%	100.0%	100.0%	13.4%
	HCT.SC.L	100.0%	100.0%	100.0%	100.0%	39.8%
	HCT.SC.I	74.3%	71.0%	71.0%	71.0%	39.8%
	HCS.SC.M	76.5%	41.2%	41.2%	41.2%	41.2%
	HCS.SC.L	60.0%	60.0%	60.0%	60.0%	60.0%
Chef Bases	CB.SC.M	76.9%	76.9%	53.8%	53.8%	53.8%
	CB.SC.L	69.2%	53.8%	38.5%	38.5%	38.5%
Total		61.4%	60.7%	49.0%	33.4%	30.5%

b. Direct Impacts on Employment

To quantitatively assess the potential impacts of 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,*[152] BLS employee compensation data,[153] 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 *ASM* inputs: Production Workers Annual Wages, Production Workers Annual Hours, Production Workers for Pay Period, and Number of Employees. DOE

[152] 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 April 11, 2024).

[153] U.S. Bureau of Labor Statistics. *Employer Costs for Employee Compensation—March 2024.* June 18, 2024. Available at *www.bls.gov/bls/news-release/ecec.htm#current* (last accessed Aug. 22, 2024).

also relied on 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.

The total production employees number 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 CRE covered by this final rule 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.[154] DOE's estimates only account for production workers who manufacture the specific equipment covered by this final 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.*[155] 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 that in the absence of new energy conservation standards, there would be 11,792 domestic production and non-production workers for CRE in 2029. shows the range of 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 table V.66.

Table V.66 Direct Employment Impacts for Domestic CRE Manufacturers in 2029*

	No-New-Standards Case	TSL 1	TSL 2	TSL 3	TSL 4	TSL 5
Direct Employment in 2029 (Production Workers + Non-Production Workers)	11,792	11,785 to 11,792	8,391 to 11,783	7,388 to 11,699	6,028 to 11,616	5,778 to 11,642
Potential Changes in Direct Employment in 2029	-	(7) to 0	(3,401) to (9)	(4,404) to (93)	(5,764) to (176)	(6,014) to (150)

*DOE presents a range of potential employee impacts. Numbers in parentheses indicate negative numbers.

The direct employment impacts in represent the potential domestic employment changes that could result following the compliance date for CRE in this final rule. 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. For the lower bound estimate, DOE maintained its methodology from the August 2024 NODA for this final rule. 89 FR 68788, 68828–68829.

The lower bound estimate conservatively assumes that some domestic manufacturing either is eliminated or moves abroad at more stringent efficiency levels. For levels that require capital investment or higher per-unit labor content, DOE assumed that some manufacturing could move abroad as relocating production to lower-labor cost countries could become increasingly attractive. At relevant TSLs, DOE used results of the shipments analysis (*i.e.,* the percent of shipments that would not meet the standard) to estimate the portion of domestic production that would shift to foreign countries. However, DOE notes that 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. As in the August 2024 NODA, for this final rule, DOE modeled an incremental increase in labor costs associated with implementing improved door designs (*i.e.,* moving to double-pane, triple-pane, or VIG door designs). 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. At the adopted TSL (*i.e.,* TSL 3), DOE projects that nearly half of industry shipments will meet the required efficiency levels by the 2029 compliance date in the no-new-standards case. Additionally, DOE notes that only two directly analyzed equipment classes would likely incorporate improved door designs. As such, DOE does not expect TSL 3 will necessitate large capital costs or significantly higher per-unit labor content. Furthermore, DOE notes that most basic models (63 percent of model listings) meet TSL 3.

Additional detail on the analysis of direct employment can be found in chapter 12 of the final rule TSD. Additionally, the employment impacts discussed in this section are

[154] 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 April 11, 2024).

[155] *Id.*

independent of the employment impacts from the broader U.S. economy, which are documented in chapter 16 of the final rule TSD.

c. Impacts on Manufacturing Capacity

In interviews conducted in advance of the October 2023 NOPR, 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 final rule. Furthermore, DOE revised its baseline insulation thickness assumptions used in the October 2023 NOPR in response to stakeholder comments. The revised insulation thicknesses analyzed in the August 2024 NODA and this final rule generally align with the insulation thicknesses analyzed in the March 2014 Final Rule,[156] which are also consistent with stakeholder comments and DOE's test data.

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 new and amended energy conservation standards. However, multiple manufacturers in confidential interviews and public comments in response to the October 2023 NOPR and August 2024 NODA 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 and industry standards and the various regulations necessitating the transition to low-GWP refrigerants. In confidential interviews and comments in response to the October 2023 NOPR and August 2024 NODA, some manufacturers stated that they are already experiencing testing laboratory shortages, which would be further exacerbated by DOE energy conservation standards if DOE adopts 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.

At the adopted TSL (*i.e.,* TSL 3), DOE estimates that approximately 63 percent of analyzed equipment class model listings (12,596 out of 19,902 unique basic models) meet the efficiency levels required. Furthermore, DOE is extending the compliance period from the 3-years analyzed in the October 2023 NOPR to 4-years in this final rule to help mitigate concerns about laboratory and engineering resource constraints.

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 Small Business Administration (''SBA'') defines a ''small business'' as having 1,250 employees or fewer 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 20 domestic OEMs 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 final rule TSD.

e. Cumulative Regulatory Burden

One aspect of assessing manufacturer burden involves looking at the cumulative impact of multiple DOE standards and the equipment/product-specific regulatory actions of other Federal agencies and States that affect the manufacturers of a covered product or equipment. While any one regulation may not impose a significant burden on manufacturers, the combined effects of several existing or impending regulations may have serious consequences for some manufacturers, groups of manufacturers, or an entire industry. 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 3 years before or after the estimated 2029 compliance date of any new and amended energy conservation standards for CRE (2026–2032).

The DOE energy conservation standards regulations potentially contributing to cumulative regulatory burden are presented in table V.67. In addition to the proposed and adopted energy conservation standards rulemakings identified, DOE also considers refrigerant regulations, such as the October 2023 EPA Final Rule, in its cumulative regulatory burden analysis. DOE discusses these refrigerant regulations in the subsection ''Refrigerant Regulations'' included in this section.

[156] DOE assumed an insulation thickness of 1.5 inches for medium- and high-temperature equipment, 2.0 inches for low-temperature equipment, and 2.5 inches for ice cream temperature equipment. See Table 5A.2.2 Baseline Specifications in the 2014 Final rule TSD at *www.regulations.gov/document/EERE-2010-BT-STD-0003-0102.*

Table V.67 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 Today's Rule**	Approx. Standards Compliance Year	Industry Conversion Costs *(Millions)*	Industry Conversion Costs / Equipment Revenue***
Automatic Commercial Ice Makers† 88 FR 30508 (May 11, 2023)	23	7	2027	$15.9 (2022$)	0.6%
Refrigerated Bottled or Canned Beverage Vending Machines† 88 FR 33968 (May 25, 2023)	5	1	2028	$1.5 (2022$)	0.2%
Room Air Conditioners 88 FR 34298 (May 26, 2023)	8	1	2026	$24.8 (2021$)	0.4%
Microwave Ovens 88 FR 39912 (June 20, 2023)	18	3	2026	$46.1 (2021$)	0.7%
Dehumidifiers† 88 FR 76510 (November 6, 2023)	20	2	2028	$6.9 (2022$)	0.4%
Consumer Furnaces 88 FR 87502 (December 18, 2023)	14	2	2028	$162.0 (2022$)	1.8%
Refrigerators, Refrigerator-Freezers, and Freezers 89 FR 3026 (January 17, 2024)	63	10	2029 and 2030‡	$830.3 (2022$)	1.3%
Consumer Conventional Cooking Products 89 FR 11548 (February 14, 2024)	35	4	2028	$66.7 (2022$)	0.3%
Consumer Clothes Dryers 89 FR 18164 (March 12, 2024)	19	3	2028	$180.7 (2022$)	1.4%
Residential Clothes Washers 89 FR 19026 (March 15, 2024)	22	4	2028	$320.0 (2022$)	1.8%
Dishwashers 89 FR 31398 (April 24, 2024)	21	4	2027	$126.9 (2022$)	2.1%
Miscellaneous Refrigeration Products 89 FR 38762 (May 7, 2024)	49	13	2029	$130.7 (2022$)	2.9%

Walk-in Coolers and Freezers††	87	11	2028	$91.5 (2023$)	0.6%

* 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 a final rule to the compliance year of the energy conservation standard. The conversion period typically ranges from 3 to 5 years, depending on the rulemaking.

† These rulemakings are at the NOPR stage, and all values are subject to change until finalized through publication of a final rule.

‡ For the refrigerators, refrigerator-freezers, and freezers energy conservation standards direct final rule, the compliance year (2029 or 2030) varies by product class.

†† At the time of issuance of this final rule, the WICFs final rule has been issued and is pending publication in the *Federal Register*. Once published, the final rule pertaining to WICFs will be available at: *www.regulations.gov/docket/EERE-2017-BT-STD-0009.*

Refrigerant Regulations

The October 2023 EPA Final Rule restricts the use of HFCs in specific sectors or subsectors, including use in certain CRE covered by this rulemaking. Consistent with the October 2023 NOPR, DOE considered the impacts of the refrigerant transition in this final rule 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. Compliance with the October 2023 EPA Final Rule ranges from January 1, 2025 to January 1, 2027 for categories relevant to CRE covered by this rulemaking (see table IV.5 for a list of compliance dates for the October 2023 EPA Final Rule applicable to CRE). Therefore, DOE expects manufacturers will complete the transition to low-GWP refrigerants in compliance with EPA regulation prior to the expected 2029 DOE compliance date for CRE. As discussed in section IV.C.1.a of this document, DOE expects CRE manufacturers will transition self-contained CRE covered by this rulemaking to R–290 to comply with anticipated refrigeration regulations. See section IV.C.1 of this document for additional information on refrigerant assumptions in the engineering analysis.

Consistent with the October 2023 NOPR and August 2024 NODA, in this final rule, 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 part of the analytical baseline. In other words, manufacturers would need to comply with the October 2023 EPA Final Rule regardless of whether or not DOE amends standards. Therefore, DOE incorporated the refrigerant transition expenses into both the no-new-standards case and standards cases. For the October 2023 NOPR, DOE relied on manufacturer feedback in confidential interviews, a report prepared for EPA,[157] 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. 88 FR 70196, 70284. For the August 2024 NODA, DOE updated its R&D estimate to reflect feedback from written comments in response to the October 2023 NOPR. 89 FR 68788, 68800. DOE also adjusted the timeline of when manufacturers would need to make investments related to the refrigerant transition to align with the revised compliance dates for CRE in the October 2023 EPA Final Rule. *Id.* DOE maintained the approach from the August 2024 NODA for this final rule, however, as this final rule only analyzes non-large self-contained CRE (see table IV. for the TDA/volume ranges for the seven relevant equipment classes) and remote-condensing CRE, DOE excluded the investments associated with large self-contained CRE in its GRIM.

Based on feedback, DOE assumed that the transition to low-GWP refrigerants would require industry to invest approximately $13.6 million in R&D and $17.7 million in capital expenditures (*e.g.,* investments in new charging equipment, leak detection systems, *etc.*) from 2024 (the final rule reference year) and 2027 (the latest EPA compliance date for CRE covered by this rulemaking). Consistent with the October 2023 NOPR, DOE notes that its refrigerant transition estimates of $13.6 million in R&D and $17.7 million capital expenditures reflect an estimate of *future* (2023–2025 for the October 2023 NOPR and 2024–2027 for this final rule) investments industry would incur to comply with Federal or State refrigerant regulations. DOE acknowledges that manufacturers have already invested a significant amount of time and capital into transitioning CRE to low-GWP refrigerants. However, as the GRIM developed for this rulemaking only analyzes future cash flows, starting with the reference year of the analysis (2024) and continuing 30 years after the analyzed compliance year, the MIA conducted for this final rule only reflects changes in annual cash flow and associated refrigerant transition expenses starting in 2024.

3. National Impact Analysis

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

a. National 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

[157] 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/2019-9/documents/nonco2_methodology_report.pdf.*

their anticipated energy consumption under each TSL. The savings are measured over the entire lifetime of equipment purchased during the 30-year period that begins in the year of anticipated compliance with new and amended standards (2029–2058). Table V. presents DOE's projections of the NES for each TSL considered for CRE. The savings were calculated using the approach described in section IV.H.2 of this document.

Table V.68 Cumulative National Energy Savings for CRE; 30 Years of Shipments (2029–2058)

	Trial Standard Level				
	1	2	3	4	5
	quads				
Primary energy	0.24	0.28	1.08	1.46	1.57
FFC energy	0.25	0.29	1.11	1.50	1.61

OMB Circular A–4 [158] 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.[159] 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.. The impacts are counted over the lifetime of CRE purchased during the period 2029–2037.

Table V.69 Cumulative National Energy Savings for CRE; 9 Years of Shipments (2029–2037)

	Trial Standard Level				
	1	2	3	4	5
	quads				
Primary energy	0.07	0.08	0.31	0.41	0.44
FFC energy	0.07	0.08	0.32	0.43	0.45

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 Circular A–4, DOE calculated NPV using both a 7-percent and a 3-percent real discount rate. Table V. shows the consumer NPV results with impacts counted over the lifetime of equipment purchased during the period 2029–2058.

Table V.70 Cumulative Net Present Value of Consumer Benefits for CRE; 30 Years of Shipments (2029–2058)

Discount Rate	Trial Standard Level				
	1	2	3	4	5
	billion 2023$				
3 percent	0.60	0.74	3.43	1.89	-8.45
7 percent	0.24	0.29	1.32	0.22	-5.36

The NPV results based on the aforementioned 9-year analytical period are presented in table V.71. The impacts are counted over the lifetime of equipment purchased during the period 2029–2058. As mentioned previously, such results are presented for informational purposes only and are not indicative of any change in DOE's

[158] U.S. Office of Management and Budget. *Circular A–4: Regulatory Analysis.* Available at *www.whitehouse.gov/omb/information-for-agencies/circulars* (last accessed July 1, 2024). DOE used the prior version of Circular A–4 (September 17, 2003) in accordance with the effective date of the November 9, 2023 version. Available at *www.whitehouse.gov/wp-content/uploads/legacy_drupal_files/omb/circulars/A4/a-4.pdf* (last accessed July 20, 2024).

[159] 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.

analytical methodology or decision criteria.

Table V.71 Cumulative Net Present Value of Consumer Benefits for CRE; 9 Years of Shipments (2029–2037)

Discount Rate	Trial Standard Level				
	1	2	3	4	5
	billion 2023$				
3 percent	0.23	0.29	1.22	0.57	-3.33
7 percent	0.12	0.15	0.62	0.03	-2.80

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 where CRE prices were assumed to remain constant over the analysis period. This analysis was considered as a part of the low economic benefits scenario, which is based on low economic growth with lower electricity price declines and lower floorspace projections for shipments. See Appendix 10C of the final rule TSD for full results of all NIA sensitivities conducted.

c. Indirect Impacts on Employment

DOE estimates that amended energy conservation standards for CRE will 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 (2029–2033), where these uncertainties are reduced.

The results suggest that the adopted standards are likely to have a negligible impact on the net demand for labor in the economy. The net change in jobs is so small that it would be imperceptible in national labor statistics and might be offset by other, unanticipated effects on employment. Chapter 16 of the final rule TSD presents detailed results regarding anticipated indirect employment impacts.

4. Impact on Utility or Performance of Equipment

As discussed in section III.F.1.d of this document, DOE has concluded that the standards adopted in this final rule will not lessen the utility or performance of the CRE under consideration in this rulemaking. Manufacturers of this equipment generally already offer units that meet or exceed the adopted standards.

5. Impact of Any Lessening of Competition

DOE considered any lessening of competition that would be likely to result from new or amended standards. As discussed in section III.F.1.e of this document, EPCA directs the Attorney General of the United States (''Attorney General'') to determine the impact, if any, of any lessening of competition likely to result from a proposed standard and to transmit such determination in writing to the Secretary within 60 days of the publication of a proposed rule, together with an analysis of the nature and extent of the impact. To assist the Attorney General in making this determination, DOE provided the Department of Justice (''DOJ'') with copies of the October 2023 NOPR and the October 2023 NOPR TSD for review. In its assessment letter responding to DOE, DOJ concluded that the proposed energy conservation standards for CRE are unlikely to have a significant adverse impact on competition. DOE is publishing the Attorney General's assessment at the end of this final rule.

6. Need of the Nation To Conserve Energy

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

Energy conservation resulting from potential energy conservation standards for CRE is expected to yield environmental benefits in the form of reduced emissions of certain air pollutants and GHGs. Table V. provides DOE's estimate of cumulative emissions reduction expected to result from the TSLs considered in this rulemaking. The emissions were calculated using the multipliers discussed in section IV.K of this document. DOE reports annual emissions reductions for each TSL in chapter 13 of the final rule TSD.

Table V.72 Cumulative Emissions Reduction for CRE Shipped During the Period 2029–2058

	Trial Standard Level				
	1	2	3	4	5
Electric Power Sector Emission					
CO_2 (*million metric tons*)	3.99	4.61	17.9	24.2	25.9
CH_4 (*thousand tons*)	0.29	0.34	1.32	1.78	1.91
N_2O (*thousand tons*)	0.04	0.05	0.18	0.25	0.26
SO_2 (*thousand tons*)	1.86	2.15	8.35	11.3	12.1
NO_X (*thousand tons*)	1.32	1.52	5.91	7.99	8.55
Hg (*tons*)	0.01	0.01	0.04	0.06	0.06
Upstream Emissions					
CO_2 (*million metric tons*)	0.41	0.47	1.83	2.48	2.66
CH_4 (*thousand tons*)	37.1	43.0	167	226	242
N_2O (*thousand tons*)	0.00	0.00	0.01	0.01	0.01
SO_2 (*thousand tons*)	6.37	7.37	28.6	38.7	41.4
NO_X (*thousand tons*)	0.02	0.03	0.11	0.15	0.16
Hg (*tons*)	0.00	0.00	0.00	0.00	0.00
Total FFC Emissions					
CO_2 (*million metric tons*)	4.39	5.09	19.7	26.7	28.6
CH_4 (*thousand tons*)	37.4	43.3	168	228	243
N_2O (*thousand tons*)	0.04	0.05	0.19	0.26	0.28
SO_2 (*thousand tons*)	8.23	9.52	36.9	50.0	53.5
NO_X (*thousand tons*)	1.34	1.55	6.02	8.14	8.71
Hg (*tons*)	0.01	0.01	0.04	0.06	0.06

* 0.00 indicates values less than 0.005

As part of the analysis for this rule, DOE estimated monetary benefits likely to result from the reduced emissions of CO_2 that DOE estimated for each of the considered TSLs for CRE. Section IV.L of this document discusses the two separate sets of estimated SC-CO_2 values that DOE used. Table V.73 and table V.74 presents the value of CO_2 emissions reductions at each TSL for each of the SC-CO_2 cases. The time-series of annual values is presented for the selected TSL in chapter 14 of the final rule TSD.

Table V.73 Present Value of CO_2 Emissions Reduction for CRE Shipped During the Period 2029–2058 (2023 SC-GHG Estimates)

TSL	SC-CO_2 Case		
	Near-term Ramsey Discount Rate		
	2.5%	2.0%	1.5%
	billion 2023$		
1	0.54	0.93	1.65
2	0.63	1.07	1.91
3	2.43	4.16	7.42
4	3.29	5.63	10.04
5	3.52	6.02	10.7

Table V.74 Present Value of CO_2 Emissions Reduction for CRE Shipped During the Period 2029–2058 (2021 Interim SC-GHG Estimates)

TSL	SC-CO_2 Case			
	Discount Rate and Statistics			
	5%	3%	2.5%	3%
	Average	Average	Average	95th percentile
	billion 2023$			
1	0.05	0.20	0.30	0.59
2	0.05	0.23	0.35	0.69
3	0.21	0.88	1.37	2.66
4	0.28	1.18	1.85	3.59
5	0.30	1.27	1.98	3.84

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.75 and table V.76 presents the value of the CH_4 emissions reduction at each TSL for each of the SC-CH_4 cases. Table V. and table V.78 presents the value of the N_2O emissions reduction at each TSL for each of the SC-N_2O cases. The time-series of annual values is presented for the selected TSL in chapter 14 of the final rule TSD.

Table V.75 Present Value of Methane Emissions Reduction for CRE Shipped During the Period 2029–2058 (2023 SC-GHG Estimates)

TSL	SC-CH_4 Case		
	Near-term Ramsey Discount Rate		
	2.5%	2.0%	1.5%
	billion 2023$		
1	0.07	0.10	0.14
2	0.08	0.11	0.16
3	0.32	0.43	0.62
4	0.43	0.59	0.84
5	0.46	0.63	0.90

Table V.76 Present Value of Methane Emissions Reduction for CRE Shipped During the Period 2029–2058 (2021 Interim SC-GHG Estimates)

TSL	SC-CH_4 Case			
	Discount Rate and Statistics			
	5%	3%	2.5%	3%
	Average	Average	Average	95th percentile
	billion 2023$			
1	0.02	0.05	0.07	0.14
2	0.02	0.06	0.09	0.16
3	0.08	0.24	0.33	0.63
4	0.11	0.32	0.45	0.86
5	0.12	0.35	0.48	0.92

Table V.77 Present Value of Nitrous Oxide Emissions Reduction for CRE Shipped During the Period 2029–2058 (2023 SC-GHG Estimates)

TSL	SC-N_2O Case		
	Near-term Ramsey Discount Rate		
	2.5%	2.0%	1.5%
	billion 2023$		
1	0.002	0.002	0.004
2	0.002	0.003	0.005
3	0.01	0.01	0.02
4	0.01	0.01	0.02
5	0.01	0.02	0.03

Table V.78 Present Value of Nitrous Oxide Emissions Reduction for CRE Shipped During the Period 2029–2058 (2021 Interim SC-GHG Estimates)

TSL	SC-N_2O Case			
	Discount Rate and Statistics			
	5%	3%	2.5%	3%
	Average	Average	Average	95th percentile
	billion 2023$			
1	0.0002	0.001	0.001	0.002
2	0.000	0.001	0.001	0.002
3	0.001	0.003	0.00	0.01
4	0.001	0.004	0.01	0.01
5	0.001	0.004	0.01	0.01

DOE is well aware that scientific and economic knowledge about the contribution of CO_2 and other GHG emissions to changes in the future global climate and the potential resulting damages to the global and U.S. economy continues to evolve rapidly. DOE, together with other Federal agencies, will continue to review methodologies for estimating the monetary value of reductions in CO_2 and other GHG emissions. This ongoing review will consider the comments on this subject that are part of the public record for this and other rulemakings, as well as other methodological assumptions and issues. DOE notes, however, that the adopted standards would be economically justified even without inclusion of monetized benefits of reduced GHG emissions.

DOE also estimated the monetary value of the economic benefits associated with NO_X and SO_2 emissions reductions anticipated to result from the considered TSLs for CRE. The dollar-per-ton values that DOE used are discussed in section IV.L of this document. Table V.79 presents the present value for NO_X emissions reduction for each TSL calculated using 7-percent and 3-percent discount rates, and table V.80 presents similar results for SO_2 emissions reductions. The results in these tables reflect application of EPA's low dollar-per-ton values, which DOE used to be conservative. The time-series of annual values is presented for the selected TSL in chapter 14 of the final rule TSD.

Table V.79 Present Value of NO_X Emissions Reduction for CRE Shipped During the Period 2029–2058

TSL	3% Discount Rate	7% Discount Rate
	million 2023$	
1	398	155
2	460	179
3	1,785	695
4	2,414	939
5	2,582	1,004

Table V.80 Present Value of SO_2 Emissions Reduction for CRE Shipped During the Period 2029–2058

TSL	3% Discount Rate	7% Discount Rate
	million 2023$	
1	91	36
2	105	42
3	408	161
4	551	218
5	590	232

Not all the public health and environmental benefits from the reduction of GHG, 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, in determining whether a standard is economically justified, may consider any other factors that the Secretary deems to be relevant. (42 U.S.C. 6295(o)(2)(B)(i)(VII), 42 U.S.C. 6316(e)(1)) No other factors were considered in this analysis.

8. Summary of Economic Impacts

Table V.81 and table V.82 presents the NPV values that result from adding the estimates of the economic benefits resulting from reduced GHG and NO_X and SO_2 emissions to the NPV of consumer benefits calculated for each TSL considered in this rulemaking. The consumer benefits are domestic U.S. monetary savings that occur as a result of purchasing the covered equipment and are measured for the lifetime of equipment shipped during the period 2029–2058. The climate benefits associated with reduced GHG emissions resulting from the adopted standards are global benefits and are also calculated based on the lifetime of CRE shipped during the period 2029–2058.

Table V.81 Consumer NPV Combined with Present Value of Climate Benefits and Health Benefits (2023 SC-GHG Estimates)

Category	TSL 1	TSL 2	TSL 3	TSL 4	TSL 5
Using 3% discount rate for Consumer NPV and Health Benefits (billion 2023$)					
2.5% Near-term Ramsey DR	1.71	2.02	8.38	8.58	-1.28
2.0% Near-term Ramsey DR	2.12	2.50	10.2	11.1	1.39
1.5% Near-term Ramsey DR	2.89	3.39	13.7	15.7	6.38
Using 7% discount rate for Consumer NPV and Health Benefits (billion 2023$)					
2.5% Near-term Ramsey DR	1.04	1.22	4.93	5.11	-0.14
2.0% Near-term Ramsey DR	1.45	1.70	6.78	7.61	2.54
1.5% Near-term Ramsey DR	2.22	2.59	10.2	12.3	7.53

Table V.82 Consumer NPV Combined with Present Value of Climate Benefits and Health Benefits (2021 Interim SC-GHG Estimates)

Category	TSL 1	TSL 2	TSL 3	TSL 4	TSL 5
Using 3% discount rate for Consumer NPV and Health Benefits (billion 2023$)					
5% Average SC-GHG case	1.2	1.4	5.9	5.2	-4.9
3% Average SC-GHG case	1.3	1.6	6.7	6.4	-3.7
2.5% Average SC-GHG case	1.5	1.7	7.3	7.2	-2.8
3% 95th percentile SC-GHG case	1.8	2.2	8.9	9.3	-0.5
Using 7% discount rate for Consumer NPV and Health Benefits (billion 2023$)					
5% Average SC-GHG case	0.5	0.6	2.5	1.8	-3.7
3% Average SC-GHG case	0.7	0.8	3.3	2.9	-2.5
2.5% Average SC-GHG case	0.8	1.0	3.9	3.7	-1.7
3% 95th percentile SC-GHG case	1.2	1.4	5.5	5.8	0.6

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)(i))

For this final rule, 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 business owners and renters). Having less than perfect foresight and a high degree of uncertainty about the future, consumers may trade off these types of investments at a higher-than-expected rate between current consumption and uncertain future energy cost savings.

In DOE's current regulatory analysis, potential changes in the benefits and costs of a regulation due to changes in consumer purchase decisions are included in two ways. First, if consumers forgo the purchase of CRE in the standards case, this decreases sales for manufacturers, and the impact on manufacturers attributed to lost revenue is included in the MIA. Second, DOE accounts for energy savings attributable only to equipment actually used by consumers in the standards case; if a standard decreases the number of equipment purchased by consumers, this decreases the potential energy savings from an energy conservation standard. DOE provides estimates of shipments and changes in the volume of CRE purchases in chapter 9 of the final rule TSD.

1. Benefits and Burdens of TSLs Considered for CRE Standards

Table V.83 and table V.84 summarize the quantitative impacts estimated for each TSL for CRE. The national impacts are measured over the lifetime of CRE purchased during the 30-year period that begins in the anticipated year of compliance with amended standards (2029–2058). The energy savings, emissions reductions, and value of emissions reductions refer to full-fuel-cycle results. DOE is presenting monetized benefits of GHG emissions reductions in accordance with the applicable Executive orders, and DOE would reach the same conclusion presented in this notice in the absence of the SC-GHG, including the 2023 SC-GHG. The efficiency levels contained in each TSL are described in section V.A of this document.

Table V.83 Summary of Analytical Results for CRE at all TSLs: National Impacts

Category	TSL 1	TSL 2	TSL 3	TSL 4	TSL 5
Cumulative FFC National Energy Savings					
FFC (Quads)	0.25	0.29	**1.11**	1.50	1.61
Cumulative FFC Emissions Reduction					
CO_2 (*million metric tons*)	4.39	5.09	**19.7**	26.7	28.6
CH_4 (*thousand tons*)	37.4	43.3	**168**	228	243
N_2O (*thousand tons*)	0.04	0.05	**0.19**	0.26	0.28
NO_x (*thousand tons*)	8.23	9.52	**36.9**	50.0	53.5
SO_2 (*thousand tons*)	1.34	1.55	**6.02**	8.14	8.71
Hg (*tons*)	0.01	0.01	**0.04**	0.06	0.06
Present Value of Benefits and Costs (*3% discount rate, billion 2023$*)					
Consumer Operating Cost Savings	0.84	1.02	**4.61**	6.90	7.40
Climate Benefits* (2023 SC-GHG)	1.03	1.19	**4.60**	6.23	6.66
Climate Benefits* (2021 interim SC-GHG estimates)	0.25	0.29	**1.12**	1.51	1.62
Health Benefits**	0.49	0.57	**2.19**	2.97	3.17
Total Benefits† (2023 SC-GHG estimates)	2.35	2.77	**11.4**	16.1	17.2
Total Benefits† (2021 interim SC-GHG estimates)	1.58	1.87	**7.92**	11.38	12.19
Consumer Incremental Equipment Costs‡	0.24	0.27	**1.18**	5.02	15.8
Consumer Net Benefits	0.60	0.74	**3.43**	1.89	-8.45
Net Benefits† (2023 SC-GHG estimates)	2.12	2.50	**10.2**	11.1	1.39
Net Benefits† (2021 interim SC-GHG estimates)	1.34	1.60	**6.74**	6.36	-3.66
Present Value of Benefits and Costs (*7% discount rate, billion 2023$*)					
Consumer Operating Cost Savings	0.36	0.44	**1.99**	2.97	3.19
Climate Benefits* (2023 SC-GHG estimates)	1.03	1.19	**4.60**	6.23	6.66
Climate Benefits* (2021 interim SC-GHG estimates)	0.25	0.29	**1.12**	1.51	1.62
Health Benefits**	0.19	0.22	**0.86**	1.16	1.24
Total Benefits† (2023 SC-GHG estimates)	1.58	1.85	**7.45**	10.4	11.1
Total Benefits† (2021 interim SC-GHG estimates)	0.80	0.95	**3.96**	5.64	6.04
Consumer Incremental Equipment Costs‡	0.13	0.15	**0.67**	2.75	8.55
Consumer Net Benefits	0.24	0.29	**1.32**	0.22	-5.36
Net Benefits† (2023 SC-GHG estimates)	1.45	1.70	**6.78**	7.61	2.54
Net Benefits† (2021 interim SC-GHG estimates)	0.68	0.80	**3.29**	2.89	-2.51

Note: This table presents the costs and benefits associated with CRE shipped during the period 2029−2058. These results include benefits to consumers which accrue after 2058 from the equipment shipped during the period 2029−2058. TSL 3 (highlighted) is the selected TSL.

* Climate benefits are calculated different estimates of the SC-CO2, SC-CH4 and SC-N2O. Climate benefits are estimated using two separate sets of estimates of the social cost for each greenhouse gas, an updated set published in 2023 by the Environmental Protection Agency (EPA) ("2023 SC-GHG") and the interim set of estimates used in the NOPR which were published in 2021 by the Interagency Working Group on the SC-GHG (IWG) ("2021 Interim 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 2 percent near-term Ramsey discount rate are shown for the 2023 SC-GHG estimates, and the climate benefits associated with the average SC-GHG at a 3-percent discount rate are shown for the 2021 interim SC-GHG estimates.

** 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. Table 5 of the EPA's *Estimating the Benefit per Ton of Reducing PM2.5 Precursors from 21 Sectors* TSD provides a summary of the health impact endpoints quantified in the analysis. 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 2-percent near term Ramsey discount rate for the 2023 SC-GHG estimates and the average SC-GHG with 3-percent discount rate for the 2021 interim SC-GHG estimates.

‡ Costs include incremental equipment costs.

Table V.84 Summary of Analytical Results for CRE TSLs: Manufacturer and Consumer Impacts

Category	TSL 1	TSL 2	TSL 3	TSL 4	TSL 5
Manufacturer Impacts					
Industry NPV (*million 2023$*) (No-new-standards case INPV = 3,022.3)	2,997.6 to 3,001.5	2,994.8 to 2,999.2	2,943.6 to 2,971.0	2,862.2 to 2,958.8	2,800.6 to 3,077.5
Industry NPV (*% change*)	(0.8) to (0.7)	(0.9) to (0.8)	(2.6) to (1.7)	(5.3) to (2.1)	(7.3) to 1.8
Consumer Average LCC Savings (2023$)					
CB.SC.L	44.3	75.4	163.6	163.6	163.6
CB.SC.M	24.6	46.4	8.1	8.1	8.1
HCS.SC.L	24.1	24.1	24.1	24.1	24.1
HCS.SC.M	12.4	18.9	18.9	18.9	18.9
HCT.SC.I	26.7	29.3	29.3	29.3	(309.8)
HCT.SC.L	n/a	n/a	n/a	n/a	(430.4)
HCT.SC.M	n/a	n/a	n/a	n/a	(340.7)
HZO.RC.L	n/a	n/a	n/a	n/a	n/a
HZO.RC.M	n/a	n/a	n/a	n/a	n/a
HZO.SC.L	54.0	54.0	1,243.6	1,243.6	1,243.6
HZO.SC.M	39.2	39.2	312.9	312.9	312.9
SOC.RC.M	n/a	n/a	n/a	743.4	(181.4)
SOC.SC.M	441.5	481.5	443.5	183.2	183.2
SVO.RC.M	97.1	97.1	97.1	473.0	473.0
SVO.SC.M	430.2	576.1	578.9	642.4	642.4
VCS.SC.H	9.8	9.8	9.8	9.8	(57.7)
VCS.SC.I	45.1	70.8	488.2	488.2	488.2
VCS.SC.L	43.3	88.0	470.5	470.5	470.5
VCS.SC.M	29.1	29.1	29.1	(42.0)	(42.0)
VCT.RC.L	n/a	n/a	n/a	(182.9)	(3,080.4)
VCT.RC.M	n/a	n/a	n/a	(108.3)	(3,333.3)
VCT.SC.H	14.6	19.3	19.3	19.3	(1,467.3)
VCT.SC.I	n/a	n/a	n/a	n/a	(990.6)
VCT.SC.L	45.2	45.2	436.9	(809.8)	(809.8)
VCT.SC.M	28.0	28.0	33.2	(66.0)	(1,421.6)
VOP.RC.L	1,300.4	1,300.4	1,300.4	1,529.7	1,529.7
VOP.RC.M	337.4	337.4	337.4	798.0	798.0
VOP.SC.M	604.6	915.5	1,867.5	1,945.9	1,945.9
Shipment-Weighted Average*	42.8	49.8	115.8	8.3	(606.9)
Consumer Simple PBP (years)					
CB.SC.L	1.2	1.8	4.0	4.0	4.0
CB.SC.M	1.9	2.8	6.8	6.8	6.8
HCS.SC.L	3.2	3.2	3.2	3.2	3.2
HCS.SC.M	3.9	4.0	4.0	4.0	4.0
HCT.SC.I	7.1	7.0	7.0	7.0	20.5
HCT.SC.L	n/a	n/a	n/a	n/a	52.6
HCT.SC.M	n/a	n/a	n/a	n/a	114.9
HZO.RC.L	n/a	n/a	n/a	n/a	n/a
HZO.RC.M	n/a	n/a	n/a	n/a	n/a
HZO.SC.L	1.8	1.8	2.4	2.4	2.4

HZO.SC.M	2.3	2.3	2.6	2.6	2.6
SOC.RC.M	n/a	n/a	n/a	4.8	18.3
SOC.SC.M	0.5	0.7	2.4	7.0	7.0
SVO.RC.M	2.4	2.4	2.4	3.5	3.5
SVO.SC.M	0.9	1.0	4.1	4.4	4.4
VCS.SC.H	4.0	4.0	4.0	4.0	9.8
VCS.SC.I	1.2	1.8	3.1	3.1	3.1
VCS.SC.L	1.2	1.8	2.2	2.2	2.2
VCS.SC.M	3.0	3.0	3.0	9.6	9.6
VCT.RC.L	n/a	n/a	n/a	16.8	57.3
VCT.RC.M	n/a	n/a	n/a	19.8	107.3
VCT.SC.H	2.7	4.0	4.0	4.0	69.2
VCT.SC.I	n/a	n/a	n/a	n/a	39.0
VCT.SC.L	2.2	2.2	3.5	16.9	16.9
VCT.SC.M	3.1	3.1	6.5	11.6	55.6
VOP.RC.L	0.9	0.9	0.9	1.6	1.6
VOP.RC.M	1.8	1.8	1.8	2.7	2.7
VOP.SC.M	0.7	0.9	1.4	1.8	1.8
Shipment-Weighted Average*	2.4	2.5	3.5	9.5	27.9
Percent of Consumers that Experience a Net Cost					
CB.SC.L	0%	0%	9%	9%	9%
CB.SC.M	0%	1%	26%	26%	26%
HCS.SC.L	4%	4%	4%	4%	4%
HCS.SC.M	3%	9%	9%	9%	9%
HCT.SC.I	10%	10%	10%	10%	59%
HCT.SC.L	n/a	n/a	n/a	n/a	61%
HCT.SC.M	n/a	n/a	n/a	n/a	86%
HZO.RC.L	n/a	n/a	n/a	n/a	n/a
HZO.RC.M	n/a	n/a	n/a	n/a	n/a
HZO.SC.L	0%	0%	0%	0%	0%
HZO.SC.M	0%	0%	1%	1%	1%
SOC.RC.M	n/a	n/a	n/a	16%	37%
SOC.SC.M	0%	0%	4%	23%	23%
SVO.RC.M	26%	26%	26%	15%	15%
SVO.SC.M	0%	0%	12%	10%	10%
VCS.SC.H	6%	6%	6%	6%	59%
VCS.SC.I	0%	0%	4%	4%	4%
VCS.SC.L	0%	0%	0%	0%	0%
VCS.SC.M	3%	3%	3%	52%	52%
VCT.RC.L	n/a	n/a	n/a	70%	86%
VCT.RC.M	n/a	n/a	n/a	32%	56%
VCT.SC.H	1%	7%	7%	7%	73%
VCT.SC.I	n/a	n/a	n/a	n/a	48%
VCT.SC.L	0%	0%	7%	83%	83%
VCT.SC.M	3%	3%	25%	45%	61%
VOP.RC.L	0%	0%	0%	3%	3%
VOP.RC.M	4%	4%	4%	7%	7%
VOP.SC.M	0%	0%	0%	0%	0%
Shipment-Weighted Average*	2%	3%	9%	40%	48%

Parentheses indicate negative (-) values. The entry "n/a" 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 2029.

This section discusses DOE's conclusions regarding CRE connected to a remote condensing unit and non-large CRE connected to a self-contained unit. As discussed previously in sections I and II.B.3 of this document, DOE is continuing to analyze the large-capacity ranges presented in table IV. for the VOP.SC.M, SVO.SC.M, HZO.SC.L, SOC.SC.M, VCT.SC.M, VCT.SC.L, and VCS.SC.L equipment classes.

DOE first considered TSL 5, which represents the max-tech efficiency levels for all equipment classes. The design options DOE analyzed at this level include the max-tech technologies for all equipment classes. DOE expects manufacturers would likely need to incorporate occupancy sensors with dimming capability for all vertical and semi-vertical open and all transparent door equipment classes. Vertical and semi-vertical open equipment classes would also likely necessitate the use of night curtains. For equipment classes with transparent doors, DOE expects manufacturers would likely need to incorporate vacuum-insulated glass doors. For most self-contained equipment, DOE expects manufacturers would likely need to incorporate variable-speed compressors. For all self-contained equipment classes, DOE expects manufacturers would likely incorporate EC evaporator and condenser fan motors.

TSL 5 would save an estimated 1.61 quads of FFC energy over 30 years of shipments (2029 to 2058), an amount DOE considers significant. Under TSL 5, the NPV of consumer benefits would be −$5.36 billion using a discount rate of 7 percent, and −$8.45 billion using a discount rate of 3 percent for the same 30-year period.

The cumulative emissions reductions at TSL 5 are 28.6 Mt of CO_2, 8.71 thousand tons of SO_2, 53.5 thousand tons of NO_X, 0.06 tons of Hg, 243 thousand tons of CH_4, and 0.28 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 2023 SC-GHG estimates at a 2-percent, near-term Ramsey discount rate) at TSL 5 is $6.66 billion, and the climate benefits associated with the average 2021 Interim SC-GHG estimates at a 3-percent discount rate are estimated to be $1.62 billion. The estimated monetary value of the health benefits from reduced SO_2 and NO_X emissions at TSL 5 is $1.24 billion using a 7-percent discount rate and $3.17 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 either the 2-percent near-term Ramsey discount rate case for climate benefits from reduced GHG emissions, or the 3-percent discount rate case for climate benefits from reduced GHG emissions, the estimated total NPV at TSL 5 is $2.54 billion (using the 2023 SC-GHG estimates) or −$2.51 billion (using the 2021 interim SC-GHG estimates). Using a 3-percent discount rate for consumer benefits and costs and health benefits from reduced NOx and SO_2 emissions, and either the 2-percent discount rate case for climate benefits from reduced GHG emissions or 3-percent discount rate case for, the estimated total NPV at TSL 5 is $1.39 billion (using the 2023 SC-GHG estimates) or −$3.66 billion (using the 2021 interim SC-GHG estimates). 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 of CRE experience average LCC savings ranging from −$3,333 to $1,946 with a payback period ranging from 1.6 years to 114.9 years. The LCC savings are negative for 12 of the 28 analyzed equipment classes, representing 78 percent of annual shipments. For example, the equipment class with the highest annual shipments volume (VCS.SC.M), representing approximately 36 percent of annual CRE shipments, has negative LCC savings of −$42 with 52 percent of consumers experiencing a net cost, and a PBP of 9.6 years. The second-highest equipment class in terms of annual units shipped (VCT.SC.M), representing about 25 percent of annual CRE shipments, has negative LCC savings of −$1,422 with 61 percent of consumers experiencing a net cost, and a PBP of 55.6 years. Overall, almost half of CRE purchasers (48 percent) experience a net cost. Furthermore, the shipment-weighted-average PBP is estimated at 27.8 years, which is generally higher than the average CRE lifetime, while the shipment-weighted-average LCC savings is negative, at −$608.

At TSL 5, the projected change in INPV ranges from a decrease of $221.7 million to an increase of $55.2 million, which corresponds to a decrease of 7.3 percent and an increase of 1.8 percent, respectively. DOE estimates that manufacturers would need to invest $254.1 million to update equipment designs and source, qualify, and test high-efficiency components across their entire CRE portfolio. DOE estimates that approximately 55 percent of analyzed equipment class model listings in its CCD (10,957 unique basic models out of a total of 19,902) do not meet the max-tech efficiency levels required.

At this level, although most design options would not necessitate purchasing new equipment or significant capital investment, nearly all manufacturers would need to spend notable development time incorporating the analyzed max-tech design options across their entire CRE portfolio. For the 84 manufacturers that offer CRE with transparent doors (which account for approximately 41 percent of model listings), 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 new technology in the commercial refrigeration market. Manufacturers pointed to the very limited industry experience with implementing vacuum-insulated glass in CRE applications. In addition to incorporating vacuum-insulated glass into transparent door CRE designs, DOE expects most manufacturers would have to invest in extensive redesign and development to incorporate variable-speed compressors across nearly all self-contained CRE models.

Based on this analysis, the Secretary concludes that at TSL 5 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 impacts 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. Almost half of CRE purchasers (48 percent) experience a net cost. Furthermore, the shipment-weighted average LCC savings are negative (−$608) and the shipment-weighted average PBP exceeds the average CRE lifetime, at 27.8 years. Consequently, the Secretary has concluded that TSL 5 is not economically justified.

DOE then considered TSL 4, an intermediate TSL representing less stringent efficiency levels for approximately one-third of the equipment classes analyzed compared to TSL 5. DOE expects manufacturers would likely need to incorporate occupancy sensors with dimming capability for all vertical and semi-vertical open and most transparent door equipment classes. Vertical and semi-vertical open equipment classes would also likely necessitate the use of night curtains. For most equipment classes with transparent doors, DOE expects manufacturers would incorporate triple-pane, argon-filled glass doors, triple-pane, krypton-filled glass doors, or vacuum-insulated glass doors. For most self-contained equipment classes, DOE expects manufacturers would likely need to incorporate variable-speed compressors. For all self-contained equipment classes, DOE expects manufacturers would likely incorporate EC evaporator and condenser fan motors.

TSL 4 would save an estimated 1.50 quads of full fuel cycle energy over 30 years of shipments (2029 to 2058), an amount DOE considers significant. Under TSL 4, the NPV of consumer benefit would be $0.22 billion using a discount rate of 7 percent, and $1.89 billion using a discount rate of 3 percent.

The cumulative emissions reductions at TSL 4 are 26.7 Mt of CO_2, 8.14 thousand tons of SO_2, 50 thousand tons of NO_X, 0.06 tons of Hg, 228 thousand tons of CH_4, and 0.26 thousand tons of N_2O. The estimated monetary value of the climate benefits from reduced GHG emissions at TSL 4 is $6.23 billion (using the 2023 SC–GHG estimates at a 2-percent near-term Ramsey discount rate) or $1.51 billion (using 2021 interim SC–GHG estimates at an average 3-percent discount rate). The estimated monetary value of the health benefits from reduced SO_2 and NO_X emissions at TSL 4 is $1.16 billion using a 7-percent discount rate and $2.97 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 either the 2-percent near-term Ramsey discount rate case or the 3-percent discount rate case for climate benefits from reduced GHG emissions, the estimated total NPV at TSL 4 is $7.61 billion (using the 2023 SC–GHG estimates) or $2.89 billion (using the 2021 interim SC–GHG estimates). Using a 3-percent discount rate for consumer benefits and costs and health benefits from reduced NO_X and SO_2 emissions, and the 2-percent near-term Ramsey discount rate case or the 3-percent discount rate case for climate benefits from reduced GHG emissions, the estimated total NPV at TSL 4 is $11.08 billion (using the 2023 SC–GHG estimates) or $6.36 billion (using the 2021 interim SC–GHG estimates). 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 4, affected purchasers for each CRE equipment class experience average LCC savings ranging from −$810 to $1,946 with a payback period ranging from 1.6 years to 19.8 years. The LCC savings are negative for 5 of the 28 analyzed equipment classes, representing 75 percent of annual shipments. For example, the equipment class with the highest annual shipments volume (VCS.SC.M), representing approximately 36 percent of annual CRE shipments, has negative LCC savings of −$42 with 52 percent of consumers experiencing a net cost, and a PBP of 9.6 years. The second-highest equipment class in terms of annual units shipped (VCT.SC.M), representing about 25 percent of annual CRE shipments, has negative LCC savings of −$66 with 45 percent of consumers experiencing a net cost, and a PBP of 11.6 years. Overall, approximately 40 percent of affected CRE purchasers would experience a net cost, while 27 percent would experience a net benefit, and the remaining purchasers would be unaffected at TSL 4. In addition, the estimated shipment-weighted average LCC savings for all CRE is $8 and the shipment-weighted average PBP is 9.5 years.

At TSL 4, the projected change in INPV ranges from a decrease of $160.1 million to a decrease of $63.5 million, which correspond to decreases of 5.3 percent and 2.1 percent, respectively. DOE estimates that industry would need to invest $223.9 million to comply with standards set at TSL 4. Similar to TSL 5, DOE estimates that over half of CRE models would require redesign to meet standards set at TSL 4. Specifically, DOE estimates that approximately 53 percent of analyzed equipment class model listings in its CCD (10,574 unique basic models out of a total of 19,902) do not meet the TSL 4 efficiency levels.

Similar to TSL 5, DOE expects manufacturers would need to dedicate notable engineering resources and time to update equipment designs and source, qualify, and test high-efficiency components. DOE also expects some manufacturers would need to invest in new tooling to accommodate the additional door thickness associated with incorporating additional panes of glass into CRE designs. At this level, DOE expects 7 out of the 11 directly analyzed transparent door equipment classes would likely necessitate vacuum-insulated glass doors or other improved door designs. Specifically, DOE expects SOC.SC.M and VCT.SC.L (which represent approximately 9 percent of transparent door CRE model listings) would incorporate vacuum-insulated glass doors, SOC.RC.M, VCT.RC.L, and VCT.RC.M (which represent approximately 63 percent of transparent door CRE model listings) would incorporate triple-pane glass doors with krypton fill, and HCT.SC.I and VCT.SC.M (which represent approximately 25 percent of transparent door CRE model listings) would incorporate triple-pane glass doors with argon fill at this level. As previously discussed, many manufacturers raised concerns about the widespread adoption of vacuum-insulated glass because the industry does not have widescale experience integrating this technology into their designs. In interviews and public comments, some manufacturers also raised concerns about the limited supply of krypton gas available to the market. (Hillphoenix, No. 77 at p. 6; Zero Zone, No. 75 at pp. 3–4) Currently, few CRE designs have triple-pane glass doors with krypton fill as nearly all CRE with double-pane or triple-pane doors are manufactured with argon fill, and single-pane doors do not have an inert gas fill. At this level, DOE expects most self-contained equipment classes (representing approximately 90 percent of self-contained CRE model listings) would likely necessitate the use of variable-speed compressors. Therefore, DOE expects most manufacturers would still have to invest in significant redesign and development time to optimize variable-speed compressors to ensure energy efficiency benefits across the majority of self-contained CRE designs.

Most CRE manufacturers offer an exhaustive range of model offerings to appeal to the unique requirements of each CRE consumer. Within a model family, manufacturers offer numerous options to customize CRE to the specifications of restaurant, supermarket, and retail chains and other bulk purchasers of CRE (*e.g.,* Coca-Cola, Pepsi). In interviews, many manufacturers noted that offering a wide-range of models with a high-level of customization and optionality (*e.g.,* different evaporator setups, different lighting arrangements, different door configurations, *etc.*) is critical to succeed in the CRE market. Many manufacturers prioritize offering a breadth of model offerings and specialty CRE, even if sales of each individual model are low. As such, manufacturers still offer hundreds of basic models for equipment classes with low annual shipments. For example, SOC.RC.M accounts for approximately 5 percent of model listings (over 1,000 unique basic models certified in DOE's CCD) even though SOC.RC.M only accounts for 0.1 percent of industry shipments (less than 2,000 units sold in 2024).

Multiple stakeholders raised concerns about the risk that stringent standards and limited laboratory and engineering resources would force manufacturers to discontinue certain equipment designs and prioritize redesigning high-volume model offerings. (Continental, No. 107 at p. 3; Continental, No. 86 at p. 6; NAFEM, No. 87 at p. 2; Structural Concepts, No. 74 at p. 4) Some manufacturers expressed concern that the discontinuation of model offerings could lead to equipment commoditization where equipment can only compete on price rather than value-added options and features. In addition to the impacts that extensive redesign and testing may have on CRE manufacturers overall, it would also disproportionately impact small businesses, which typically have limited personnel, engineering, and laboratory resources relative to larger CRE manufacturers and account for approximately 20 percent of CRE manufacturers (20 out of 103 OEMs).

Based on this analysis, the Secretary concludes that at TSL 4 for CRE, the benefits of energy savings, emission reductions, and the estimated monetary value of the emissions reductions would be outweighed by the economic burden on a large fraction of CRE purchasers, the risk of reduced customization and optionality if manufacturers have insufficient resources to redesign their full portfolio of models within the compliance period, the impacts on manufacturers including small businesses, including the conversion costs that could result in a reduction in INPV, and limited industry experience with vacuum-insulated glass doors in commercial applications. If manufacturers do not have sufficient resources to redesign models within the compliance period, manufacturers would likely discontinue low-volume equipment designs and prioritize redesigning high-volume model offerings, potentially leading to equipment commoditization. Finally, although the shipments-weighted average LCC savings for all CRE are marginally positive (at $8), overall the LCC savings are negative for five equipment classes representing 75 percent of annual shipments. Consequently, the Secretary has concluded that TSL 4 is not economically justified.

DOE then considered TSL 3, an intermediate TSL representing less stringent efficiency levels for 12 equipment classes compared to TSL 4. In contrast to TSL 4 and TSL 5, DOE expects that manufacturers could meet TSL 3 efficiencies without incorporating occupancy sensors with dimming capability into vertical and semi-vertical open and transparent door CRE designs, and without use of vacuum-insulated-glass or triple-pane glass with krypton fill into transparent door CRE designs. For vertical and semi-vertical open equipment classes, DOE expects manufacturers would likely require the use of night curtains. For some equipment classes with transparent doors, DOE expects manufacturers would incorporate triple-pane, argon-filled glass doors. For all self-contained equipment classes, DOE expects manufacturers would incorporate EC evaporator and condenser fan motors. For most self-contained equipment classes, DOE expects manufacturers would likely need to incorporate variable-speed compressors. DOE also expects that, given the reduced number of models requiring redesign at this TSL and the lower overall cost to implement this level compared with TSL 4, manufacturers would be able to continue to offer numerous options to customize CRE to the specifications of restaurant, supermarket, and retail chains and other bulk purchasers of CRE (*e.g.,* Coca-Cola, Pepsi) and offer a wide-range of models with a high-level of customization and optionality (*e.g.,* different evaporator setups, different lighting arrangements, different door configurations, *etc.*) which is critical to succeed in the CRE market.

TSL 3 would save an estimated 1.11 quads of full fuel cycle energy over 30 years of shipments (2029 to 2058), an amount DOE considers significant. Under TSL 3, the NPV of consumer benefit would be $1.32 billion using a discount rate of 7 percent, and $3.43 billion using a discount rate of 3 percent.

The cumulative emissions reductions at TSL 3 are 19.7 Mt of CO_2, 6.02 thousand tons of SO_2, 36.9 thousand tons of NO_X, 0.04 tons of Hg, 168 thousand tons of CH_4, and 0.19 thousand tons of N_2O. At TSL 3, the estimated monetary value of the climate benefits from reduced GHG emissions is $4.6 billion (using the SC–GHG estimates at a 2-percent near term Ramsey discount rate) or $1.12 billion (using the 2021 interim SC–GHG estimates at an average 3-percent discount rate) . The estimated monetary value of the health benefits from reduced SO_2 and NO_X emissions at TSL 3 is $0.86 billion using a 7-percent discount rate and $2.19 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 either the 2-percent near term Ramsey discount rate case or the 3-percent discount rate case for climate benefits from reduced GHG emissions, the estimated total NPV at TSL 3 is $6.78 billion (using the 2023 SC–GHG estimates) or $3.29 billion (using the 2021 interim SC–GHG estimates). Using a 3-percent discount rate for consumer benefits and costs and health benefits from reduced NO_X and SO_2 emissions, and either the 2-percent near-term Ramsey discount rate case or the 3-percent discount rate case for climate benefits from reduced GHG emissions, the estimated total NPV at TSL 3 is $10.2 billion (using the 2023 SC–GHG estimates) or $6.74 billion (using the 2021 interim SC–GHG estimates). 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 3, affected purchasers for each CRE equipment class experience an average LCC savings ranging from $8 to $1,868 with a payback period ranging from 0.9 years to 7.0 years. For example, for equipment classes VCS.SC.M, VCT.SC.M, VCS.SC.L, and VCT.SC.L, which account for 77 percent of annual CRE shipments, there is a net LCC savings of $29, $33, $471, and $437 and a PBP of 3.0, 6.5, 2.2, and 3.5 years, respectively. Overall, approximately 91 percent of affected CRE purchasers would experience a net benefit or not be affected at TSL 3. Furthermore, the estimated shipment-weighted-average LCC savings is $116 and PBP is 3.5 years, which is lower than the average CRE lifetime.

At TSL 3, the projected change in INPV ranges from a decrease of $78.7 million to a decrease of $51.3 million, which correspond to decreases of 2.6 percent and 1.7 percent, respectively. DOE estimates that industry must invest $117.7 million to comply with standards set at TSL 3. At this level, notably fewer models would require redesign compared to TSL 4 and TSL 5. DOE estimates that approximately 37 percent of analyzed equipment class model listings in its CCD (7,306 unique basic models out of a total of 19,902) do not meet the TSL 3 efficiency levels required.

Similar to TSL 4 and TSL 5, DOE expects manufacturers would spend development time updating equipment designs to incorporate high-efficiency components. However, DOE expects manufacturers could meet TSL 3 without implementing triple-pane doors with krypton fill or vacuum-insulated glass doors, alleviating industry concerns about the availability and supply of krypton gas and vacuum-insulated glass. Additionally, DOE expects fewer equipment classes would necessitate the use of variable-speed compressors. At TSL 3, approximately 63 percent of self-contained CRE model listings may need to incorporate variable-speed compressors, significantly less than at TSL 4 where DOE expects 90 percent of self-contained CRE model listings would necessitate the use of variable-speed compressors. Since the majority of basic models (63 percent of model listings) already meet TSL 3 efficiencies, the estimated industry investment and strain on manufacturers' testing facilities and engineering resources would be less at TSL 3 than at TSL 4 and TSL 5, reducing the risk that manufacturers would need to prioritize resources and discontinue low-volume CRE designs.

After considering the analysis and weighing the benefits and burdens, the Secretary has concluded that a standard set at TSL 3 for CRE would be economically justified. At this TSL, the average LCC savings for all affected purchasers are positive. An estimated 42 percent of purchasers experience a net benefit, while 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 3, the NPV of consumer benefits, even measured at the more conservative discount rate of 7 percent is over 16 times higher than the maximum estimated manufacturers' loss in INPV. The standard levels at TSL 3 are economically justified even without weighing the estimated monetary value of emissions reductions. When those emissions reductions are included—representing $4.6 billion in climate benefits (associated with the average SC–GHG at a 2-percent near-term Ramsey discount rate), and $2.19 billion (using a 3-percent discount rate) or $0.86 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 amended energy conservation standards, DOE notes that as compared to TSL 5 and TSL 4, TSL 3 has a lower maximum decrease in INPV and lower manufacturer conversion costs. Furthermore, DOE notes that notably more basic models meet TSL 3 compared TSL 4 and TSL 5, reducing the amount of time and investment associated with redesigning and testing CRE models.

Finally, compared to TSL 5 and TSL 4, TSL 3 results in the highest consumer NPV and positive LCC savings for all CRE equipment classes, while PBPs for each equipment class are considerably less than the average CRE lifetime. In addition, DOE has determined that a 4-year compliance period to redesign CRE to meet the adopted standards will help alleviate manufacturers' concerns about engineering and laboratory resource constraints. Furthermore, the longer compliance period will help mitigate cumulative regulatory burden by allowing manufacturers more flexibility to spread investments across 4 years instead of 3 years. Manufacturers will also have more time to recoup any investments made to redesign CRE to comply with the October 2023 EPA Final Rule as compared to a 3-year compliance period.

Therefore, based on the previous considerations, DOE adopts the energy conservation standards for CRE at TSL 3. The new and amended energy conservation standards for CRE, which are expressed as kWh/day, are shown in table V.85.

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Table V.85 New and Amended Energy Conservation Standards for CRE

Equipment Class	Capacity Range	Maximum Daily Energy Consumption *kWh/day*
VOP.RC.H	All TDAs are applicable	0.551 × TDA + 3.506
VOP.RC.M	All TDAs are applicable	0.591 × TDA + 3.758
VOP.RC.L	All TDAs are applicable	2.079 × TDA + 6.472
VOP.RC.I	All TDAs are applicable	2.637 × TDA + 8.222
SVO.RC.H	All TDAs are applicable	0.572 × TDA + 2.756
SVO.RC.M	All TDAs are applicable	0.611 × TDA + 2.944
SVO.RC.L	All TDAs are applicable	2.079 × TDA + 6.473
SVO.RC.I	All TDAs are applicable	2.637 × TDA + 8.222
HZO.RC.H	All TDAs are applicable	0.350 × TDA + 2.880
HZO.RC.M	All TDAs are applicable	0.350 × TDA + 2.880
HZO.RC.L	All TDAs are applicable	0.550 × TDA + 6.880
HZO.RC.I	All TDAs are applicable	0.700 × TDA + 8.740
VCT.RC.H	All TDAs are applicable	0.150 × TDA + 1.950
VCT.RC.M	All TDAs are applicable	0.150 × TDA + 1.950
VCT.RC.L	All TDAs are applicable	0.490 × TDA + 2.610
VCT.RC.I	All TDAs are applicable	0.580 × TDA + 3.050
HCT.RC.M	All TDAs are applicable	0.160 × TDA + 0.130
HCT.RC.L	All TDAs are applicable	0.340 × TDA + 0.260
HCT.RC.I	All TDAs are applicable	0.356 × TDA + 0.276
VCS.RC.H	All volumes are applicable	0.100 × V + 0.260
VCS.RC.M	All volumes are applicable	0.100 × V + 0.260
VCS.RC.L	All volumes are applicable	0.210 × V + 0.540
VCS.RC.I	All volumes are applicable	0.250 × V + 0.630
HCS.RC.M	All volumes are applicable	0.100 × V + 0.260
HCS.RC.L	All volumes are applicable	0.210 × V + 0.540
HCS.RC.I	All volumes are applicable	0.250 × V + 0.630
SOC.RC.H	All TDAs are applicable	0.440 × TDA + 0.110
SOC.RC.M	All TDAs are applicable	0.440 × TDA + 0.110
SOC.RC.L	All TDAs are applicable	0.930 × TDA + 0.220
SOC.RC.I	All TDAs are applicable	0.970 × TDA + 0.231
CB.RC.M	All volumes are applicable	0.050 × V + 0.686
CB.RC.L	All volumes are applicable	0.194 × V + 1.693
VOP.SC.H	All TDAs are applicable	0.890 × TDA + 2.480[1]
VOP.SC.M – Non-Large	TDA ≤ 17	1.230 × TDA + 3.428
VOP.SC.M – Large***	TDA > 17	1.690 × TDA + 4.710
VOP.SC.L	All TDAs are applicable	3.092 × TDA + 8.598
VOP.SC.I	All TDAs are applicable	3.928 × TDA + 10.926
SVO.SC.H	All volumes are applicable	1.045 × TDA + 2.822
SVO.SC.M – Non-Large	TDA ≤ 15	1.207 × TDA + 3.258
SVO.SC.M – Large***	TDA > 15	1.700 × TDA + 4.590
SVO.SC.L	All TDAs are applicable	3.024 × TDA + 8.169

SVO.SC.I	All TDAs are applicable	3.840 × TDA + 10.384
HZO.SC.H	All TDAs are applicable	0.546 × TDA + 4.211
HZO.SC.M	All TDAs are applicable	0.532 × TDA + 4.100
HZO.SC.L – Non-Large	TDA ≤ 35	1.490 × TDA + 5.554
HZO.SC.L – Large***	TDA > 35	1.900 × TDA + 7.080
HZO.SC.I	All TDAs are applicable	1.900 × TDA + 7.065
VCT.SC.H	All volumes are applicable	0.047 × V + 0.493
VCT.SC.M – Non-Large	V ≤ 100	0.073 × V + 0.630
VCT.SC.M with Feature**	V ≤ 100	0.078 × V + 0.674
VCT.SC.M – Large***	V > 100	0.100 × V + 0.860
VCT.SC.L – Non-Large	V ≤ 70	0.233 × V + 2.374
VCT.SC.L with Feature**	V ≤ 70	0.249 × V + 2.540
VCT.SC.L – Large***	V > 70	0.290 × V + 2.950
VCT.SC.I	All TDAs are applicable	0.620 × TDA + 3.290
HCT.SC.M	All volumes are applicable	0.060 × V + 0.370
HCT.SC.L	All volumes are applicable	0.080 × V + 1.230
HCT.SC.I	All TDAs are applicable	0.498 × TDA + 0.383
VCS.SC.H	All volumes are applicable	0.021 × V + 0.793
VCS.SC.M	All volumes are applicable	0.038 × V + 1.039
VCS.SC.M with Feature**	All volumes are applicable	0.041 × V + 1.112
VCS.SC.L – Non-Large	V ≤ 100	0.169 × V + 1.050
VCS.SC.L with Feature**	V ≤ 100	0.181 × V + 1.133
VCS.SC.L – Large***	V > 100	0.220 × V + 1.380
VCS.SC.I	All volumes are applicable	0.264 × V + 0.683
HCS.SC.M	All volumes are applicable	0.037 × V + 0.675
HCS.SC.L	All volumes are applicable	0.055 × V + 1.033
HCS.SC.L with Feature**	All TDAs are applicable	0.059 × V + 1.105
HCS.SC.I	All volumes are applicable	0.313 × V + 0.811
SOC.SC.H	All TDAs are applicable	0.304 × TDA + 0.584
SOC.SC.M – Non-Large	TDA ≤ 40	0.356 × TDA + 0.685
SOC.SC.M – Large***	TDA > 40	0.520 × TDA + 1.000
SOC.SC.L	All TDAs are applicable	1.100 × TDA + 2.100
SOC.SC.I	All TDAs are applicable	1.530 × TDA + 0.360
CB.SC.M	All volumes are applicable	0.081 × V + 1.117
CB.SC.L	All volumes are applicable	0.297 × V + 2.591
PD.SC.M	All volumes are applicable	0.110 × V + 0.810

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 or Griddle Stand; 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.

* V is the representative value of volume and TDA is the representative value of total display area as determined in accordance with the DOE test procedure at appendix B to subpart C of part 431and applicable sampling plans.

** For equipment classes designated "with Feature," refer to table I.2 for the list of qualifying features applicable to each class.

*** As discussed in section II.B.3 of this document, DOE is continuing to analyze the large-capacity ranges presented in table IV.6 for the VOP.SC.M, SVO.SC.M, HZO.SC.L, SOC.SC.M, VCT.SC.M, VCT.SC.L, and VCS.SC.L equipment classes.

Table V.86 Applicable Features for Equipment Classes with Feature for Maximum Daily Energy Consumption Standards for Commercial Refrigerators, Freezers, and Refrigerator-Freezers

Equipment Class	Applicable Feature(s)
VCT.SC.M (≤ 100)	Pass-through doors Sliding doors Both pass-through and sliding doors Roll-in doors Roll-through doors
VCT.SC.L (≤ 70)	Pass-through doors
VCS.SC.M	Pass-through doors Roll-in doors Roll-through doors Drawer units
VCS.SC.L (≤ 100)	Pass-through doors Roll-in doors Roll-through doors Drawer units
HCS.SC.L	Forced air evaporator

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2. Annualized Benefits and Costs of the Adopted Standards

The benefits and costs of the adopted standards can also be expressed in terms of annualized values. The annualized net benefit is: (1) the annualized national economic value (expressed in 2023$) of the benefits from operating equipment that meet the adopted standards (consisting primarily of operating cost savings from using less energy), minus increases in equipment purchase costs; and (2) the annualized monetary value of the climate and health benefits.

Table V.87 shows the annualized values for CRE under TSL 3, expressed in million 2023$. The results under the primary estimate are as follows.

Using a 7-percent discount rate for consumer benefits and costs and NOx and SO_2 reduction health benefits, and a 2-percent near-term Ramsey discount rate case or the 3-percent discount rate case for climate benefits from reduced GHG emissions,, the estimated cost of the adopted standards for CRE is $71 million per year in increased equipment installed costs, while the estimated annual benefits are $210 million from reduced equipment operating costs, $222 million in climate benefits (using the 2023 SC–GHG estimates) or $64 million in climate benefits (using the 2021 interim SC–GHG estimates), and $90 million from reduced NO_X and SO_2 emissions. In this case, the net benefit amounts to $452 million per year (using the 2023 SC–GHG estimates) or $294 million per year (using the 2021 interim SC–GHG estimates).

Using a 3-percent discount rate for consumer benefits and costs and health benefits from reduced NOx and SO_2 emissions, and either the 2-percent near-term Ramsey discount rate case or the 3-percent discount rate case for climate benefits from reduced GHG emissions, the estimated cost of the standards is $68 million per year in increased equipment costs, while the estimated annual benefits are $265 million in reduced operating costs, $222 million in climate benefits (using the 2023 SC–GHG estimates) or $64 million in climate benefits (using the 2021 interim SC–GHG estimates), and $126 million in health benefits. In this case, the net benefit would amount to $545 million per year (using the 2023 SC–GHG estimates) or $387 million per year (using the 2021 interim SC–GHG estimates).

[1] The equation for VOP.SC.H was written incorrectly in the August 2024 NODA Support Document and has been corrected here which is consistent with the secondary mapping in Table 4.1 of the August 2024 NODA.

Table V.87 Annualized Benefits and Costs of the Adopted Energy Conservation Standards for CRE at TSL 3 Shipped During the Period 2029–2058

	Million 2023$/year		
	Primary Estimate	Low-Net-Benefits Estimate	High-Net-Benefits Estimate
3% discount rate			
Consumer Operating Cost Savings	265	254	278
Climate Benefits* (2023 SC-GHG estimates)	222	221	228
Climate Benefits* (2021 interim SC-GHG estimates)	64.2	63.8	65.8
Health Benefits**	126	125	129
Total Benefits† (2023 SC-GHG estimates)	613	600	634
Total Benefits† (2021 interim SC-GHG estimates)	455	443	472
Consumer Incremental Equipment Costs‡	68	108	69
Net Benefits (2023 SC-GHG estimates)	545	492	565
Net Benefits (2021 interim SC-GHG estimates)	387	335	403
Change in Producer Cash Flow (INPV)‡‡	(8) – (5)	(8) – (5)	(8) – (5)
7% discount rate			
Consumer Operating Cost Savings	210	202	220
Climate Benefits* (2023 SC-GHG estimates)	222	221	228
Climate Benefits* (2021 interim SC-GHG estimates)	64.2	63.8	65.8
Health Benefits**	90	90	92
Total Benefits† (2023 SC-GHG estimates)	523	513	540
Total Benefits† (2021 interim SC-GHG estimates)	365	356	378
Consumer Incremental Equipment Costs‡	71	107	72
Net Benefits (2023 SC-GHG estimates)	452	406	468
Net Benefits (2021 interim SC-GHG estimates)	294	250	306
Change in Producer Cash Flow (INPV)‡‡	(8) – (5)	(8) – (5)	(8) – (5)

Note: These results include consumer, climate, and health benefits that accrue after 2058 from the equipment shipped during the period 2029−2058. The Primary, Low-Net-Benefits, and High-Net-Benefits Estimates utilize projections of energy prices from the *AEO2023* Reference case, Low Economic Growth case, and High Economic Growth case, respectively. In addition, incremental equipment costs reflect a price decline rate (applicable to LED lighting and electronics in variable speed compressors) in the Primary and High-Net-Benefits Estimates, and no price-decline for the Low-Net-Benefits Estimate. The methods used to derive projected price trends are explained in sections IV.F of this document. Note that the Benefits and Costs may not sum to the Net Benefits due to rounding.

* Climate benefits are calculated using different estimates of the global SC-GHG (see section IV.L of this document). Climate benefits are estimated using two separate sets of estimates of the social cost for each greenhouse gas, an updated set published in 2023 by the Environmental Protection Agency (EPA) ("2023 SC-GHG") and the interim set of estimates used in the NOPR which were published in 2021 by the Interagency Working Group on the SC-GHG (IWG) ("2021 Interim 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 2 percent near-term Ramsey discount rate are shown for the 2023 SC-GHG estimates, and the climate benefits associated with the average SC-GHG at a 3 percent discount rate are shown for the 2021 interim SC-GHG estimates.

** 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. Table 5 of the EPA's *Estimating the Benefit per Ton of Reducing PM2.5 Precursors from 21 Sectors* TSD provides a summary of the health impact endpoints quantified in the analysis. 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 a 2 percent near-term Ramsey discount rate for the 2023 SC-GHG estimates and the average SC-GHG with 3-percent discount rate for the 2021 interim SC-GHG estimates.

‡ Costs include incremental equipment costs.

‡‡ Operating Cost Savings are calculated based on the life-cycle cost analysis and national impact analysis as discussed in detail below. See sections IV.F and IV.H of this document. DOE's national impact analysis includes all impacts (both costs and benefits) along the distribution chain beginning with the increased costs to the manufacturer to manufacture the product and ending with the increase in price experienced by the consumer. DOE also separately conducts a detailed analysis on the impacts on manufacturers (*i.e.*, MIA). See section IV.J of this document. In the detailed MIA, DOE models manufacturers' pricing decisions based on assumptions regarding investments, conversion costs, cash flow, 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 final rule TSD for a complete description of the industry weighted-average cost of capital). For CRE, the annualized change in INPV ranges from -$8.2 million to -$5.3 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 markup manufacturer 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 final rule to society, including potential changes in production and consumption, which is consistent with OMB's Circular A-4 and E.O. 12866. If DOE were to include the INPV into the annualized net benefit calculation using the 2023 SC-GHG estimates for this final rule, the annualized net benefits would range from $537 million to $540 million at 3-percent discount rate and would range from $444 million to $447 million at 7-percent discount rate.

3. Removal of Obsolete Provisions

The energy conservation standards for CRE, located at 10 CFR 431.66, currently contain provisions in paragraphs (b) through (d) for equipment manufactured before March 27, 2017. As such, the provisions in paragraphs (b) through (d) are now obsolete for any CRE manufactured on or after March 27, 2017. In this final rule, DOE is removing these obsolete provisions.

In addition, paragraph (a) of 10 CFR 431.66 currently contains definitions for the terms ''AV'', ''V'', and ''TDA,'' which are similarly obsolete. The term ''AV'' is referenced only in paragraph (b)(1), which is now obsolete (as discussed in the previous paragraph). The definitions for the terms ''V'' and ''TDA'' are obsolete because the measurement instructions for volume and total display area were updated in the September 2023 Test Procedure Final Rule and are separately codified within appendix B to Subpart C of part 431. For these reasons, in this final rule, DOE is removing paragraph (a) of 10 CFR 431.66.

Given the removal of paragraphs (a) through (d) of 10 CFR 431.66, this final rule redesignates paragraph (e)—which contains the currently applicable standards—as paragraph (a). DOE is codifying the new and amended standards enacted by this final rule at paragraph (b). Finally, this final rule redesignates paragraph (f) (''Exclusions'') as paragraph (c).

VI. Procedural Issues and Regulatory Review

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

Executive Order (''E.O.'') 12866, ''Regulatory Planning and Review,'' as supplemented and reaffirmed by E.O. 13563, ''Improving Regulation and Regulatory Review,'' 76 FR 3821 (Jan. 21, 2011) and amended by E.O. 14094, ''Modernizing Regulatory Review,'' 88 FR 21879 (April 11, 2023), requires agencies, to the extent permitted by law, to: (1) propose or adopt a regulation only upon a reasoned determination that its benefits justify its costs (recognizing that some benefits and costs are difficult to quantify); (2) tailor regulations to impose the least burden on society, consistent with obtaining regulatory objectives, taking into account, among other things, and to the extent practicable, the costs of cumulative regulations; (3) select, in choosing among alternative regulatory approaches, those approaches that maximize net benefits (including potential economic, environmental, public health and safety, and other advantages; distributive impacts; and equity); (4) to the extent feasible, specify performance objectives, rather than specifying the behavior or manner of compliance that regulated entities must adopt; and (5) identify and assess available alternatives to direct regulation, including providing economic incentives to encourage the desired behavior, such as user fees or marketable permits, or providing information upon which choices can be made by the public. DOE emphasizes as well that E.O. 13563 requires agencies to use the best available techniques to quantify anticipated present and future benefits and costs as accurately as possible. In its guidance, the Office of Information and Regulatory Affairs (''OIRA'') in the Office of Management and Budget 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 final regulatory action is consistent with these principles.

Section 6(a) of E.O. 12866 also requires agencies to submit ''significant regulatory actions'' to OIRA for review. OIRA has determined that this final regulatory action constitutes a ''significant regulatory action'' within the scope of section 3(f)(1) of E.O. 12866, as amended by E.O. 14094. 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 final regulatory action, together with, to the extent feasible, a quantification of those costs; and an assessment, including the underlying analysis, of costs and benefits of potentially effective and reasonably feasible alternatives to the planned regulation, and an explanation why the planned regulatory action is preferable to the identified potential alternatives. These assessments are summarized in this preamble and further detail can be found in the technical support document for this rulemaking.

B. Review Under the Regulatory Flexibility Act

The Regulatory Flexibility Act (5 U.S.C. 601 *et seq.*) requires preparation of an initial regulatory flexibility analysis (''IRFA'') and a final regulatory flexibility analysis (''FRFA'') for any rule that by law must be proposed for public comment, unless the agency certifies that the rule, if promulgated, will not have a significant economic impact on a substantial number of small entities. As required by E.O. 13272, ''Proper Consideration of Small Entities in Agency Rulemaking,'' 67 FR 53461 (Aug. 16, 2002), DOE published procedures and policies on February 19, 2003, to ensure that the potential impacts of its rules on small entities are properly considered during the rulemaking process. 68 FR 7990. DOE has made its procedures and policies available on the Office of the General Counsel's website (*www.energy.gov/gc/office-general-counsel*). DOE has prepared the following FRFA for the equipment that are the subject of this 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. Need for, and Objectives of, Rule

DOE is adopting 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 Pub. L. 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 six 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))

2. Significant Issues Raised by Public Comments in Response to the IRFA

In response to the October 2023 NOPR, AHRI provided a list of known suppliers of CRE sold in the United States that are not listed on the CCD site: Amtecko Industries, Inc.; Atlantic Food Bars; Borgen Merchandising Systems; Buffalo Outfront; Carrier; Cayuga Displays; Custom Deli's Inc.; Duke Manufacturing Co.; Federal Industries; GTI Designs; MTL Cool, a Due North brand; NAFCool; Picadeli; Pure Cold; USR Brands; Unity® Commercial Refrigeration; and Vortex Refrigeration. (AHRI, No. 81, at p. 6)

As part of DOE's market assessment for the October 2023 NOPR and this final rule, DOE compiled an equipment database of CRE models available in the United States. To develop a comprehensive equipment database of CRE basic models, DOE reviewed its CCD [161] supplemented by information from CEC's MAEDbS,[162] company websites, and prior CRE rulemakings. To identify chef bases or griddle stands and high-temperature units, DOE reviewed publicly available data from web scraping of company websites. DOE then reviewed its comprehensive equipment database to identify the OEMs of the CRE models identified. DOE compared the list of suppliers provided by AHRI against its list of CRE manufacturers to ensure completeness. Based on this comparison, DOE amended its manufacturer assessment to include 10 additional manufacturers, including 2 additional OEMs, Atlantic Food Bars and Borgen Merchandising Systems, for this final rule.

In response to the October 2023 NOPR and August 2024 NODA, NAMA commented the refrigerant transition is a large burden for smaller manufacturers investing in safety compliance to low-GWP refrigerants, capital improvements to factories, changes to service, and training of factory employees and service providers. (NAMA, No. 85 at p. 4; NAMA, No. 112 at p. 5)

In response to NAMA, DOE notes that it considered the October 2023 EPA Final Rule and the expenses associated with the refrigerant transition in the analytical baseline of the October 2023 NOPR, August 2024 NODA, and this final rule analysis. 88 FR 70196, 70284; 88 FR 70247, 68800. Although refrigerant transition costs associated with the October 2023 EPA Final Rule are not attributed to this rulemaking, DOE accounted for these refrigerant transition costs in the no-new-standards case and standards cases to better reflect industry finances and cash flow over the analysis period. Since industry would incur costs associated with the refrigerant transition regardless of any DOE rulemaking, this FRFA assesses the potential small business investments incurred as a direct result of this DOE rulemaking. DOE reviewed this final rule under the provisions of the Regulatory Flexibility Act and the

[161] 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 Jan. 31, 2024).

[162] California Energy Commission's Modernized Appliance Efficiency Database is available at *cacertappliances.energy.ca.gov/Pages/Search/AdvancedSearch.aspx* (last accessed Jan. 31, 2024).

procedures and policies published on February 19, 2003. 68 FR 7990, 7993. See section V.B.2.e of this document for additional discussion of how DOE accounts for cumulative regulatory burden in its analysis.

In response to the October 2023 NOPR, Continental stated that adopting the standards proposed in the October 2023 NOPR with a 3-year lead-in would force them to exit in the market for many equipment configurations, which could negatively impact domestic employment and small businesses. (Continental, No. 86 at p. 6)

In response to the comment from Continental, DOE understands that small businesses could be affected disproportionately by amended standards. DOE analyzes the potential impacts of this final rule on small business manufacturers of CRE in section VI.B.5 of this document. As discussed in section III.A.2.a of this document, based on stakeholder comments and DOE's assessment of the overlapping Federal refrigerant regulations and recent changes to UL safety standards for CRE, DOE is extending the compliance period from the 3-years analyzed in the October 2023 NOPR (modeled as a 2028 compliance year) to 4-years (modeled as a 2029 compliance year) for this final rule. Furthermore, DOE notes that compared to the October 2023 NOPR, DOE is adopting less stringent standards for 22 out of the 28 directly analyzed equipment classes. See section VI.B.5 of this document for an analysis of the estimated conversion costs small businesses may incur as a result of this final rule.

3. Response to Comments Filed by Chief Counsel for Advocacy of the Small Business Administration

The SBA's Chief Counsel for Advocacy did not submit public comments on this rulemaking.

4. Description and Estimated Number of Small Entities Affected

DOE reviewed this final 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. As discussed in section VI.B.2 of this document, to develop a comprehensive equipment database of CRE basic models, DOE reviewed its CCD[163] supplemented by information from CEC's MAEDbS,[164] individual company websites, stakeholder comments (AHRI, No. 81 at p. 6), and prior CRE rulemakings. 79 FR 17725. To identify chef bases or griddle stands and high-temperature units, DOE reviewed publicly available data from web scraping of retail websites. DOE then reviewed the comprehensive equipment database to identify the companies that sell the CRE models identified. DOE then consulted publicly available data, such as manufacturer websites, manufacturer specifications and equipment literature, import/export logs (*e.g.,* bills of lading from ImportYeti[165]), and basic model numbers, to identify OEMs of CRE covered by this rulemaking. DOE further relied on public data and subscription-based market research tools (*e.g.,* Dun & Bradstreet reports[166]) to determine company, location, headcount, and annual revenue. DOE also asked industry representatives if they were aware of any small OEMs 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.

For the October 2023 NOPR, DOE initially identified 83 OEMs that sell CRE in the United States. For this final rule, DOE refreshed its database of model listings to include the most up-to-date information on CRE models currently available on the U.S. market. Through its comprehensive review of its updated equipment database, other public sources, and stakeholder comments in response to the October 2023 NOPR, DOE identified 43 additional OEMs selling CRE in the United States (2 of which were identified as small, domestic businesses). DOE also determined 23 OEMs (7 of which were identified as small domestic businesses in the October 2023 NOPR) do not currently produce covered CRE for the U.S. market (*i.e.,* they do not manufacture CRE in-house). Therefore, of the 103 OEMs identified in this final rule, DOE determined that 20 companies qualify as small businesses and are not foreign-owned and operated.

5. Description of Reporting, Recordkeeping, and Other Compliance Requirements

Of the 20 small domestic CRE OEMs, 19 OEMs manufacture vertical equipment classes (*i.e.,* vertical open ("VOP"), vertical closed transparent ("VCT"), or vertical closed solid ("VCS")); 7 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")); 6 OEMs manufacture service-over-counter ("SOC") equipment classes (*i.e.,* SOC.RC.M or SOC.SC.M); 8 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 or griddle stands.

For the purposes of this FRFA, 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 adopted standard. As discussed in section IV.J.2.c of this document, DOE scaled the industry capital conversion costs by the number of relevant 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 TSL 3 efficiency levels. DOE used unique basic model counts to scale the industry product conversion costs.

DOE expects manufacturers could meet TSL 3 without implementing occupancy sensors with dimming capability, triple-pane doors with krypton fill, or vacuum-insulated glass doors. At this level, only 2 self-contained equipment classes, HCT.SC.I and SOC.SC.M (together accounting for approximately 3 percent of transparent door CRE shipments), would likely incorporate improved door designs, which may necessitate new fixtures. For some self-contained equipment classes totaling approximately 50 percent of self-contained CRE shipments, manufacturers would likely have to incorporate variable-speed compressors into CRE designs. To incorporate variable-speed compressors, which could be larger than existing single-speed compressors, manufacturers may need new tools for the baseplate.

[163] 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 Jan. 31, 2024).

[164] California Energy Commission's Modernized Appliance Efficiency Database is available at *cacertappliances.energy.ca.gov/Pages/Search/AdvancedSearch.aspx* (last accessed Jan. 31, 2024).

[165] ImportYeti, LLC. "ImportYeti." *www.importyei.com* (last accessed March 15, 2024).

[166] D&B Hoover's subscription login is accessible at *app.dnbhoovers.com.*

Product conversion costs may be necessary to qualify, source, and test new high-efficiency components (*e.g.,* BLDC fan motors, variable-speed compressors).

Of the 19 small OEMs of vertical equipment classes, DOE expects 15 OEMs would incur some conversion costs to redesign models that do not currently meet the efficiency levels adopted in this final rule. The remaining 4 small OEMs would likely not incur conversion costs as a direct result of the standard as all their vertical CRE models currently meet or exceed TSL 3. Vertical equipment classes account for approximately 90 percent of industry shipments. Manufacturers will likely incorporate night curtains for all VOP equipment classes and BLDC condenser fan motors for nearly all vertical self-contained equipment classes. DOE further expects manufacturers to implement variable-speed compressors into some self-contained vertical equipment classes.

DOE expects all 7 small OEMs of semi-vertical equipment classes would incur some conversion costs to redesign models that do not currently meet the efficiency levels adopted in this final rule. Semi-vertical equipment classes account for approximately 2 percent of industry shipments in 2028. For SVO.SC.M, manufacturers will likely incorporate night curtains, BLDC condenser fan motors, and variable-speed compressors to meet TSL 3. For SVO.RC.M, manufacturers will likely incorporate night curtains to meet TSL 3.

Out of the 6 small OEMs of service-over-counter equipment classes, DOE expects 5 OEMs would incur some conversion costs to redesign models that do not currently meet the efficiency levels adopted in this final rule. The remaining small OEM would likely not incur conversion costs as a direct result of the standard as all their service-over-counter CRE models currently meet or exceed TSL 3. Service-over-counter equipment classes account for less than 1 percent of industry shipments. Manufacturers will likely incorporate BLDC evaporator and condenser fan motors, variable-speed compressors, and triple-pane doors with argon fill for SOC.SC.M to meet TSL 3. For SOC.RC.M, TSL 3 corresponds to the baseline efficiency level.

Out of the 8 small OEMs of horizontal equipment classes, DOE expects 7 OEMs would incur some conversion costs to redesign models that do not currently meet the efficiency levels adopted in this final rule. The remaining small OEM would likely not incur conversion costs as a direct result of the standard as all their horizontal CRE models currently meet or exceed TSL 3. Horizontal equipment classes account for approximately 6 percent of industry shipments. Manufacturers will likely implement BLDC condenser fan motors in both HCS equipment classes to meet TSL 3. Manufacturers will likely incorporate triple-pane doors with argon fill for HCT.SC.I. Manufacturers will likely incorporate BLDC condenser fan motors and variable-speed compressors for some HZO equipment classes to meet TSL 3. For HCT.SC.L, HCT.SC.M, HZO.RC.L, and HZO.RC.M, TSL 3 corresponds to the baseline efficiency levels.

DOE expects all 3 small OEMs offering chef base or griddle stand equipment to incur some conversion costs to redesign models that do not meet efficiency levels at TSL 3. Chef bases or griddle stands account for approximately 1 percent of industry shipments. Manufacturers would likely incorporate BLDC condenser fan motors and variable-speed compressors for CB.SC.M. None of the small businesses identified manufacture CB.SC.L models.

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 $2.3 million to $307.9 million, with an average annual revenue of approximately $74.8 million. DOE estimates that conversion costs could range from $0.0 million to $12.9 million, with the average per OEM conversion costs of $1.5 million. The estimated total conversion costs as a percent of company revenue over the 4-year conversion period range from approximately 0.0 percent to 5.0 percent, with an average of 1.0 percent. See table VI.1 for additional details.

Table VI.1 Potential Small Business Impacts (TSL 3)

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	$0.5	$2.3	5.0%	X				
B	$0.8	$4.7	4.2%	X		X		
C	$12.9	$100.7	3.2%	X			X	X
D	$1.0	$9.0	2.9%	X	X	X		
E	$7.7	$131.1	1.5%	X	X	X	X	
F	$2.1	$110.3	0.5%	X	X	X	X	X
G	$1.5	$85.3	0.4%	X			X	
H	$1.6	$94.5	0.4%	X	X	X	X	
I	$0.4	$23.6	0.4%	X	X			
J	$0.1	$9.3	0.3%	X	X	X		
K	$0.1	$11.8	0.1%	X			X	
L	$0.1	$48.7	0.1%	X			X	
M	$0.2	$96.8	0.1%	X				
N	$0.2	$167.3	0.0%	X				X
O	$0.0	$20.0	0.0%	X	X			
P	$0.0	$27.5	0.0%	X				
Q	$0.0***	$4.0	0.0%				X	
R	$0.0***	$307.9	0.0%	X				
S	$0.0***	$217.0	0.0%	X				
T	$0.0***	$24.0	0.0%	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 4-year conversion period: (Est. Conversion Costs) ÷ [(Est. Annual Revenue) × 4 years].

***All models of directly analyzed CRE equipment classes meet or exceed the efficiency levels adopted in this final rule. Therefore, DOE does not expect these manufacturers would incur conversion costs as direct result of the final rule.

6. Significant Alternatives Considered and Steps Taken To Minimize Significant Economic Impacts on Small Entities

The discussion in the previous section analyzes impacts on small businesses that would result from the adopted standards, represented by TSL 3. In reviewing alternatives to the adopted standards, DOE examined energy conservation standards set at lower efficiency levels. While TSL 1 and TSL 2 would reduce the impacts on small business manufacturers, it would come at the expense of a reduction in energy savings.

TSL 1 achieves 78 percent lower energy savings compared to the energy savings at TSL 3. TSL 2 achieves 74 percent lower energy savings compared to the energy savings at TSL 3.

Establishing standards at TSL 3 balances the benefits of the energy savings at TSL 3 with the potential burdens placed on CRE manufacturers, including small business manufacturers. Accordingly, DOE is not adopting 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 final rule TSD.

Additionally, DOE notes that statutory provisions under EPCA state that should the Secretary determine that a 3-year period is inadequate, the Secretary may provide that the amended standard can apply to CRE manufactured on or after the date that is not later than 5 years after the date on which the final rule is published in the **Federal Register**. (See 42 U.S.C. 6313(c)(6)(C)(ii)) Pursuant to this EPCA provision, DOE is extending the compliance period from the 3-years analyzed in the October 2023 NOPR (modeled as a 2028 compliance year) to 4-years (modeled as a 2029 compliance year) for this final rule. DOE has determined that a longer compliance period for CRE is warranted based on stakeholder comments and DOE's assessment of the overlapping Federal refrigerant regulations and recent changes to UL safety standards for CRE. DOE understands that the longer compliance period will help mitigate cumulative regulatory burden by allowing manufacturers of CRE, including small businesses, more flexibility to spread investments across 4 years instead of 3 years. Manufacturers, including small businesses, will also have more time to recoup any investments made to redesign CRE models in compliance with the October 2023 EPA Final Rule as compared to a 3-year compliance period. 88 FR 73098.

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 1003 for additional details.

C. Review Under the Paperwork Reduction Act

Manufacturers of CRE must certify to DOE that their products comply with any applicable energy conservation standards. In certifying compliance, manufacturers must test their products according to the DOE test procedures for CRE, including any amendments adopted for those test procedures. DOE has established regulations for the certification and recordkeeping requirements for all covered consumer products and commercial equipment, including 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

Pursuant to the National Environmental Policy Act of 1969 (''NEPA''), DOE has analyzed this rule in accordance with NEPA and DOE's NEPA implementing regulations (10 CFR part 1021). DOE has determined that this rule qualifies for categorical exclusion under 10 CFR part 1021, subpart D, appendix B5.1 because it is a rulemaking that establishes energy conservation standards for consumer products or industrial equipment, none of the exceptions identified in B5.1(b) apply, no extraordinary circumstances exist that require further environmental analysis, and it meets the requirements for application of a categorical exclusion. *See* 10 CFR 1021.410. Therefore, DOE has determined that promulgation of this rule is not a major Federal action significantly affecting the quality of the human environment within the meaning of NEPA, and does not require an environmental assessment or an environmental impact statement.

E. Review Under Executive Order 13132

E.O. 13132, ''Federalism,'' 64 FR 43255 (Aug. 10, 1999), imposes certain requirements on Federal agencies formulating and implementing policies or regulations that preempt State law or that have Federalism implications. The Executive order requires agencies to examine the constitutional and statutory authority supporting any action that would limit the policymaking discretion of the States and to carefully assess the necessity for such actions. The Executive order also requires agencies to have an accountable process to ensure meaningful and timely input by State and local officials in the development of regulatory policies that have Federalism 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 rule and has determined that it would not have a substantial direct effect on the States, on the relationship between the national government and the States, or on the distribution of power and responsibilities among the various levels of government. EPCA governs and prescribes Federal preemption of State regulations as to energy conservation for the equipment that are the subject of this final rule. States can petition DOE for exemption from such preemption to the extent, and based on criteria, set forth in EPCA. (42 U.S.C. 6316(e)(2)–(3); 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 (February 7, 1996). Regarding the review required by section 3(a), section 3(b) of E.O. 12988 specifically requires that Executive agencies make every reasonable effort to ensure that the regulation: (1) clearly specifies the preemptive effect, if any; (2) clearly specifies any effect on existing Federal law or regulation; (3) provides a clear legal standard for affected conduct while promoting simplification and burden reduction; (4) specifies the retroactive effect, if any; (5) adequately defines key terms; and (6) addresses other important issues affecting clarity and general draftsmanship under any guidelines issued by the Attorney General. Section 3(c) of E.O. 12988 requires Executive agencies to review regulations in light of applicable standards in section 3(a) and section 3(b) to determine whether they are met or it is unreasonable to meet one or more of them. DOE has completed the required review and determined that, to the extent permitted by law, this final rule meets the relevant standards of E.O. 12988.

G. Review Under the Unfunded Mandates Reform Act of 1995

Title II of the Unfunded Mandates Reform Act of 1995 (''UMRA'') requires each Federal agency to assess the effects of Federal regulatory actions on State, local, and Tribal governments and the private sector. Pub. L. 104–4, sec. 201 (codified at 2 U.S.C. 1531). For a regulatory action likely to result in a rule that may cause the expenditure by State, local, and Tribal governments, in the aggregate, or by the private sector of $100 million or more in any one year (adjusted annually for inflation), section 202 of UMRA requires a Federal agency to publish a written statement that estimates the resulting costs, benefits, and other effects on the national economy. (2 U.S.C. 1532(a), (b)) UMRA also requires a Federal agency to develop an effective process to permit timely input by elected officers of State, local, and Tribal governments on a ''significant intergovernmental mandate,'' and requires an agency plan for giving notice and opportunity for timely input to potentially affected small governments before establishing any requirements that might significantly or uniquely affect them. On March 18, 1997, DOE published a statement of policy on its process for intergovernmental consultation under UMRA. 62 FR 12820. DOE's policy statement is also available at *www.energy.gov/sites/prod/files/gcprod/documents/umra_97.pdf.*

DOE has concluded that this final rule may require expenditures of $100 million or more in any one year by the private sector. Such expenditures may include: (1) investment in research and development and in capital expenditures by 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 final rule. (2 U.S.C. 1532(c)) The content requirements of section 202(b) of UMRA relevant to a private sector mandate substantially overlap the economic analysis requirements that apply under section 325(o) of EPCA and Executive Order 12866. The **SUPPLEMENTARY INFORMATION** section of this document and the TSD for this final rule respond to those requirements.

Under section 205 of UMRA, DOE is obligated to identify and consider a reasonable number of regulatory alternatives before promulgating a rule for which a written statement under section 202 is required. (2 U.S.C. 1535(a)) DOE is required to select from those alternatives the most cost-effective and least burdensome alternative that achieves the objectives of the rule unless DOE publishes an explanation for doing otherwise, or the selection of such an alternative is inconsistent with law. As required by 42 U.S.C. 6295(m) or a product-specific directive in 6295, and 42 U.S.C. 6316(e)(1), and 6313(c)(6), this final rule establishes 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 sections 6316(e)(1), 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 final rule.

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

Section 654 of the Treasury and General Government Appropriations Act, 1999 (Pub. L. 105–277) requires Federal agencies to issue a Family Policymaking Assessment for any proposed rule or policy that may affect family well-being. When developing a Family Policymaking Assessment, agencies must assess whether: (1) the action strengthens or erodes the stability or safety of the family and, particularly, the marital commitment; (2) the action strengthens or erodes the authority and rights of parents in the education, nurture, and supervision of their children; (3) the action helps the family perform its functions, or substitutes governmental activity for the function; (4) the action increases or decreases disposable income or poverty of families and children; (5) the proposed benefits of the action justify the financial impact on the family; (6) the action may be carried out by State or local government or by the family; and whether (7) the action establishes an implicit or explicit policy concerning the relationship between the behavior and personal responsibility of youth, and the norms of society. In evaluating the above factors, DOE has concluded that it is not necessary to prepare a Family Policymaking Assessment as none of the above factors are implicated. Further, this proposed determination would not have any financial impact on families nor any impact on the autonomy or integrity of the family as an institution.

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 proposed rule or policy that may affect family well-being. Although this final rule would not have any impact on the autonomy or integrity of the family as an institution as defined, this final rule could impact a family's well-being. When developing a Family Policymaking Assessment, agencies must assess whether: (1) the action strengthens or erodes the stability or safety of the family and, particularly, the marital commitment; (2) the action strengthens or erodes the authority and rights of parents in the education, nurture, and supervision of their children; (3) the action helps the family perform its functions, or substitutes governmental activity for the function; (4) the action increases or decreases disposable income or poverty of families and children; (5) the proposed benefits of the action justify the financial impact on the family; (6) the action may be carried out by State or local government or by the family; and whether (7) the action establishes an implicit or explicit policy concerning the relationship between the behavior and personal responsibility of youth, and the norms of society.

DOE has considered how the benefits of this final rule compare to the possible financial impact on a family (the only factor listed that is relevant to this rule). As part of its rulemaking process, DOE must determine whether the energy conservation standards enacted in this final rule are economically justified. As discussed in section V.C.1 of this document, DOE has determined that the standards enacted in this final rule are economically justified because the benefits to consumers would far outweigh the costs to manufacturers. Customers will also see LCC savings as a result of this final rule. Moreover, as discussed further in section V.B.1 of this document, DOE has determined that for small businesses, average LCC savings and PBP at the considered efficiency levels are similar compared to those for all purchasers. Further, the standards will also result in climate and health benefits for all businesses.

I. Review Under Executive Order 12630

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

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

Section 515 of the Treasury and General Government Appropriations Act, 2001 (44 U.S.C. 3516, note) provides for Federal agencies to review most disseminations of information to the public under information quality guidelines established by each agency pursuant to general guidelines issued by OMB. OMB's guidelines were published at 67 FR 8452 (February 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 final rule under the OMB and DOE guidelines and has concluded that it is consistent with applicable policies in those guidelines.

K. Review Under Executive Order 13211

E.O. 13211, ''Actions Concerning Regulations That Significantly Affect Energy Supply, Distribution, or Use,'' 66 FR 28355 (May 22, 2001), requires Federal agencies to prepare and submit to OIRA at OMB, a Statement of Energy Effects for any significant energy action. A ''significant energy action'' is defined as any action by an agency that promulgates or is expected to lead to promulgation of a final rule, and that: (1) is a significant regulatory action under Executive Order 12866, or any successor order, and is likely to have a significant adverse effect on the supply, distribution, or use of energy; or (2) is designated by the Administrator of OIRA as a significant energy action. For any significant energy action, the agency must give a detailed statement of any adverse effects on energy supply, distribution, or use should the proposal be implemented, and of reasonable alternatives to the action and their expected benefits on energy supply, distribution, and use.

DOE has concluded that this regulatory action, which sets forth new and amended energy conservation standards for CRE, is not a significant energy action because the standards are not likely to have a significant adverse effect on the supply, distribution, or use of energy, nor has it been designated as such by the Administrator at OIRA. Accordingly, DOE has not prepared a Statement of Energy Effects on this final rule.

L. Information Quality

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

In response to OMB's Bulletin, DOE conducted formal peer reviews of the energy conservation standards development process and the analyses that are typically used and prepared a report describing that peer review.[167] Generation of this report involved a rigorous, formal, and documented evaluation using objective criteria and qualified and independent reviewers to make a judgment as to the technical/scientific/business merit, the actual or anticipated results, and the productivity and management effectiveness of programs and/or projects. Because available data, models, and technological understanding have changed since 2007, DOE has engaged with the National Academy of Sciences to review DOE's analytical methodologies to ascertain whether modifications are needed to improve DOE's analyses. DOE is in the process of evaluating the resulting report.[168]

M. Congressional Notification

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

VII. Approval of the Office of the Secretary

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

List of Subjects in 10 CFR Part 431

Administrative practice and procedure, Confidential business information, Energy conservation test procedures, Incorporation by reference, and Reporting and recordkeeping requirements.

Signing Authority

This document of the Department of Energy was signed on December 20, 2024, by Jeffrey Marootian, Principal Deputy Assistant Secretary for Energy Efficiency and Renewable Energy, pursuant to delegated authority from the Secretary of Energy. That document with the original signature and date is maintained by DOE. For administrative purposes only, and in compliance with requirements of the Office of the Federal Register, the undersigned DOE Federal Register Liaison Officer has been authorized to sign and submit the document in electronic format for publication, as an official document of the Department of Energy. This administrative process in no way alters the legal effect of this document upon publication in the **Federal Register**.

Signed in Washington, DC, on December 20, 2024.

Treena V. Garrett,

Federal Register Liaison Officer, U.S. Department of Energy.

For the reasons set forth in the preamble, DOE amends part 431 of chapter II, subchapter D, 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,'' ''Drawer unit,'' and ''Forced-air evaporator;''

■ b. Revising the definition of ''Ice-cream freezer;''

■ c. Adding in alphabetical order a definition for ''Pass-through doors;''

■ d. Revising the definition of ''Rating temperature;'' and

■ e. Adding in alphabetical order definitions for ''Roll-in door,'' ''Roll-through doors,'' and ''Sliding door.''

The additions and revisions 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.

* * * * *

Drawer unit means a commercial refrigerator, freezer, or refrigerator-freezer in which all the externally accessed compartments are drawers.

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.

* * * * *

Ice-cream freezer means:

(1) Prior to Monday, January 22, 2029, 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) On or after Monday, January 22, 2029, 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.

* * * * *

Pass-through doors mean 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

[167] 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 April 15, 2024).

[168] The report is available at *www.nationalacademies.org/our-work/review-of-methods-for-setting-building-and-equipment-performance-standards.*

2.1. or section 2.2. of appendix B to this subpart, 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) Each commercial refrigerator, freezer, and refrigerator-freezer with a self-contained condensing unit designed for holding temperature applications and with solid or transparent doors; commercial refrigerator with a self-contained condensing unit designed for pull-down temperature applications and with transparent doors; commercial refrigerator, freezer, and refrigerator-freezer with a self-contained condensing unit and without doors; commercial refrigerator, freezer, and refrigerator-freezer with a remote condensing unit; and commercial ice-cream freezer manufactured on or after March 27, 2017, and before Monday, January 22, 2029, shall have a daily energy consumption (in kilowatt-hours per day or ''kWh/day'') that does not exceed the levels specified:

(1) For equipment other than hybrid equipment, refrigerator/freezers, or wedge cases:

TABLE 1 TO PARAGRAPH (a)(1)—MAXIMUM DAILY ENERGY CONSUMPTION STANDARDS

Equipment category	Condensing unit configuration	Equipment family	Rating temp. °F	Operating temp. °F	Equipment class designation *	Maximum daily energy consumption ** (kWh/day)
Remote Condensing Commercial Refrigerators and Commercial Freezers.	Remote (RC)	Vertical Open (VOP)	38 (M)	≥32	VOP.RC.M	0.64 × TDA + 4.07
			0 (L)	<32	VOP.RC.L	2.2 × TDA + 6.85
		Semivertical Open (SVO).	38 (M)	≥32	SVO.RC.M	0.66 × TDA + 3.18
			0 (L)	<32	SVO.RC.L	2.2 × TDA + 6.85
		Horizontal Open (HZO)	38 (M)	≥32	HZO.RC.M	0.35 × TDA + 2.88
			0 (L)	<32	HZO.RC.L	0.55 × TDA + 6.88
		Vertical Closed Transparent (VCT).	38 (M)	≥ 32	VCT.RC.M	0.15 × TDA + 1.95
			0 (L)	<32	VCT.RC.L	0.49 × TDA + 2.61
		Horizontal Closed Transparent (HCT).	38 (M)	≥32	HCT.RC.M	0.16 × TDA + 0.13
			0 (L)	<32	HCT.RC.L	0.34 × TDA + 0.26
		Vertical Closed Solid (VCS).	38 (M)	≥32	VCS.RC.M	0.1 × V + 0.26
			0 (L)	< 32	VCS.RC.L	0.21 × V + 0.54
		Horizontal Closed Solid (HCS).	38 (M)	≥32	HCS.RC.M	0.1 × V + 0.26
			0 (L)	<32	HCS.RC.L	0.21 × V + 0.54
		Service Over Counter (SOC).	38 (M)	≥32	SOC.RC.M	0.44 × TDA + 0.11
			0 (L)	<32	SOC.RC.L	0.93 × TDA + 0.22
Self-Contained Commercial Refrigerators and Commercial Freezers Without Doors.	Self-Contained (SC)	Vertical Open (VOP)	38 (M)	≥32	VOP.SC.M	1.69 × TDA + 4.71
			0 (L)	<32	VOP.SC.L	4.25 × TDA + 11.82
		Semivertical Open (SVO).	38 (M)	≥32	SVO.SC.M	1.7 × TDA + 4.59
			0 (L)	<32	SVO.SC.L	4.26 × TDA + 11.51
		Horizontal Open (HZO)	38 (M)	≥32	HZO.SC.M	0.72 × TDA + 5.55
			0 (L)	<32	HZO.SC.L	1.9 × TDA + 7.08
Self-Contained Commercial Refrigerators and Commercial Freezers With Doors.	Self-Contained (SC)	Vertical Closed Transparent (VCT).	38 (M)	≥32	VCT.SC.M	0.1 × V + 0.86
			0 (L)	<32	VCT.SC.L	0.29 × V + 2.95
		Vertical Closed Solid (VCS).	38 (M)	≥32	VCS.SC.M	0.05 × V + 1.36
			0 (L)	<32	VCS.SC.L	0.22 × V + 1.38
		Horizontal Closed Transparent (HCT).	38 (M)	≥32	HCT.SC.M	0.06 × V + 0.37
			0 (L)	<32	HCT.SC.L	0.08 × V + 1.23
		Horizontal Closed Solid (HCS).	38 (M)	≥32	HCS.SC.M	0.05 × V + 0.91
			0 (L)	<32	HCS.SC.L	0.06 × V + 1.12
		Service Over Counter (SOC).	38 (M)	≥32	SOC.SC.M	0.52 × TDA + 1
			0 (L)	<32	SOC.SC.L	1.1 × TDA + 2.1
Self-Contained Commercial Refrigerators with Transparent Doors for Pull-Down Temperature Applications.	Self-Contained (SC)	Pull-Down (PD)	38 (M)	≥32	PD.SC.M	0.11 × V + 0.81
Commercial Ice-Cream Freezers.	Remote (RC)	Vertical Open (VOP)	−15 (I)	≤−5	VOP.RC.I	2.79 × TDA + 8.7
		Semivertical Open (SVO).			SVO.RC.I	2.79 × TDA + 8.7
		Horizontal Open (HZO)			HZO.RC.I	0.7 × TDA + 8.74
		Vertical Closed Transparent (VCT).			VCT.RC.I	0.58 × TDA + 3.05
		Horizontal Closed Transparent (HCT).			HCT.RC.I	0.4 × TDA + 0.31

TABLE 1 TO PARAGRAPH (a)(1)—MAXIMUM DAILY ENERGY CONSUMPTION STANDARDS—Continued

Equipment category	Condensing unit configuration	Equipment family	Rating temp. °F	Operating temp. °F	Equipment class designation *	Maximum daily energy consumption ** (kWh/day)
		Vertical Closed Solid (VCS).			VCS.RC.I	$0.25 \times V + 0.63$
		Horizontal Closed Solid (HCS).			HCS.RC.I	$0.25 \times V + 0.63$
		Service Over Counter (SOC)			SOC.RC.I	$1.09 \times TDA + 0.26$
	Self-Contained (SC)	Vertical Open (VOP)			VOP.SC.I	$5.4 \times TDA + 15.02$
		Semivertical Open (SVO).			SVO.SC.I	$5.41 \times TDA + 14.63$
		Horizontal Open (HZO)			HZO.SC.I	$2.42 \times TDA + 9$
		Vertical Closed Transparent (VCT).			VCT.SC.I	$0.62 \times TDA + 3.29$
		Horizontal Closed Transparent (HCT).			HCT.SC.I	$0.56 \times TDA + 0.43$
		Vertical Closed Solid (VCS).			VCS.SC.I	$0.34 \times V + 0.88$
		Horizontal Closed Solid (HCS).			HCS.SC.I	$0.34 \times V + 0.88$
		Service Over Counter (SOC).			SOC.SC.I	$1.53 \times TDA + 0.36$

* The meaning of the letters in this column is indicated in the columns to the left.

** "V" is the volume, expressed in ft^3, as determined in appendix B to this subpart. "TDA" is the total display area, expressed in ft^2, as determined in appendix B to this subpart.

(2) For commercial refrigeration equipment with two or more compartments (*i.e.,* hybrid refrigerators, hybrid freezers, hybrid refrigerator-freezers, and non-hybrid 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 (a)(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 entire case:

(i) For remote condensing commercial hybrid refrigerators, hybrid freezers, hybrid refrigerator-freezers, and non-hybrid refrigerator-freezers, where two or more independent condensing units each separately cool only one compartment, measure the total refrigeration load of each compartment separately according to AHRI Standard 1200 (I–P)-2010 test procedure (incorporated by reference, see § 431.63). Calculate compressor energy consumption (CEC) for each compartment using table 1 in ARI Standard 1200–2006 (incorporated by reference, see § 431.63) or AHRI Standard 1200 (I–P)-2010 (incorporated by reference, see § 431.63) using the saturated evaporator temperature for that compartment. The CDEC for the entire case shall be the sum of the CEC for each compartment, fan energy consumption (FEC), lighting energy consumption (LEC), anti-condensate energy consumption (AEC), defrost energy consumption (DEC), and condensate evaporator pan energy consumption (PEC) (as measured in AHRI Standard 1200 (I–P)-2010).

(ii) For remote condensing commercial hybrid refrigerators, hybrid freezers, hybrid refrigerator-freezers, and non-hybrid refrigerator-freezers, where two or more compartments are cooled collectively by one condensing unit, measure the total refrigeration load of the entire case according to the AHRI Standard 1200 (I–P)-2010 test procedure (incorporated by reference, see § 431.63). Calculate a weighted saturated evaporator temperature for the entire case by:

multiplying the saturated evaporator temperature of each compartment by the volume of that compartment (as measured in AHRI Standard 1200 (I–P)-2010 (incorporated by reference, see § 431.63)),

summing the resulting values for all compartments; and

dividing the resulting total by the total volume of all compartments.

Calculate the CEC for the entire case using table 1 in ARI Standard 1200–2006 (incorporated by reference, see § 431.63) or AHRI Standard 1200 (I–P)-2010 (incorporated by reference, see § 431.63), using the total refrigeration load and the weighted average saturated evaporator temperature. The CDEC for the entire case shall be the sum of the CEC, FEC, LEC, AEC, DEC, and PEC.

(iii) For self-contained commercial hybrid refrigerators, hybrid freezers, hybrid refrigerator-freezers, and non-hybrid refrigerator-freezers, measure the TDEC for the entire case according to the AHRI Standard 1200 (I–P)-2010 test procedure (incorporated by reference, see § 431.63).

(3) For remote condensing and self-contained wedge cases, measure the CDEC or TDEC according to the AHRI Standard 1200 (I–P)-2010 test procedure (incorporated by reference, see § 431.63). 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 (a)(1) of this section. For wedge cases of equipment classes for which a TDA metric is used, the MDEC for each model shall be the amount derived by incorporating into the standards equation in paragraph (a)(1) of this section for the equipment class 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.

(b) Each commercial refrigerator, freezer, and refrigerator-freezer, except as specified in paragraph (c) of this section, manufactured on or after Monday, January 22, 2029, shall have a daily energy consumption (in kilowatt-hours per day or "kWh/day"), when measured in accordance with the DOE test procedure at appendix B to this subpart, that does not exceed the following:

(1) For commercial refrigerators, freezers, and refrigerator-freezers other than commercial hybrids or commercial refrigerator-freezers:

TABLE 2 TO PARAGRAPH (b)(1)—MAXIMUM DAILY ENERGY CONSUMPTION STANDARDS FOR EQUIPMENT CONNECTED TO REMOTE CONDENSING UNITS

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	0.551 × TDA + 3.506
		38.0 (M)	≤40.0 and ≥32.0	VOP.RC.M	0.591 × TDA + 3.758
		0.0 (L)	<32.0	VOP.RC.L	2.079 × TDA + 6.472
		− 15.0 (I)	≤ − 13.0	VOP.RC.I	2.637 × TDA + 8.222
	Semivertical Open (SVO)	55.0 (H)	>40.0	SVO.RC.H	0.572 × TDA + 2.756
		38.0 (M)	≤40.0 and ≥32.0	SVO.RC.M	0.611 × TDA + 2.944
		0.0 (L)	<32.0	SVO.RC.L	2.079 × TDA + 6.473
		− 15.0 (I)	≤ − 13.0	SVO.RC.I	2.637 × TDA + 8.222
	Horizontal Open (HZO)	55.0 (H)	>40.0	HZO.RC.H	0.350 × TDA + 2.880
		38.0 (M)	≤40.0 and ≥32.0	HZO.RC.M	0.350 × TDA + 2.880
		0.0 (L)	<32.0	HZO.RC.L	0.550 × TDA + 6.880
		− 15.0 (I)	≤ − 13.0	HZO.RC.I	0.700 × TDA + 8.740
	Vertical Closed Transparent (VCT).	55.0 (H)	>40.0	VCT.RC.H	0.150 × TDA + 1.950
		38.0 (M)	≤40.0 and ≥32.0	VCT.RC.M	0.150 × TDA + 1.950
		0.0 (L)	<32.0	VCT.RC.L	0.490 × TDA + 2.610
		− 15.0 (I)	≤ − 13.0	VCT.RC.I	0.580 × TDA + 3.050
	Horizontal Closed Transparent (HCT).	38.0 (M)	≥32.0	HCT.RC.M	0.160 × TDA + 0.130
		0.0 (L)	<32.0	HCT.RC.L	0.340 × TDA + 0.260
		− 15.0 (I)	≤ − 13.0	HCT.RC.I	0.356 × TDA + 0.276
	Vertical Closed Solid (VCS)	55.0 (H)	>40.0	VCS.RC.H	0.100 × V + 0.260
		38.0 (M)	≤40.0 and ≥32.0	VCS.RC.M	0.100 × V + 0.260
		0.0 (L)	<32.0	VCS.RC.L	0.210 × V + 0.540
		− 15.0 (I)	≤ − 13.0	VCS.RC.I	0.250 × V + 0.630
	Horizontal Closed Solid (HCS)	38.0 (M)	≥32.0	HCS.RC.M	0.100 × V + 0.260
		0.0 (L)	<32.0	HCS.RC.L	0.210 × V + 0.540
		− 15.0 (I)	≤ − 13.0	HCS.RC.I	0.250 × V + 0.630
	Service Over Counter (SOC)	55.0 (H)	>40.0	SOC.RC.H	0.440 × TDA + 0.110
		38.0 (M)	≤40.0 and ≥ 32.0	SOC.RC.M	0.440 × TDA + 0.110
		0.0 (L)	<32.0	SOC.RC.L	0.930 × TDA + 0.220
		− 15.0 (I)	≤ − 13.0	SOC.RC.I	0.970 × TDA + 0.231
	Chef Base (CB)	38.0 (M)	≥32.0	CB.RC.M	0.050 × V + 0.686
		0.0 (L)	<32.0	CB.RC.L	0.194 × V + 1.693

* The meaning of the letters in this column is indicated in the columns to the left.
** "V" is the volume, expressed in ft^3, as determined in appendix B to this subpart. "TDA" is the total display area, expressed in ft^2, as determined in appendix B to this subpart.

TABLE 3 TO PARAGRAPH (b)(1)—MAXIMUM DAILY ENERGY CONSUMPTION STANDARDS FOR EQUIPMENT CONNECTED TO SELF-CONTAINED UNITS

Condensing unit configuration	Equipment family	Rating temperature (°F)	Operating temperature (°F)	Capacity range	Equipment class designation *	Maximum daily energy consumption ** (kWh/day)
Self-Contained (SC)	Vertical Open (VOP)	55.0 (H)	>40.0	All TDAs	VOP.SC.H	0.890 × TDA + 2.480
		38.0 (M)	≤40.0 and ≥32.0	TDA ≤17 ft^2	VOP.SC.M (≤17)	1.230 × TDA + 3.428
				TDA >17 ft^2	VOP.SC.M (>17)	1.69 × TDA + 4.71
		0.0 (L)	<32.0	All TDAs	VOP.SC.L	3.092 × TDA + 8.598
		− 15.0 (I)	≤ − 13.0		VOP.SC.I	3.928 × TDA + 10.926
	Semivertical Open (SVO).	55.0 (H)	>40.0	All TDAs	SVO.SC.H	1.045 × TDA + 2.822
		38.0 (M)	≤40.0 and ≥32.0	TDA ≤15 ft^2	SVO.SC.M (≤15)	1.207 × TDA + 3.258
				TDA >15 ft^2	SVO.SC.M (>15)	1.7 × TDA + 4.59
		0.0 (L)	<32.0	All TDAs	SVO.SC.L	3.024 × TDA + 8.169
		− 15.0 (I)	≤ − 13.0		SVO.SC.I	3.840 × TDA + 10.384
	Horizontal Open (HZO).	55.0 (H)	>40.0	All TDAs	HZO.SC.H	0.546 × TDA + 4.211
		38.0 (M)	≤40.0 and ≥32.0		HZO.SC.M	0.532 × TDA + 4.100
		0.0 (L)	<32.0	TDA ≤35 ft^2	HZO.SC.L (≤35)	1.490 × TDA + 5.554
				TDA >35 ft^2	HZO.SC.L (>35)	1.9 × TDA + 7.08
		− 15.0 (I)	≤ − 13.0	All TDAs	HZO.SC.I	1.900 × TDA + 7.065
	Vertical Closed Transparent (VCT).	55.0 (H)	>40.0	All TDAs	VCT.SC.H	0.047 × V + 0.493
		38.0 (M)	≤40.0 and ≥32.0	V ≤100 ft^3	VCT.SC.M (≤100)	0.073 × V + 0.630
					VCT.SC.M (≤100) with Feature ***.	0.078 × V + 0.674
				V >100 ft^3	VCT.SC.M (>100)	0.1 × V + 0.86
		0.0 (L)	<32.0	V ≤70 ft^3	VCT.SC.L (≤70)	0.233 × V + 2.374
					VCT.SC.L (≤70) with Feature ***.	0.249 × V + 2.540
				V >70 ft^3	VCT.SC.L (>70)	0.29 × V + 2.95
		− 15.0 (I)	≤ − 13.0	All Volumes	VCT.SC.I	0.620 × TDA + 3.290

TABLE 3 TO PARAGRAPH (b)(1)—MAXIMUM DAILY ENERGY CONSUMPTION STANDARDS FOR EQUIPMENT CONNECTED TO SELF-CONTAINED UNITS—Continued

Condensing unit configuration	Equipment family	Rating temperature (°F)	Operating temperature (°F)	Capacity range	Equipment class designation *	Maximum daily energy consumption ** (kWh/day)
	Vertical Closed Solid (VCS).	55.0 (H)	>40.0	All Volumes	VCS.SC.H	0.021 × V + 0.793
		38.0 (M)	≤40.0 and ≥32.0	All Volumes	VCS.SC.M	0.038 × V + 1.039
					VCS.SC.M with Feature ***.	0.041 × V + 1.112
		0.0 (L)	<32.0	V ≤100 ft^3	VCS.SC.L (≤100)	0.169 × V + 1.059
					VCS.SC.L (≤100) with Feature ***.	0.181 × V + 1.133
				V >100 ft^3	VCS.SC.L (>100)	0.22 × V + 1.38
		−15.0 (I)	≤−13.0	All Volumes	VCS.SC.I	0.264 × V + 0.683
	Horizontal Closed Transparent (HCT).	38.0 (M)	≥32.0	All Volumes	HCT.SC.M	0.060 × V + 0.370
		0.0 (L)	<32.0		HCT.SC.L	0.080 × V + 1.230
		−15.0 (I)	≤−13.0		HCT.SC.I	0.498 × TDA + 0.383
	Horizontal Closed Solid (HCS).	38.0 (M)	≥32.0	All Volumes	HCS.SC.M	0.037 × V + 0.675
		0.0 (L)	<32.0		HCS.SC.L	0.055 × V + 1.033
					HCS.SC.L with Feature ***.	0.059 × V + 1.105
		−15.0 (I)	≤−13.0		HCS.SC.I	0.313 × V + 0.811
	Service Over Counter (SOC).	55.0 (H)	>40.0	All TDAs	SOC.SC.H	0.304 × TDA + 0.584
		38.0 (M)	≤40.0 and ≥32.0	TDA ≤40 ft^2	SOC.SC.M (≤40)	0.356 × TDA + 0.685
				TDA >40 ft^2	SOC.SC.M (>40)	0.52 × TDA + 1
		0.0 (L)	<32.0	All TDAs	SOC.SC.L	1.100 × TDA + 2.100
		−15.0 (I)	≤−13.0		SOC.SC.I	1.530 × TDA + 0.360
	Chef Base (CB)	38.0 (M)	≥32.0	All Volumes	CB.SC.M	0.081 × V + 1.117
		0.0 (L)	<32.0		CB.SC.L	0.297 × V + 2.591
	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.
** "V" is the volume, expressed in ft^3, as determined in appendix B to this subpart. "TDA" is the total display area, expressed in ft^2, as determined in appendix B to this subpart.
*** For equipment classes designated "with Feature," refer to table 4 to this paragraph for the list of qualifying features applicable to each class.

TABLE 4 TO PARAGRAPH (b)(1)—QUALIFYING FEATURES FOR EQUIPMENT CLASSES DESIGNATED "WITH FEATURE"

Equipment class	Qualifying feature(s)
VCT.SC.M (≤100)	Pass-through doors. Sliding doors. Both pass-through and sliding doors. Roll-in doors. Roll-through doors.
VCT.SC.L (≤70)	Pass-through doors.
VCS.SC.M	Pass-through doors. Roll-in doors. Roll-through doors. Drawer units.
VCS.SC.L (≤100)	Pass-through doors. Roll-in doors. Roll-through doors. Drawer units.
HCS.SC.L	Forced air evaporator.

(2) For commercial hybrids and commercial refrigerator-freezers, for each compartment, measure the TDA or volume of that compartment. 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. The total MDEC limit for each model shall be the sum of the MDEC values for all of its compartments. Measure the CDEC or TDEC for the model as follows:

(i) For commercial hybrids and commercial refrigerator-freezers where two or more independent remote condensing units are each connected to a separate, individual compartment, measure the total refrigeration load of each compartment separately according to appendix B to this subpart. 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 this subpart. Calculate a weighted average adjusted dew point temperature for the model by: multiplying the adjusted dew point temperature of each compartment by the volume of that compartment; summing the resulting values for all compartments; and dividing the resulting total by the total volume of all compartments. 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 this subpart.

(c) The energy conservation standards in paragraph (a) of this section do not apply to chef bases or griddle stands, buffet tables or preparation tables, blast chillers, blast freezers, or mobile refrigerated cabinets. The energy conservation standards in paragraph (b) of this section do not apply to buffet tables or preparation tables, blast chillers, blast freezers, or mobile refrigerated cabinets.

Note: The following appendix will not appear in the Code of Federal Regulations.

November 27, 2023

Ami Grace-Tardy,
Assistant General Counsel for Litigation, Regulation and Energy Efficiency, U.S. Department of Energy, Washington, DC 20585.

Re: Commercial Refrigerators, Freezers, and Refrigerator-Freezers Energy Conservation Standards DOE Docket No. EERE–2017–BT–STD–0007

Dear Assistant General Counsel Grace-Tardy:

I am responding to your October 10, 2023 letter seeking the views of the Attorney

General about the potential impact on competition of proposed energy conservation standards for commercial refrigerators, freezers, and refrigerator-freezers (collectively ''CRF'').

Your request was submitted under Section 325(o)(2)(B)(i)(V) of the Energy Policy and Conservation Act, as amended (ECPA), 42 U.S.C. 6295(o)(2)(B)(i)(V), which requires the Attorney General to make a determination of the impact of any lessening of competition that is likely to result from the imposition of proposed energy conservation standards. The Attorney General's responsibility for responding to requests from other departments about the effect of a program on competition has been delegated to the Assistant Attorney General for the Antitrust Division in 28 CFR 0.40(g). The Assistant Attorney General for the Antitrust Division has authorized me, as the Policy Director for the Antitrust Division, to provide the Antitrust Division's views regarding the potential impact on competition of proposed energy conservation standards on his behalf.

In conducting its analysis, the Antitrust Division examines whether a proposed standard may lessen competition, for example, by substantially limiting consumer choice, by placing certain manufacturers at an unjustified competitive disadvantage, or by inducing avoidable inefficiencies in production or distribution of particular products. A lessening of competition could result in higher prices to manufacturers and consumers.

We have reviewed the proposed standards contained in the Notice of proposed rulemaking and announcement of public meeting (88 FR 70196, October 10, 2023) and the related Technical Support Documents. We have also reviewed public comments and information provided by industry participants and have attended and reviewed information presented at the Webinar of the Public Meeting held on November 7, 2023.

Based on this review, our conclusion is that the proposed energy conservation standards for CRF are unlikely to have a significant adverse impact on competition.

Sincerely,

David G.B. Lawrence,

Policy Director.

[FR Doc. 2024–31214 Filed 1–17–25; 8:45 am]

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