This document, concerning Consumer Gas-fired Instantaneous Water Heaters is an action issued by the Department of Energy. Though it is not intended or expected, should any discrepancy occur between the document posted here and the document published in the Federal Register, the Federal Register publication controls. This document is being made available through the Internet solely as a means to facilitate the public's access to this document.

**[6450-01-P]**

**DEPARTMENT OF ENERGY**

**10 CFR Part 430**

**[EERE-2017-BT-STD-0019]**

**RIN 1904-AF65**

# Energy Conservation Program: Energy Conservation Standards for Consumer Gas-fired Instantaneous Water Heaters

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

**ACTION:** Final rule.

**SUMMARY:** The Energy Policy and Conservation Act, as amended ("EPCA"), prescribes energy conservation standards for various consumer products and certain commercial and industrial equipment, including gas-fired instantaneous water heaters, which are a type of consumer water heater. EPCA also requires the U.S. Department of Energy ("DOE" or the "Department") to periodically review its existing standards to determine whether more-stringent standards would be technologically feasible and economically justified, and would result in significant energy savings. In this final rule, DOE is adopting amended energy conservation standards for gas-fired instantaneous water heaters. It has determined that the amended energy conservation standards for these products would result in significant conservation of energy, and are technologically feasible and economically justified.

**DATES:** The effective date of this rule is **INSERT DATE 75 DAYS AFTER DATE OF PUBLICATION IN THE *FEDERAL REGISTER***. Compliance with the amended standards established for gas-fired instantaneous water heaters in this final rule is required on and after **[INSERT 5 YEARS AFTER DATE OF PUBLICATION IN THE FINAL RULE]**.

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

The docket webpage can be found at *www.regulations.gov/docket/EERE-2017-BT-STD-0019*. The docket webpage contains instructions on how to access all documents, including public comments, in the docket.

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

**FOR FURTHER INFORMATION CONTACT:**

Ms. Julia Hegarty, U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, Building Technologies Office, EE-5B, 1000 Independence Avenue SW, Washington, DC, 20585-0121. Email: *ApplianceStandardsQuestions@ee.doe.gov*.

Mr. Uchechukwu "Emeka" Eze, U.S. Department of Energy, Office of the General Counsel, GC-33, 1000 Independence Avenue SW, Washington, DC, 20585-0121. Telephone: (240) 961-8879. Email: *uchechukwu.eze@hq.doe.gov*.

**SUPPLEMENTARY INFORMATION:**

**Table of Contents**

## I. Synopsis of the Final Rule

The Energy Policy and Conservation Act, Pub. L. 94-163, as amended ("EPCA"),[1] authorizes DOE to regulate the energy efficiency of a number of consumer products and certain industrial equipment. (42 U.S.C. 6291–6317, as codified) Title III, Part B of EPCA[2] established the Energy Conservation Program for Consumer Products Other Than Automobiles. (42 U.S.C. 6291–6309) These products include gas-fired instantaneous water heaters, the subject of this document. (42 U.S.C. 6292(a)(4))

[1] All references to EPCA in this document refer to the statute as amended through the Energy Act of 2020, Pub. L. 116-260 (Dec. 27, 2020), which reflect the last statutory amendments that impact Parts A and A-1 of EPCA.
[2] For editorial reasons, upon codification in the U.S. Code, Part B was redesignated Part A.

Pursuant to EPCA, DOE is required to review its existing energy conservation standards for covered consumer products no later than six years after issuance of any final rule establishing or amending a standard. (42 U.S.C. 6295(m)(1)) Pursuant to that statutory provision, DOE must publish either a notification of determination that standards for the product do not need to be amended, or a notice of proposed rulemaking ("NOPR") including new proposed energy conservation standards (proceeding to a final rule, as appropriate). (*Id.*) Any new or amended energy conservation standard must be designed to achieve the maximum improvement in energy efficiency that DOE determines is technologically feasible and economically justified. (42 U.S.C. 6295(o)(2)(A)) Furthermore, the new or amended standard must result in significant conservation of energy. (42 U.S.C. 6295(o)(3)(B)) DOE has conducted this review of the energy conservation standards for gas-fired instantaneous water heaters under EPCA's six-year-lookback authority described herein. Additionally, for gas-fired instantaneous water heaters with 2 or more gallons of storage volume and gas-fired instantaneous water heaters with less than or equal to 50,000 British thermal units per hour ("Btu/h") of input, DOE is following the provisions in EPCA to translate the current energy factor ("EF")-based standards to the uniform energy factor ("UEF") metric. (42 U.S.C. 6295(e)(5))

In accordance with these and other statutory provisions discussed in this document, DOE analyzed the benefits and burdens of four trial standard levels ("TSLs") for gas-fired instantaneous water heaters with less than 2 gallons of effective storage volume and rated inputs greater than 50,000 Btu/h. The TSLs and their associated benefits and burdens are discussed in detail in sections V.A through V.C of this document. As discussed in section V.C of this document, DOE has determined that TSL 2 represents the maximum improvement in energy efficiency that is technologically feasible and economically justified. The adopted standards, which are expressed in UEF are shown in Table I.1. These standards apply to products with effective storage volumes less than 2 gallons and input ratings greater than 50,000 Btu/h (as listed in Table I.1) and manufactured in, or imported into, the United States starting on **[INSERT DATE 5 YEARS AFTER DATE OF PUBLICATION IN THE FINAL RULE]**.

For all other gas-fired instantaneous water heaters, DOE is adopting new standards that do not constitute an increase to stringency, but simply a change in rating metric to the UEF descriptor. These standards apply to all remaining products listed in Table I.1 and manufactured in, or imported into, the United States starting on **[INSERT DATE 5 YEARS AFTER DATE OF PUBLICATION IN THE FINAL RULE]**.

**Table I.1 Energy Conservation Standards for Gas-fired Instantaneous Water Heaters**

| Product Class | Effective Storage Volume ($V_{eff}$)* and Input Rating | Draw Pattern | UEF |
|---|---|---|---|
| Gas-fired Instantaneous Water Heater | < 2 gallons ("gal") and ≤50,000 Btu/h | Very Small | 0.64 |
| | | Low | 0.64 |
| | | Medium | 0.64 |
| | | High | 0.64 |
| | < 2 gal and >50,000 Btu/h | Very Small | 0.89 |
| | | Low | 0.91 |
| | | Medium | 0.91 |
| | | High | 0.93 |
| | ≥2 gal and ≤200,000Btu/h | Very Small | 0.2534 − (0.0018 x $V_{eff}$) |
| | | Low | 0.5226 − (0.0022 x $V_{eff}$) |
| | | Medium | 0.5919 − (0.0020 x $V_{eff}$) |
| | | High | 0.6540 − (0.0017 x $V_{eff}$) |

* $V_{eff}$ is the Effective Storage Volume (in gallons), as determined pursuant to 10 CFR 429.17.

The following sections of this synopsis summarize the findings of the analysis carried out for gas-fired instantaneous water heaters with less than 2 gallons of effective storage volume and rated inputs greater than 50,000 Btu/h.

*A. Benefits and Costs to Consumers*[3]

The average life-cycle cost ("LCC") savings are $112, and the simple payback period ("PBP")[4], 8.9 years, is less than the 20 year average lifetime of a gas-fired instantaneous water heater (*see* section IV.F of this document).

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

*B. Impact on Manufacturers*

The industry net present value ("INPV") is the sum of the discounted cash flows to the industry from the base year through the end of the analysis period (2024–2059). Using a real discount rate of 9.6 percent, DOE estimates that the INPV for manufacturers of gas-fired instantaneous water heaters in the case without amended standards is $1,193.9 million in 2023$. Under the adopted standards, DOE estimates the change in INPV to range from -2.8 percent to 3.4 percent, which is approximately -$33.7 million to $40.5 million. In order to bring products into compliance with amended standards, it is estimated that industry will incur total conversion costs of $20.4 million.

[3] All monetary values in this document are expressed in 2023 dollars unless indicated otherwise. For purposes of discounting future monetary values, the present year in the analysis was 2024.

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

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

*C. National Benefits and Costs*

DOE's analyses indicate that the adopted energy conservation standards for gas-fired instantaneous water heaters would save a significant amount of energy. Relative to the case without amended standards, the lifetime energy savings for gas-fired instantaneous water heaters purchased during the 30-year period that begins in the anticipated year of compliance with the amended standards (2030–2059), amount to 0.58 quadrillion British thermal units ("Btu"), or quads.[5] This represents a savings of 1.9 percent relative to the energy use of these products in the case without amended standards (referred to as the "no-new-standards case").

The cumulative net present value ("NPV") of total consumer benefits of the standards for gas-fired instantaneous water heaters ranges from $0.87 billion (at a 7-percent discount rate) to $3.06 billion (at a 3-percent discount rate). This NPV expresses the estimated total value of future operating-cost savings minus the estimated increased product and installation costs for gas-fired instantaneous water heaters purchased during the period 2030–2059.

[5] The quantity refers to full-fuel-cycle ("FFC") energy savings. FFC energy savings includes the energy consumed in extracting, processing, and transporting primary fuels (*i.e.*, coal, natural gas, petroleum fuels), and, thus, presents a more complete picture of the impacts of energy efficiency standards. For more information on the FFC metric, *see* section IV.H.2 of this document.

In addition, the adopted standards for gas-fired instantaneous water heaters are projected to yield significant environmental benefits. DOE estimates that the standards will result in cumulative emission reductions (over the same period as for energy savings) of 32 million metric tons ("Mt")[6] of carbon dioxide ("$CO_2$"), 0.12 thousand tons of sulfur dioxide ("$SO_2$"), 86 thousand tons of nitrogen oxides ("$NO_X$"), 398 thousand tons of methane ("$CH_4$"), 0.06 thousand tons of nitrous oxide ("$N_2O$"), and an increase of 0.0004 tons of mercury ("Hg") due to a small increase in electricity use at the adopted standards.[7]

DOE estimates the value of climate benefits from a reduction in greenhouse gases ("GHG") using different estimates of the social cost of $CO_2$ ("SC-$CO_2$"), the social cost of methane ("SC-$CH_4$"), and the social cost of nitrous oxide ("SC-$N_2O$").[8] Together these represent the social cost of GHG ("SC-GHG"). DOE used an updated set of SC-GHG estimates published in 2023 by the Environmental Protection Agency ("EPA") ("2023 SC-GHG"), as well as the interim SC-GHG values (in terms of benefit per ton of GHG avoided) developed by an Interagency Working Group on the Social Cost of Greenhouse Gases ("IWG") in 2021 ("2021 Interim SC-GHG"), which DOE used in the notice of proposed rulemaking for this rule before the updated values were available.[9]

---

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

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

[8] Estimated climate-related benefits are provided in compliance with Executive Order 12866.

[9] *Technical Support Document: Social Cost of Carbon, Methane, and Nitrous Oxide Interim Estimates Under Executive Order 13990* published in February 2021 by the IWG. ("February 2021 SC-GHG TSD"*)*. *www.whitehouse.gov/wp-*

These values is discussed in section IV.L of this document. The climate benefits associated with the average SC-GHG at a 2-percent near-term Ramsey discount rate using the 2023 SC-GHG estimates are estimated to be $7.1 billion, and the climate benefits associated with the average 2021 Interim SC-GHG estimates at a 3-percent discount rate are estimated to be $1.7 billion. DOE notes, however, that the adopted standards would be economically justified even without inclusion of the estimated monetized benefits of reduced GHG emissions.

DOE estimated the monetary health benefits of $SO_2$ and $NO_X$ emissions reductions using benefit per ton estimates from the EPA's Benefits Mapping and Analysis Program,[10] as discussed in section IV.L of this document. DOE did not monetize the change in mercury emissions because the quantity is very small. DOE estimated the present value of the health benefits would be $0.9 billion using a 7-percent discount rate, and $2.7 billion using a 3-percent discount rate.[11] DOE is currently only monetizing health benefits from changes in ambient fine particulate matter ("$PM_{2.5}$") concentrations from two precursors ($SO_2$ and $NO_X$), and from changes in ambient ozone from one precursor ($NO_X$), but will continue to assess the ability to monetize other effects such as health benefits from reductions in direct $PM_{2.5}$ emissions.

---

*content/uploads/2021/02/TechnicalSupportDocument_SocialCostofCarbonMethaneNitrousOxide.pdf*. https://www.epa.gov/system/files/documents/2023-12/eo12866_oil-and-gas-nsps-eg-climate-review-2060-av16-final-rule-20231130.pdf; https://www.epa.gov/system/files/documents/2023-12/epa_scghg_2023_report_final.pdf (last accessed July 3, 2024)

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

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

Table I.2 summarizes the monetized benefits and costs expected to result from the amended standards for gas-fired instantaneous water heaters. There are other important unquantified effects, including certain unquantified climate benefits, unquantified public health benefits from the reduction of toxic air pollutants and other emissions, unquantified energy security benefits, and distributional effects, among others.

**Table I.2 Summary of Monetized Benefits and Costs of the Adopted Energy Conservation Standards for Gas-fired Instantaneous Water Heaters at TSL 2 Shipped During the Period 2030-2059 ($V_{eff}$ < 2 gal, Rated Input > 50,000 Btu/h)**

| | **Billion 2023$** |
|---|---|
| **3% discount rate** | |
| **Consumer Operating Cost Savings** | 4.5 |
| **Climate Benefits* (2023 SC-GHG estimates)** | 7.1 |
| **Climate Benefits* (2021 interim SC-GHG estimates)** | 1.7 |
| **Health Benefits**** | 2.7 |
| **Total Benefits† (2023 SC-GHG estimates)** | 14.3 |
| **Total Benefits† (2021 interim SC-GHG estimates)** | 8.9 |
| **Consumer Incremental Product Costs‡** | 1.5 |
| **Net Benefits† (2023 SC-GHG estimates)** | 12.8 |
| **Net Benefits† (2021 interim SC-GHG estimates)** | 7.4 |
| **Change in Producer Cashflow (INPV)‡‡** | (0.03) – 0.04 |
| **7% discount rate** | |
| **Consumer Operating Cost Savings** | 1.7 |
| **Climate Benefits* (2023 SC-GHG estimates)** | 7.1 |
| **Climate Benefits* (2021 interim SC-GHG estimates)** | 1.7 |
| **Health Benefits**** | 0.9 |
| **Total Benefits† (2023 SC-GHG estimates)** | 9.6 |
| **Total Benefits† (2021 interim SC-GHG estimates)** | 4.2 |
| **Consumer Incremental Product Costs‡** | 0.8 |
| **Net Benefits† (2023 SC-GHG estimates)** | 8.9 |
| **Net Benefits† (2021 interim SC-GHG estimates)** | 3.4 |
| **Change in Producer Cashflow (INPV)‡‡** | (0.03) – 0.04 |

Note: These results include consumer, climate, and health benefits that accrue after 2030 from the products shipped during the period 2030−2059.
* Climate benefits are calculated using different estimates of the social cost of carbon (SC-$CO_2$), methane (SC-$CH_4$), and nitrous oxide (SC-$N_2O$). 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 and net benefits include those consumer, climate, and health benefits that can be quantified and monetized. For presentation purposes, total and net benefits for both the 3-percent and 7-percent cases are presented using the average SC-GHG with 2-percent near-term Ramsey discount rate for the 2023 estimate and the average SC-GHG with 3-percent discount rate for the 2021 interim SC-GHG estimate.
‡ Costs include incremental equipment costs as well as installation costs.
‡‡ Operating Cost Savings are calculated based on the life-cycle costs analysis and national impact analysis as discussed in detail below. *See* sections IV.F and IV.H of this document. DOE's national impacts analysis includes all impacts (both costs and benefits) along the distribution chain beginning with the increased costs to the manufacturer to manufacture the product and ending with the increase in price experienced by the consumer. DOE also separately conducts a detailed analysis on the impacts on manufacturers (*i.e.*, manufacturer impact analysis, or "MIA"). *See* section IV.J of this document. In the detailed MIA, DOE models manufacturers' pricing decisions based on assumptions regarding investments, conversion costs, cashflow, and margins. The MIA produces a range of impacts, which is the rule's expected impact on the INPV. The change in INPV is the present value of all changes in industry cash flow, including changes in production costs, capital expenditures, and manufacturer profit margins. Change in INPV is calculated using the industry weighted average cost of capital value of 9.6 percent that is estimated in the MIA (*see* chapter 12 of the final rule technical support document ("TSD") for a complete description of the industry weighted average cost of capital). For gas-fired instantaneous water heaters, the change in INPV ranges from -$34 million to $41 million. DOE accounts for that range of likely impacts in analyzing whether a TSL is economically justified. *See* section V.C of this document. DOE is presenting the range of impacts to the INPV under two manufacturer markup scenarios: the Preservation of Gross Margin scenario, which is the manufacturer markup scenario used in the calculation of Consumer Operating Cost Savings in this table; and the Preservation of Operating Profit scenario, where DOE assumed manufacturers would not be able to increase per-unit operating profit in proportion to increases in manufacturer production costs. DOE includes the range of estimated INPV in the above table, drawing on the MIA explained further in section IV.J of this document to provide additional context for assessing the estimated impacts of this final rule to society, including potential changes in production and consumption, which is consistent with OMB's Circular A-4 and E.O. 12866. If DOE were to include the INPV into the net benefit calculation (2023 SC-GHG estimates) for this final rule, the net benefits would be $12.8 billion at 3-percent discount rate and $8.9 billion at 7-percent discount rate. Parentheses indicate negative () values.

The benefits and costs of the adopted standards can also be expressed in terms of annualized values. The monetary values for the total annualized net benefits are: (1) the reduced consumer operating costs, minus (2) the increase in product purchase prices and installation costs, plus (3) the value of climate and health benefits of emission reductions, all annualized.[12]

The national operating cost savings are domestic private U.S. consumer monetary savings that occur as a result of purchasing the covered products and are measured for the lifetime of gas-fired instantaneous water heaters shipped during the period 2030–2059. The benefits associated with reduced emissions achieved as a result of the adopted standards are also calculated based on the lifetime of gas-fired instantaneous water heaters shipped during the period 2030–2059. 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.[13]

Table I.3 presents the total estimated monetized benefits and costs associated with the adopted standard, expressed in terms of annualized values. The results under the primary estimate are as follows.

Using a 7-percent discount rate for consumer benefits and costs and health benefits from reduced $NO_X$ and $SO_2$ emissions, and the 2-percent near-term Ramsey

[12] To convert the time-series of costs and benefits into annualized values, DOE calculated a present value in 2024, the year used for discounting the NPV of total consumer costs and savings. For the benefits, DOE calculated a present value associated with each year's shipments in the year in which the shipments occur (*e.g.*, 2020 or 2030), and then discounted the present value from each year to 2024. Using the present value, DOE then calculated the fixed annual payment over a 30-year period, starting in the compliance year, that yields the same present value.
[13] DOE notes that using consumption-based discount rates (*e.g.*, 2 or 3 percent) is appropriate when discounting the value of climate impacts. Combining climate effects discounted at an appropriate consumption-based discount rate with other costs and benefits discounted at a capital-based rate (*i.e.*, 7 percent) is reasonable because of the different nature of the types of benefits being measured.

discount rate case or the 3-percent discount rate case for climate benefits from reduced GHG emissions, the estimated cost of the standards adopted in this rule is $88 million per year in increased equipment costs, while the estimated annual benefits are $187 million in reduced equipment operating costs, $349 million in climate benefits (using the 2023 SC-GHG estimates) or $98 million in climate benefits (using the 2021 interim SC-GHG estimates), and $101 million in health benefits. In this case, the net benefit would amount to $549 million per year (using the 2023 SC-GHG estimates) or $297 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 $NO_X$ 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 cost of the standards is $87 million per year in increased equipment costs, while the estimated annual benefits are $268 million in reduced operating costs, $349 million in climate benefits (using the 2023 SC-GHG estimates) or $98 million in climate benefits (using the 2021 interim SC-GHG estimates), and $158 million in health benefits. In this case, the net benefit would amount to $689 million per year (using the 2023 SC-GHG estimates) or $437 million per year (using the 2021 interim SC-GHG estimates).

**Table I.3 Annualized Benefits and Costs of the Adopted Energy Conservation Standards for Gas-fired Instantaneous Water Heaters at TSL 2 Shipped During the Period 2030–2059 ($V_{eff}$ < 2 gal, Rated Input > 50,000 Btu/h)**

| | Million 2023$/year | | |
|---|---|---|---|
| | **Primary Estimate** | **Low-Net-Benefits Estimate** | **High-Net-Benefits Estimate** |
| **3% discount rate** | | | |
| **Consumer Operating Cost Savings** | 268 | 249 | 288 |
| **Climate Benefits* (2023 SC-GHG estimates)** | 349 | 344 | 355 |
| **Climate Benefits* (2021 interim SC-GHG estimates)** | 98 | 96 | 100 |
| **Health Benefits**** | 158 | 156 | 161 |
| **Total Benefits† (2023 SC-GHG estimates)** | 776 | 749 | 804 |
| **Total Benefits† (2021 interim SC-GHG estimates)** | 525 | 502 | 548 |
| **Consumer Incremental Product Costs‡** | 87 | 86 | 89 |
| **Net Benefits† (2023 SC-GHG estimates)** | 689 | 663 | 715 |
| **Net Benefits† (2021 interim SC-GHG estimates)** | 437 | 416 | 459 |
| **Change in Producer Cashflow (INPV)‡‡** | (3) – 4 | (3) – 4 | (3) – 4 |
| **7% discount rate** | | | |
| **Consumer Operating Cost Savings** | 187 | 174 | 200 |
| **Climate Benefits* (2023 SC-GHG estimates)** | 349 | 344 | 355 |
| **Climate Benefits* (2021 interim SC-GHG estimates)** | 98 | 96 | 100 |
| **Health Benefits**** | 101 | 99 | 102 |
| **Total Benefits† (2023 SC-GHG estimates)** | 637 | 616 | 658 |
| **Total Benefits† (2021 interim SC-GHG estimates)** | 386 | 369 | 402 |
| **Consumer Incremental Product Costs‡** | 88 | 87 | 90 |
| **Net Benefits† (2023 SC-GHG estimates)** | 549 | 530 | 568 |
| **Net Benefits† (2021 interim SC-GHG estimates)** | 297 | 283 | 312 |
| **Change in Producer Cashflow (INPV)‡‡** | (3) – 4 | (3) – 4 | (3) – 4 |

Note: These results include consumer, climate, and health benefits that accrue after 2059 from the products shipped during the period 2030–2059. The Primary, Low Net Benefits, and High Net Benefits Estimates utilize projections of energy prices from the *AEO2023* Reference case, Low Economic Growth case, and High Economic Growth case, respectively. In addition, incremental equipment costs reflect a medium decline rate in the Primary Estimate, a low decline rate in the Low Net Benefits Estimate, and a high decline rate in the High Net Benefits Estimate. The methods used to derive projected price trends are explained in sections IV.F.1 and IV.H.3 of this document. Note that the Benefits and Costs may not sum to the Net Benefits due to rounding.

* Climate benefits are calculated using 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 2-percent near-term Ramsey discount rate for the 2023 estimate and the average SC-GHG with 3-percent discount rate for the 2021 interim SC-GHG estimate.

‡ Costs include incremental equipment costs as well as installation costs.

‡‡ Operating Cost Savings are calculated based on the life-cycle costs analysis and national impact analysis as discussed in detail below. *See* sections IV.F and IV.H of this document. DOE's national impacts analysis includes all impacts (both costs and benefits) along the distribution chain beginning with the increased costs to the manufacturer to manufacture the product and ending with the increase in price experienced by the consumer. DOE also separately conducts a detailed analysis on the impacts on manufacturers (*i.e.*, MIA). *See* section IV.J of this document. In the detailed MIA, DOE models manufacturers' pricing decisions based on assumptions regarding investments, conversion costs, cashflow, and margins. The MIA produces a range of impacts, which is the rule's expected impact on the INPV. The change in INPV is the present value of all changes in industry cash flow, including changes in production costs, capital expenditures, and manufacturer profit margins. The annualized change in INPV is calculated using the industry weighted average cost of capital value of 9.6 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 gas-fired instantaneous water heaters, the annualized change in INPV ranges from -$3 million to $4 million. DOE accounts for that range of likely impacts in analyzing whether a TSL is economically justified. *See* section V.C of this document. DOE is presenting the range of impacts to the INPV under two manufacturer markup scenarios: the Preservation of Gross Margin scenario, which is the manufacturer markup scenario used in the calculation of Consumer Operating Cost Savings in this table; and the Preservation of Operating Profit scenario, where DOE assumed manufacturers would not be able to increase per-unit operating profit in proportion to increases in manufacturer production costs. DOE includes the range of estimated annualized change in INPV in the above table, drawing on the MIA explained further in section IV.J of this document to provide additional context for assessing the estimated impacts of this 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 (2023 SC-GHG estimates) for this final rule, the annualized net benefits would range from $686 million to $693 million at 3-percent discount rate and would range from $546 million to $553 million at 7-percent discount rate. Parentheses indicate negative () values.

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

*D. Conclusion*

DOE concludes that the standards adopted in this final rule represent the maximum improvement in energy efficiency that is technologically feasible and economically justified, and would result in the significant conservation of energy. Specifically, with regards to technological feasibility products achieving these standard levels are already commercially available. As for economic justification, DOE's analysis shows that the benefits of the standards exceed, to a great extent, the burdens of the standards.

Using a 7-percent discount rate for consumer benefits and costs and NOx and $SO_2$ reduction benefits, and a 2-percent near-term Ramsey discount rate case or the 3-percent discount rate case for GHG social costs, the estimated cost of the standards for gas-fired instantaneous water heaters is $88 million per year in increased product costs, while the estimated annual benefits are $187 million in reduced product operating costs, $349 million in climate benefits (using the 2023 SC-GHG estimates) or $98 million in climate benefits (using the 2021 interim SC-GHG estimates), and $101 million in health benefits. The net benefit amounts to $549 million per year (using the 2023 SC-GHG estimates) or $297 million per year (using the 2021 interim SC-GHG estimates). DOE notes that the net benefits are substantial even in the absence of the climate benefits,[14] and DOE would adopt the same standards in the absence of such benefits.

[14] The information on climate benefits is provided in compliance with Executive Order 12866.

The significance of energy savings offered by a new or amended energy conservation standard cannot be determined without knowledge of the specific circumstances surrounding a given rulemaking.[15] For example, some covered products and equipment have most of their energy consumption occur during periods of peak energy demand. The impacts of these products on the energy infrastructure can be more pronounced than the impacts of products with relatively constant demand. Accordingly, DOE evaluates the significance of energy savings on a case-by-case basis.

As previously mentioned, the standards are projected to result in estimated national energy savings ("NES") of 0.58 quads full-fuel-cycle ("FFC"), the equivalent of the primary annual energy use of 4 million homes. Based on these findings, DOE has determined the energy savings from the standard levels adopted in this final rule are "significant" within the meaning of 42 U.S.C. 6295(o)(3)(B). A more detailed discussion of the basis for these conclusions is contained in the remainder of this document and the accompanying TSD.

## II. Introduction

The following section briefly discusses the statutory authority underlying this final rule, as well as some of the relevant historical background related to the establishment of standards for gas-fired instantaneous water heaters, which, as discussed in section III.B of this document, are a subset of consumer water heaters. Gas-fired

[15] Procedures, Interpretations, and Policies for Consideration in New or Revised Energy Conservation Standards and Test Procedures for Consumer Products and Commercial/Industrial Equipment, 86 FR 70892, 70901 (Dec. 13, 2021).

instantaneous water heaters are defined at 10 CFR 430.2 as a water heater that uses gas as the main energy source, has a nameplate input rating less than 200,000 Btu/h, and contains no more than one gallon of water per 4,000 Btu per hour of input.

*A. Authority*

EPCA authorizes DOE to regulate the energy efficiency of a number of consumer products and certain industrial equipment. (42 U.S.C. 6291–6317, as codified) Title III, Part B of EPCA[16] established the Energy Conservation Program for Consumer Products Other Than Automobiles. (42 U.S.C. 6291–6309) These products include gas-fired instantaneous water heaters, the subject of this document. (42 U.S.C. 6292(a)(4))

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

Federal energy efficiency requirements for covered products established under EPCA generally supersede State laws and regulations concerning energy conservation testing, labeling, and standards. (42 U.S.C. 6297(a)–(c)) DOE may, however, grant

[16] As noted previously, for editorial reasons, upon codification in the U.S. Code, Part B was redesignated Part A.

waivers of Federal preemption in limited circumstances for particular State laws or regulations, in accordance with the procedures and other provisions set forth under EPCA. (42 U.S.C. 6297(d))

Subject to certain criteria and conditions, DOE is required to develop test procedures to measure the energy efficiency, energy use, or estimated annual operating cost of each covered product. (42 U.S.C. 6295(o)(3)(A) and 42 U.S.C. 6295(r)) Manufacturers of covered products must use the prescribed DOE test procedure as the basis for certifying to DOE that their product complies with the applicable energy conservation standards and as the basis for any representations regarding the energy use or energy efficiency of the product. (42 U.S.C. 6295(s) and 42 U.S.C. 6293(c)). Similarly, DOE must use these test procedures to evaluate whether a basic model complies with the applicable energy conservation standard(s). (42 U.S.C. 6295(s)) The DOE test procedures for gas-fired instantaneous water heaters appear at title 10 of the Code of Federal Regulations ("CFR") part 430, subpart B, appendix E ("appendix E").

EPCA prescribed energy conservation standards for gas-fired instantaneous water heaters (42 U.S.C. 6295(e)(1)) and directed DOE to conduct future rulemakings to determine whether to amend these standards. (42 U.S.C. 6295(e)(4)) 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 ("NOPD") that standards for the product do not need to be amended, or a NOPR including new proposed energy conservation standards (proceeding to a final rule, as appropriate). (42 U.S.C. 6295(m)(1)) DOE must make the analysis on which a NOPD or NOPR is based publicly available and provide an opportunity for written comment. (42 U.S.C. 6295(m)(2)) Not later than two years after a NOPR is issued, DOE must publish a final rule amending the energy conservation standard for the product. (42 U.S.C. 6295(m)(3)(A))

DOE must follow specific statutory criteria for prescribing new or amended standards for covered products, including gas-fired instantaneous water heaters. Any new or amended standard for a covered product must be designed to achieve the maximum improvement in energy efficiency that the Secretary of Energy ("Secretary") determines is technologically feasible and economically justified. (42 U.S.C. 6295(o)(2)(A)) Furthermore, DOE may not adopt any standard that would not result in the significant conservation of energy. (42 U.S.C. 6295(o)(3)(B))

Moreover, DOE may not prescribe a standard if: (1) for certain products, including gas-fired instantaneous water heaters, no test procedure has been established for the product; or (2) DOE determines by rule that the establishment of such standard will not result in significant conservation of energy (or, for certain products, water), or is not technologically feasible or economically justified. (42 U.S.C. 6295(o)(3)(A)–(B)) In deciding whether a proposed standard is economically justified, DOE must determine whether the benefits of the standard exceed its burdens. (42 U.S.C. 6295(o)(2)(B)(i)) DOE must make this determination after receiving comments on the proposed standard, and by considering, to the greatest extent practicable, the following seven statutory factors:

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

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

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

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

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

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

7) Other factors the Secretary considers relevant.

(42 U.S.C. 6295(o)(2)(B)(i)(I)–(VII))

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

EPCA, as codified, also contains what is known as an "anti-backsliding" provision, which prevents the Secretary from prescribing any amended standard that either increases the maximum allowable energy use or decreases the minimum required energy efficiency of a covered product. (42 U.S.C. 6295(o)(1)) Also, the Secretary may not prescribe an amended or new standard if interested persons have established by a preponderance of the evidence that the standard is likely to result in the unavailability in the United States in any covered product type (or class) of performance characteristics (including reliability), features, sizes, capacities, and volumes that are substantially the same as those generally available in the United States. (42 U.S.C. 6295(o)(4))

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

Finally, pursuant to the amendments to EPCA contained in the Energy Independence and Security Act of 2007, Pub. L. 110-140, any final rule for new or amended energy conservation standards promulgated after July 1, 2010, is required to address standby mode and off mode energy use. (42 U.S.C. 6295(gg)(3)) Specifically, when DOE adopts a standard for a covered product after that date, it must, if justified by the criteria for adoption of standards under EPCA (42 U.S.C. 6295(o)), incorporate standby mode and off mode energy use into a single standard, or, if that is not feasible, adopt a separate standard for such energy use for that product. (42 U.S.C. 6295(gg)(3)(A)–(B))

DOE is publishing this final rule pursuant to the six-year-lookback review requirement in EPCA described herein for gas-fired instantaneous water heaters with less than 2 gallons of effective storage volume and rated inputs greater than 50,000 Btu/h. (42 U.S.C. 6295(m)) DOE is also publishing this final rule pursuant to its authority to establish uniform efficiency descriptors for covered water heaters (42 U.S.C. 6295(e)(5))

*B. Background*

1. Current Standards

As directed by EPCA (42 U.S.C. 6295(e)(4)), DOE conducted two cycles of rulemakings to determine whether to amend the statutory standards for consumer water heaters found in 42 U.S.C. 6295(e)(1). The most recent rulemaking from April 2010 resulted in amended standards using the EF metric originally prescribed by EPCA with a requirement for compliance starting on April 16, 2015. 75 FR 20112 (the "April 2010 Final Rule"). Later amendments to EPCA directed DOE to establish a uniform efficiency metric for consumer water heaters (*see* 42 U.S.C. 6295(e)(5)(B)).[17] The Federal test procedure was revised to use a new metric, UEF, in a final rule published on July 11, 2014 (the "July 2014 UEF TP Final Rule"). 79 FR 40542. In a final rule published in the *Federal Register* on December 29, 2016, the existing EF-based energy conservation standards were then translated from EF to UEF using a "conversion factor" method for water heater basic models that were in existence at the time. 81 FR 96204 ("December 2016 Conversion Factor Final Rule").

The resulting standards for gas-fired instantaneous water heaters set forth in DOE's regulations at 10 CFR 430.32(d)(1) are shown in Table II.1.

[17] The requirement for a consumer water heater test procedure using UEF as a metric, as well as the requirement for DOE to undertake a conversion factor rulemaking to translate existing consumer water heater standards denominated in terms of EF to ones denominated in terms of UEF, were part of the amendments to EPCA contained in the American Energy Manufacturing Technical Corrections Act ("AEMTCA"), Public Law 112-210 (Dec. 18, 2012).

**Table II.1 Federal Energy Efficiency Standards for Gas-fired Instantaneous Water Heaters**

| Product Class | Rated Storage Volume and Input Rating | Draw Pattern* | Uniform Energy Factor |
|---|---|---|---|
| Instantaneous Gas-fired Water Heater | < 2 gal and >50,000 Btu/h | Very Small | 0.80 |
| | | Low | 0.81 |
| | | Medium | 0.81 |
| | | High | 0.81 |

* The draw pattern dictates the frequency and duration of hot water draws during the 24-hour simulated use test, and is an indicator of delivery capacity of the water heater. Draw patterns are assigned based on the first hour rating ("FHR"), for non-flow-activated water heaters, or maximum GPM rating ("Max GPM"), for flow-activated water heaters. For the specific FHR and Max GPM ranges which correspond to each draw pattern, see section 5.4.1 of Appendix E to Subpart B of 10 CFR 430.

In the December 2016 Conversion Factor Final Rule, DOE declined to develop conversion factors and UEF-based standards for consumer water heaters of certain sizes (by rated storage volume or input rating) and of certain types (*i.e.*, oil-fired instantaneous water heaters) where models did not exist on the market at the time to inform the analysis of the standards conversion. 81 FR 96204, 96210-96211. For consumer water heaters that did not receive converted UEF-based standards, DOE provided its interpretation that the original statutory standards—found at 42 U.S.C. 6295(e)(1) and expressed in terms of the EF metric—still applied; however, DOE would not enforce those statutorily-prescribed standards until such a time that conversion factors are developed for these products and they can be converted to UEF. *Id.* Thus, the EF-based standards specified by EPCA apply to any consumer water heaters which do not have UEF-based standards found at 10 CFR 430.32(d). The EF-based standards for gas-fired instantaneous water heaters which do not have UEF-based standards are set forth at 42 U.S.C. 6295(e)(1) and are repeated in Table II.2.

**Table II.2 EF-Based Federal Energy Conservation Standards for Gas-fired Consumer Water Heaters**

| Product Class | Energy Factor* |
|---|---|
| Gas water heaters | $0.62 - (0.0019 \times V_r)$ |

* $V_r$ is the rated storage volume (in gallons), as determined pursuant to 10 CFR 429.17.

2. History of Standards Rulemaking for Gas-fired Instantaneous Water Heaters

On May 21, 2020, DOE initiated the most recent rulemaking for consumer water heaters, including gas-fired instantaneous water heaters, by publishing in the *Federal Register* a request for information ("May 2020 RFI"), soliciting public comment on various aspects of DOE's planned analyses to help DOE determine whether to amend energy conservation standards for consumer water heaters. 85 FR 30853 (May 21, 2020). DOE subsequently published a notice requesting feedback on its preliminary analysis and technical support document ("preliminary TSD") on March 1, 2022 (the "March 2022 Preliminary Analysis") with a 60-day comment period. 87 FR 11327 (Mar. 1, 2022). The comment period was extended by 14 days in a notice published on May 4, 2022. 87 FR 26303.

On October 21, 2022, DOE received a set of recommendations on amended energy conservation standards for consumer water heaters from a coalition of seven public- and private-sector organizations, including two water heater manufacturers, three energy efficiency organizations, one environmental group, and one consumer organization—collectively the Joint Stakeholders—which, in part, addressed standards for gas-fired instantaneous water heaters. This coalition's submission has been referred to as the "Joint Stakeholder Recommendation." (*See* Document No. 49 in Docket No. EERE-2017-BT-STD-0019.)

On July 28, 2023, DOE published in the *Federal Register* a notice of proposed rulemaking ("July 2023 NOPR") and technical support document ("NOPR TSD") with a 60-day comment period that proposed new and amended standards for consumer water heaters, including gas-fired instantaneous water heaters. 88 FR 49058 (Jul. 28, 2023). On September 13, 2023, DOE presented the proposed standards and accompanying analysis at a public meeting. The submissions DOE received in response to the July 2023 NOPR pertaining to gas-fired instantaneous water heaters are listed in Table II.3.

**Table II.3 List of Commenters with Written Submissions Specific to Gas-fired Instantaneous Water Heaters in Response to the July 2023 NOPR**

| Commenter(s) | Abbreviation | Comment No. in the Docket | Commenter Type |
|---|---|---|---|
| Individual | Hardy | 0185 | Individual |
| NPGA, APGA, AGA, and Rinnai | NPGA, APGA, AGA, and Rinnai | 0441 | Trade Associations and Manufacturer |
| Carolinas Natural Gas Coalition | CNGC | 0648 | Trade Association |
| Jackson Energy Authority | JEA | 0865 | Utility |
| Watertown Municipal Utilities | WMU | 0872 | Utility |
| Philadelphia Gas Works | PGW | 0886 | Utility |
| Southeast Gas | Southeast Gas | 0887 | Utility |
| Consumer Energy Alliance | CEA | 0914 | Consumer Advocate |
| American Society of Gas Engineers | ASGE | 0976 | Trade Association |
| Chesapeake Utilities Corporation | CHPK | 1008 | Utility |
| Georgia Office of the Attorney General | Attorney General of GA | 1026 | State Official/Agency |
| Advanced Water Heating Initiative | AWHI | 1036 | Efficiency Organization |
| Tennessee Attorney General's Office | Attorney General of TN | 1149 | State Official/Agency |
| American Pipeline Contractors Association | APCA | 1152 | Trade Association |
| Texas Public Policy Foundation | TPPF | 1153 | Academic Institute |

| | | | |
|---|---|---|---|
| Midwest Energy Efficiency Alliance, Northeast Energy Efficiency Partnerships, Northwest Energy Efficiency Alliance, South-central Partnership for Energy Efficiency as a Resource, Southeast Energy Efficiency Alliance, Southwest Energy Efficiency Project | Joint Regional Advocacy Groups | 1154 | Efficiency Organizations |
| American Council for an Energy-Efficient Economy, Natural Resources Defense Council, Appliance Standards Awareness Project, Northwest Energy Efficiency Alliance, Consumer Federation of America, Rheem Manufacturing | Joint Stakeholders | 1156 | Coalition |
| Office of Governor Brian P. Kemp | Governor of GA | 1157 | State Official/Agency |
| Bradford White Corporation | BWC | 1164 | Manufacturer |
| Air-Conditioning, Heating, and Refrigeration Institute | AHRI | 1167 | Trade Association |
| California Energy Commission | CEC | 1173 | State Official/Agency |
| Pacific Gas and Electric Company; Southern California Edison; and San Diego Gas & Electric Company; collectively, the California Investor-owned Utilities | CA IOUs | 1175 | Utilities |
| Huntsville Utilities | Huntsville Utilities | 1176 | Utility Association |
| Rheem Manufacturing Company | Rheem | 1177 | Manufacturer |
| AGA, APGA, NPGA, Spire | Gas Association Commenters | 1181 | Utility Association |
| A.O. Smith Corporation | A.O. Smith | 1182 | Manufacturer |
| Rinnai America Corporation | Rinnai | 1186 | Manufacturer |
| Northwest Energy Efficiency Alliance | NEEA | 1199 | Efficiency Organization |
| ONE Gas, Inc. | ONE Gas | 1200 | Utility |
| Noritz America Corporation | Noritz | 1202 | Efficiency Organization |
| Robert Bosch LLC | Bosch | 1204 | Manufacturer |
| U.S. House of Representatives (Nine members, all from Georgia) | U.S. House of Representatives | 1205 | Government Official/Agency |

Subsequent to the July 2023 NOPR, DOE determined it would continue to consider comments prior to finalizing standards for gas-fired instantaneous water heaters, although standards for all other consumer water heaters were finalized in a rule published on May 6, 2024 ("May 2024 Final Rule"). 89 FR 37778. Most recently, DOE published a notice of data availability in the *Federal Register* on July 23, 2024 ("July 2024 NODA"). 89 FR 59692. The purpose of the July 2024 NODA was to make publicly available a full set of analytical results specific to gas-fired instantaneous water heaters, including updates as compared to the analysis conducted for the July 2023 NOPR after considering the comments received. DOE received comments in response to the July 2024 NODA from the interested parties listed in Table II.4Table II.4.

In response to the July 2024 NODA, a larger coalition of stakeholders co-signed a joint comment recommending standards for gas-fired instantaneous water heaters. This coalition— consisting of AHRI (a trade association representing the views of multiple manufacturers), three energy efficiency organizations, one environmental group, and one consumer organization— submitted the previous Joint Stakeholder Recommendation for renewed consideration by DOE. Hence the submission by this larger, more recent coalition is still referred to as the Joint Stakeholder Recommendation throughout this final rule.

**Table II.4 List of Commenters with Written Submissions in Response to the July 2024 NODA**

| Commenter(s) | Abbreviation | Comment No. in the Docket | Commenter Type |
|---|---|---|---|
| Sophie Charlotte DuBard-Weis | DuBard-Weis | 1430 | Individual |
| Lucy Anderson | Anderson | 1431 | Individual |
| Anonymous | Anonymous | 1432 | Individual |
| American Gas Association (AGA), American Public Gas Association (APGA), National Propane Gas Association (NPGA), and Rinnai America Corporation | Joint Requesters | 1433 | Utility Associations; Manufacturer |
| Northwest Energy Efficiency Alliance | NEEA | 1434 | Efficiency Organization |
| Rinnai America Corporation | Rinnai | 1435, 1443 | Manufacturer |
| Rheem Manufacturing Company | Rheem | 1436 | Manufacturer |
| Air-Conditioning, Heating, and Refrigeration Institute | AHRI | 1437 | Trade Association |
| AHRI, ACEEE, ASAP, CFA, NRDC, and NEEA | AHRI and the Joint Stakeholders | 1438 | Trade Association |
| American Gas Association (AGA), American Public Gas Association (APGA), and National Propane Gas Association (NPGA) | AGA *et al.* | 1439 | Utility Association |
| A.O. Smith Corporation | A.O. Smith | 1440 | Manufacturer |
| Bradford White Corporation | BWC | 1441 | Manufacturer |
| Pacific Gas and Electric Company; Southern California Edison; and San Diego Gas & Electric Company; collectively, the California Investor-owned Utilities | CA IOUs | 1442 | Utility |
| ASAP, ACEEE, CFA, NCLC, NRDC, NBI, and NEEA | Joint Advocates | 1444 | Efficiency Organization |
| U.S. House of Representatives (Three members, all from Georgia) | U.S. House of Representatives | 1445 | Government Official/Agency |

A parenthetical reference at the end of a comment quotation or paraphrase provides the location of the item in the public record.[18] To the extent that interested parties have provided written comments that are substantively consistent with any oral

[18] The parenthetical reference provides a reference for information located in the docket of DOE's rulemaking to develop energy conservation standards for consumer water heaters. (Docket No. EERE-2017-BT-STD-0019, which is maintained at: *www.regulations.gov*). The references are arranged as follows: (commenter name, comment docket ID number at page of that document).

comments provided during the September 13, 2023 public meeting, DOE cites the written comments throughout this final rule. DOE did not identify any oral comments provided during the September 13, 2023 public meeting that are not substantively addressed by written comments.

## III. General Discussion

DOE developed this final rule after a review of the market for the subject gas-fired instantaneous water heaters. DOE also considered comments, data, and information from interested parties that represent a variety of interests. This final rule addresses issues raised by these commenters.

### *A. General Comments*

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

In response to the July 2024 NODA, the Joint Requesters recommended that DOE provide stakeholders with an additional 30 days (*i.e.*, for a total of 60 days) to comment. The Joint Requesters stated that the 30 days provided by DOE does not allow stakeholders to sufficiently analyze the NODA and the related documents, which appear to incorporate new data, use new methodologies, and reach different results from the July 2023 NOPR. The Joint Requesters further commented that their organizations had limited staff availability during the comment period. (Joint Requesters, No. 1433 at pp. 2–3)

DOE notes the limited scope of the NODA and reiterates that the July 2024 NODA updated only specific aspects of DOE's analysis of potential amended energy conservation standards for gas-fired instantaneous water heaters. The analysis from the July 2023 NOPR was updated to reflect the latest available versions of the data sources used. Overall, the cost-benefit analysis methodology remains largely unchanged between the July 2024 NODA and the July 2023 NOPR (*see* 89 FR 59692, 59693). Furthermore, this analysis has been subject to extensive stakeholder input and feedback throughout the course of this rulemaking. Commenters were provided a full 60-day comment period to review the July 2023 NOPR analysis, and the July 2024 NODA described in depth the specific areas where DOE's analysis was updated while providing the rationale for each update. As such, DOE believes a 30-day comment period was appropriate for stakeholders to review a limited set of revisions to a previously published analysis and provide meaningful comments on the notice. (*See* Document No. 1446 in Docket No. EERE-2017-BT-STD-0019.)

AGA *et al.* stated that due to the use of data designed for other natural gas appliances and not gas-fired instantaneous water heaters specifically, DOE should restart the rulemaking process for gas-fired instantaneous water heaters, or at a minimum issue a supplemental notice. (AGA *et al.*, No. 1439 at p. 1)

In response, DOE notes that it published the July 2024 NODA to inform stakeholders of newly available data and results with respect to potential amended standards for gas-fired instantaneous water heaters, a limited update to the July 2023 NOPR analysis.

1. General Support

In response to the July 2023 NOPR, DOE received 2,880[19] general comments (those which provided general remarks on the impact of the rulemaking)[20] with a significant number of commenters expressing support of the proposed standards – including those proposed for gas-fired instantaneous water heaters – and acknowledging the significant energy savings that would result from the adoption of the proposed standards.[21]

AWHI expressed support for more stringent standards for gas-fired instantaneous water heaters. (AWHI, No. 1036 at pp. 3–4) The Joint Stakeholders stated that the proposed standards for gas-fired instantaneous water heaters are consistent with their recommendations. (Joint Stakeholders, No. 1156 at p. 2) NEEA, the Joint Regional Advocacy Groups (citing the estimated FFC and monetary savings), and Bosch supported the proposed standards for gas-fired instantaneous water heaters. (NEEA, No. 1199 at p. 9; Joint Regional Advocacy Groups, No. 1154 at p. 1; Bosch, No. 1204 at p. 2) Bosch commented that condensing gas-fired instantaneous water heaters are readily available and widely accepted in the market, and can create significant energy savings and emissions reductions. Bosch stated that nearly every gas-fired instantaneous water heater manufacturer sells a condensing-level product and, therefore, the required technology is

[19] The number of comments reflects the number of individual party submissions. Specifically, form letters with multiple submissions count each submission individually.

[20] Commenters who are directly referenced in this final rule and appear in Table II.3 are not counted in these statistics because these submitters typically expressed detailed views that could not be generalized as either clear support or clear opposition for all aspects of the proposal.

[21] One comment in support of the proposed standards, including the proposal for gas-fired instantaneous water heaters, had 8,357 signatories.

well-understood and minimal research and development efforts would be required to achieve the proposed efficiency levels. (Bosch, No. 1204 at p. 2)

CEC and A.O. Smith also supported DOE's proposed standards for gas-fired instantaneous water heaters because they would result in significant savings, lower monthly energy bills for homeowners, and also provide emissions benefits. CEC urged DOE to finalize the proposed standards as soon as possible. (CEC, No. 1173 at p. 12; A.O. Smith, No. 1182 at p. 14)

Two individual commenters expressed support for the proposed rulemaking on the basis that clean energy is necessary for securing a peaceful and prosperous future and for the economic benefits that will result from the proposed rulemaking. (DuBard-Weis, No. 1430 at p. 1; Anderson, No. 1431 at p. 1) An anonymous commenter also expressed support for the proposed rulemaking on the basis of reducing emissions related to water heaters for the benefit of the planet. (Anonymous, No. 1432 at p. 2)

2. Support for Updated Analysis and Standards at EL 2

In response to the July 2024 NODA, DOE received the following comments in support of the updated analytical results and potential amended standards at efficiency level ("EL") 2.

NEEA, AHRI, AHRI and the Joint Stakeholders, the Joint Advocates, Rheem, and BWC expressed support for the standards proposed at EL 2 for gas-fired instantaneous water heaters in the July 2023 NOPR, with NEEA, AHRI, AHRI and the Joint Stakeholders, the Joint Advocates, and BWC noting the significant national energy savings and LCC savings for consumers.  NEEA, The Joint Advocates, and BWC stated that the proposed standard aligns with the Joint Stakeholder Recommendations made in 2022. AHRI and the Joint Stakeholders expressed concern that DOE had not yet adopted these standards and commented that the proposed levels would, enable a broad set of consumer options while meeting EPCA's directives of achieving significant national energy savings as well as cost effectiveness and technological feasibility for consumers who install these products. The Joint Advocates supported DOE's proposal to adopt EL 2 for gas-fired instantaneous water heaters because EL 2 represents an intermediate condensing level and reflects the Joint Stakeholder recommendations. The Joint Advocates further commented that DOE's updated analysis in the NODA reinforces the economic and energy benefits of adopting EL 2 for gas-fired instantaneous water heaters and, while similar to those in the July 2023 NOPR, the updates in the July 2024 NODA improve the analysis. (NEEA, No. 1434 at p. 1; Rheem, No. 1436 at p. 1; AHRI, No. 1437 at p. 2; AHRI and the Joint Stakeholders, No. 1438 at p. 1; BWC, No. 1441 at p. 1; Joint Advocates, No. 1444, at pp. 1–2)

NEEA commented that the July 2024 NODA effectively updates the analysis for gas-fired instantaneous water heaters to thoroughly represent the market and better account for manufacturer impacts of updating standards for gas-fired instantaneous water heaters by updating from Energy Information Administration's Residential Energy Consumption Survey ("RECS") 2015 to RECS 2020 data, accounting for the use of concentric pipe venting for both condensing and non-condensing gas-fired instantaneous water heaters, and updating the analysis to include outdoor installations of gas-fired instantaneous water heaters that don't require venting or that require short through-the-wall vents. NEEA commented that according to DOE's analysis, impacts on manufacturers from a condensing-level standard would be modest and potentially beneficial to domestic production. NEEA recommended that DOE quickly issue a final rule for gas-fired instantaneous water heaters, as NEEA agreed with DOE that condensing-level standards at EL 2 would be cost effective and deliver significant energy savings while having minimal negative impacts. (NEEA, No. 1434 at pp. 1–3)

Rheem recommended that DOE amend standards for gas-fired instantaneous water heaters to EL 2, stating that DOE's analysis remains justified. (Rheem, No. 1436 at p. 1) BWC urged DOE to establish minimum energy conservation standards for gas-fired instantaneous water heaters at EL 2 as originally proposed in the July 2023 NOPR and in accordance with the Joint Stakeholder Recommendation. BWC stated that establishing standards consistent with the Joint Stakeholder Recommendation would result in national energy savings of 0.8 quads and provide individual consumers average savings of $31 per year.[22] (BWC, No. 1441 at p. 1)

3. General Opposition

In response to the July 2023 NOPR, DOE received comments from several stakeholders raising concern over the impact of the proposed standards.

[22] BWC cited analytical results provided in the original Joint Stakeholder Recommendation (Document No. 49 in this docket), which relied on DOE's results from the March 2022 Preliminary Analysis (see Joint Stakeholder, No. 49 at p. 5). DOE's most up-to-date analysis provided in this final rule indicates a potential for 0.58 quads of national energy savings, with an average consumer LCC savings of $112.

An individual commenter requested careful consideration of the impacts of the proposed levels for gas-fired instantaneous water heaters on the economy. The individual commenter noted that they work at a propane company whose installation and servicing of tankless[23] water heaters is a large part of its income, asserting that the proposals, if adopted, could be detrimental to the economy. (Hardy, No. 185 at p. 1)

Commenters from the U.S. House of Representatives indicated that the popularity of non-condensing gas-fired instantaneous water heaters among homeowners and small business owners across the United States reflects the efficiency and affordability of the products. Additionally, the Commenters from the U.S. House of Representatives stated that restricting consumer access to gas-fired instantaneous water heaters by adopting higher standards would reduce consumer choice and increase product prices. (U.S. House of Representatives, No. 1205 at p. 1) Then, in response to the July 2024 NODA, the Commenters from the U.S. House of Representatives stated that gas-fired instantaneous water heaters are projected to reach 11 percent of the U.S. market by 2028 and that sales of non-condensing tankless water heaters from 2005 to 2022 have saved 339 million MMBtus (0.34 quads) and 37.7 billion pounds (17 million metric tons) of carbon emissions. Commenters from the U.S. House of Representatives also stated that the July 2023 NOPR would eliminate the non-condensing gas-fired instantaneous water heaters while leaving costlier or higher emission profile products on the market. (U.S. House of Representatives, No. 1445 at p. 1)

[23] "Tankless" models are instantaneous water heaters with very little storage volume. These designs comprise the majority of consumer gas-fired instantaneous water heaters on the market today.

Regarding stakeholders' comments that the standards proposed in the July 2023 NOPR would discourage adoption of gas-fired instantaneous water heaters, DOE notes that it expects the share of gas-fired instantaneous water heaters to continue to increase as a percentage of the overall U.S. market in both the no-new-standards case and standards cases. *See* section IV.F.10 for a discussion regarding why adoption of other types of water heaters in response to amended standards for gas-fired instantaneous water heaters is highly unlikely. Additionally, DOE notes that only one-third of gas-fired instantaneous water heaters shipped in 2024 were non-condensing models, with a market share that is projected to decrease even in the absence of amended standards. *See* section IV. G of this document and chapter 9 of the final rule TSD for additional information on DOE's shipments analysis.

In addition to emphasizing several of the points it made in response to the July 2023 NOPR, Rinnai claimed that, although the July 2024 NODA appears to make some adjustments for data provided by Rinnai as well as other inputs, methods and approaches, it does not sufficiently account for historic market data and trends, consumer decision making, product and installation costs, and concerns with modeling and methodology, nor does it suffice to meet statutory requirements relating to economic justification, significant energy savings, or product unavailability. Rinnai stated that the analysis in the July 2024 NODA does not change its conclusion that the proposed rule would limit the affordable, efficient options available to consumers, would impede a market-driven shift toward more efficient storage-type water heaters,[24] and would likely result in a net reduction in energy savings and an increase in carbon emissions. Rinnai therefore requested that DOE correct its claimed deficiencies and flaws in the July 2024 NODA, issue a supplemental notice of proposed rulemaking to address these changes and allow thorough stakeholder input, and reconsider the July 2023 NOPR's proposed rule. Rinnai suggested that DOE should either maintain the existing standard for gas-fired instantaneous water heaters, or alternatively promulgate separate standards for condensing and non-condensing gas-fired instantaneous water heaters. (Rinnai, No. 1443 at pp. 2–3)

Rinnai raised concern with the condensing-level standards supported by the Joint Stakeholders, asserting that such standards would not adequately consider the gas-fired instantaneous water heater market and industry as a whole. Specifically, Rinnai expressed that it does not believe that non-condensing gas-fired instantaneous water heaters are "on the way out" of the market. According to Rinnai, the July 2024 NODA showed a projected 30 percent of gas-fired instantaneous water heater sales in 2030 would be non-condensing models, consistent with current trends. Rinnai stated that it would suffer the direct impacts of this rule, being not only one of the leading manufacturers of gas-fired instantaneous water heaters in general but also the market leader in sales of non-condensing models, producing approximately 60 percent of the market share of non-condensing models. (Rinnai, No. 1443 at pp. 23–24) Rinnai argued

[24] The commenter used the phrase “tank water heaters” but did not clarify how amended standards for gas-fired instantaneous water heaters would impede a market transition towards more efficient types of storage water heaters; however, they later reiterate the concern regarding a shift towards gas-fired storage water heaters, which, in general, tend to have lower UEF ratings today compared to gas-fired instantaneous water heaters.

that DOE’s consumer water heater rulemaking, and in particular its actions with regard to gas-fired instantaneous water heaters, depend heavily on DOE’s interpretation of several statutory provisions in EPCA. According to Rinnai, DOE’s interpretations of statutory provisions are not entitled to deference—for example, DOE’s interpretation of the unavailability provision, Section 6295(o)(4), the “significant conservation of energy” provision, Section 6295(o)(3), the economic justification provision, Section 6295(o)(2)(B), and the separate standards provision, Section 6295(q). Rinnai expressed its concern that DOE’s consumer water heater rulemaking, in conjunction with its rulemaking proceedings on furnaces and boilers, represent a significant overhaul of the appliance manufacturing industry. Rinnai commented that, in line with the outcome of *West Virginia v. EPA*,[25] EPCA was not intended to allow DOE to favor one fuel or type of appliance over another or to reshape the appliance industry. (Rinnai, No. 1443 at pp. 23–24)

DOE’s rulemaking to amend energy conservation standards for gas-fired instantaneous water heaters does not disallow the production, import, or sale of water heaters using any specific fuel type. Moreover, gas-fired instantaneous water heaters will not be made unavailable as a result of this rulemaking. Stakeholders have not indicated that raising standards for gas-fired instantaneous water heaters would push consumers towards electric or oil-fired water heaters—and such a case would be highly improbable based on DOE’s own analysis of consumer purchasing decisions. Instead, stakeholders

[25] In *West Virginia v. EPA*, 597 U.S. 697 (2022), the Court expounded on the major questions doctrine, and held that agencies could not adopt rules with, as Rinnai put it, “significant economic, industry and consumer choice impacts” without having clear congressional authorization to do so. (Rinnai, No. 1443 at p. 24)

such as Rinnai and the Gas Association Commenters appear to indicate that more-stringent standards for gas-fired instantaneous water heaters may impact shipments of other gas-fired water heaters, and these comments are discussed further in section IV.F.10 of this document. As such, there is no evidence to support Rinnai's suggestion that DOE's action "favors" one fuel type over another. Furthermore, since the statutory consumer water heater standards were established by EPCA at 42 U.S.C. 6295(e)(1), DOE has maintained separate product classes (*i.e.*, separate standards) for gas-fired, oil-fired, and electric water heaters. *See* 10 CFR 430.32(d)(1)–(2). These separate product classes are consistent with the statutory provisions at 42 U.S.C. 6295(q).

DOE has statutory authority to routinely evaluate and address minimum efficiency levels for gas-fired instantaneous water heaters (and all other consumer water heaters). *See* section II.A of this document. As a general matter, energy conservation standards save energy by removing the least-efficient technologies and designs from the market. Discussed further in section IV.A.1 of this document, non-condensing gas-fired instantaneous water heaters use only one heat exchanger that operates at a higher temperature, whereas condensing gas-fired instantaneous water heaters make use of corrosion-resistant condensing heat exchangers that can extract far more energy from the flue gases exhausted by combustion—causing the exhaust flue gases to condense into liquid (hence, the term "condensing"). Because of this, condensing gas-fired instantaneous water heaters are a step up in efficiency from non-condensing products. The energy-saving purposes of EPCA would be frustrated if DOE were required to set standards that maintain less-energy-efficient covered products and equipment in the market based simply on the fact that they use a specific type of less-efficient design.

DOE has evaluated the statutory criteria— technological feasibility, significant energy savings, and economic justification— and considered the application of the statutory “unavailability provision” (*see* 42 U.S.C. 6295(o)(4)) to determine the product class structure for gas-fired instantaneous water heaters; *see* section IV.A.1 of this document for further details. DOE has not sought to “reshape the appliance industry,” but rather to set standards in accordance with the statutory requirements of EPCA. Analytical results from multiple rulemakings indicate that certain segments of the space and water heating industries have made significant progress in transitioning the market towards more-efficient condensing products, and the analysis herein for gas-fired instantaneous water heaters also reflects this trend. As such, DOE is not setting condensing-level standards simply to increase the usage of condensing technology. Rather, DOE has found that condensing-level standards are justified for gas-fired instantaneous water heaters based on extensive analysis and review.

4. Comments on Higher Standards than Proposed in the NOPR

EL 3 corresponds to the efficiency that would meet the current ENERGY STAR Specification version 5.0, and as such is an efficiency level that many manufacturers currently target. In the July 2023 NOPR, DOE tentatively determined that the additional benefits and savings from amended standards at EL 3 could be considered significant, but there was uncertainty as to whether manufacturing capacity of EL 3 models could be scaled up to meet national demand for gas-fired instantaneous water heaters. 88 FR 49058, 49161. While the July 2023 NOPR proposed standards at EL 2, DOE requested additional information on the benefits and burdens of a potential amended standard for gas-fired instantaneous water heaters at EL 3, especially with respect to manufacturers being able to scale their entire production to EL 3 in the compliance time frame being considered by this rulemaking. *Id*.

In response, Bosch stated that EL 3 would be significantly more difficult to reach compared to EL 2, adding that though EL 3 is feasible with current technology, the technology comes with increased complexity. Specifically, Bosch stated that the most significant challenge in raising the efficiency of a gas-fired instantaneous water heater from a UEF of 0.93 to 0.95 for the high draw pattern is the need for significant burner modulation. Bosch recommended DOE retain the EL 2 proposal for gas-fired instantaneous water heaters. (Bosch, No. 1204 at pp. 4–5) Noritz stated that EL 3 is significantly more difficult to reach than EL 2, due to complexity related to the software, controls, fan, and gas valve, as well as higher material costs due to increased heat exchanger surface area. (Noritz, No. 1202 at p. 3) BWC recommended against adopting standards for gas-fired instantaneous water heaters at EL 3 because this would be inconsistent with the Joint Stakeholder Recommendation, and the proposed standards at EL 2 already amount to substantial increase in efficiency. (BWC, No. 1164 at p. 16) Rheem stated that it does not support EL 3 for gas-fired instantaneous water heaters as the costs to the manufacturer outweigh the benefit of the slight increase in UEF. Rheem further stated that EL 3 requires completely different condensing technology than EL 2 and will have significantly more impact on existing manufacturing facilities. (Rheem, No. 1177 at p. 13)

AHRI stated that gas-fired instantaneous water heaters would experience more difficulty achieving EL 3 compared to EL 2 due to increasing complexity, driven by designs incorporating full burner modulation. AHRI further stated that this would require substantial research and development and more expensive components. (AHRI, No. 1167 at pp. 12—13)

CEC stated that if DOE received data in response to the request for information in the July 2023 NOPR, DOE should consider finalizing a standard consistent with EL 3 for gas-fired instantaneous water heaters. (CEC, No. 1173 at p. 12)

In response to the July 2023 NOPR, the CA IOUs encouraged DOE to set more stringent standards for gas-fired instantaneous water heaters, recommending that DOE establish the standards proposed at TSL 6 in the July 2023 NOPR, equivalent to max-tech (*i.e.*, EL 4). According to the CA IOUs, more stringent standards for all gas-fired consumer water heater sub-classes, specifically at condensing efficiencies, would result in significant savings of natural gas in California and across the United States. Regarding statements from some stakeholders that significant installation barriers are associated with gas condensing water heaters, the CA IOUs referred DOE to a report docketed in 2019 titled "Investigation of Installation Barriers and Costs for Condensing Gas Appliances."[26] Key findings from this report indicate that these challenges impact less than 5 percent of condensing gas retrofit installations for residential and commercial applications, and that condensate management and chimney relining were minor concerns for installing gas condensing products. (CA IOUs, No. 1175 at p. 2) In response to the July 2024 NODA, the CA IOUs reiterated that more-stringent efficiency standards for gas-fired instantaneous water heaters would conserve natural gas, reduce emissions, and lower utility payments for Californians. The CA IOUs stated that while a standard based

[26] EERE-2018-BT-ST-0018-0062. February 28, 2019. Available at: www.regulations.gov/comment/EERE-2018-BT-STD-0018-0062 (last accessed: Oct. 1, 2024)

on EL 2 would generate between $0.13 billion ($2022, at a 7-percent discount rate) and $0.47 billion ($2022, at a 3-percent discount rate) in consumer benefits for all Californians over 30 years, a standard based on EL 3 would generate between $0.21 billion ($2022, at a 7-percent discount rate) and $0.75 billion ($2022, at a 3-percent discount rate) in consumer benefits for all Californians over the same time period. The CA IOUs stated that adoption of EL 3 would increase consumer benefits by 60 percent relative to EL 2 and reiterated that EL 3 has the shortest simple payback period of any gas-fired instantaneous water heater efficiency level. The CA IOUs urged DOE to adopt a standard for gas-fired instantaneous water heaters based on EL 3. (CA IOUs, No. 1442 at pp. 1–2)

In this final rule analysis, DOE finds that although EL 3 would present many consumer benefits, the average estimated simple payback period for EL 3 is 8.3 years, whereas for EL 2 it is 8.9 years, which is not strikingly different in the context of the product's lifespan, which is estimated to be about 20 years. DOE acknowledges that setting standards at EL 3 for gas-fired instantaneous water heaters would require notably higher levels of investment compared to EL 2 for gas-fired instantaneous water heaters. In this final rule, DOE is adopting TSL 2, which corresponds to EL 2 for gas-fired instantaneous water heaters. DOE notes that industry would need to significantly scale up production of models that meet EL 3 given the lower quantity of shipments of these models today. Approximately 60 percent of gas-fired instantaneous water heater shipments currently meet the adopted level (*i.e.*, EL 2).[27] However, only 15 percent of

[27] The term "current shipments" refers to no-new-standards shipments estimated to occur in 2024 (the reference year).

gas-fired instantaneous water heater shipments currently meet EL 3. To meet EL 3, DOE expects manufacturers would implement a more efficient heat exchanger design (*e.g.*, replacing a tube condensing heat exchanger with a flat plate condensing heat exchanger) and increase the condensing heat exchanger area relative to EL 2. DOE understands that implementing the larger, improved condensing heat exchanger technology could increase the complexity of the manufacturing process compared to the tube design condensing heat exchanger technology analyzed at EL 1 and EL 2. Given the low shipments volumes and increased complexity of EL 3 models, DOE expects most manufacturers would need to add new production lines to maintain existing capacity at TSL 3. DOE does not expect most manufacturers would need to add new production lines or incur notable capital investments to meet TSL 2. DOE estimates that industry conversion costs at EL 2 would reach approximately $20 million whereas industry conversion costs would triple at EL 3 (approximately $60 million). *See* section V.B.2.a of this document for the estimated industry conversion costs at each TSL. *See* section V.C.1 of this document for the benefits and burdens of the TSLs considered in this rulemaking.

*B. Scope of Coverage*

Gas-fired instantaneous water heaters are a subset of consumer water heaters. Generally, DOE defines a "water heater," consistent with EPCA's definition at 42 U.S.C. 6291(27) and codified at 10 CFR 430.2, as a product which utilizes oil, gas, or electricity to heat potable water for use outside the heater upon demand. An instantaneous-type water heater is one that heats water but contains no more than one gallon of water per 4,000 Btu per hour of input, and consumer gas-fired instantaneous water heaters are additionally defined as having an input rating less than 200,000 Btu per hour. 10 CFR 430.2; (42 U.S.C. 6291(27))

This rulemaking does not cover gas-fired circulating water heaters, which must be used in combination with recirculation pump and a storage tank or recirculation loop, and therefore constitute storage-type water heaters. 10 CFR 430.2.

As stated in section I of this document, EPCA prescribed energy conservation standards for all consumer water heaters (*i.e.*, those that meet the definition of "water heater" above). For the purposes of this final rule, DOE is solely considering "gas-fired instantaneous water heaters," including those for which there are no current UEF-based standards codified at 10 CFR 430.32(d)(1).

*See* section IV.A.1 of this document for discussion of the product classes analyzed in this final rule.

*C. Test Procedure*

EPCA sets forth generally applicable criteria and procedures for DOE's adoption and amendment of test procedures. (42 U.S.C. 6293) Manufacturers of covered products must use these test procedures as the basis for certifying to DOE that their product complies with the applicable energy conservation standards and as the basis for any representations regarding the energy use or energy efficiency of the product. (42 U.S.C. 6295(s) and 42 U.S.C. 6293(c)). Similarly, DOE must use these test procedures to evaluate whether a basic model complies with the applicable energy conservation standard(s). 10 CFR 429.110(e). The current test procedure for consumer and residential-duty commercial water heaters is codified at 10 CFR 430, subpart B, appendix E. Appendix E includes provisions for determining UEF, the metric on which current standards are based. 10 CFR 430.32(d)(1).

DOE most recently amended the test procedure for these products at appendix E in the consumer and residential-duty commercial water heater test procedure final rule published on June 21, 2023 ("June 2023 TP Final Rule") pursuant to the 7-year review requirement as specified by EPCA. (42 U.S.C. 6293(b)(1)(A) and 42 U.S.C. 6314(a)(1)(A)) In that final rule, DOE established effective storage volume ("$V_{eff}$") as a metric to address how much hot water could be immediately delivered by the system, taking into account the temperature of the stored water and, in the case of circulating water heaters, the volume of the paired storage tank. 88 FR 40406. The amended test procedure established by the June 2023 TP Final Rule is mandatory for gas-fired instantaneous water heater testing starting December 18, 2023, 180 days after publication. *Id*.

In response to the July 2023 NOPR, BWC reiterated its comments in response to the March 2022 Preliminary Analysis asserting that there is evidence to suggest that gas-fired instantaneous water heaters may gain an unfair advantage in the current test procedure as compared to gas-fired storage water heaters. The commenter provided DOE with a study published by the Davis Energy Group, Inc. and requested that DOE elaborate on its disagreement with the outcome of that study. In particular, BWC pointed out that while gas-fired instantaneous water heaters are not subjected to standby losses like their storage-type counterparts, the number, timing, and frequency of draws required for these products causes the heat exchanger to be raised to temperature for each draw; and this, according to Davis Energy Group, Inc., can cause a bias toward higher efficiency ratings for gas-fired instantaneous water heaters. BWC requested further discussion on this topic to ensure that both types of gas-fired products are treated fairly. (BWC, No. 1164 at pp. 9–10)

In response, DOE notes that the current test procedure for consumer water heaters is designed to represent generally how consumer water heaters are used in-field. As such, if one type of water heater generally receives higher efficiency ratings than another, it would be the result of that water heater type having a more efficient design for actual consumer usage patterns than the other. This difference would therefore not be a bias, but a reflection of actual differences in operating efficiency being captured by the test result. The Davis Energy Group, Inc. study cited by BWC shows the efficiency of the gas-fired instantaneous water heater that was tested was more affected by the time between water draws than that of the gas-fired storage water heater that was tested. That is, the efficiency of the gas-fired instantaneous water heater degraded more when the time between water draws increased than did the gas-fired storage water heater. However, for these findings to have any significance, DOE would also need evidence to show that the water draw sequencing of the current test procedure at appendix E is unrepresentative. The draw sequence was developed as a representative test method in the 2014 test procedure rulemaking that established the UEF test method, and it considered factors such as standby loss periods, test stand capabilities, and water heater recovery rates (*see* 79 FR 40542). In the absence of sufficient data provided by BWC or the Davis Energy Group, Inc. report demonstrating that the current test procedure is unrepresentative, DOE cannot conclude that the prescribed test method results in an unfair advantage for gas-fired instantaneous water heaters over gas-fired storage water heaters. In this standards analysis, DOE has relied on an efficiency-level approach to identify potential standards based on UEF ratings that are demonstrated (certified) for gas-fired instantaneous water heaters on the basis of testing under the DOE test procedure. Therefore, hypothetically, even if these products do benefit from factors in the test procedure that allow them to have higher UEF ratings, all gas-fired instantaneous water heaters would benefit equally, and the increase in UEF is reflected in product ratings and the efficiency levels selected for the analysis. By basing its analysis around commercially available products and their certified ratings in the product classes separately, DOE is ensuring that the standards it is setting for gas-fired instantaneous water heaters are reflective of these products' performance under the appendix E test procedure. DOE used a similar approach for all other types of consumer water heaters (*e.g.*, gas-fired storage water heaters) when it finalized amended standards in a May 6, 2024 final rule pertaining to those products. 89 FR 37778.

## *D. Technological Feasibility*

### 1. General

As discussed, any new or amended energy conservation standard must be designed to achieve the maximum improvement in energy efficiency that DOE determines is technologically feasible and economically justified. (42 U.S.C. 6295(o)(2)(A))

To determine whether potential amended standards would be technologically feasible, DOE first develops a list of all known technologies and design options that could improve the efficiency of the products or equipment that are the subject of the rulemaking.  DOE considers technologies incorporated in commercially available products or in working prototypes to be "technologically feasible."  10 CFR 430, subpart C, appendix A, sections 6(a)(3)(iii)(A) and 7(b)(1). Section IV.A.2 of this document discusses the technology options identified by DOE for this analysis. For further details on the technology assessment conducted for this final rule, *see* chapter 3 of the final rule technical support document ("TSD").

After DOE has determined which, if any, technologies and design options are technologically feasible, it further evaluates each technology and design option in light of the following additional screening criteria: (1) practicability to manufacture, install, and service; (2) adverse impacts on product utility or availability; (3) adverse impacts on health or safety; and (4) unique-pathway proprietary technologies.  10 CFR part 430, subpart C, appendix A, sections 6(a)(3)(iii)(B)–(E) and 7(b)(2)–(5).  Those technology options that are "screened out" based on these criteria are not considered further.  Those technology and design options that are not screened out are considered as the basis for higher efficiency levels that DOE could consider for potential amended standards. Section IV.B of this document discusses the results of this screening analysis conducted for this final rule.  For further details on the screening analysis conducted for this final rule, *see* chapter 4 of the final rule TSD.

2. Maximum Technologically Feasible Levels

EPCA requires that for any proposed rule that prescribes an amended or new energy conservation standard, or prescribes no amendment or no new standard for a type (or class) of covered product, DOE must determine the maximum improvement in energy efficiency or maximum reduction in energy use that is technologically feasible for each type (or class) of covered products. (42 U.S.C. 6295(p)(1)) Accordingly, in the engineering analysis, DOE identifies the maximum efficiency level currently available on the market. DOE also defines a "max-tech" efficiency level, representing the maximum theoretical efficiency that can be achieved through the application of all available technology options retained from the screening analysis.[28] In many cases, the max-tech efficiency level is not commercially available because it is not currently economically feasible.

The max-tech levels that DOE determined for this analysis are described in section IV.C.1.a of this document and in chapter 5 of the final rule TSD.

*E. Energy Savings*

1. Determination of Savings

For each TSL, DOE projected energy savings from application of the TSL to gas-fired instantaneous water heaters purchased during the 30-year period that begins in the first year of compliance with the amended standards (2030–2059).[29] The savings are

[28] In applying these design options, DOE would only include those that are compatible with each other that when combined, would represent the theoretical maximum possible efficiency.
[29] DOE also presents a sensitivity analysis that considers impacts for products shipped in a 9-year period.

measured over the entire lifetime of products purchased during the 30-year analysis period. DOE quantified the energy savings attributable to each TSL as the difference in energy consumption between each standards case and the no-new-standards case. The no-new-standards case represents a projection of energy consumption that reflects how the market for a product would likely evolve in the absence of amended energy conservation standards.

DOE used its national impact analysis ("NIA") spreadsheet models to estimate NES from potential amended standards for gas-fired instantaneous water heaters. The NIA spreadsheet model (described in section IV.H of this document) calculates energy savings in terms of site energy, which is the energy directly consumed by products at the locations where they are used. For electricity, DOE reports NES in terms of primary energy savings, which is the savings in the energy that is used to generate and transmit the site electricity. For natural gas, the primary energy savings are considered to be equal to the site energy savings. DOE also calculates NES in terms of FFC energy savings. The FFC metric includes the energy consumed in extracting, processing, and transporting primary fuels (*i.e.*, coal, natural gas, petroleum fuels), and thus presents a more complete picture of the impacts of energy conservation standards.[30] DOE's approach is based on the calculation of an FFC multiplier for each of the energy types used by covered products or equipment. For more information on FFC energy savings, *see* section IV.H.2 of this document.

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

2. Significance of Savings

To adopt any new or amended standards for a covered product, DOE must determine that such action would result in significant energy savings. (42 U.S.C. 6295(o)(3)(B))

The significance of energy savings offered by a new or amended energy conservation standard cannot be determined without knowledge of the specific circumstances surrounding a given rulemaking.[31] For example, some covered products and equipment have most of their energy consumption occur during periods of peak energy demand. The impacts of these products on the energy infrastructure can be more pronounced than the impacts of products with relatively constant demand. Accordingly, DOE evaluates the significance of energy savings on a case-by-case basis, taking into account the significance of cumulative FFC national energy savings, the cumulative FFC emissions reductions, and the need to confront the global climate crisis, among other factors.

As stated, the standard levels adopted in this final rule are projected to result in NES of 0.58 quad, the equivalent of the primary annual energy use of about 4 million homes. Based on the amount of FFC savings, the corresponding reduction in emissions, and the need to confront the global climate crisis, DOE has determined the energy

[31] The numeric threshold for determining the significance of energy savings established in a final rule published on February 14, 2020 (85 FR 8626, 8670) was subsequently eliminated in a final rule published on December 13, 2021 (86 FR 70892).

savings from the standard levels adopted in this final rule are "significant" within the meaning of 42 U.S.C. 6295(o)(3)(B).

### *F. Economic Justification*

#### 1. Specific Criteria

As noted previously, EPCA provides seven factors to be evaluated in determining whether a potential energy conservation standard is economically justified. (42 U.S.C. 6295(o)(2)(B)(i)(I)(VII)) The following sections discuss how DOE has addressed each of those seven factors in this rulemaking.

##### a. Economic Impact on Manufacturers and Consumers

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

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

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

EPCA requires DOE to consider the savings in operating costs throughout the estimated average life of the covered product in the type (or class) compared to any increase in the price of, or in the initial charges for, or maintenance expenses of, the covered product that are likely to result from a standard. (42 U.S.C. 6295(o)(2)(B)(i)(II)) DOE conducts this comparison in its LCC and PBP analysis.

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

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

For its LCC and PBP analysis, DOE assumes that consumers will purchase the covered products in the first year of compliance with new or amended standards. The LCC savings for the considered efficiency levels are calculated relative to the case that reflects projected market trends in the absence of new or amended standards. DOE's LCC and PBP analysis is discussed in further detail in section IV.F of this document.

c. Energy Savings

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

d. Lessening of Utility or Performance of Products

In establishing product classes, and in evaluating design options and the impact of potential standard levels, DOE evaluates potential standards that would not lessen the utility or performance of the considered products. (42 U.S.C. 6295(o)(2)(B)(i)(IV)) Based on data available to DOE, the standards adopted in this document would not reduce the utility or performance of the gas-fired instantaneous water heaters under consideration in this rulemaking.

e. Impact of Any Lessening of Competition

EPCA directs DOE to consider the impact of any lessening of competition, as determined in writing by the Attorney General, that is likely to result from a standard. (42 U.S.C. 6295(o)(2)(B)(i)(V)) It also directs the Attorney General to determine the impact, if any, of any lessening of competition likely to result from a standard and to transmit such determination to the Secretary within 60 days of the publication of a proposed rule, together with an analysis of the nature and extent of the impact. (42 U.S.C. 6295(o)(2)(B)(ii)) To assist the Department of Justice ("DOJ") in making such a determination, DOE transmitted copies of its proposed rule and the NOPR TSD to the Attorney General for review, with a request that the DOJ provide its determination on this issue. In its assessment letter responding to DOE, DOJ concluded that the proposed energy conservation standards for gas-fired instantaneous water heaters are unlikely to substantially lessen competition. DOE is publishing the Attorney General's assessment at the end of this final rule.

In response to the July 2023 NOPR, Rinnai asserted that eliminating non-condensing gas-fired instantaneous water heaters from the market would create detrimental effects on competition by limiting consumer choice, raising prices on more efficient products, eliminating consumers' option to make like-for-like product replacements, all of which would place Rinnai at a disadvantage as a smaller competitor in a concentrated water heater market. (Rinnai, No. 1186 at p. 7) In response to the July

2024 NODA, Rinnai commented that the consumer water heater market is already a highly concentrated market with three dominant players, and that moving to a standard for gas-fired instantaneous water heaters that requires condensing technology would impede competition. (Rinnai, No. 1443 at p. 22)

DOE recognizes the importance of competition in the marketplace. For this final rule, DOE reviewed its Compliance Certification Database,[32] Air-Conditioning, Heating, and Refrigeration Institute's Directory of Certified Product Performance,[33] California Energy Commission's Modernized Appliance Efficiency Database System,[34] and the ENERGY STAR Product Finder dataset[35] to ensure an up-to-date assessment of gas-fired instantaneous water heater manufacturers operating in the United States. Through its review, DOE identified 12 OEMs of gas-fired instantaneous water heaters subject to more stringent standards under this rulemaking. All 12 OEMs already manufacture condensing gas-fired instantaneous water heaters. Of these 12 manufacturers, 10 manufacturers, including Rinnai, manufacture products that meet the standards adopted in this final rule. Collectively, these 10 OEMs offer 71 basic models (accounting for 51 percent of model listings and 60 percent of shipments in 2024 ) that meet the adopted level (TSL 2). Thus, a variety of companies already participate in the condensing gas-fired instantaneous water heater market. Comparatively, only eight OEMs currently

[32] U.S. Department of Energy's Compliance Certification Database is available at *regulations.doe.gov/certification-data* (last accessed July 19, 2024).
[33] Air-Conditioning, Heating and Refrigeration Institute's Directory of Certified Product Performance is available at *https://ahridirectory.org/search/searchhome?Returnurl=%2f* (last accessed July 23, 2024)
[34] California Energy Commission's Modernized Appliance Efficiency Database System is available at *cacertappliances.energy.ca.gov/Pages/Search/AdvancedSearch.aspx* (last accessed July 19, 2024).
[35] ENERGY STAR Product Finder is available at *www.energystar.gov/productfinder* (last accessed July 22, 2024).

manufacture non-condensing gas-fired instantaneous water heaters. *See* chapter 3 of the final rule TSD for a complete list of manufacturers of gas-fired instantaneous water heaters. Based on Rinnai's comments in response to the July 2023 NOPR, DOE understands that Rinnai's market share of non-condensing gas-fired instantaneous water heaters is 60 percent and their market share of condensing gas-fired instantaneous water heater sales is 20 percent. (Rinnai No. 1186 at p. 1) Given that all 12 manufacturers already offer condensing gas-fired instantaneous water heater products, DOE does not anticipate lessening of competition in the gas-fired instantaneous water heater market; which is estimated to represent 14 percent of the total consumer water heater market in 2030. As previously discussed, this conclusion is also supported by the DOJ's assessment letter.

f. Need for National Energy Conservation

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

DOE maintains that environmental and public health benefits associated with the more efficient use of energy are important to take into account when considering the need for national energy conservation. The adopted standards are likely to result in environmental benefits in the form of reduced emissions of air pollutants and GHGs associated with energy production and use. DOE conducts an emissions analysis to estimate how potential standards may affect these emissions, as discussed in section IV.K of this document; the estimated emissions impacts are reported in section V.B.6 of this document. DOE also estimates the economic value of emissions reductions resulting from the considered TSLs, as discussed in section IV.L of this document.

#### g. Other Factors

In determining whether an energy conservation standard is economically justified, DOE may consider any other factors that the Secretary deems to be relevant. (42 U.S.C. 6295(o)(2)(B)(i)(VII)) To the extent DOE identifies any relevant information regarding economic justification that does not fit into the other categories described previously, DOE could consider such information under "other factors."

### 2. Rebuttable Presumption

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

## IV. Methodology and Discussion of Related Comments

This section addresses the analyses DOE has performed for this rulemaking with regard to gas-fired instantaneous water heaters. Separate subsections address each component of DOE's analyses.

DOE used several analytical tools to estimate the impact of the standards considered in this document. The first tool is a spreadsheet that calculates the LCC savings and PBP of potential amended or new energy conservation standards. The NIA uses a second spreadsheet set that provides shipments projections and calculates NES and NPV of total consumer costs and savings expected to result from potential energy conservation standards. DOE uses the third spreadsheet tool, the Government Regulatory Impact Model ("GRIM"), to assess manufacturer impacts of potential standards. These three spreadsheet tools are available on the DOE website for this rulemaking: *www.regulations.gov/docket/EERE-2017-BT-STD-0019*. Additionally, DOE used output from the latest version of the Energy Information Administration's ("EIA's") *Annual Energy Outlook* ("*AEO*") for the emissions and utility impact analyses.

*A. Market and Technology Assessment*

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

1. Product Classes

When evaluating and establishing or amending energy conservation standards, DOE establishes separate standards for a group of covered products (*i.e.*, establish a separate product class) based on the type of energy used, or if DOE determines that a product's capacity or other performance-related feature justifies a different standard. (42 U.S.C. 6295(q)) In making a determination whether a performance-related feature justifies a different standard, DOE considers such factors as the utility of the feature to the consumer and other factors DOE determines are appropriate. (*Id.*)

EPCA, as amended by the National Appliance Energy Act (NAECA; Pub. L. 100-12), established initial energy conservation standards for consumer water heaters, expressed in EF, that were based on three product classes differentiated by fuel type: (1) gas-fired, (2) oil-fired, and (3) electric. (42 U.S.C. 6295(e)(1)) These standards applied to consumer water heaters manufactured on or after January 1, 1990. Gas-fired instantaneous water heaters were, at the time, required to comply with the same EF standards as gas-fired storage water heaters because the standards were not differentiated by storage versus instantaneous water heaters.

DOE subsequently amended these EF standards twice, most recently in the April 2010 Final Rule, with which compliance was required starting on April 16, 2015. 75 FR 20112. By the April 2010 Final Rule, DOE had further divided gas-fired consumer water heaters into product classes based on demand type (storage, instantaneous), storage volume, and input rate. While the April 2010 Final Rule had separate standards for gas-fired instantaneous water heaters and gas-fired storage water heaters, DOE did not adopt standards for gas-fired instantaneous water heaters with less than 50,000 Btu/h of input because, at that time, there were no such low-input gas-fired instantaneous water heaters available on the market. *Id.* at 20127.

Most recently, the December 2016 Conversion Factor Final Rule, published and effective on December 29, 2016, translated the EF-based standards to UEF-based standards. 81 FR 96204. In doing so, separate product classes were created for each of the four draw patterns (very small, low, medium, and high) in the UEF test procedure. However, due to concerns that the UEF test procedure would not apply to gas-fired instantaneous water heaters 2 gallons or larger at the time, DOE determined that the translated UEF-based standards would apply only to gas-fired instantaneous water heaters with less than 2 gallons of storage volume. *Id.* at 96205. As a result, UEF-based standards were established only for gas-fired instantaneous water heaters with less than 2 gallons of storage volume and more than 50,000 Btu/h of input. *Id.* at 96205. As discussed in the December 2016 Conversion Factor Final Rule, the standards established in EPCA do not define a minimum fuel input rate or maximum storage volume for gas-fired instantaneous water heaters; therefore, the original standards established by EPCA in terms of EF remained applicable to all gas-fired instantaneous water heaters without UEF-based standards. *Id.* at 96209–96211. The four product classes for which DOE has currently established UEF-based standards are summarized in Table IV.1. The product classes without UEF-based standards, for which EF-based standards from EPCA apply, are shown in Table IV.2.

**Table IV.1 Gas-fired Instantaneous Water Heater Product Classes with Current UEF-Based Standards**

| Product Type | Rated Storage Volume and Input Rating | Draw Patterns |
|---|---|---|
| Instantaneous Gas-Fired Water Heater | < 2 gal and > 50,000 Btu/h | Very Small |
| | | Low |
| | | Medium |
| | | High |

**Table IV.2 Gas-fired Instantaneous Water Heater Product Classes without Current UEF-Based Standards**

| Product Class | Rated Storage Volume and Input Rating (if applicable) |
|---|---|
| Gas-fired Instantaneous | < 2 gal and ≤ 50,000 Btu/h |
| | ≥ 2 gal |

In response to the July 2024 NODA, A.O. Smith noted that the conversion factor rulemaking did not establish a product class for gas-fired instantaneous water heaters ≥ 2 gallons and ≤ 200,000 Btu/h. A.O. Smith noted that, while the intent of the December 2016 Conversion Factor Final Rule was to satisfy the requirements of AEMTCA, DOE is not statutorily required under EPCA to establish standards in terms of UEF for the entirety of this product class because some products meet the criteria for exclusion on account of being commercial equipment. (A.O. Smith, No. 1440 at p. 3) A.O. Smith claimed that the hot water delivery capacity, as a function of input capacity and storage volume, of a subset of products in the ≥2 gallon, ≤ 200,000 Btu/h proposed product class for gas-fired instantaneous water heaters includes equipment that would not be used or installed residentially and would only be suitable for commercial applications. A.O. Smith noted that equipment meeting the capacity ranges of the proposed product class already exist on the market and are exclusively used in commercial applications. (A.O. Smith, No. 1440 at pp. 3–4) A.O. Smith recommended that DOE re-evaluate the gas-instantaneous water heater product class structure and avoid prescribing a UEF test metric and standard for these water heaters where the UEF metric is inappropriate. A.O. Smith noted that EPCA's definition for commercial gas-fired instantaneous water heaters does not include a minimum input or volume limit and claimed that it does not prevent DOE from specifying a reasonable storage volume threshold for gas-fired instantaneous water heaters above which the product would be rated to commercial metrics and considered as commercial equipment. (A.O. Smith, No. 1440 at p. 4)

As stated earlier, in the December 2016 Conversion Factor Final Rule, DOE determined that the translated UEF-based standards would apply only to gas-fired instantaneous water heaters with less than 2 gallons of storage volume due to concerns at the time that the UEF test procedure would not apply to gas-fired instantaneous water heaters 2 gallons or larger.  81 FR 96204, 96205.  However, after conducting the market assessment for this rulemaking, DOE is now aware of multiple gas-fired instantaneous water heaters with 2 or more gallons of storage volume presently on the market.  These products are specifically marketed for residential applications in publicly available product listings and literature.[36,37]  DOE is not aware of, nor has A.O. Smith provided, evidence suggesting that products in this product class are designed or marketed exclusively for commercial applications.  As such, products in this size range have demonstrated residential use and therefore do not meet the requirement for exclusion from the UEF descriptor as specified at 42 U.S.C. 6295(e)(5)(F)(i).

In response to the July 2023 NOPR, some stakeholders provided comments specific to the proposed standards for gas-fired instantaneous water heaters in reference to the "unavailability provision" found in EPCA, 42 U.S.C. 6295(o)(4).  DOE indicated that these comments would not be addressed in the May 2024 Final Rule.  89 FR 37778, 37814.  After further consideration of these comments DOE is addressing them in this final rule. Relatedly, DOE received a multitude of comments throughout this rulemaking pertaining to a potential product class structure that differentiates between non-condensing and condensing products.

---

[36] American Water Heaters. See the ProLine® XE Polaris® PG10-34-150-2NV 34-gallon "Commercial-Grade Residential Gas Water Heater" with 150,000 Btu input rate. Information available online at *www.americanwaterheater.com/media/28107/nrgss03316.pdf* (Last accessed Aug. 29, 2024).
[37] HTP. See the "High Efficiency Crossover Floor Water Heater," with information provided to compare against typical residential 50-gallon gas-fired storage water heaters and tankless 199,000 Btu/h gas-fired instantaneous water heaters. Information available online at *www.htproducts.com/literature/mktlit-117.pdf* (Last accessed Aug. 27, 2024).

Per 42 U.S.C. 6295(o)(4), which outlines certain criteria for prescribing new or amended standards, the Secretary may not prescribe an amended or new standard under this section if the Secretary finds (and publishes such finding) that interested persons have established by a preponderance of the evidence that the standard is likely to result in the unavailability in the United States in any covered product type (or class) of performance characteristics (including reliability), features, sizes, capacities, and volumes that are substantially the same as those generally available in the United States at the time of the Secretary's finding. The failure of some types (or classes) to meet this criterion shall not affect the Secretary's determination of whether to prescribe a standard for other types (or classes).

Briefly, condensing and non-condensing products differ in how efficiently they make use of flue gas heat. A baseline gas-fired instantaneous water heater relies on a single heat exchanger, which extracts heat energy from the flue gases and transfers it to the water being delivered to the consumer. However, these flue gases contain more heat energy than the baseline heat exchanger is able to extract and, as a result, much of the heat in the flue gases is lost as they are exhausted outdoors. Enhancements to the heat exchanger—including the use of a secondary heat exchanger— enable high-efficiency gas-fired instantaneous water heaters to extract much more of the energy available in the flue gases. When enough energy is extracted by the heat exchangers, the flue gases cool to the point where they begin to condense, forming liquid condensate. This results in a significant rise in efficiency. *See* chapter 3 of the final rule TSD for further discussion of condensing heat exchangers.

As noted in the comments submitted by NPGA, APGA, AGA, and Rinnai in response to the July 2023 NOPR, the UEF requirements for gas-fired instantaneous water heaters as proposed in the July 2023 NOPR would require condensing technology. (NPGA, APGA, AGA, and Rinnai, No. 441 at pp. 2–3) Rinnai contended that the proposed rule exceeds DOE's authority because it is in conflict with statutory provisions in EPCA, most notably the unavailability provision. Rinnai added that if the proposed rule were adopted, it would eliminate non-condensing tankless water heaters, one of its product offerings. (Rinnai, No. 1186 at p. 2) Rinnai further argued that DOE may not make non-condensing gas-fired instantaneous water heaters unavailable pursuant to the section 6295(o)(4) of EPCA (the "unavailability provision"). Rinnai cited to DOE's interpretation of the unavailability provision in a recent rulemaking for residential furnaces and commercial water heaters and suggested that DOE's interpretation of the provision is unduly narrow and not supported by the provision's plain language.[38] (Rinnai, No. 1186 at p. 9) Rinnai noted that there is no reference to "consumer utility" in the unavailability provision detailed in section 6295(o)(4) of EPCA. Rinnai stated that, rather than relying on the plain language of section 6295(o)(4) itself, DOE's interpretation of the unavailability provision in section 6295(o)(4) of EPCA relies on reading section 6295(q) as a redundant companion provision to section 6295(o)(4) and suggested there is no basis to do so. Rinnai added that this misinterpretation constitutes

[38] DOE finds the better reading of the term "features" in the unavailability provision (*i.e.*, those features that cannot be eliminated by the establishment of a new or amended energy conservation standard) to be those features that provide a consumer unique utility during the operation of the appliance in performance of its major function(s). Stated another way, the "features" provision and the related utility of such features pertain to those aspects of the appliance with which the consumer interacts during the operation of the product (*i.e.*, when the product is providing its "useful output") and the utility derived from those features during normal operation. 86 FR 73947, 73955.

an evasion of the limits placed on DOE's authority by section 6295(o)(4) of EPCA. (Rinnai, No. 1186 at p. 10)

Rinnai stated that even if DOE's interpretation of the unavailability provision in section 6295(o)(4) of EPCA is taken as correct, non-condensing gas-fired instantaneous water heaters still provide utility because the consumer's operation of, or interaction with, the appliance necessarily depends on whether or not the appliance can be installed. Rinnai added that installation costs should be considered under the unavailability provision in section 6295(o)(4) of EPCA, not just as part of determining whether or not a standard is economically justified. (Rinnai, No. 1186 at pp. 10–11) Similarly, ONE Gas claimed that DOE's proposed standards for gas-fired instantaneous water heaters violate section 6295(o)(4) of EPCA because the unavailability provision is not only limited to product classes and types, but also certain performance characteristics including, features, reliability, sizes, capacities, and volumes within those product classes and types. ONE Gas asserted that DOE's association of customer utility with understanding of, and interaction with, the covered appliance is incorrect and is an overreach in interpretation of section 6295 of EPCA. (ONE Gas, No. 1200 at pp. 4–5)

In response to the July 2024 NODA, Rinnai reiterated its position that non-condensing gas-fired instantaneous water heaters have useful and valuable features, including the ability to have like-for-like replacements, compatibility for easier and wider applications of installations, compatibility with non-condensing venting, smaller space requirements, and greater efficiency at lower cost than gas-fired storage water heaters. Rinnai claimed that there is no sound statutory basis for DOE's refusal to recognize that non-condensing gas-fired instantaneous water heaters have distinct features and characteristics from those of condensing gas-fired instantaneous water heaters that provide utility to consumers. Rinnai stated that DOE could instead establish separate standards for condensing and non-condensing gas-fired instantaneous water heaters to recognize the different functions, capabilities, and installation requirements while preserving consumer choice, and therefore retain the increased energy efficiency standard for condensing gas-fired instantaneous water heaters. Rinnai requested that DOE run an analysis of this proposal with product substitution and other factors taken properly into account. (Rinnai, No. 1443 at pp. 4–5)

Regarding Rinnai's request for further analysis on product substitution, see section IV.F.10 of this document for further details.

Regarding Rinnai's assertion that DOE's interpretation of the unavailability provision requires a redundant reading of 42 U.S.C. 6295(q) to 42 U.S.C. 6295(o)(4), DOE notes that while these provisions are related, they are not redundant. EPCA provides DOE authority to establish product classes with different standard levels under 42 U.S.C. 6295(q). Under this authority, DOE has to determine if a performance-related feature justifies a different standard, *i.e.*, is worth preserving in the market, by considering, among other things, utility to the consumer. In contrast, for the performance characteristics, features, sizes, capacities, and volumes protected under the unavailability provision, Congress has already made the determination that they should be preserved in the market. DOE uses its authority under the product class provision at 42 U.S.C. 6295(q) to then ensure that these performance characteristics, features, sizes, capacities, and volumes are preserved in the market. Without the product class authority, DOE would have to set one standard for a covered product that preserves every aspect of a covered product protected under the unavailability provision. For example, larger capacity gas-fired storage water heaters are generally less-efficient than smaller capacity units because standby losses are higher for larger capacity storage tanks. As a result, the lower efficiency of the largest capacity models could limit DOE's ability to set standards under 42 U.S.C. 6295(o)(4). But 42 U.S.C. 6295(q) lets DOE set a more-stringent standard for smaller capacity gas-fired storage water heaters that saves more energy and a less-stringent standard for larger capacity gas-fired storage water heaters that helps preserve their presence in the market. Finally, it is important to note that the product class provision is not just limited to implementing the unavailability provision. As the product class provision contemplates that the utility of some performance-related features to the consumer may not justify preservation in the market under a separate product class, it is clear that Congress intended this provision to apply to a larger set of performance-related features than would be protected under the unavailability provision.

As for Rinnai's statement that there is no reference to "consumer utility" in the unavailability provision detailed in section 6295(o)(4) of EPCA, Rinnai's own comment also cited a House of Representatives report that stated the purpose of the unavailability provision is to ensure that an amended standard does not deprive consumers of product choices and characteristics, features, sizes, etc., and that significant energy savings can be achieved without sacrificing the utility of an appliance to a consumer. (Rinnai, No. 1186 at pp. 10). Performance characteristics, features, sizes, capacities, and volumes all offer some utility or benefit to the consumer. To the extent that Rinnai is suggesting that the protection of the unavailability provision in EPCA should be extended to aspects of a covered product that offer no utility to a consumer during operation, like the less-efficient heat exchanger design of a non-condensing gas-fired water heater, or whether the venting material is plastic or stainless steel, DOE strongly disagrees. Any interpretation of the unavailability provision not based on the assumption that Congress was concerned with preserving the utility of covered products, results in a regulatory framework where DOE is forced to create so many product classes that achieving any significant amount of energy savings is all but impossible.

DOE also disagrees with Rinnai's contention that the specific provisions of the unavailability provision-- performance characteristics (including reliability), features, sizes, capacities, and volumes—should be read to also include, among other things, "installation costs" and "greater efficiency at lower cost than gas-fired storage water heaters." Extending the unavailability provision to installation costs and efficiency is demonstrably an impossibly broad interpretation of what DOE is expected to preserve in the market under the unavailability provision. Efficiency is certainly a performance characteristic of a water heater as it measures how well a water heater performs its intended function. However, it would be nonsensical for efficiency to be a performance characteristic under the unavailability provision as the express purpose of the statute is to improve the energy efficiency of covered products and equipment, *i.e.*, eliminate less-efficient products and equipment from the market. Furthermore, cost is certainly a feature of a product. Arguably, it is one of the most important features of a product to a consumer. But again, the energy-saving purposes of EPCA would be frustrated if DOE were required to set standards under the unavailability provision that maintain less-energy-efficient covered products based solely on the fact that they cost less to install. Instead, EPCA expressly contemplates increases in the installed cost of a covered product or equipment in the economic justification analysis where DOE is directed to consider, among other things, the savings in operating costs compared to any increase in the initial and maintenance costs of a covered product. (42 U.S.C. 6295(o)(2)(B)(i)(II)). At bottom, Rinnai's argument is that DOE may not eliminate one water-heating option (non-condensing gas instantaneous water heaters) if that option is cheaper to install than another, different option (condensing gas-fired instantaneous water heaters). But, Congress made it clear that kind of comparative assessment is to be done as part of the economic analysis and has no role under the unavailability provision. As discussed at length elsewhere in this document, DOE's economic analysis considers the extent to which its standards for gas-fired instantaneous water heaters will affect the market.

Additionally, in determining whether a standard is economically justified under EPCA, DOE is directed, among other things, to consider any lessening of the utility or performance of the covered product likely to result from the standard. Thus, extending the unavailability provision to preserve any performance characteristic or feature would frustrate EPCA's purpose and statutory scheme. Simply put, EPCA requires DOE to adopt standards set at the maximum improvement in energy efficiency determined to be technologically feasible and economically justified. EPCA anticipates that new or amended energy conservation standards will result in the unavailability of certain inefficient technologies. An overly broad reading of the unavailability provision to include attributes of the covered product not addressed by the text of that provision (*i.e.*, efficiency, costs, installation costs, *etc.*) would be at odds with the statute's energy-saving purposes. Similarly, DOE disagrees with reading other qualifiers into the unavailability provisions, including "like-for-like replacements, compatibility for easier and wider applications of installations, compatibility with non-condensing venting, smaller space requirements.” As discussed further below, an existing non-condensing gas-fired instantaneous water heater can always be replaced with a condensing gas-fired instantaneous water heater in the same place (*i.e.*, it is always technically feasible).

As discussed previously, DOE’s interpretation of the unavailability provision does not require a redundant reading of 42 U.S.C. 6295(q). Instead, DOE interprets these two provisions as complementing one another. EPCA provides DOE some discretionary authority to establish product classes with different standard levels under 42 U.S.C. 6295(q). Under this authority, DOE has to determine if a performance-related feature justifies a different standard by considering, among other things, utility to the consumer. And based on DOE’s own research as well as information presented in stakeholder comments, differences in cost or complexity of installation between different methods of venting (*e.g.*, a condensing water heater versus a non-condensing water heater) do not make specific methods of venting a performance-related feature under 42 U.S.C. 6295(q)(1)(B), so as to justify separating the products into different product classes. In reaching this determination, DOE considered Category III venting (for non-condensing designs) and Category IV venting (for condensing designs), which are associated but external to the covered product, and concluded that condensing gas-fired instantaneous water heaters can be installed in the same locations where non-condensing gas-fired water heaters are currently installed. As stated throughout this rulemaking, installation costs and considerations are very relevant to the establishment of energy conservation standards, and are accounted for in the LCC analysis to determine the economic justification of standards.

Unlike specific methods of venting, a covered product's capacity is addressed under the unavailability provision in 42 U.S.C. 6295(o)(4), and described under the product class provision in 42 U.S.C. 6295(q)(1)(B). DOE notes that a water heater's capacity provides utility to a consumer during use (unlike the type of venting or installation costs). For example, water heaters with higher capacities enable consumers to run multiple applications requiring hot water at the same time. Further, DOE is required to preserve the utility offered by larger capacity water heaters in the market under the unavailability provision in 42 U.S.C. 6295(o)(4). Unlike capacity, a lower installation cost has no effect on the performance of a water heater and offers no utility to a consumer during use. In addition to capacity, DOE has also established product classes for water heaters based on: volumes (*e.g.*, a division at 2 gallons), input rating (*e.g.*, a division at 50,000 Btu/h), delivery capacities (*e.g.*, divisions for the very small, low, medium, and high usage patterns), and demand type (*e.g.*, storage versus instantaneous); in addition to distinguishing by context and applications (*e.g.*, consumer product versus commercial equipment) as well as fuel types (*e.g.*, gas-fired, oil-fired, or electric) as required under 42 U.S.C. 6295(q)(1)(A).

APCA opposed DOE's proposed standards for gas-fired instantaneous water heaters because these standards would require condensing operation. (APCA, No. 1152 at p. 1) The Governor of Georgia commented that the proposed standards would limit consumer choice by reducing the availability of many non-condensing tankless water heaters currently on the market, negatively impact consumers through increased product costs, and contradict EPCA requirements. (Governor of Georgia, No. 1157 at pp. 1–3)

ONE Gas indicated that non-condensing/positive vent pressure gas-fired instantaneous water heaters peak at approximately 0.82 UEF and that UEF ratings from 0.89 to 0.93 would be technologically infeasible for non-condensing products. (ONE Gas, No. 1200 at pp. 2–3) Huntsville Utilities expressed opposition to the proposed standards for gas-fired water heaters, adding that it is especially concerned with the proposed standards for gas-fired instantaneous water heaters that require an efficiency level over 91 percent, effectively eliminating the non-condensing option for this product class. (Huntsville Utilities, No. 1176 at p. 1) JEA, WMU, PGW, Southeast Gas, CEA, ASGE and ONE Gas stated that the proposed standard for gas-fired water heaters would effectively eliminate the option of a non-condensing instantaneous water heater and requested that DOE reassess the negative impacts on public gas utility customers and manufacturers of water heaters that would result from the proposed standard for gas-fired water heaters. (JEA, No. 865 at pp. 1–2; WMU, No. 872 at pp. 1–2; PGW, No. 886 at pp. 1–2; Southeast Gas, No. 887 at pp. 1–2; CEA, No. 914 at pp. 1–2; ASGE, No. 976 at pp. 1–2; ONE Gas, No. 1200 at p. 2)

The Gas Association Commenters expressed that the transition to condensing-level efficiencies for gas-fired instantaneous water heaters would result in the unavailability of products with what it considered to be performance characteristics and features provided by non-condensing products. This group of commenters cited comments submitted by Rinnai, stating that non-condensing gas-fired instantaneous water heaters can be installed and used in cases where condensing products cannot be (*e.g.*, in high-rise buildings, historically protected buildings, or any other building with complications to venting capabilities). According to EPCA, the Gas Association

Commenters stated, DOE should decline to adopt the proposed standard for gas-fired instantaneous water heaters on the grounds that it would result in the unavailability of products with "performance characteristics" and "features" currently available to consumers in the United States. (Gas Association Commenters, No. 1181 at p. 7)

In response to these comments, DOE acknowledges that the standards for gas-fired instantaneous water heaters cannot be achieved by non-condensing designs. Nevertheless, in response to comments from ONE Gas suggesting that the amended standards are technologically infeasible, condensing-level standards are still technologically feasible because condensing designs are widely available on the market. DOE has determined that non-condensing technology does not provide any inherent performance benefit to consumers beyond what is provided by condensing designs. Instead, as discussed previously in this section of this document, DOE has determined that non-condensing technology does not constitute a performance-related feature for which a separate product class must be established under EPCA, nor does non-condensing technology warrant preservation under the unavailability provision. Condensing gas-fired instantaneous water heaters can be installed in the same locations where non-condensing gas-fired water heaters are currently installed with proper consideration for the venting requirements of condensing water heaters. As discussed in section IV.F.2 of this document, the venting requirements of each type of water heater are considered in the analysis of installation costs. Moreover, DOE has not identified, nor have commenters provided, any specific examples of buildings that currently use gas-fired water heaters that cannot be retrofitted to accommodate a condensing gas-fired water heater in place of an existing non-condensing gas-fired water heater. DOE research indicates that historically protected buildings can be renovated with appropriate permitting from local jurisdictions.[39] In the case of buildings preserved under the U.S. General Services Administration's stewardship program, HVAC renovations have increased energy and water efficiency.[40] When a chimney is not used to vent the flue gases (such as when sidewall venting is used), venting terminations on the exterior of a building are visually unobtrusive—far less prominent than outdoor units for air-conditioning systems that are often installed in privately-owned homes in historic districts. With respect to high-rise buildings, DOE has found that these buildings are uncommonly outfitted with consumer gas-fired instantaneous water heaters at present because these types of buildings more commonly rely on central domestic hot water production (*i.e.*, commercial water heaters). This is because if consumer gas-fired instantaneous water heaters are centrally located in a multi-family building, they could require multiple long vents for flue gases and for combustion air, which can be generally prohibitive for both non-condensing and condensing products alike. However, even if gas-fired instantaneous water heaters are located in some high-rise buildings, they can be located near exterior walls, and therefore each unit can have separate venting. If high-rise buildings rely on non-condensing gas-fired instantaneous water heaters that are installed in each individual dwelling rather than in a central location, the building would already have venting in place (which would need to be modified to accommodate a condensing product, resulting in added installation cost, just as any other case). In

[39] For example, the Historic Beacon Hill District in Boston, Massachusetts has an architectural commission to review proposed alterations to exterior architectural features within the district that are open to view from a public way. Guidelines for this district are provided by the City of Boston, available at: *www.cityofboston.gov/images_documents/Beacon%20Hill%20Architectural%20Commission%20Guidelines_tcm3-17489.pdf* (last accessed August 6, 2024).

[40] See, for example, the 2023 report by The Center for Historic Buildings, available at: *www.gsa.gov/system/files/Stewardship2023_0.pdf* (last accessed August 8, 2024).

general, as any gas-fired instantaneous water heater would already require venting to the outside, the existing non-condensing venting can always be converted to condensing venting.  These installation costs and considerations have been included in the quantitative factors of the analysis.  *See* section IV.F.2 for details on how they are accounted for in the installation cost analysis and the development of LCC estimates.  In summary, DOE has not found any cases where complications in venting cannot be overcome.  As a result, DOE finds that interested persons have not established by a preponderance of the evidence that the standard is likely to result in the unavailability of gas-fired instantaneous water heaters in certain applications, *e.g.*, high-rise buildings, historically protected buildings, or any other building with complications to venting capabilities.  So, any argument that non-condensing gas-fired instantaneous water heaters should be preserved in the market under 42 U.S.C. 6295(o)(4) must be based on a performance characteristic (*e.g.*, reliability), feature, size, capacity, or volume that is unique to non-condensing gas-fired instantaneous water heaters.

First, regarding reliability, as discussed in the March 2022 preliminary analysis and the July 2023 NOPR, standards adopted at EL 2 would result in a transition towards condensing technology for gas-fired instantaneous water heaters (for those with less than 2 gallons of storage volume and more than 50,000 Btu/h of rated input) but would not result in the unavailability of reliably-performing products. (*See* chapter 2 of the preliminary analysis TSD; 88 FR 49058, 49079).  Condensing gas-fired instantaneous water heaters have been on the market for many years.  DOE has noted clusters of models at condensing efficiency levels as far back as the April 2010 Final Rule.  (*See* Table IV.11 at 75 FR 20112, 20145, which includes condensing technology at efficiency level

7). Over time, condensing models have only grown in popularity. Today, about two-thirds of gas-fired instantaneous water heater shipments are condensing products. Given this substantial market penetration, and the fact that a significant portion of these shipments are installed in replacement applications where the upfront cost is likely higher than for non-condensing products, and that DOE does not expect that consumers on a large scale would trade off efficiency for reliability, DOE concludes that condensing gas-fired instantaneous water heaters are likely to be just as reliable as non-condensing models— otherwise, they would not comprise more than half of nationwide shipments. *See* chapter 9 of the final rule TSD for more details on product shipments.

Regarding sizes, capacities and volumes, gas-fired instantaneous water heaters are typically described in terms of capacity, *i.e.*, Btu/hr. Based on DOE's market assessment, gas-fired instantaneous water heaters that meet the adopted EL 2 efficiency are available over the full range of capacities up to the maximum input that is allowable by statute (200,000 Btu/h), and models on the market also offer modulating burners to meet reduced demands. Therefore, no sizes, capacities or volumes[41] will be made unavailable as a result of DOE not separating product classes for non-condensing and condensing gas-fired instantaneous water heaters in this rule. As a result, DOE finds that interested persons have not established by a preponderance of the evidence that the standard is likely to result in the unavailability of any sizes, capacities, or volumes of gas-fired

[41] Consumer gas-fired instantaneous water heaters often have little to no storage volume (*i.e.*¸ can have 0 gallons of rated storage volume), however. These models are also referred to as "tankless." Hence volume of the gas-fired instantaneous water heater is not typically a consideration for most consumers, nor does it substantially affect the model's ability to deliver hot water on-demand.

instantaneous water heaters that are substantially the same as those generally available in the market.

DOE has found no sound statutory basis for interpreting “size” to refer to the physical dimensions or total installation footprint of a covered product. As technology advances, many products get smaller. Computers used to be the size of rooms and now they can fit in a pocket. Similarly, televisions, which are covered products under 42 U.S.C. 6292(a)(12) and are typically referred to by screen size, have undergone significant technological advances over the past two decades as the market has shifted from cathode-ray-tube (CRT) televisions and rear-projection televisions to liquid-crystal-display (LCD) televisions. LCD televisions are a fraction of the physical size of a CRT television or rear-projection television for the same screen size. It would make little sense for the unavailability provision to require DOE to preserve CRT and rear-projection televisions in the market because they take up more space than an LCD television with the same screen size. As such, DOE views size, capacities, and volumes as product-specific terms that all refer to the same aspect of a covered product.

Nonetheless, even if a smaller installation footprint is considered a performance characteristic or feature, interested persons have not established by a preponderance of the evidence that the standard is likely to result in the unavailability of gas-fired instantaneous water heaters with smaller installation footprints. Gas-fired instantaneous water heaters that only just meet the current standards (“baseline” models) are designed with a combustion blower to help exhaust the flue gases and improve heat exchange.

These designs use "category III"[42] venting, which is a type of vent made for pressurized flue gases (such as those generated by a baseline gas-fired instantaneous water heater with a combustion blower). While category III venting is for non-condensing appliances, it is similar to category IV venting (used for condensing appliances) because both types handle pressurized flue gases from appliances with blowers. Condensing gas-fired instantaneous water heaters also use combustion blowers. The primary difference in the venting for these designs is the material that the vent is made of: category III vents handle higher temperatures and are therefore made of metal, whereas category IV vents have to be able to withstand corrosion from condensate but can be made of less expensive plastics due to the lower temperatures produced by condensing appliances (condensing appliances do not exhaust as much heat as non-condensing appliances do because condensing appliances are more effective at transferring the heat to the water). In a replacement scenario, the existing category III venting must be removed and replaced with category IV venting, however the new venting can utilize the existing vent run because both venting types operate with positive static pressure and can be configured horizontally or vertically. As a result, the installation footprint can be maintained when switching from a non-condensing to a condensing gas-fired instantaneous water heater. As discussed previously, the replacement of the venting will incur additional labor and material costs, but it is technically feasible. *See* section IV.F.2 for further details on

[42] In 2021, the National Fire Protection Association (NFPA) and American National Standards Institute (ANSI) published the NFPA 54/ANSI Z223.1, "National Fuel Gas Code." (NFPA 54-2021). Chapter 3 of NFPA 54-2021 divides the "vented appliance" definition into four categories according to whether the appliance operates with positive or nonpositive static pressure in the vent and whether there is excessive condensate formation in the vent. NFPA 54-2021 can be found online at: *www.nfpa.org/codes-and-standards/nfpa-54-standard-development/54*. (Last accessed December 4, 2024).

installation costs. *See* chapter 3 of the TSD for more details on venting types and baseline components and operation.

For these reasons, DOE has concluded that interested persons have not established by a preponderance of the evidence that the standard is likely to result in the unavailability in the United States of gas-fired instantaneous water heaters with performance characteristics (including reliability), features, sizes, capacities, and volumes that are substantially the same as those generally available in the United States. Additionally, DOE has determined that separate product classes for inefficient non-condensing technology and designs are not justified under 42 U.S.C. 6295(q)(1)(B).

Lastly, DOE notes that the condensing-level standards adopted by this final rule do not apply to *all* gas-fired instantaneous water heaters, but only those with less than 2 gallons of storage volume and more than 50,000 Btu/h of rated input. While these products comprise the vast majority of gas-fired instantaneous water heaters, it is not the entirety. Further discussion of condensing standards for other gas-fired instantaneous water heaters is presented in section IV.C.2.b of this document.

2. Technology Options

In the July 2023 NOPR market analysis and technology assessment, DOE identified several technology options initially determined to improve the efficiency of gas-fired instantaneous water heaters, as measured by the DOE test procedure. The technology options DOE identified are listed in Table IV.3. These technology options pertain to gas-fired instantaneous water heaters with less than 2 gallons of stored volume and over 50,000 Btu/h of rated input. Technology options for other types of gas-fired instantaneous water heaters are largely similar; however, additional options may be used to complement the applications of those products. For example, gas-fired instantaneous water heaters with substantial storage volume may employ thicker insulation to improve UEF ratings by reducing standby losses. As discussed in section IV.C of this document, the engineering analysis for products with 2 or more gallons of storage volume and for products with less than 50,000 Btu/h of rated input consists of a "crosswalk," *i.e.*, a translation of existing standards from one metric (EF) to another (UEF). Because a crosswalk maintains the same stringency of standards, DOE has not completed an assessment of the market for technology options used to improve UEF in models subject to the translated standards. DOE will continue to monitor the market and assess the designs of these models as more information pertaining to UEF ratings becomes available.

**Table IV.3 Potential Technologies for Increasing Gas-Fired Instantaneous Water Heater Efficiency**

<table>
<tr><th colspan="3">Technology Option</th></tr>
<tr><td rowspan="3">Electronic ignition</td><td colspan="2">Intermittent pilot ignition</td></tr>
<tr><td colspan="2">Intermittent direct ignition</td></tr>
<tr><td colspan="2">Hot surface ignition</td></tr>
<tr><td rowspan="5">Improved burners</td><td colspan="2">Condensing pulse combustion</td></tr>
<tr><td colspan="2">Power burner</td></tr>
<tr><td colspan="2">Reduced burner size (burner derating)</td></tr>
<tr><td rowspan="2">Modulating burners</td><td>Step modulating burners</td></tr>
<tr><td>Fully modulating burners</td></tr>
<tr><td rowspan="3">Heat exchanger improvements</td><td colspan="2">Increased heat exchanger surface area</td></tr>
<tr><td colspan="2">Flue baffle</td></tr>
<tr><td colspan="2">Condensing technology</td></tr>
<tr><td rowspan="2">Improved venting</td><td colspan="2">Direct venting</td></tr>
<tr><td colspan="2">Concentric direct venting</td></tr>
<tr><td>Improved controls</td><td colspan="2">Modulating controls</td></tr>
</table>

*B. Screening Analysis*

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

1) *Technological feasibility*. Technologies that are not incorporated in commercial products or in commercially viable, existing prototypes will not be considered further.

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

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

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

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

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

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

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

1. Screened-Out Technologies

In the July 2023 NOPR, DOE screened out the following technology options pertaining to gas-fired instantaneous water heaters based on the previously described criteria: condensing pulse combustion and reduced burner size. 88 FR 49058, 49083. DOE did not modify its screening analysis in the July 2024 NODA or in this final rule analysis.

Regarding condensing pulse combustion, DOE has determined it is not technologically feasible for the broader market and not likely to be practicable to manufacture, install, and service this technology on the scale necessary to serve the relevant market at the time of the effective date of this standard.  Although condensing pulse combustion technology shows promising results in increasing efficiency, it has not yet been demonstrated in any commercially-available consumer gas-fired instantaneous water heaters. Similar efficiencies are achievable with other technologies that have already been introduced on the market such that it is unlikely for manufacturing with condensing pulse combustion technology to be scaled up in the future.  DOE screened out reduced burner size due to adverse impacts to consumer utility (because reducing the burner size reduces the amount of heat the water heater can provide).  Further details of the screening analysis are provided in chapter 4 of the final rule TSD.

2. Remaining Technologies

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

**Table IV.4 Remaining Technology Options**

<table>
<tr><th colspan="3">Technology Option</th></tr>
<tr><td rowspan="3">Electronic ignition</td><td colspan="2">Intermittent pilot ignition</td></tr>
<tr><td colspan="2">Intermittent direct ignition</td></tr>
<tr><td colspan="2">Hot surface ignition</td></tr>
<tr><td rowspan="3">Burner improvements</td><td colspan="2">Power burner</td></tr>
<tr><td rowspan="2">Modulating burners</td><td>Step modulating burners</td></tr>
<tr><td>Fully modulating burners</td></tr>
<tr><td rowspan="2">Heat exchanger improvements</td><td colspan="2">Increased heat exchanger surface area</td></tr>
<tr><td colspan="2">Flue baffle</td></tr>
</table>

| **Technology Option** | |
|---|---|
| | Condensing technology |
| Improved venting | Direct venting |
| | Concentric direct venting |
| Improved controls | Modulating controls |

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

*C. Engineering Analysis*

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

As discussed in section IV.A.1 of this document, certain classes of gas-fired instantaneous water heaters currently have UEF-based standards, while for others EPCA's EF-based standards apply. For this rulemaking, DOE analyzed amended UEF standards for the product classes that currently have standards in terms of UEF. For the product classes with EF-based standards, DOE developed translated standards in terms of UEF for use in the analysis but did not analyze higher efficiency levels because, as discussed in section IV.C.2.b of this document, DOE does not currently have sufficient information to determine which higher efficiencies may be economically justified and result in significant national energy savings.

DOE has analyzed standards with respect to the effective storage volume metric (as proposed in the July 2023 NOPR) to allow consistency between standards in different product classes. As outlined in the July 2023 NOPR, there are two types of water heaters that can cause the system to store more energy than would be otherwise determined by the rated storage volume: (1) water heaters capable of operating with an elevated tank temperature, and (2) circulating water heaters.[43] 88 FR 49058, 49086. For water heaters that are not capable of storing water at elevated tank temperatures, including "tankless" models (*e.g.*, products with current UEF-based standards), the effective storage volume is equivalent to the rated storage volume. However, some gas-fired instantaneous water heaters can include smaller tanks (*i.e.*¸ the product class for models with at least 2 gallons

[43] As discussed in section III.B of this document, circulating gas-fired water heaters are storage-type water heaters that are outside the scope of this final rule.

of storage volume), therefore the effective storage volume metric was determined to be useful for gas-fired instantaneous water heaters as well.

The product classes analyzed in this final rule and the respective analytical approaches utilized are listed in Table IV.5.

**Table IV.5 Analysis Approach by Product Class**

| Product Category Analyzed in this Final Rule | Distinguishing Characteristics (Effective Storage Volume and Input Rating) | Analysis |
|---|---|---|
| Gas-fired Instantaneous Water Heater | < 2 gal and ≤ 50,000 Btu/h | Converting EF-based standards to UEF-based standards |
| | < 2 gal and > 50,000 Btu/h<br>All Draw Patterns | Amending UEF-based standards |
| | ≥ 2 gal and ≤ 200,000 Btu/h | Converting EF-based standards to UEF-based standards |

1. Products with Current UEF-based Standards

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

In the July 2023 NOPR, DOE developed efficiency levels with a combination of the efficiency-level and design-option approaches. DOE conducted a market analysis of currently available models listed in DOE's Compliance Certification Database to determine which efficiency levels were most representative of the current distribution of gas-fired instantaneous water heaters available on the market. DOE also completed physical teardowns of commercially available units to determine which design options manufacturers may use to achieve certain efficiency levels. DOE requested comments from stakeholders concerning these efficiency levels, which, in this final rule, are consistent with those analyzed in the July 2024 NODA.

a. Efficiency Levels

For each product class, DOE generally selects a baseline model as a reference point for each class, and measures anticipated changes resulting from potential energy conservation standards against the baseline model. The baseline model in each product class represents the characteristics of a product typical of that class (*e.g.*, capacity, physical size). Generally, a baseline model is one that just meets current energy conservation standards, or, if no standards are in place, the baseline is typically the most common or least efficient unit on the market. The maximum available efficiency level is the highest efficiency unit currently available on the market. DOE also defines a "max-tech" efficiency level to represent the maximum possible efficiency for a given product.

In this final rule, DOE has analyzed the same efficiency levels as were considered in the July 2023 NOPR and the July 2024 NODA. These efficiency levels are presented in Table IV.6. For each draw pattern, EL 2 corresponded with the levels proposed in the Joint Stakeholder Recommendation ("JSR") as discussed in section II.B.2. *See* chapter 5 of the final rule TSD for further details regarding the efficiency level analysis.

**Table IV.6 Efficiency Levels for Products with $V_{eff}$ < 2 gal, Rated Input > 50,000 Btu/h**

| Efficiency Level | UEF | | | |
|---|---|---|---|---|
| | **Very Small*** | **Low*** | **Medium** | **High** |
| 0 (Baseline) | 0.80 | 0.81 | 0.81 | 0.81 |
| 1 | 0.86† | 0.87† | 0.87 | 0.89 |
| 2 (JSR) | 0.89† | 0.91† | 0.91 | 0.93 |
| 3 | 0.90† | 0.92† | 0.92 | 0.95 |
| 4 (Max-Tech) | 0.91† | 0.93† | 0.93 | 0.96 |

* Only one brand has commercially-available products in the very small draw pattern and low draw pattern at the time of this analysis.
† DOE applied the differences in efficiency levels from the medium draw pattern to define the Efficiency Levels 1 through 4 for the very small draw pattern and the low draw pattern.

In response to the July 2023 NOPR, ONE Gas stated that as efficiencies of non-condensing instantaneous gas water heaters have increased since their introduction, replacements would accrue efficiency gains and emissions reductions over the products when first introduced in the 2000s and now at the end of their predicted lives (20 years according to the Department's analysis). (ONE Gas, No. 1200 at p. 4)

DOE agrees that efficiencies of gas-fired instantaneous water heaters have increased over time. In the present rulemaking, DOE considered the baseline efficiency of gas-fired instantaneous water heaters to be equivalent to the current standards. This efficiency was required as a result of the April 2010 Final Rule, which set standards at a level that typically corresponds to electronic ignition, larger non-condensing heat exchangers, and power venting. As shown in chapter 3 of the final rule TSD, models are now able to achieve significantly higher efficiencies (*e.g.*, condensing levels).

With respect to efficiency level 2, Rinnai stated that DOE's proposed standard is not technically achievable by non-condensing gas-fired instantaneous water heaters, and, accordingly, will make them obsolete. Rinnai noted that it had previously submitted comments on the July 2023 NOPR, stating that the proposed rule would eliminate one of Rinnai's two residential water heater product offerings and significantly impact Rinnai's tankless water heater sales and manufacturing facility. (Rinnai, No. 1443 at pp. 1–2)

DOE has concluded that the efficiency levels analyzed in this rulemaking are technologically feasible for gas-fired instantaneous water heaters through the use of condensing heat exchangers, which are widely used in the market today. DOE understands Rinnai's concern regarding the elimination of less-efficient models impacting the manufacturer, and therefore these topics are addressed more in detail in section IV.J.3 of this document, which discusses MIA comments. After consideration of feedback from commenters, DOE is maintaining the efficiency levels provided in the July 2024 NODA.

b. Design Options

Based on its teardown analyses and feedback provided by manufacturers in confidential interviews, DOE determined the technology options that are most likely to constitute the pathway to achieving the efficiency levels assessed.  These technology options are referred to as "design options."  While manufacturers may achieve a given efficiency level using more than one design strategy, the selected design options reflect what DOE expects to be the most likely approach (most likely to prove cost-effective) for the market in general in a standards-case scenario.  Further details are provided in chapter 5 of the final rule TSD.

DOE has found that gas-fired instantaneous water heaters are often differentiated based on heat exchanger and burner designs.  Step-modulating burners feature a manifold with multiple solenoids regulating the gas flow into the burner. Sections of the burner can be shut off or opened up as demand for hot water varies.  Each additional open solenoid means another "step up" in heat input.  By contrast, fully modulating burners make use of the full combustion chamber and heat exchanger surface area, modulating the input rate in tandem with the combustion blower. Such systems tend to be more complex than step-modulating gas-fired instantaneous water heaters.  In the March 2022 Preliminary Analysis, DOE observed some manufacturers using fully modulating burners in lieu of step-modulating burners at the max-tech efficiency level.  In the July 2023 NOPR, DOE analyzed an additional efficiency level, EL 3, that was close to the max-tech level, EL 4, and used generally similar design options. However, in the July 2024 NODA, upon further review DOE found products that meet EL 3 but not EL 4 using step modulation. Thus, DOE tentatively determined that fully modulating burners are more likely to be implemented in only EL 4 designs. In the July 2024 NODA, based on additional data collected in its analyses, DOE also surmised that EL 4 efficiencies could still be met without the use of fully modulating burners—*i.e.*, relying mainly on improvements to the condensing heat exchanger. DOE stated that this result is consistent with the conclusion in the July 2023 NOPR because the pathway relying on heat exchanger improvements could be more cost-effective for manufacturers to mass-produce designs at a scale necessary to meet national demand, therefore the Department expects that such designs may be more common if standards were to be set at EL 4 than in the current market. As such, DOE analyzed EL 4 to be achievable using either step modulating or fully modulating burners, and the manufacturer production cost for EL 4 estimated in the July 2024 NODA reflected an average of these design pathways. 89 FR 59692, 59693-59694. Due to the uncertainty regarding which design pathway would be more prevalent in the case of standards set at the max-tech efficiency level, DOE raised the issue to seek additional information from interested parties on this topic.

In response to the July 2024 NODA, AHRI disagreed with DOE's assessment that EL 3 and EL 4 can be achieved using step modulating burners. AHRI stated that fully modulating burners are required to achieve EL 3 and EL 4. AHRI claimed that fully modulating burners provide the precise control necessary to optimize combustion efficiency, minimize energy waste, and consistently achieve the higher performance levels associated with EL 3 and EL 4. AHRI claimed that this is supported by current market data, which shows that the vast majority of gas-fired instantaneous water heaters achieving high efficiency levels, particularly those with a UEF above 0.93, rely on fully modulating burners. AHRI claimed DOE's findings are not supported by the existing market landscape. AHRI urged DOE to consider performing a detailed review of the efficiency gains that can be realistically expected from step modulating versus fully modulating burners, as well as a comprehensive assessment of market data in order to support the claim that step-modulating burners can be used to achieve EL 3 and EL 4. (AHRI, No. 1437 at pp. 1-2)

Rinnai requested that DOE analyze and validate the assumptions regarding the feasibility of achieving EL 3 or EL 4 using step modulating burners, a change made in the July 2024 NODA. According to Rinnai, fully modulating burners consistently achieve EL 3 and EL 4, which the July 2024 NODA now contradicts. (Rinnai, No. 1443 at p. 23)

Rheem disagreed with the design options for EL 3 and EL 4 as described in the July 2024 NODA, claiming that step modulation was not reflected in the MPCs. Rheem indicated that there are currently no models utilizing step modulating burners on the market that meet EL 4. In addition, Rheem stated that, while there are step modulating designs currently on the market that meet EL 3, some are complex down-fired designs that were not reflected in the technology options discussed in the NOPR TSD. Finally, Rheem questioned whether traditional step modulating designs can meet EL 3 at all input rates. (Rheem, No. 1436 at p. 2)

A. O. Smith stated that DOE's engineering analysis should reflect the technologies and design pathways currently available on the market and avoid making speculative assumptions regarding cost and performance of theoretical designs which have not been fully vetted or proven to be market ready and emphasized that the use of theoretical design pathways is more prone to inaccurate or incomplete cost estimates. (A.O. Smith, No. 1440 at pp. 5-6)

BWC agreed that designs utilizing step modulating burners can achieve EL 4, but stated that manufacturers do not widely design their products in this way due to their increased complexity, which correlates with reduced product lifetimes. Additionally, the manufacturer stressed that added product complexity would entail more specialized manufacturing processes, leading to additional costs passed on to consumers. (BWC, No. 1441 at pp. 1-2) BWC further stated that for products achieving EL 4 efficiencies with the use of step modulating burners the increased complexity of step modulating burners would make products more difficult to efficiently mass produce, requiring the development of more specialized manufacturing processes. BWC stated that this would lead to increased production costs that may be passed on to consumers. (BWC No. 1441 at p. 2)

To clarify, DOE bases its assignment of design options not only on publicly available product literature, but also on its independent analysis of teardown samples. DOE combines this information to determine what the most cost-effective pathway to increasing efficiency may be.

With respect to burner configuration (*i.e.*, up-fired vs. down-fired), DOE notes that it has not found evidence to suggest that the configuration itself lends to improvements in UEF. Although the topic was discussed, burner configuration was not attributed as a design option to improve the efficiency of commercial gas-fired instantaneous water heaters in DOE's recent rulemaking pertaining to standards for that equipment.[44] Traditional designs of consumer gas-fired instantaneous water heaters utilize an "up-fired" approach where the burner is located at the bottom and directs the flame upwards through a heat exchanger above it. This configuration is the natural choice for product lines that used buoyancy to vent the flue gases away because the hot flue gases can rise through the heat exchanger and exit through the vent. However, baseline models today utilize power burners with blowers to expel the flue gases without the need for buoyancy to move these gases out. Because of this, designs are no longer limited to up-fired configurations. Down-fired configurations— where the burner and blower are located above the heat exchanger— may be preferred by some manufacturers due to this design's natural ability to manage condensate in condensing models. In a down-fired configuration, gravity allows the condensate to collect at a receiver near the secondary (condensing) heat exchanger because, in this configuration, the condensing heat exchanger is towards the bottom of the water heater. Teardown samples show that both firing configurations are used in condensing models today. As such, DOE finds that the burner configuration is likely the manufacturer's preference rather than an inherent benefit to efficiency. *See* chapters 3 and 5 of the final rule TSD for more details.

[44] See chapter 5 of the TSD to the October 2023 commercial water heater standards final rule, available online at: *www.regulations.gov/document/EERE-2021-BT-STD-0027-0038*.

Where DOE has found a correlation between down-fired configurations and UEF is in the implementation of fully modulating burners. Down-fired configurations tend to have higher UEF ratings because fully modulating burners are typically always down-fired. This may be because, as discussed further in the following paragraphs, fully modulating burners require different manufacturing equipment and production lines. For example, if a manufacturer is designing a new production line for models with fully modulating burners, there may be an opportunity to implement a down-fired design for the condensate. However, the research and teardown analyses conducted by DOE did not yield evidence to suggest that the down-fired configuration causes an increase in UEF without the implementation of a fully modulating burner. Hence DOE maintains that the pathway to increasing efficiencies up to the max-tech level includes incorporating fully modulating burner designs, which happen to be down-fired. For condensing efficiency levels below the max-tech level, DOE's teardown analyses indicate that there would not be a significant difference in MPC between a down-fired design and an up-fired design, all else the same. Therefore, DOE has not directly analyzed the incorporation of down-fired burners as a design option in this engineering analysis except where fully modulating burners are used.

With respect to the burner modulation type, DOE agrees that fully modulating burners are capable of achieving higher efficiencies, including those from EL 1 through EL 4. However, in its teardowns, DOE identified samples of gas-fired instantaneous water heaters currently on the market meeting the efficiencies as high as EL 3 using step-modulating burners. Additionally, the comments from Rheem implicitly provide that fully modulating designs are associated with higher costs compared to step-modulating designs, which may be a reason step-modulating burners are still commonly used at higher efficiencies. DOE's teardown analyses verify this understanding— fully modulating burners use more advanced components that cause MPCs to rise commensurately. Responding to the comments from BWC, DOE understands that a production line built to manufacture step-modulating burners would have additional equipment that a fully modulating burner production line would not require. For example, manufacturers typically need additional metal presses and/or dies to stamp the compartments of a step-modulated burner and combustion chamber. Each manufacturer has the ability to choose which type of burner to implement in its designs, taking into consideration the pros and cons of each approach (*e.g.*, step-modulating burners may cost less overall, but have a trade-off in that they require more equipment to manufacture). The availability of step-modulating burners at various efficiency levels strongly suggests that manufacturers do opt to use this pathway despite the added complexity of the production line.

As stated earlier, DOE aims to identify the most cost-effective and likely pathway to achieving higher efficiency levels. The cost-efficiency curves serve as estimates for what the overall market—not just one manufacturer—would experience in a scenario where standards are set to that efficiency levels. In the July 2024 NODA, DOE tentatively determined that the continued use of step-modulating burners, along with heat exchanger improvements, would be the most cost-effective pathway to achieve EL 3. Then, to reach EL 4, fully modulating burners may have similar cost-effectiveness such that manufacturers could opt to use either a step-modulating burner with an even larger heat exchanger or a fully modulating burner at this level.

DOE once again reviewed its teardowns and online product literature to assess how different manufacturers implement step-modulating and fully modulating burner designs, as suggested by AHRI. To Rheem's point, DOE once again found that step-modulating designs on the market today can achieve EL 3 and can span the full range of capacities (up to 200,000 Btu/h), as described in chapter 5 of the final rule TSD. While there may be some cases of product lines not reaching EL 3 across the full span of capacities, DOE believes these discrepancies in efficiency can be addressed by improving the heat exchanger (and the added costs of doing so are included in DOE's estimates of MPCs). Considering this, the Department has confirmed that the design option pathway to EL 3 could be more cost-effective using step-modulating burners.

DOE also found that, although step-modulating designs would be capable of meeting EL 4 (as BWC indicated), more manufacturers use fully-modulating burners at EL 4. To determine whether step-modulating burners would be appropriate to consider for EL 4, DOE evaluated the comments from manufacturers regarding manufacturing complexity. Currently, approximately only 8 percent of shipments currently meet EL 4. In a standards-case-scenario, manufacturers would have to significantly ramp up production capacity such that 100 percent of models sold in the U.S. would meet that efficiency level. The comments from multiple manufacturers serve as a strong indication that, in a standards-case-scenario where production capacity for these high-efficiency models would have to be multiplied, it is more realistic to expect designs to use fully modulating burners to simplify the production process. Hence, DOE agrees with commenters indicating that fully modulating burners are more appropriate for EL 4.

As a result, the design options analyzed in this final rule are listed in Table IV.7.

**Table IV.7 Design Options for Gas-fired Instantaneous: $V_{eff}$ < 2 gal, Rated Input > 50,000 Btu/h**

| EL | Design Options |
|---|---|
| **0** | Step modulating burner; Non-condensing tube-and-fin heat exchanger |
| **1** | Step modulating burner; Condensing tube heat exchanger |
| **2** | Step modulating burner; Larger condensing heat exchanger |
| **3** | Step modulating burner; Larger, flat plate condensing heat exchanger |
| **4** | Fully modulating burner; Larger condensing heat exchanger |

c. Cost Analysis

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

- Physical teardowns: Under this approach, DOE physically dismantles a commercially available product, component-by-component, to develop a detailed bill of materials for the product.

- Catalog teardowns: In lieu of physically deconstructing a product, DOE identifies each component using parts diagrams (available from manufacturer websites or appliance repair websites, for example) to develop the bill of materials for the product.

- Price surveys: If neither a physical nor catalog teardown is feasible (e.g., for tightly integrated products such as fluorescent lamps, which are infeasible to disassemble and for which parts diagrams are unavailable), cost-prohibitive, or otherwise impractical (e.g., large commercial boilers), DOE conducts price surveys using publicly available pricing data published on major online retailer websites and/or by soliciting prices from distributors and other commercial channels.

In the present case, DOE conducted the analysis using a combination of the physical and catalog teardown approaches to develop estimates of the manufacturer production cost ("MPC") at each UEF efficiency level analyzed. Data from the teardowns were used to create bills of materials ("BOMs") that capture all of the materials, components, and manufacturing processes necessary to manufacture products at various efficiency levels spanning the full range of efficiencies from the baseline to max-tech. DOE used the BOMs along with publicly available material and component cost data as the basis for estimating the MPCs. DOE refined its cost estimates and its material and component cost data based on feedback received during confidential manufacturer interviews conducted during this rulemaking.

To perform this analysis, DOE selects representative capacities for each product class. These capacities reflect the most common or average size of a gas-fired instantaneous water heater in that product class, and this step is important because the MPC is dependent upon the size of the water heater— water heaters with higher input rates cost more to manufacture.  In the July 2023 NOPR and July 2024 NODA, DOE analyzed input rates of 120,000 Btu/h and 199,000 Btu/h as representative capacities for the medium and high draw patterns, respectively.  DOE has determined that these capacities remain representative in this final rule.  Based on the results of the market assessment, DOE has determined that there are very few models in the low draw pattern, with only one manufacturer making these products.  There are no very small draw pattern gas-fired instantaneous water heaters greater than 50,000 Btu/h in input rating.  DOE's teardown analyses have shown that the design option pathways and manufacturer production cost versus efficiency curves are generally similar for all tankless gas-fired instantaneous water heaters, such that the results from a direct analysis of the medium and high draw patterns would be representative for the very small and low draw patterns as well.  Thus, the very small and low draw patterns were not directly analyzed product classes in this final rule.

Rheem stated that the incremental MPCs from EL 2 to EL 3 and from EL 3 to EL 4 are too low, and do not adequately capture the higher costs associated with the new step modulation or fully modulating burner systems. Furthermore, Rheem reiterated its comment in response to the July 2023 NOPR that the incremental retail cost between step modulating and fully modulating gas-fired instantaneous water heater designs is 50 percent lower than expected.  (Rheem, No. 1436 at pp. 2–3)

As described in section IV.C.1.b, DOE determined that the burner design options for EL 3 and EL 4 would be step-modulating burners and fully modulating burners, respectively. The July 2024 NODA assumed that only a fraction of the market would switch to fully modulating burners at EL 4, and, therefore, the incremental cost increase reflected an average of some manufacturers retaining the step-modulating burner (no additional burner cost) and some manufacturers switching to fully modulating burners (significant additional burner cost). As a result, the incremental MPC between EL 3 and EL 4 in the July 2024 NODA averaged out to be lower than the estimated total cost of switching to a fully modulating burner. In this final rule analysis, DOE assumes that all models at EL 4 would utilize fully modulating burners. Hence, the MPCs at EL 4 are increased to reflect this change in design pathway, and this would in turn increase the incremental retail cost between EL 3 and EL 4.

*See* chapter 5 of the final rule TSD for additional details.

d. Shipping Costs and Manufacturer Selling Price

As discussed in the July 2024 NODA, DOE similarly maintained the methodology for shipping costs from the July 2023 NOPR (*see* 88 FR 49058, 49095-49096). DOE updated the cost per trailer using the most recent data available. 89 FR 59692. Because many gas-fired instantaneous water heaters sold in the United States are manufactured overseas, these shipping costs include the cost of shipping products from overseas to the United States, and then from the coast to the middle of the country.

A.O. Smith stated that DOE does not account for the increase in downstream shipping costs at EL 3 and EL 4 that would result from incorporating larger heat exchangers into consumer gas fired instantaneous water heaters. (A.O. Smith, No. 1440 at pp. 5–6)

DOE agrees that larger heat exchangers would increase the product footprint. In some cases, this causes fewer units to fit in a container or trailer, thereby increasing the per-unit outbound shipping cost to manufacturers. To determine how many units would fit, DOE assumed standard trailer dimensions and a nearly full truckload configuration (*see* chapter 5 of the final rule TSD for details). In DOE's shipping cost calculation, the maximum units that can fit is based not only on the size of each unit, but also the possible orientations that boxes can be loaded in with. Per DOE's analysis, the same number of units could fit in one load whether the model is an EL 3 design or a slightly larger EL 4 design. As a result, the shipping costs are estimated to be the same at these two efficiency levels.

To account for manufacturers' non-production costs and profit margin, DOE applies a multiplier (the manufacturer markup) to the MPC. The resulting manufacturer selling price ("MSP") is the price at which the manufacturer distributes a unit into commerce. DOE developed an average manufacturer markup by examining the annual Securities and Exchange Commission ("SEC") 10-K[45] reports filed by publicly traded manufacturers that produce gas-fired instantaneous water heaters, the manufacturer

[45] U.S. Securities and Exchange Commission. Company Filings. Available at *www.sec.gov/search-filings* (last accessed August 7, 2024).

markups from the April 2010 Final Rule, and feedback from confidential manufacturer interviews. 75 FR 20112. *See* section IV.J.2.d of this document and chapter 12 of the final rule TSD for additional detail on the manufacturer markup.

e. Cost-Efficiency Results

The results of the engineering analysis are reported as cost-efficiency data in the form of MPCs and shipping costs calculated for each efficiency level of each product class for which DOE is proposing amended UEF-based standards. As discussed previously, DOE determined these costs by developing BOMs based on a combination of physical and catalog teardowns and using information in the BOMs along with component and material price data to estimate MPCs. As discussed in section IV.C.1.c of this document, the very small and low draw patterns were not directly analyzed due to the low number of basic models identified in these draw patterns during the market and technology assessment. However, as shown in section IV.C.1.a of this document, higher efficiency levels of the very small and low draw pattern product classes continue to be assessed. Further evaluation of the economic justification of potential amended standards for gas-fired instantaneous water heaters (all models with $V_{eff}$ < 2 gal and rated input > 50,000 Btu/h) is based on the understanding that the medium and high draw pattern results are representative of the overall market given the very low shipments of very small and low draw pattern models. The results of the engineering analysis, in 2023 dollars, are summarized in Table IV.8.

**Table IV.8 Engineering Analysis Results for Gas-fired Instantaneous: $V_{eff}$ < 2 gal, Rated Input > 50,000 Btu/h**

| EL | UEF | | | | MPC (2023$) | MSP (2023$) | Shipping (2023$) |
|---|---|---|---|---|---|---|---|
| | Very Small | Low | Medium 120,000 Btu/h | High 199,000 Btu/h | | | |
| **0 (Baseline)** | N/A | N/A | 0.81 | 0.81 | Med: 310.51<br>High: 327.89 | Med: 450.24<br>High: 475.44 | Med: 4.52<br>High: 7.63 |
| **1** | N/A | N/A | 0.87 | 0.89 | Med: 441.74<br>High: 461.02 | Med: 640.52<br>High: 668.48 | Med: 7.07<br>High: 9.49 |
| **2 (JSR)** | N/A | N/A | 0.91 | 0.93 | Med: 445.63<br>High: 466.00 | Med: 646.16<br>High: 675.71 | Med: 10.17<br>High: 11.45 |
| **3 (E*)** | N/A | N/A | 0.92 | 0.95 | Med: 451.39<br>High: 473.22 | Med: 654.52<br>High: 686.17 | Med: 10.17<br>High: 11.45 |
| **4 (Max tech)** | N/A | N/A | 0.93 | 0.96 | Med: 490.04<br>High: 514.99 | Med: 710.56<br>High: 746.74 | Med: 10.17<br>High: 11.45 |

2. Products without Current UEF-based Standards

In the December 2016 Conversion Factor Final Rule, DOE established that EF-based standards as established by EPCA are applicable to consumer water heaters but would not be enforced until conversion factors and converted standards are adopted. 81 FR 96204, 96209-96211. To convert these EF-based standards to UEF-based standards, DOE first developed conversion factors that convert tested values measured under the DOE test procedure in effect prior to the July 2014 TP Final Rule (which produces the EF metric) to values found under the current DOE test procedure (which produces the UEF metric). DOE then applied these conversion factors to representative baseline models and derived the UEF-based energy conservation standards from the resulting UEF values.

For the July 2023 NOPR, DOE applied a similar methodology to translate from minimum efficiency levels denominated in EF to those in UEF for classes of covered consumer water heaters that do not yet have UEF-based standards. 88 FR 49058, 49098. The translated standards for gas-fired instantaneous water heaters are shown in Table IV.9. These efficiencies all correspond to non-condensing operation.

**Table IV.9 Translated UEF-based Energy Conservation Standards for Product Classes without established UEF-based Standards**

| Product Class | Nominal Input | Effective Storage Volume | Draw Pattern | Uniform Energy Factor |
|---|---|---|---|---|
| Instantaneous Gas-fired Water Heater | ≤ 50,000 Btu/h | < 2 gal | Very Small | 0.64 |
| | | | Low | 0.64 |
| | | | Medium | 0.64 |
| | | | High | 0.64 |
| | ≤ 200,000 Btu/h | ≥ 2 gal | Very Small | $0.2534 - (0.0018 \times V_{eff})$ |
| | | | Low | $0.5226 - (0.0022 \times V_{eff})$ |
| | | | Medium | $0.5919 - (0.0020 \times V_{eff})$ |
| | | | High | $0.6540 - (0.0017 \times V_{eff})$ |

In the July 2023 NOPR, DOE proposed to adopt these translated standards and reiterated that the stringency of the standards is not increasing as a result of the conversion. 88 FR 49058, 49098-49100.

a. Crosswalk to Equivalent-Stringency UEF-Based Standards

In the July 2023 NOPR, DOE requested feedback regarding the appropriateness of the proposed converted UEF-based standards and whether products on the market can meet or exceed the proposed levels. 88 FR 49058, 49100.

The Gas Association Commenters stated that DOE did not justify the proposed new standards for gas-fired instantaneous water heaters that are < 2 gallons and < 50,000 Btu/h or greater than or equal to 2 gallons. In its comments, the Gas Association Commenters interpreted the economic analysis performed for gas-fired instantaneous water heaters that are < 2 gallons and > 50,000 Btu/h as being treated as representative for all gas-fired instantaneous water heater standards being proposed in the July 2023 NOPR. These commenters noted that DOE tentatively concluded these product classes are different enough to warrant separate standards, but that there was no economic justification provided for the two product categories remaining at non-condensing efficiency levels. Citing the statutory requirement for any new or amended energy conservation standards to be technologically feasible and economically justified, the Gas Association Commenters recommended that DOE modify its approach. (Gas Association Commenters, No. 1181 at p. 8)

EPCA directed DOE to establish a uniform efficiency descriptor to be used to regulate all covered water heaters, with certain exceptions for water heaters used only in commercial applications. (42 U.S.C. 6295(e)(5)) Therefore, DOE has conducted this analysis in satisfaction of its statutory obligation to delineate standards for all consumer water heaters, including gas-fired instantaneous water heaters, in terms of UEF. Because the statute requires that the UEF-based standards for these product classes reflect the same stringency as the statutory EF-based standards that are currently applicable—*i.e.*, these are not standards that would require higher efficiency to comply— it is not necessary for DOE to conduct an assessment of energy savings or economic justification prior to proposing such standards. (42 U.S.C. 6295(e)(5)(E)(iii) For example, the translated UEF standards can be met by non-condensing models and products with standing pilot lights as well. The Department believes that the Gas Association Commenters may have misinterpreted the analysis for product classes with current UEF-based standards as also applying to these product classes which have EF-based standards. To reiterate, these standards are not being established pursuant to EPCA provisions at 42 U.S.C. 6295(o)(A), but instead in accordance with those at 42 U.S.C. 6295(e)(5). Additionally, the statutory EF-based standards are provided within EPCA and do not require separate justification to adopt these stringencies. 89 FR 37778, 37845.

b. Consideration of More Stringent Standards

In the July 2023 NOPR, DOE also requested information and data regarding the UEF of products within these product classes if they are found to generally exceed the proposed levels. 88 FR 49058, 49100.

Some commenters identified a need to consider more stringent standards for gas-fired instantaneous water heaters with less than 50,000 Btu/h of input, discussed as follows.

A.O. Smith indicated that simultaneous establishment of baseline UEF levels for converted product classes while increasing the standard levels for existing product classes creates a scenario where new products may emerge, and shipments may shift from product classes with more stringent standards to very similar products in new product classes with less stringent standards. (A.O. Smith, No. 1182 at p. 14) A.O. Smith identified that product classes for $< 2$ gallon and $< 50,000$ Btu/h gas-fired instantaneous water heaters and $\geq 2$ gallon and $\leq 200,000$ Btu/h gas-fired instantaneous water heaters with non-condensing standard levels are likely to incentivize circumvention of the < 2 gallon and > 50,000 Btu/h condensing standards. (A.O. Smith, No. 1182 at p. 14)

Bosch noted that there are still pathways for non-condensing gas-fired instantaneous water heaters to stay in the market, which could be realized by creating model lines that are either below 50,000 Btu/h in input or above 2 gallons in storage capacity. To remedy this, Bosch recommended DOE require condensing technology for all gas-fired instantaneous water heaters. (Bosch, No. 1204 at pp. 2–3)

By contrast, the CA IOUs stated that the proposed product sub-class with a rated volume of < 2 gallons and an input rating of ≤ 50,000 Btu/h is appropriate for point-of-use applications and that this subclass will not account for a significant amount of gas fired instantaneous water heater shipments. (CA IOUs, No. 1442 at pp. 2-3) Rheem suggested that DOE consider increasing the standards for gas-fired instantaneous water heaters < 2 gallons and less than or equal to 50,000 Btu/h of input to an efficiency that corresponds to removal of standing pilot lights, but not an efficiency that utilizes condensing technology. Rheem stated that gas-fired instantaneous water heaters under 50,000 Btu/h exist and have residential applications (*i.e.*, they are not exclusively marketed for recreational vehicles or as portable equipment). However, the commenter also wrote that these products are not a direct replacement for the condensing gas-fired instantaneous water heaters that would be required for input rates greater than 50,000 Btu/h, and thus generally supported the translated standards for these products. (Rheem, No. 1177 at p. 12)

DOE agrees that there may be a market for gas-fired instantaneous water heaters with less than 50,000 Btu/h of input based on the designs it has reviewed. Gas-fired instantaneous water heaters with less than 50,000 Btu/h of heat input are typically used in "point-of-use" applications (*e.g.*, affixed to a showerhead) because the heat input is generally not high enough to serve an entire house. Hence, DOE expects that shipments of these "point-of-use" tankless gas-fired instantaneous water heaters would not easily replace shipments of "whole-home" tankless gas-fired instantaneous water heaters with input rates higher than 50,000 Btu/h.

While DOE acknowledges that removing standing pilot lights would result in additional energy savings, DOE does not currently possess data supporting more stringent standards than those being established as part of this rulemaking. However, DOE may analyze the benefits and burdens of higher standards for these products at a later time. Further, after the compliance date of this final rule, the availability of UEF certification data for these products may inform a future analysis of more stringent standards in a future rulemaking.

In addition to Bosch and A.O. Smith, several other commenters raised concerns regarding non-condensing standards for larger gas-fired instantaneous water heaters—those with 2 or more gallons of storage volume.

Rheem commented that gas-fired instantaneous water heaters greater than or equal to 2 gallons of rated storage volume do not currently exist on the market because there is no need for them. (Rheem, No. 1177 at p. 13) Rheem stated that the ≥ 2 gallons and ≤ 200,000 Btu/h product category could be used to circumvent the condensing-level standards for < 2 gallon and > 50,000 Btu/h gas-fired instantaneous water heaters and recommended aligning the standards to the condensing levels (*e.g.*, change the intercepts in the standards equations for the > 2 gallon classes to match the amended standards for the < 2 gallon classes). (Rheem, No. 1177 at p. 13) Rheem reiterated these comments in response to the July 2024 NODA. (Rheem, No. 1436 at p. 3)

In response to the July 2024 NODA, the CA IOUs stated that manufacturers could produce gas fired instantaneous water heaters with a rated volume of ≥ 2 gallons and an input rating of ≤ 200,000 Btu/h that do not meet condensing standards. The CA IOUs expressed concern that this would allow manufacturers to avoid meeting condensing standards for all consumer gas fired instantaneous water heater offerings. The CA IOUs expressed concern that, because of the low cost to manufacturers of increasing the rated volume of existing non-condensing gas fired instantaneous water heaters to 2 gallons or higher, DOE's proposal could allow non-condensing products to remain in the market at lower prices than condensing products. The CA IOUs urged DOE to modify its proposed subclass definitions if it can do so in a timely manner and to immediately begin a new rulemaking to address its concerns should modifying product sub-classes present a significant delay to a final rule being issued for gas fired instantaneous water heaters (CA IOUs, No. 1442 at pp. 3-4). Specifically, the CA IOUs recommended that DOE expand the existing subclass to include all gas fired instantaneous water heaters with a volume less than 20 gallons and an input rating >50,000 Btu/h and ≤200,000 Btu/h. (CA IOUs, No. 1442 at pp. 3-4)

A.O. Smith claimed that, because some products ≥ 2 gallons and ≤ 200,000 Btu/h are used only in commercial applications, condensing-level standards are justified for these products, citing the conclusions of DOE's rulemaking for commercial water heaters. (A.O. Smith, No. 1440 at p. 4) A.O. Smith emphasized the importance of establishing condensing-level standards for all gas-fired instantaneous water heaters, noting that finalizing the proposed standard for this product class leaves open the opportunity for the entry of new products intended to circumvent both consumer condensing standards and commercial condensing standards effective in October 2026. (A.O. Smith, No. 1440 at p. 4) A.O. Smith stated that in this rulemaking, in contrast with the conversion factor rulemaking, DOE is evaluating whether more stringent standards for gas-fired instantaneous water heaters would be technologically feasible, economically justified, and result in significant energy savings and that in this context, DOE must consider the factors outlined in EPCA at 42 U.S.C. 6295(q) for establishing product classes and adjust the gas-instantaneous product classes accordingly. (A.O. Smith, No. 1440 at p.4)

A.O. Smith recommended that DOE expand the analyzed product class from < 2 gallons and > 50,000 Btu/h to < 5 gallons and > 50,000 Btu/h to ensure that condensing standards are not circumvented through minor design changes. (A.O. Smith, No. 1440 at p. 4) A.O. Smith claimed that a gas-fired instantaneous water heater with a 5-gallon storage volume would have negligible standby losses and a consistent UEF standard value could apply to the entire zero-to-five-gallon range. A.O. Smith noted that EPCA only established standby loss standards for commercial gas-fired instantaneous water heaters with a rated storage volume greater than 10 gallons, stating that this indicates that standby losses are not expected to be significant enough to warrant separate standards and separate product classes until 10 gallons of storage volume for commercial gas-fired instantaneous water heaters. A.O. Smith stated that this suggests that DOE expanding the storage capacity range up to 5 gallons for the gas-fired instantaneous consumer water heater product class under consideration for amended standards is appropriate. (A.O. Smith, No. 1440 at pp. 4-5)

In response to A.O. Smith, DOE notes that the most recent commercial water heaters rulemaking, which published in the *Federal Register* a final rule on October 6, 2023 (the "October 2023 Commercial Water Heaters Final Rule"), analyzed gas-fired instantaneous water heaters that are considered covered commercial equipment under EPCA. 88 FR 69686, 69706. Specifically, these commercial gas-fired instantaneous water heaters are defined at 10 CFR 431.102 as having a rated input above 200,000 Btu/h. *Id.* While the October 2023 Commercial Water Heaters Final Rule established condensing-level standards for commercial gas-fired instantaneous water heaters, the conclusions of that rulemaking would not necessarily apply to gas-fired instantaneous water heaters ≥ 2 gallons and ≤ 200,000 Btu/h because these are consumer water heaters and were not analyzed in that rulemaking.

Further, DOE understands that the recommendations to expand the applicability of the condensing-level standards to products with 2 or more gallons of storage may be based on an assumption that such a stringency increase would have minimal impact to the market. However, contrary to the comments from Rheem, Bosch, and A.O. Smith, DOE has identified several consumer gas-fired instantaneous water heaters on the market with 2 or more gallons, as discussed in section IV.A.1 of this document. Some of these models use non-condensing operation and would not comply with condensing-level standards at efficiency level 2. DOE does not currently possess data supporting more stringent standards for these products or how more stringent standards would affect the market share or consumers of these products. Lastly, DOE believes the size of larger, non-condensing gas-fired instantaneous water heaters may be a barrier for many consumers choosing between products with 2 or more gallons of storage and products with less than 2 gallons of storage. Many consumers who use gas-fired instantaneous water heaters with less than 2 gallons of storage do so because of how little space these units take up. As of this final rule, all of the gas-fired instantaneous water heaters certified to DOE have rated storage volumes of either 0 or 1 gallon— hence, the term "tankless" is often used to describe these products. A 2-gallon gas-fired instantaneous water heater would be much larger than a model with 0 or 1 gallon of storage. DOE compared the sizes of large (*i.e.*, stored volume ≥ 2 gallons) gas-fired instantaneous water heaters to the average sizes determined in the engineering analysis for products less than 2 gallons. For instance, based on product literature published by one manufacturer of large gas-fired instantaneous water heaters, its 2.3-gallon model and 3.5-gallon model are over twice as deep and significantly taller compared to a typical model on the market today.[46] Thus, it is unclear to what extent consumers would choose to install a gas-fired instantaneous water heater with stored volume ≥ 2 gallons over one with < 2 gallons.

In light of these considerations, DOE is maintaining the proposed separation of product classes for products without current UEF-based standards in this final rule as proposed in the July 2023 NOPR. DOE will continue to monitor the market for these

[46] For example, DOE reviewed the product dimensions of the HTP Crossover series, a product line of larger gas-fired instantaneous water heaters intended for residential wall-hung installations. Product dimensions can be found online at: *www.htproducts.com/literature/mktlit-118.pdf*. (Last accessed on August 28, 2024).

products and may address consider potential more-stringent standards for larger gas-fired instantaneous water heaters in a future rulemaking.

*D. Markups Analysis*

The markups analysis develops appropriate markups (*e.g.*, retailer markups, distributor markups, contractor markups) in the distribution chain and sales taxes to convert the MSP estimates derived in the engineering analysis to consumer prices, which are then used in the LCC and PBP analysis. At each step in the distribution channel, companies mark up the price of the product to cover business costs and profit margin.

As part of the analysis, DOE identifies key market participants and distribution channels. For consumer gas-fired instantaneous water heaters, the main parties in the distribution chain are (1) manufacturers, (2) wholesalers or distributors, (3) retailers, (4) plumbing contractors, (5) builders, (6) manufactured home manufacturers, and (7) manufactured home dealers/retailers. *See* chapter 6 and appendix 6A of the final rule TSD for a more detailed discussion about parties in the distribution chain.

For this final rule, DOE characterized how consumer gas-fired instantaneous water heater products pass from the manufacturer to residential and commercial consumers[47] by gathering data from several sources, including consultant reports (available in appendix 6A of the final rule TSD), the 2023 BRG report,[48] and the 2022

[47] DOE estimates that 6 percent of gas-fired instantaneous water heaters will be shipped to commercial applications in 2030.
[48] BRG Building Solutions, The North American Heating & Cooling Product Markets (2023 Edition). Available at *www.brgbuildingsolutions.com/reports-insights* (last accessed August 29, 2024).

Clear Seas Research Water Heater contractor survey[49] to determine the distribution channels and fraction of shipments going through each distribution channel. The distribution channels for replacement or new owners of consumer water heaters in residential applications (not including mobile homes) are characterized as follows:[50]

Manufacturer → Wholesaler → Plumbing Contractor → Consumer
Manufacturer → Retailer → Consumer
Manufacturer → Retailer → Plumbing Contractor → Consumer

For mobile home replacement or new owner applications, the same distribution channels are applicable for consumer gas-fired instantaneous water heaters.[51]

For consumer gas-fired instantaneous water heaters in commercial applications, DOE considers an additional distribution channel for which the manufacturer sells the equipment to the wholesaler and then to the consumer through a national account in both replacement and new construction markets.

The new construction distribution channel includes an additional link in the chain—the builder. The distribution channels for consumer gas-fired instantaneous water

[49] Clear Seas Research, 2022 Mechanical System - Water Heater. Available at *clearseasresearch.com/reports/industries/mechanical-systems/* (last accessed August 29, 2024).

[50] Based on available data, DOE assumed that for replacement or new owners in residential applications consumer gas-fired instantaneous water heaters go through the wholesaler/contractor 55 percent of the time, directly form the retailer 40 percent of the time, and through the retailer/contractor 5 percent of the time.

[51] Based on available data, DOE assumed that consumer gas-fired instantaneous water heaters in mobile homes go through the wholesaler/contractor 55 percent of the time, directly form the retailer 40 percent of the time, and though the retailer/contractor 5 percent of the time. The data indicate that gas-fired instantaneous water heaters are almost never sold directly through a mobile home retailer.

heaters in new construction[52] in residential applications (not including mobile homes) are characterized as follows:[53]

Manufacturer ➔ Wholesaler ➔ Plumbing Contractor ➔ Builder ➔ Consumer
Manufacturer ➔ Wholesaler ➔ Builder ➔ Consumer
Manufacturer ➔ Wholesaler (National Account) ➔ Consumer

DOE developed baseline and incremental markups for each actor in the distribution chain. Baseline markups are applied to the price of products with baseline efficiency, while incremental markups are applied to the difference in price between baseline and higher-efficiency models (the incremental cost increase). The incremental markup is typically less than the baseline markup and is designed to maintain similar per-unit operating profit before and after new or amended standards.[54]

To estimate average baseline and incremental markups, DOE relied on several sources, including: (1) form 10-K[55] from U.S. Securities and Exchange Commission ("SEC") for Home Depot, Lowe's, Wal-Mart, and Costco (for retailers); (2) U.S. Census Bureau 2017 Annual Retail Trade Report for miscellaneous store retailers (NAICS 453)

[52] DOE estimates that in the residential market 48 percent of gas-fired instantaneous water heaters will be shipped to new construction applications in 2030.
[53] DOE's analysis indicates that many builders are large enough to have a master plumber and not hire a separate contractor, and assigned approximately half of water heater shipments to new construction to this channel. DOE estimated that in the new construction market, 90 percent of the residential (not including mobile homes) and 80 percent in commercial applications goes through a wholesaler to builders channel and the rest go through national account distribution channel.
[54] Because the projected price of standards-compliant products is typically higher than the price of baseline products, using the same markup for the incremental cost and the baseline cost would result in higher per-unit operating profit. While such an outcome is possible, DOE maintains that in markets that are reasonably competitive it is unlikely that standards would lead to a sustainable increase in profitability in the long run.
[55] U.S. Securities and Exchange Commission. Company Filings. Available at *www.sec.gov/search-filings* (last accessed August 29, 2024).

(for online retailers).[56]; (3) U.S. Census Bureau 2017 Economic Census data.[57] on the residential and commercial building construction industry (for builder, plumbing contractor, mobile home manufacturer); and (4) the U.S. Census Bureau 2017 Annual Wholesale Trade Report data.[58] (for wholesalers). DOE assumes that the markups for national accounts is half of the value of wholesaler markups. In addition, DOE used the 2005 Air Conditioning Contractors of America's ("ACCA") Financial Analysis on the Heating, Ventilation, Air-Conditioning, and Refrigeration ("HVACR") contracting industry.[59] to disaggregate the mechanical contractor markups into replacement and new construction markets for consumer gas-fired instantaneous water heaters used in commercial applications.

*E. Energy Use Analysis*

The purpose of the energy use analysis is to determine the annual energy consumption of consumer gas-fired instantaneous water heaters at different efficiencies in representative U.S. single-family homes, mobile homes, multi-family residences, and commercial buildings, and to assess the energy savings potential of increased consumer gas-fired instantaneous water heater efficiency. The energy use analysis estimates the range of energy use of consumer gas-fired instantaneous water heaters in the field (*i.e.*, as

---

[56] U.S. Census Bureau, *2017 Annual Retail Trade Report*, available at *www.census.gov/programs-surveys/arts.html* (last accessed August 29, 2024). Note that the 2017 Annual Retail Trade Report was the latest version of the report that includes detailed operating expenses data at the time of the analysis.
[57] U.S. Census Bureau, *2017 Economic Census Data*. available at *www.census.gov/programs-surveys/economic-census.html* (last accessed August 29, 2024). Note that the 2017 Economic Census Data is the latest version of this data.
[58] U.S. Census Bureau, *2017 Annual Wholesale Trade Report*. available at *www.census.gov/wholesale/index.html* (last accessed August 29, 2024). Note that the 2017 AWTR Census Data is the latest version of the report that includes detailed operating expenses data.
[59] Air Conditioning Contractors of America ("ACCA"), *Financial Analysis for the HVACR Contracting Industry* (2005), available at *www.acca.org/store#/storefront* (last accessed August 29, 2024). Note that the 2005 Financial Analysis for the HVACR Contracting Industry is the latest version of the report and is only used to disaggregate the mechanical contractor markups into replacement and new construction markets.

they are actually used by consumers). The energy use analysis provides the basis for other analyses DOE performed, particularly assessments of the energy savings and the savings in consumer operating costs that could result from adoption of amended or new standards.

DOE estimated the annual energy consumption of consumer gas-fired instantaneous water heaters at specific energy efficiency levels across a range of climate zones, building characteristics, and water heating applications. The annual energy consumption includes the natural gas, liquid petroleum gas ("LPG"), and electricity used by the consumer gas-fired instantaneous water heater.

1. Building Sample

To determine the field energy use of consumer water heaters used in homes, DOE established a sample of households using consumer water heaters from EIA's 2015 Residential Energy Consumption Survey ("RECS 2015") in the July 2023 NOPR, which was the most recent such survey that was then fully available.[60] DOE selected the household sample based on the reported variables from RECS on water heating equipment type. The RECS data provide information on the vintage of the home, as well as water heating energy use in each household. These data reflect how water heaters are actually used by consumers. DOE used the household samples not only to determine water heater annual energy consumption, but also as the basis for conducting the LCC and PBP analyses. DOE projected household weights and household characteristics in

[60] Energy Information Administration ("EIA"), 2015 Residential Energy Consumption Survey ("RECS"). Available at *www.eia.gov/consumption/residential/* (last accessed August 29, 2024).

2030, the first year of compliance with any amended or new energy conservation standards for consumer water heaters. To characterize future new homes, DOE used a subset of homes in RECS that were built after 2000.

For this final rule, DOE incorporated RECS 2020 as the basis of the building sample development and updated the analyses accordingly.[61] Incorporating RECS 2020 improves the representativeness of the residential building sample as RECS 2020 brings a threefold increase in sample size compared to RECS 2015.[62] A larger sample size generally results in smaller standard errors, especially for estimates of smaller subpopulations. In this final rule, DOE maintains the same methodology in residential sample development as the July 2023 NOPR, using the updated RECS.

To determine the field energy use of consumer water heaters used in commercial buildings, DOE established a sample of buildings using consumer water heaters from EIA's 2018 Commercial Building Energy Consumption Survey ("CBECS 2018"), which is the most recent such survey that is currently fully available.[63] DOE has maintained its sample development methodology used in July 2023 NOPR for consumer gas-fired instantaneous water heaters used in commercial applications.

[61] Energy Information Administration ("EIA"), 2020 Residential Energy Consumption Survey ("RECS"). Available at *www.eia.gov/consumption/residential/* (last accessed August 29, 2024).
[62] According to published data and EIA website, RECS 2020 is based upon responses collected from in total 18,496 households which is three times greater than 5,686 respondents in RECS 2015.
[63] U.S. Department of Energy: Energy Information Administration, Commercial Buildings Energy Consumption Survey (2018). Available at: *www.eia.gov/consumption/commercial/data/2018/index.php?view=microdata* (last accessed August 29, 2024).

AGA *et al.* supported DOE's incorporation of EIA's 2020 RECS data in the July 2024 NODA. (AGA *et al.*, No. 1439 at p. 10)

2. Hot Water Use Determination

Based on the reported water heating energy use from RECS and CBECS, DOE estimated the hot water use for each sampled household and building. Then, in order to disaggregate the selected sampled gas-fired instantaneous water heaters into draw patterns, DOE used model data from DOE's public CCD[64] and AHRI certification directory[65] together with other publicly available data from manufacturers' catalogs of consumer water heaters. DOE also used a combination of confidential data provided by AHRI from 2004-2007[66] and shipments data from BRG Building Solutions 2023 report from 2007 to 2022.[67]

Responding to the July 2023 NOPR, AHRI recommended DOE explain its inputs in the energy use calculations. AHRI commented that DOE's use of nesting of various assumptions for residential water heaters leads to unlikely results that DOE does not, or cannot, explain. AHRI raised concerns on two oddities in the energy use calculations for gas-fired instantaneous water heaters. First, the water consumption for residential use as computed for the median RECS building is 41 gallons per day and the 95th highest use

[64] U.S. Department of Energy's Compliance Certification Database is available at *regulations.doe.gov/certification-data* (last accessed August 29, 2024).
[65] Air Conditioning Heating and Refrigeration Institute. Consumer's Directory of Certified Efficiency Ratings for Heating and Water Heating Equipment. December 1, 2023. (Available at *www.ahridirectory.org*) (last accessed August 29, 2024).
[66] AHRI. Confidential Instantaneous Gas-fired Water Heater Shipments Data from 2004-2007 to LBNL. December 1, 2023
[67] BRG Building Solutions. The North American Heating & Cooling Product Markets (2023 Edition). 2023.

(95th percentile) is 3.5 times as much (141 gallons per day) and the remaining 5 percent of RECS buildings use between 141 and 997 gallons per day, or up to 24 times as much water per day, an unlikely amount for a residential household. AHRI stated that this high usage rate for these 5-percent heavy users raises the average consumption to 61 gallons per day, or 50-percent more than the typical or median user. AHRI commented that presence and magnitude of these outlier 5-percent, heavy users raise serious questions about the accuracy and reliability of either (or both) the data that DOE used and/or the methodology it used to compute water consumption. Second, even assuming some market inefficiencies, AHRI claimed that there still should be a general trend towards RECS buildings with greater water use selecting more efficient water heaters absent standards. DOE contends that at least some purchasers make economically efficient choices. In that circumstance, the data should show a trend toward the highest-consuming RECS buildings appearing in the higher ELs absent standards. AHRI commented that this is not the case in the actual DOE data. Instead, if anything, the highest-consuming RECS buildings are assumed to purchase baseline water heaters. (AHRI, No. 1167 at p. 19) AHRI asked for an explanation of these outlier data points and asked how DOE validated its methodology to assure that these are accurate representations of real life. AHRI also asked why DOE has not accepted the suggestion by AHRI and others to use median, not the mean values for consumption and LCC savings to avoid the effects of these outliers and to alleviate, at least in part, the deficiencies of its base case efficiency assignment issue. (AHRI, No. 1167 at p. 20)

Gas Association Commenters argued that water consumption should be based on household size and that there are problems with water consumption calculations, particularly for gas-fired instantaneous water heaters. Gas Association Commenters argue that for gas-fired instantaneous water heaters, DOE models incorrect tankless water heater results (greater outliers than there are for storage unit equivalents) in regard to household size. Gas Association Commenters argue the model results in unrealistic outliers for smaller households reaching consumption levels equivalent to space heating. Gas Association Commenters argue that a potential reason for this failure is how the model calculates daily water usage. For example, Gas Association Commenters argued that in DOE's model, some single person households use 200-350 gallons a day which is far from reasonable (4-7 baths of water a day every day of the year). Gas Association Commenters argued that Draw Pattern ID is based on randomly assigned distribution. Gas Association Commenters state that DOE assumes that households will always use more water if they use an instantaneous unit. Gas Association Commenters argue that while for small storage units, there is a 5 percent chance of a large draw pattern but there is a 75 percent chance for instantaneous. Gas Association Commenters argued that if consumption behavior was more consistent between the gas storage water heaters and gas-fired instantaneous water heaters, LCC savings would be lower. Gas Association Commenters argues that a better solution would be to use the test procedure for water heaters as a basis for modeling energy usage rather than assuming draw rates based on the size of the original equipment in RECS. Gas Association Commenters suggested that alternately, gas-fired instantaneous water heaters could just have the same assumptions about water usage as their gas storage water heaters counterparts. (Gas Association Commenters, No. 1181 at pp. 25-31) Similarly, in response to the July 2024 NODA, Rinnai stated that the energy use estimates in the energy conservation standard should use the same standardized draw patterns outlined in the UEF test method rather than relying on RECS, which the commenters characterized as unreliable. Rinnai recommended that the Department use the hot water draw patterns from the UEF test method as the basis for comparing efficiency proposals and reserve the RECS hot water consumption data for estimating national energy savings potential and other downstream impacts. (Rinnai, No. 1443 at p. 20)

In response, DOE notes that RECS and CBECS data provide the information on the household size and water heating energy use in buildings. RECS and CBECS are the most comprehensive, nationally-representative, and robust data source on actual household and commercial building energy consumption available to DOE. In general, DOE has found that the weighted average energy use for water heating correlates with the size of the household, *i.e.*, the reported number of people in that household. Greater energy expenditure on water heating largely falls into the bins of households of larger sizes (4 people and above). The hot water use derived based on the water heating energy use follows similar pattern (see chapter 7 of the final rule TSD for the calculation of hot water use). In terms of AHRI and Gas Association Commenters' concern over the heavy users of hot water in the sample, when reporting the distribution of the derived hot water use, DOE takes into account both consumer water heaters used in residential as well as commercial applications. In the final rule analysis, DOE estimated that close to 40 percent of the top 5 percent of water-consuming sample buildings/households are commercial applications which generally have higher upper bound of hot water use. These outlier data points therefore represent either data directly reported from RECS or CBECS for larger households or commercial applications using consumer water heaters, both of which represent real-world usage. In addition, DOE evaluates each sampled building/household individually by calculating its hot water use and the corresponding cost efficiency thereafter such that the average LCC savings as reported is a good representation of the aggregated national values. Nevertheless, the LCC spreadsheet includes a calculation of median LCC savings, as well as LCC savings at various percentiles. These results are publicly available. Even if DOE were to rely on the median LCC savings instead of the mean LCC savings, DOE's conclusion of economic justification would remain the same.[68]

For this final rule, DOE incorporated the latest RECS 2020 data for its analyses. With the increased sample size and the most recent timeline of the fielding of the survey, RECS 2020 provides a large sample pool with current national representation of housing characteristics and energy consumption. Specifically, for gas-fired instantaneous water heaters, which historically have had a lower market share relative to the gas storage type, RECS 2020 reports over 800 sample households utilizing a gas-fired instantaneous water heater. As discussed previously, the weighted average of the energy use on water heating and the derived hot water use generally correlates with the size of the household with deviations that represent the real world complexities of the use of a hot water heater in households of different types. With the update to RECS 2020, for example, the estimate for the hot water use in a single-person household is now between 7 and 91 gallons for gas-fired instantaneous water heaters, with a weighted average of 32 gallons. The average hot water use across all household sizes is 73 gallons, relatively stable compared to 71 gallons DOE estimated with RECS 2015 in the July 2023 NOPR. DOE continues

[68] See LCC analytical tool spreadsheet for gas-fired instantaneous water heater final rule:

to rely on RECS as the basis of its analyses for its incomparable scope of coverage on housing characteristics and energy consumption. RECS 2020 is a reflection of the real-world usage in the national water heater market. In terms of the assignment of draw pattern for gas-fired instantaneous water heaters, DOE derived the distribution of different draw patterns based on market research of the number of models in each bin that are available on the market. The breakdown can be found in chapter 7 of the final rule TSD.

### 3. Energy Use Determination

To calculate the energy use of consumer water heaters, DOE determined the energy consumption associated with water heating and any auxiliary electrical use. DOE calculated the energy use of water heaters using a simplified energy equation, the water heater analysis model ("WHAM"). WHAM accounts for a range of operating conditions and energy efficiency characteristics of water heaters. The current version of WHAM is most appropriate for calculating the energy use of electric resistance storage water heaters. To account for the characteristics of consumer gas-fired instantaneous water heaters, energy use must be calculated using modified versions of the WHAM equation. For gas-fired instantaneous water heaters, the water heater operating conditions are indicated by the daily hot water draw volume, inlet water temperature, and thermostat setting. To describe energy efficiency characteristics of water heaters, WHAM also uses parameters in the DOE test procedure including recovery efficiency ("*RE*") and rated input power ("$P_{ON}$"). These modified versions are further discussed in chapter 7 and appendix 7B of the final rule TSD.

The daily hot water draw volume is estimated based on the gas-fired instantaneous water heater energy use from RECS 2020 and CBECS 2018. The inlet water temperature is based on weather station temperature data and RECS 2020 ground water temperature data for each household. The consumer gas-fired instantaneous water heater thermostat setting is based on multiple sources including contractor survey data and field data.

AGA *et al.* stated that electricity consumption should be slightly higher for all units installed in unconditioned spaces in the winter that are exposed to freezing temperatures because of freeze protection. (AGA *et al.*, No. 1439 at p. 7) Similarly, Rinnai noted that the absence of freeze protection in the model doesn't adequately account for seasonal variation in electricity use and higher consumption for all units in unconditioned spaces during winter. (Rinnai, No. 1443 at p.18) In response, DOE acknowledges that freeze protection is an integrated feature in many tankless water heaters. A freeze protection electric heater will activate to protect the internal of the water heater from freezing when it reaches certain ambient temperatures. Power consumption varies slightly by models but generally is up to 200 Watts during freeze protection mode. DOE's energy use analysis is aimed to evaluate the electricity and fuel consumption associated with water heating, where the electricity use covers the burner operating mode and standby mode, and then compare the energy consumed by models at various analyzed efficiency levels. Taking into consideration the electricity consumption associated with freeze protection mode not only will have trivial impact to the total annual electricity use results, given the negligible fraction of time the water heater being in such mode throughout the year, but also will be inconsequential to the electricity use differential between different efficiency levels.  Therefore, for this final rule DOE maintained its energy use analysis method without taking into account electricity use from freeze protection operation.

Gas Association Commenters commented that there is a bug in the LCC tool that causes it to use only a single year of weather data rather than 10-year average, which they believe impacts gas-fired instantaneous water heater results. (Gas Association Commenters, No. 1181 at p. 34)  In response, DOE notes that the analysis uses the NOAA's 30 year average weather data for the outside air temperature.

Chapter 7 of the final rule TSD provides details on DOE's energy use analysis for consumer gas-fired instantaneous water heaters.

*F. Life-Cycle Cost and Payback Period Analysis*

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

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

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

For any given efficiency level, DOE measures the change in LCC relative to the LCC in the no-new-standards case, which reflects the estimated efficiency distribution of consumer gas-fired instantaneous water heaters in the absence of new or amended energy conservation standards. In contrast, the PBP for a given efficiency level is measured relative to the baseline product.

For each considered efficiency level, DOE calculated the LCC and PBP for a nationally representative set of housing units and commercial buildings. As stated previously, DOE developed household samples from the RECS 2020 and CBECS 2018. For each sample household and commercial building, DOE determined the energy consumption for the consumer gas-fired instantaneous water heaters and the appropriate energy price. By developing a representative sample of households and commercial buildings, the analysis captured the variability in energy consumption and energy prices associated with the use of consumer gas-fired instantaneous water heaters.

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

The computer model DOE uses to calculate the LCC relies on a Monte Carlo simulation to incorporate uncertainty and variability into the analysis. The Monte Carlo simulations sample input values from constrained probability distributions based on available data and consumer water heater user samples. For this rulemaking, the Monte Carlo approach is implemented in MS Excel together with the Crystal Ball™ add-on.[69] The model calculated the LCC for products at each efficiency level for 10,000 gas-fired instantaneous water heater installations in housing and commercial building units per simulation run. The analytical results include a distribution of 10,000 data points showing the range of LCC savings for a given efficiency level relative to the no-new-standards case efficiency distribution (as shown in chapter 8 of the final rule TSD). In performing an iteration of the Monte Carlo simulation for a given consumer, product

[69] Crystal Ball™ is commercially-available software tool to facilitate the creation of these types of models by generating probability distributions and summarizing results within Excel, available at *www.oracle.com/technetwork/middleware/crystalball/overview/index.html* (last accessed August 29, 2024).

efficiency is chosen based on its probability. At the high end of the range, if the chosen product efficiency is greater than or equal to the efficiency of the standard level under consideration, the LCC calculation reveals that the hypothetical consumer represented by that data point is not impacted by the standard level because that consumer is already purchasing a more-efficient product. At the low end of the range, if the chosen product efficiency is less than the efficiency of the standard level under consideration, the LCC calculation reveals that the hypothetical consumer represented by that data point is impacted by the standard level. By accounting for consumers who are already projected to purchase more-efficient products, DOE avoids overstating the potential benefits from increasing product efficiency.

DOE calculated the LCC and PBP for consumers of consumer gas-fired instantaneous water heaters as if each were to purchase a new product in the first year of required compliance with new or amended standards. New and amended standards apply to consumer water heaters manufactured 5 years after the date on which any new or amended standard is published. (42 U.S.C. 6295(m)(4)(A)(ii)) Therefore, DOE used 2030 as the first full year of compliance with any amended standards for consumer gas-fired instantaneous water heaters.

Table IV.10 summarizes the approach and data DOE used to derive inputs to the LCC and PBP calculations. The subsections that follow provide further discussion. Details of the spreadsheet model, and of all the inputs to the LCC and PBP analyses, are contained in chapter 8 of the final rule TSD and its appendices.

**Table IV.1010 Summary of Inputs and Methods for the LCC and PBP Analysis***

| Inputs | Source/Method |
|---|---|
| Product Cost | Derived by multiplying MPCs by manufacturer and distribution chain markups and sales tax, as appropriate. Used historical data to derive a price scaling index to project future product costs. |
| Installation Costs | Determined with labor and material cost data from RSMeans. |
| Annual Energy Use | Including fuel use and electricity use.<br>Variability: Based on the RECS 2020 and CBECS 2018. |
| Energy Prices | Natural Gas: Based on EIA's Natural Gas Navigator data for 2022.<br>Electricity: Based on EIA's Form 861 data for 2022.<br>Propane: Based on EIA's State Energy Data System ("SEDS") for 2021.<br>Variability: Regional energy prices determined for 50 states and District of Columbia for residential and commercial applications.<br>Marginal prices used for natural gas and electricity prices. |
| Energy Price Trends | Based on *AEO2023* price projections. |
| Repair and Maintenance Costs | Based on RSMeans data and other sources. Assumed variation in cost by efficiency. |
| Product Lifetime | Based on shipments data, multi-year RECS, American Housing Survey, American Home Comfort Survey data. |
| Discount Rates | Residential: approach involves identifying all possible debt or asset classes that might be used to purchase the considered appliances, or might be affected indirectly. Primary data source was the Federal Reserve Board's Survey of Consumer Finances.<br>Commercial: Calculated as the weighted average cost of capital. Primary data source was Damodaran Online. |
| Compliance Date | 2030 |

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

1. Product Cost

To calculate consumer product costs, DOE multiplied the total manufacturer price, which is MSPs developed in the engineering analysis plus shipping cost, by the markups described previously (along with sales taxes). DOE used different markups for baseline products and higher-efficiency products, because DOE applies an incremental markup to the increase in total manufacturer price associated with higher-efficiency products.

Examination of historical price data for certain appliances and equipment that have been subject to energy conservation standards indicates that the assumption of constant real prices may, in many cases, overestimate long-term trends in appliance and equipment prices. Economic literature and historical data suggest that the real costs of these products may in fact trend downward over time according to “learning” or “experience” curves.[70]

In the experience curve method, the real cost of production is related to the cumulative production or “experience” with a manufactured product. This experience is usually measured in terms of cumulative production. As experience (production) accumulates, the cost of producing the next unit decreases. The percentage reduction in cost that occurs with each doubling of cumulative production is known as the learning rate. In typical experience curve formulations, the learning rate parameter is derived using two historical data series: cumulative production and price (or cost). DOE obtained historical PPI data for water heating equipment from 1967-1973 and 1977-2022 for all other consumer water heaters from the U.S. Bureau of Labor Statistics’ (“BLS”).[71] The PPI data reflect nominal prices, adjusted for product quality changes. An inflation-adjusted (deflated) price index for heating equipment manufacturing was calculated by dividing the PPI series by the implicit price deflator for Gross Domestic Product Chained Price Index.

From 1967 to 2002, the deflated price index for consumer gas-fired instantaneous water heaters was mostly decreasing, or staying flat. Since then, the index has risen, primarily due to rising prices of copper, aluminum, and steel products which are the

[70] Desroches, L.-B., K. Garbesi, C. Kantner, R. Van Buskirk, and H.-C. Yang. Incorporating Experience Curves in Appliance Standards Analysis. *Energy Policy*. 2013. 52 pp. 402–416; Weiss, M., M. Junginger, M. K. Patel, and K. Blok. A Review of Experience Curve Analyses for Energy Demand Technologies. *Technological Forecasting and Social Change*. 2010. 77(3): pp. 411–428.
[71] Series ID PCU 33522033522083; see *www.bls.gov/ppi/*.

major raw material used in water heating equipment. The rising prices for copper and steel products were attributed to a series of global events, from strong demand from China and other emerging economies to the recent severe delay in commodity shipping due to the COVID-19 pandemic. Given the slowdown in global economic activity in recent years and the lingering impact from the global pandemic, DOE believes that the extent to which the trends of the past five years will continue is very uncertain. DOE also assumes that any current supply chain constraints are short-lived and will not persist to the first year of compliance. Given the uncertainty regarding the magnitude and direction of potential future price trends, DOE decided to use constant prices as the default price assumption to project future consumer gas-fired instantaneous water heater prices. Thus, projected prices for the LCC and PBP analysis are equal to the 2023 values for each efficiency level in each product class. However, DOE performed a sensitivity analysis utilizing both a decreasing and an increasing price trend (see appendix 8C). The relative comparison of potential standard levels remains the same regardless of which price trend is utilized and the conclusions of the analysis do not change.

BWC requested that DOE detail its methods in utilizing price learning curves for condensing gas products, as was indicated in Section IV(F)(1) of the July 2023 NOPR, so that stakeholders may review them. BWC suggested the additional components required to manufacture higher efficiency products required by this proposal, in addition to their more complex manufacturing processes, will continue to compel higher product costs than is currently expected of non-condensing gas water heaters common in the market today, economies of scale notwithstanding. (BWC No. 1164 at p. 17) The available data only allow estimation of price trends for water heaters as a group, not for different efficiency levels of water heaters. DOE agrees that the product costs of condensing gas products will continue to be higher than non-condensing gas water heaters. However, it is reasonable to expect that factors affecting water heaters as a whole, such as growing experience in production or changes in commodity prices, will affect all water heaters. Thus, for this final rule, DOE maintained that same methodology as the July 2023 NOPR and assumed the same price trend assumptions would apply to all gas-fired instantaneous water heater efficiency levels. To assess the impact of alternative price learning assumptions, DOE analyzed scenarios using low- and high-price trends in the LCC. From this sensitivity analysis, DOE finds that LCC savings for alternative price trends are similar to the reference case results and DOE would arrive at the same policy conclusion. *See* appendix 8C for details.

Responding to the July 2023 NOPR, Ecotemp stated that non-condensing tankless water heaters typically cost half the price of comparable condensing tankless water heaters. (Ecotemp, No. 1092 at p. 1) Rinnai argued that the marginal price for non-condensing to condensing gas-fired instantaneous water heater prices are too low and should be $450 rather than the $310 calculated by DOE. (Rinnai, No. 1186 at p. 24) Rinnai claimed DOE's installed cost differential of $200 between non-condensing and condensing is too low and based on data collected from installers and distributors the value is closer to $665. (Rinnai, No. 1443 at p. 19)

To investigate stakeholder concerns, DOE reviewed present-day retail prices for non-condensing and condensing models for this final rule. Overall, DOE determined that comparable non-condensing and condensing gas-fired instantaneous water heater models can retail for similar prices, with condensing models priced competitively at 1.2-1.3 times the retail price of non-condensing models. In this final rule LCC analysis, DOE estimates average retail prices of gas-fired instantaneous water heaters at condensing efficiency levels are 1.30-1.42 times that of the baseline non-condensing gas-fired instantaneous water heater corresponding to incremental retail price of $294 to $414. DOE notes that gas-fired instantaneous water heaters are marked up differently per distribution channels, as discussed in section IV.D, and that the incremental in retail prices between any given condensing and non-condensing models can be higher or lower than the reported values above. DOE's analysis calculated weighted averages taking into account both the markup associated with individual distribution channels and the probability of water heaters sold to customers through each channel. In response to Rinnai's comment on installed cost, which is the sum of retail price and installation cost, DOE estimated that the differential between non-condensing and condensing slightly lowered to between $217 and $337. This is due to average installation cost for condensing gas-fired instantaneous water heaters being slightly lower than that for non-condensing baseline. *See* section IV.F.2 for more details in the calculation of installation cost.

Rheem believes that incremental retail costs between step and fully modulating designs is about 50 percent too low. (Rheem, No. 1436 at p. 3; Rheem, No. 1177 at p.12)

In response, DOE revised the manufacturer production cost for EL 4 for the final rule such that retail price estimates for max-tech designs, which incorporate fully modulating burners, have increased in this final rule analysis. The incremental retail price between step modulating burner and fully modulating burner gas-fired instantaneous water heaters, taking EL 2 and EL 4 as an example, is $106, increasing from $56 (in 2022$) in the July 2024 NODA (see section IV.C.1.c for more details).

2. Installation Cost

The installation cost is the cost to the consumer of installing the consumer gas-fired instantaneous water heater, in addition to the cost of the water heater itself. The cost of installation covers all labor, overhead, and material costs associated with the replacement of an existing water heater or the installation of a water heater in a new home, as well as delivery of the new water heater, removal of the existing water heater, and any applicable permit fees. Higher-efficiency water heaters may require consumers to incur additional installation costs.

DOE's analysis of installation costs estimated specific installation costs for each sample household based on building characteristics given in RECS 2020 and CBECS 2018. For this final rule, DOE used 2023 RSMeans data for the installation cost estimates, including labor costs.[72,73,74,75] DOE's analysis of installation costs accounted for regional differences in labor costs by aggregating city-level labor rates from RSMeans into 50 U.S. States and the District of Columbia to match RECS 2020 data and CBECS 2018 data.

AHRI stated that replacement costs are not uniform across the country and vary by regional labor rates, building codes, and availability of skilled installers. AHRI believes that this variability should be factored in each state when assessing economic

---

[72] RSMeans Company Inc., *RSMeans Mechanical Cost Data*. Kingston, MA (2023) (Available at: *www.rsmeans.com/products/books/2022-cost-data-books*) (Last accessed August 29, 2024).
[73] RSMeans Company Inc., *RSMeans Residential Repair & Remodeling Cost Data. Kingston,* MA (2023) (Available at: *www.rsmeans.com/products/books/2022-cost-data-books*) (Last accessed August 29, 2024).
[74] RSMeans Company Inc., *RSMeans Plumbing Cost Data*. Kingston, MA (2023) (Available at: *www.rsmeans.com/products/books/2022-cost-data-books*) (Last accessed August 29, 2024).
[75] RSMeans Company Inc., *RSMeans Electrical Cost Data*. Kingston, MA (2023) (Available at: *www.rsmeans.com/products/books/2022-cost-data-books*) (Last accessed August 29, 2024).

impacts. (AHRI, No. 1437 at p. 3) In response, as stated above, DOE has accounted for the regional difference in labor rates by incorporating regional labor cost factors derived from RSMeans. DOE believes that, therefore, variability in state level labor costs is factored in in its analysis.

a. Basic Installation Costs

First, DOE estimated basic installation costs that are applicable to all consumer gas-fired instantaneous water heaters, in replacement, new owner, and new home or building installations. These costs include putting in place and setting up the consumer water heater, gas piping and/or electrical hookup, permits, water piping, removal of the existing consumer water heater, and removal or disposal fees.

AGA *et al.* stated that DOE's final Furnaces rule and pending Boilers rule show that market shares for condensing and non-condensing units vary significantly across different climates, which they believed is likely true for gas-fired instantaneous water heaters suggesting that different climates and household characteristics could heavily influence not only the type of products installed but also the required venting parts to ensure safe and effective operation. (AGA *et al.*, No. 1439 at p. 7) In response to AGA *et al.*'s comment, it is true that space heating products typically have some regionalities, which is mainly driven by the varying heating needs across different climate zones. For water heating equipment like gas-fired instantaneous water heater, however, DOE has not found, nor have stakeholders pointed to, any data showing that there would be a similar level of impact of the climate on market adoption. In terms of the required venting parts, DOE calculated the costs for venting based on the vent material suggested by manufacturers and code.

b. Venting Costs

After accounting for the basic costs for removing the old water heater and setting up the new, DOE considered the installation costs associated with venting. Non-condensing gas-fired instantaneous water heaters are Category III appliances that operate under positive pressure. They require stainless steel vent material. Condensing gas-fired instantaneous water heaters are Category IV appliance that can be vented through a PVC, CPVC, or polypropylene vent material. In its analysis, DOE accounted for the cost for setting up the vent pipes, vent elbows, and terminations of the appropriate material and the air intake pipe for those that are direct vented (i.e. combustion air is brought in from outdoors).

DOE received comments after the publication of July 2023 NOPR and July 2024 NODA regarding the use of concentric vent, vent length, and outdoor installations.

In response to July 2023 NOPR, Rinnai stated the Department’s estimated venting costs of $499 for non-condensing gas-fired instantaneous water heater and $263 for condensing gas-fired instantaneous water heater overstate the cost differential, if any even exists. (Rinnai, No. 1186 at p. 24) Rinnai stated that most non-condensing gas-fired instantaneous water heaters require 3” diameter venting and not 4” diameter venting as is used in the analysis, leading to 25 percent reduction in the cost of venting materials. Rinnai stated that more than 75 percent of non-condensing models do not use stainless steel venting and instead use concentric and aluminum venting. Rinnai stated that 20ft of venting and associated fittings used in the LCC analysis needs to be subjected to additional sensitivity analysis, including the variation in installed vent lengths, materials used, concentric versus single wall vents, and product installation location. Rinnai stated that tankless water heaters are installed typically on an outside wall, which would require far less than 20 feet of venting, and for outdoor installations, no venting would be required. (Rinnai, No. 1186 at p. 24)

In response to July 2024 NODA, Rinnai claimed that the analysis overlooks that gas-fired instantaneous water heater installation uses a different pipe installation from furnaces that is cheaper and significantly shorter than vertical venting. Rinnai stated that they account for half of sales for non-condensing gas-fired instantaneous water heater units and those units use aluminum/plastic concentric venting and have on average 1-2 feet of venting because they are mostly installed outside or on outside walls (e.g., garages). Rinnai claimed that DOE's estimate for venting components is overestimated compared to costs found on retailer websites ($131 vs $85). (Rinnai, No. 1443 at pp. 14-15) BWC disagreed with DOE considering a 1 ft. minimum vent length as part of their analysis for this July 2024 NODA. They commented that while it may be true that some manufacturers of gas-fired instantaneous water heaters indicate this vent length is possible in their literature, according to their experience this is rarely. (BWC, No. 1441 at p. 3)

Rinnai claimed DOE's model makes unjustified assumptions on the gas-fired instantaneous water heater installation location. Rinnai claimed that the July 2024 NODA only estimates 12 percent of gas-fired instantaneous water heaters installed outdoors which is much lower than the value inferred from RECS 2020 which reports half of households install their water heater in an “outdoor closet, crawlspace, or outdoor”. Rinnai stated their data indicate 23 percent of gas-fired instantaneous water heaters are installed outdoors. Rinnai further stated that their data show that an additional 55 percent of gas-fired instantaneous water heater installations are likely to be located close to outside walls in order to minimize venting. (Rinnai, No. 1443 at p.18)

Rheem believed that only 20 percent of condensing units would be installed with concentric venting due to lower relative costs of plastic venting and wall/roof penetrations. Rheem estimated that up to 50 percent of non-condensing units are installed outdoors in new construction where non-condensing is more common. Rheem estimated that about 40 percent of outdoor installations use recess boxes or pipe covers (split evenly between the two). Rheem estimated that 7 percent of condensing units are installed outdoors and expects that number to rise if energy conservation standards are amended. (Rheem, No. 1436 at p. 2-3)

A.O. Smith and BWC commented that they found DOE’s estimate of 50 percent of condensing gas-fired instantaneous water heaters using concentric vent to be high. BWC did not provide a percentage that they believe is reasonable. A.O. Smith commented that they would estimate only 20 percent of condensing gas-fired instantaneous water heaters use a concentric pipe. (A.O. Smith, No. 1440 at p. 6; BWC, No. 1441 at p. 3)

BWC stated that DOE underestimated the installed costs for gas-fired instantaneous water heaters in the July 2024 NODA when assuming half of these products installed outdoors, in outdoor closets, or crawlspaces, would not require venting. BWC countered that the need for venting in these install locations is not uncommon, particularly in crawlspaces, which are often located within the building envelope. BWC added that some outdoor units require use of a special vent kit, or a box that would protect product controls from inclement weather, both of which would add to the installed cost of the product. (BWC, No. 1441 at p. 3)

In response, for the July 2024 NODA, DOE made further improvements to its methodology used in the July 2023 NOPR to account for the venting costs for gas-fired instantaneous water heaters. First, DOE took into account the use of a concentric pipe (a pipe used for both air intake and venting) for some installations in its analysis, which was not previously included in the NOPR analysis. There are two main vent configurations for gas-fired instantaneous water heaters – (1) single pipe for venting with room air intake or two pipes with one for outdoor air intake and one for venting; (2) concentric pipe for both air intake and venting. DOE estimated that 90 percent of the non-condensing and 50 percent of the condensing gas-fired instantaneous water heaters that would be direct vented would use concentric pipes for the benefit of only having to make one wall penetration. Among all installations, these updates result in approximately 22 percent of condensing gas-fired instantaneous water heaters and 41 percent of non-condensing gas-fired instantaneous water heaters being installed with a concentric vent. In terms of its impact to the total installation costs, because a single concentric pipe is cheaper to install than two separate pipes (one for air intake and one for venting) this installation scenario reduced overall installation costs, particularly for non-condensing gas-fired instantaneous water heaters. Additionally, because metal venting for non-condensing water heaters is more expensive per foot than plastic venting for condensing water heaters, updates to the analysis that decrease the length of total venting required for some installations will lower the LCC savings when replacing a non-condensing gas-fired instantaneous water heater with a condensing gas-fired instantaneous water heater for these installations. For this final rule, DOE maintained the methodology used in July 2024 NODA.

Second, DOE adjusted its methodology of estimating the minimum length of the vent run in the July 2024 NODA. In the July 2023 NOPR, DOE calculated the minimum vent length based on housing configuration and installation location and estimated that the shortest route to vent a gas-fired instantaneous water heater is 3 ft. DOE conducted further research of product literature and concluded that for many installations a shorter vent run could be achieved, primarily by venting through a side wall. Therefore, DOE recalibrated its methodology and estimated that the minimum vent length can be as low as 1 ft for a certain subset of installations.

Lastly, in the July 2023 NOPR, DOE did not account for the outdoor installation of gas-fired tankless water heaters. In the July 2024 NODA, DOE utilized the location information from RECS 2020 and assumed that half of the residential households that report their water heaters being installed in an "outdoor closet, crawlspace, or outdoor" would actually install the tankless water heater on the outside of a wall without venting. Therefore, DOE estimated that among the entire sample, about 12 percent of gas-fired instantaneous water heaters are installed outdoors. For the outdoor installations, DOE assumed no venting costs but a cost for an outdoor installation conversion kit or box needed to protect the water heater from weather impacts. As with lowering the minimum vent length above, this update to the analysis reduces LCC savings when replacing a non-condensing gas-fired instantaneous water heater with a condensing gas-fired instantaneous water heater for these installations.

Rinnai asserted that the vent cost distributions used in the July 2024 NODA are skewed with the average vent cost for non-condensing units being higher than the average for condensing units. Additionally, Rinnai noted that for EL 0, the vent cost distribution has a border spread of higher costs relative to EL1-3 which have a gradual taper with more concentration in lower cost brackets. Rinnai claimed that, on average, the two types of venting installations are not significantly different, though noted that there is a small increase for non-condensing units due to the venting materials used. (Rinnai, No. 1443 at pp.15-16) Rinnai pointed to a particular simulation case in which the venting cost for EL 0 is $841 and the venting cost at higher ELs is $83 and noted that this variation is not supported by typical data and affect the accuracy of the July 2024 NODA's economic assessments. (Rinnai, No. 1443 at p. 16)

In response, the difference between the venting costs for non-condensing and condensing gas-fired instantaneous water heaters depends largely on the vent configuration (type of vent pipe and vent length). As indicated by Rinnai, the non-condensing units generally have higher installation cost because of the more expensive vent material required. For this final rule, after accounting for concentric pipes, shorter vent lengths, and outdoor installations, as elaborated above, DOE noted a decrease in the differential in installation cost between non-condensing and condensing. The installation cost for non-condensing gas-fired instantaneous water heaters is 7 percent higher than the condensing, instead of 10 percent higher compared to the July 2023 NOPR. For this final rule analysis, DOE estimated an average installation cost of $1,102 for non-condensing units and $1,025 for condensing units. Further details regarding installation cost methodology can be found in chapter 8 and appendix 8D of the final rule TSD.

PHCC commented that DOE did not mention additional installation costs for vertical vents. PHCC commented that in most vertical instances, the installation will require walls to be opened for vent removal, new vents and supports installed, and the finished surfaces replaced and it appears that DOE did not consider these costs. (PHCC, No. 1151 at p. 3) In response, DOE determined that for a fraction of replacement installations of gas tankless water heater in an indoor closet, the household may opt to conceal the vent pipe that passes through the living space. For the length of the concealing needed, DOE determined that for most household configurations, when concealing is needed, typically the horizontal vent is more likely to pass through living space. Vertical run is more likely to be installed by the plumber where it is enclosed and outside of living space.

In response to July 2024 NODA, AGA *et al.* and Rinnai claimed that DOE had applied the same installation cost and venting assumptions from gas furnaces to gas-fired instantaneous water heaters which led to overestimation of both labor hours and material costs. They noted that Category I furnaces operate under negative pressure and are mainly vented vertically with substantially longer venting systems, which does not reflect the typical venting of a gas-fired instantaneous water heater. (AGA *et al.*, No. 1439 at pp. 3-5 and p. 6; Rinnai, No. 1443 at pp. 11-14) AGA *et al.* and Rinnai claimed that in the model 100 percent of installations were assumed to use stainless steel parts with associated high labor costs due to the complexity of vertical installations and that the model failed to account for the fact that gas-fired instantaneous water heaters do not universally require such extensive venting solutions. They later acknowledged that DOE's model had identified 86 percent of installations as horizontal but still believed that the percentage of vertical installations was overestimated. Additionally, they stated that the average horizontal system requires less than 7 feet of venting and follows a straightforward work plan like that of a condensing unit, and that DOE's model applied the same labor costs to horizontal installations as it does to vertical, which resulted in an overestimation. Rinnai also echoed this comment. (AGA *et al.*, No. 1439 at pp. 3-5 and p. 6; Rinnai, No. 1143, at p. 13)

AGA *et al.* claimed that while DOE's model includes cost data for alternative materials like double-walled aluminum flex pipe, which is approximately half the cost of stainless steel, these alternatives were not applied in any of the 10,000 trials, which led to inflated installation cost estimates for gas-fired instantaneous water heaters. (AGA *et al.*, No. 1439 at p. 4) Similarly, Rinnai commented that the July 2024 NODA model incorrectly assumed that stainless-steel pipes are used in all 10,000 trials with the end result being venting costs are significantly overstated. Furthermore, both AGA et al. and Rinnai stated that an additional markup of 39 percent is applied to metal venting which further widens the gap in installation cost between EL 0 and higher efficiency levels. (AGA *et al.*, No. 1439 at p. 5; Rinnai, No. 1443 at pp. 14-15)

In response, DOE believes that commenters have misinterpreted documentation in July 2023 NOPR TSD and the July 2024 NODA analytical tool. As discussed above, non-condensing gas-fired instantaneous water heaters are Category III appliance that operates under positive pressure requiring stainless steel vent material. Condensing gas-fired instantaneous water heaters are Category IV appliance that can be vented through a PVC, CPVC, or polypropylene vent material. DOE did not assume the same venting for gas-fired instantaneous water heaters as for furnaces. DOE also did not assume 100 percent of non-condensing gas-fired instantaneous water heater installations to be using stainless steel vent pipe. To further clarify, for the 41 percent of non-condensing gas-fired instantaneous water heater installations that are assumed to be using a concentric pipe, DOE applied the material cost estimated based on market research of aluminum/PVC concentric pipe which is the most affordable option on the market. In its analytical tool, a conversion factor of 1.33 was applied to convert the material price data for a regular 4” stainless steel vent to that of a concentric pipe for simplicity. Note that the conversion factor changed slightly from 1.39 in July 2024 NODA because of the update from 2022$ to 2023$.

Rinnai claimed that in the July 2024 NODA, DOE ignored the replacement market where consumers already using a non-condensing gas-fired instantaneous water heaters will have no venting cost with a like-for-like replacement. (Rinnai, No. 1443 at p.18) In response, DOE believes that it is unlikely for a new gas-fired instantaneous water heater to be compatible with the old vent of a unit being replaced, even if both water heaters fall under the same vent category. According to product literature, many models recommend installation with vent pipes from a suggested list of specific brands. Even if the new non-condensing water heater is from the same manufacturer, the model is not likely to be the same since the model nomenclature, specifications and designs change every several years and therefore such installation will likely require a new venting system. Therefore, DOE did not consider the case of reusing stainless steel vent.

DOE notes that even if no venting cost was associated with a like-for-like replacement of non-condensing units, given the limited market share of non-condensing gas-fired instantaneous water heaters in no-new-standards case, this assumption will not impact the economic justification reflected in the positive LCC savings at the adopted TSL.

c. Condensate Management Costs

Besides the basic installation cost for removing the old water heater and setting up the new and the venting cost associated with setting up the flue vent and air intake pipework, DOE also considered specifically for condensing gas-fired instantaneous water heaters the cost of condensate management. In order to drain condensate properly, cost items can apply based on the specifics of the installation including condensate pipe, condensate pump, condensate neutralizer, and condensate drain. DOE additionally considered cases where a heat tape is applied and cases where an electric connection setup is needed.

In response to the June 2023 NOPR, Rinnai stated that DOE excluded from its analysis of condensing gas-fired instantaneous water heaters many of the costs of condensate management including drains, pumps, neutralizers, and associated and recurring maintenance costs. (Rinnai, No. 1186 at pp. 24-25) In response to July 2024 NODA, Rinnai further claimed that the analysis underestimates the cost of condensate management and states that DOE either omits typical costs needed for condensing installations or applies them to a relatively small proportion of condensing gas-fired instantaneous water heater installations. For example, Rinnai claimed that the July 2024 NODA only applies a condensate neutralizer to 12.5 percent of installations rather than 25 percent of cases. Rinnai further requested DOE provide evidence that the default of

12.5 percent represents a survey of installations and market conditions. (Rinnai, No. 1443 at p. 17) In response, as mentioned above, DOE took into account various cost items for condensate management. DOE assumed that some cost items would apply to only a certain fraction of installation. For example, DOE assumed that condensate pipe cost is needed for both replacement and new construction installations but then only 12.5 percent of replacement installations where the household does not have a central AC or heat pump would need to be applied the cost of a condensate pump. As Rinnai pointed out, DOE assumed that 12.5 percent of all installations would be applied the cost of condensate neutralizer. DOE adopted this estimate based on its market and technology assessment, engineering analysis, and its expert consultant feedback. Rinnai however provided no basis to support doubling the installation of condensate neutralizers to 25% of all cases. Nor has DOE found any other market data to support an alternative estimate. For lack of further data and evidence, DOE maintained its assumption of 12.5 percent of condensate neutralizer installations in this final rule.

PHCC commented that DOE's assumption that drains are required at or near water heaters is wrong as codes do not require it. They commented that changing to an appliance that produces condensate will require a pump or drain that is near the heater because that condensate cannot drain routinely across the floor as it can create slippery surfaces, and that an installed pipe to a remote drain can be a trip hazard. PHCC commented that the cost for adding a drain should be allocated against all replacement water heaters that will produce condensate. (PHCC, No. 1151 at p. 3) In response, DOE took into consideration the cost items of setting up a condensate pump and condensate drain in its analysis. Condensate pump is usually needed when the water heater is below the closest drain or when without an immediate drain the condensate need to be pumped to a remote drain. DOE assumed that for gas-fired instantaneous water heaters, around 12.5 percent of the replacements will need to set up a new condensate pump when the households do not have installed central air conditioner or heat pump that may already be equipped with a condensate pump. Accordingly, DOE applied the cost of non-corrosive drain to those installations that require the setup of a condensate pump. On average, DOE estimated a cost of $36 for condensate management in total.

Noritz commented that the ability to replace a water heater in an emergency is an important attribute of value to consumers, and changes in installation patterns raise costs and impose other time-related constraints such as changing venting patterns, carpentry to make changes to the house, and possible electrical work to complete installation. Noritz commented that a condensing gas-fired instantaneous water heater does provide the same utility to customers, but as noted in the NOPR there are significant installation changes which would require significant cost. (Noritz, No. 1202 at pp. 1-2) DOE agrees that in emergency replacement, like-for-like equipment provides the most convenience to the consumer. However, DOE estimates that the installation of condensing equipment, including the flue venting, the condensate pipe, and pump can be accomplished as part of an emergency replacement, meaning that for emergency replacements, non-condensing equipment do not necessarily bring significant additional value.

3. Annual Energy Consumption

For each sampled household and building, DOE determined the energy consumption for consumer gas-fired instantaneous water heaters at different efficiency levels using the approach described previously in section IV.E of this document.

Higher-efficiency gas-fired instantaneous water heaters reduce the operating costs for a consumer, which can lead to greater use of the water heater. A direct rebound effect occurs when a product that is made more efficient is used more intensively, such that the expected energy savings from the efficiency improvement may not fully materialize. At the same time, consumers benefit from increased utilization of products due to rebound. Although some households may increase their water heater use in response to increased efficiency, DOE does not include the rebound effect in the LCC analysis because the increased utilization of the water heater provides value to the consumer, thus it is not simply an added cost. DOE does include rebound in the NIA for a conservative estimate of national energy savings and the corresponding impact to consumer NPV. See chapter 10 of the final rule TSD for more details.

4. Energy Prices

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

DOE derived average monthly marginal residential and commercial electricity, natural gas, and LPG prices for each state using data from EIA.[76,77,78] DOE calculated marginal monthly regional energy prices by: (1) first estimating an average annual price for each region; (2) multiplying by monthly energy price factors, and (3) multiplying by seasonal marginal price factors for electricity and natural gas. For the derivation of monthly price factors and marginal price factors, DOE used historical data from EIA from 2003 up to 2022 and from 2013 up to 2022, respectively. DOE adjusted energy prices to 2023$ using the Consumer Price Index. Further details may be found in chapter 8 of the final rule TSD.

To estimate energy prices in future years, DOE multiplied the 2022 energy prices by the projection of annual average price changes for each of the 50 U.S. states and District of Columbia from the reference case in *AEO2023*, which has an end year of 2050.[79] To estimate price trends after 2050, DOE used the average annual growth rate in prices from 2046 to 2050 based on the methods used in the 2022 Life-Cycle Costing Manual for the Federal Energy Management Program ("FEMP").[80]

---

[76] U.S. Department of Energy-Energy Information Administration, Form EIA-861M (formerly EIA-826) detailed data (2022) (Available at: *www.eia.gov/electricity/data/eia861m/*) (Last accessed August 29, 2024).
[77] U.S. Department of Energy-Energy Information Administration, Natural Gas Navigator (2022) (Available at: *www.eia.gov/naturalgas/data.php*) (Last accessed August 29, 2024).
[78] U.S. Department of Energy-Energy Information Administration, State Energy Data System ("SEDS") (2021) (Available at: *www.eia.gov/state/seds/*) (Last accessed August 29, 2024).
[79] EIA. *Annual Energy Outlook 2023 with Projections to 2050*. Washington, DC. Available at *www.eia.gov/forecasts/aeo/* (last accessed August 29, 2024).
[80] Lavappa, Priya D. and J. D. Kneifel. Energy Price Indices and Discount Factors for Life-Cycle Cost Analysis – 2022 Annual Supplement to NIST Handbook 135. National Institute of Standards and Technology (NIST). NISTIR 85-3273-37, available at *www.nist.gov/publications/energy-price-indices-and-discount-factors-life-cycle-cost-analysis-2022-annual* (last accessed August 29, 2024).

Rinnai stated that the July 2024 NODA improperly uses national averages in its state-level analysis and failed to account for regional differences in cost and utilization. Rinnai noted that there are significant regional and state differences that directly impact water heating demands, the efficiency and operational costs of water heating. Rinnai encouraged DOE to consider state-specific data in its distribution using discrete inputs to ensure results reflect diverse conditions across the US. (Rinnai, No. 1443 at p. 20) In response to Rinnai's concern, DOE reiterates that, given that the hot water use was derived based on representative energy consumption data reported from RECS 2020, there is already embedded regionality accounted for in the results. For no-new-standards case efficiency distribution, for lack of more granular data, DOE did not derive a market share that varies by state. In terms of operating costs of water heating, as discussed above, DOE utilized state-level energy prices for calculating the operating costs. *See* appendix 8E of the final rule TSD for more details.

5. Maintenance and Repair Costs

Repair costs are associated with repairing or replacing product components that have failed in an appliance; maintenance costs are associated with maintaining the operation of the product. DOE included additional maintenance and repair costs for higher efficiency consumer gas-fired instantaneous water heaters (including maintenance costs associated with condensate withdrawal and deliming of the heat exchanger and repair costs associated with burner and blower assembly) based on 2023 RSMeans data.[81] DOE accounted for regional differences in labor costs by using RSMeans regional cost factors.

Rinnai and AGA *et al.* claimed that the July 2024 NODA underestimated the maintenance cost associated with general condensate withdrawal for condensing gas-fired instantaneous water heater units. Rinnai claimed that a basic neutralizer refill can cost between $35-50 (instead of $20 as assumed in July 2024 NODA). Rinnai also requested clarification on the source of the $20 estimate. (Rinnai, No. 1443 at p. 17; AGA *et al.*, No. 1439 at p. 7) In response, DOE derived the material cost of $20 for condensate management maintenance based on its consultant report included in the appendix 8F of the final rule TSD. For this final rule, given that the market price can change between the time of the final rule analysis and that of the report, DOE reviewed the current market prices for refills of condensate neutralizer and decided that an average price of $41.17 would be more representative of the price paid by the consumers. DOE has updated the LCC analytical tool and the final rule TSD accordingly to reflect the market prices it reviewed and the updated cost assumption.

6. Product Lifetime

Product lifetime is the age at which an appliance is retired from service. DOE conducted an analysis of gas-fired instantaneous water heater lifetimes based on the methodology described in a journal paper.[82] For this analysis, DOE relied on RECS

[81] RSMeans Company, Inc., *RS Means Facilities Repair and Maintenance* (2023), available at *www.rsmeans.com/* (last accessed August 29, 2024).

[82] Lutz, J., A. Hopkins, V. Letschert, V. Franco, and A. Sturges, Using national survey data to estimate lifetimes of residential appliances, *HVAC&R Research* (2011) 17(5): pp. 28 (Available at: *www.tandfonline.com/doi/abs/10.1080/10789669.2011.558166*) (Last accessed August 29, 2024).

1990, 1993, 2001, 2005, 2009, 2015, and 2020.[83] DOE also used the U.S. Census's biennial American Housing Survey ("AHS"), from 1974-2021, which surveys all housing, noting the presence of a range of appliances.[84] DOE used the appliance age data from these surveys, as well as the historical water heater shipments, to generate an estimate of the survival function. The survival function provides a lifetime range from minimum to maximum, as well as an average lifetime. DOE estimates the average product lifetime to be around 20 years for instantaneous water heaters.

Noritz disputed that condensing and non-condensing products have the same average lifespan based on their internal testing. Noritz argued that the less complex nature of the non-condensing product in their testing typically lasts between 10 and 20 percent longer than a similar condensing product. Noritz argued that the analysis conducted by DOE that proposes the average lifespan of the two products to be identical will impact the LCC and payback analysis. (Noritz, No. 1202 at p. 3). In response, DOE has not found any evidence in its research pointing to a significantly different lifespan for the two types of water heaters. As described in appendix 8G of the final rule TSD, the data sources cited did not indicate any systematic decrease in lifetime for gas-fired condensing products (additionally, a majority of gas-fired instantaneous water heaters in the market are condensing). For this final rule, DOE maintains its methodology of assuming the same lifetime for all gas-fired instantaneous water heaters.

[83] U.S. Department of Energy: Energy Information Administration, *Residential Energy Consumption Survey ("RECS")*, Multiple Years (1990, 1993, 1997, 2001, 2005, 2009, 2015, and 2020) (Available at: *www.eia.gov/consumption/residential/*) (Last accessed August 29, 2024).

[84] U.S. Census Bureau: Housing and Household Economic Statistics Division, *American Housing Survey*, Multiple Years (1974, 1975, 1976, 1977, 1978, 1979, 1980, 1981, 1983, 1985, 1987, 1989, 1991, 1993, 1995, 1997, 1999, 2001, 2003, 2005, 2007, 2009, 2011, 2013, 2015, 2017, 2019, and 2021) (Available at: *www.census.gov/programs-surveys/ahs/*) (Last accessed August 29, 2024).

In order to evaluate the impact of the lifetime on the economic analysis results, for this final rule DOE conducted a sensitivity analysis, where two additional lifetime scenarios were evaluated. The sensitivity results do not change DOE's conclusion of economic justification of the adopted standards (see appendix 8G of the final rule TSD for the comparison of results).

7. Discount Rates

In the calculation of LCC, DOE applies discount rates appropriate to households to estimate the present value of future operating cost savings. DOE estimated a distribution of discount rates for consumer gas-fired instantaneous water heaters based on the opportunity cost of consumer funds.

DOE applies weighted average discount rates calculated from consumer debt and asset data, rather than marginal or implicit discount rates.[85] The LCC analysis estimates net present value over the lifetime of the product, so the appropriate discount rate will reflect the general opportunity cost of household funds, taking this time scale into account. Given the long time horizon modeled in the LCC analysis, the application of a marginal interest rate associated with an initial source of funds is inaccurate. Regardless of the method of purchase, consumers are expected to continue to rebalance their debt and asset holdings over the LCC analysis period, based on the restrictions consumers face

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

in their debt payment requirements and the relative size of the interest rates available on debts and assets. DOE estimates the aggregate impact of this rebalancing using the historical distribution of debts and assets.

To establish residential discount rates for the LCC analysis, DOE identified all relevant household debt or asset classes in order to approximate a consumer's opportunity cost of funds related to appliance energy cost savings. It estimated the average percentage shares of the various types of debt and equity by household income group using data from the Federal Reserve Board's triennial Survey of Consumer Finances.[86] ("SCF") starting in 1995 and ending in 2019. Using the SCF and other sources, DOE developed a distribution of rates for each type of debt and asset by income group to represent the rates that may apply in the year in which amended standards would take effect. DOE assigned each sample household a specific discount rate drawn from one of the distributions. The average rate across all types of household debt and equity and income groups is 4.2 percent. See chapter 8 of the final rule TSD for further details on the development of consumer discount rates.

To establish commercial discount rates for the small fraction of consumer gas-fired instantaneous water heaters installed in commercial buildings, DOE estimated the weighted-average cost of capital using data from Damodaran Online..[87] The weighted-average cost of capital is commonly used to estimate the present value of cash flows to be

[86] The Federal Reserve Board, *Survey of Consumer Finances* (1995, 1998, 2001, 2004, 2007, 2010, 2013, 2016, and 2019) (Available at: *www.federalreserve.gov/econres/scfindex.htm*) (last accessed August 29, 2024). The Federal Reserve Board is currently processing the 2022 Survey of Consumer Finances, which is expected to be fully available in late 2023.
[87] Damodaran Online, Data Page: Costs of Capital by Industry Sector (2021) (Available at: *pages.stern.nyu.edu/~adamodar/*) (Last accessed August 29, 2024).

derived from a typical company project or investment. Most companies use both debt and equity capital to fund investments, so their cost of capital is the weighted average of the cost to the firm of equity and debt financing. DOE estimated the cost of equity using the capital asset pricing model, which assumes that the cost of equity for a particular company is proportional to the systematic risk faced by that company. DOE's commercial discount rate approach is based on the methodology described in a Lawrence Berkeley National Laboratory report, and the distribution varies by business activity.[88] The average rate for consumer gas-fired instantaneous water heaters used in commercial applications in this final rule analysis, across all business activity, is 6.9 percent.

See chapter 8 of this final rule TSD for further details on the development of consumer and commercial discount rates.

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

To accurately estimate the share of consumers that would be affected by a potential energy conservation standard at a particular efficiency level, DOE's LCC analysis considered the projected distribution (market shares) of product efficiencies under the no-new-standards case (*i.e.*, the case without amended or new energy conservation standards). This approach reflects the fact that some consumers may purchase products with efficiencies greater than the baseline levels.

[88] Fujita, S., Commercial, Industrial, and Institutional Discount Rate Estimation for Efficiency Standards Analysis: Sector-Level Data 1998 – 2018 (Available at: *ees.lbl.gov/publications/commercial-industrial-and*) (Last accessed August 29, 2024).

To estimate the energy efficiency distribution of consumer gas-fired instantaneous water heaters for 2030, DOE used available shipments data by efficiency including in previous AHRI submitted historical shipment data,[89] ENERGY STAR unit shipments data,[90] and data from a 2023 BRG Building Solutions report.[91] To cover gaps in the available shipments data, DOE used DOE's public CCD model database[92] and AHRI certification directory.[93]

The estimated market shares for the no-new-standards case for consumer gas-fired instantaneous water heaters are shown in Table IV.11. See chapter 8 of the final rule TSD for further information on the derivation of the efficiency distributions.

**Table IV.11 No-New-Standards Case Energy Efficiency Distributions in 2030 for Consumer Gas-Fired Instantaneous Water Heaters**

| Efficiency Level | Draw Pattern | | | | | |
|---|---|---|---|---|---|---|
| | Low | | Medium | | High | |
| | UEF* | Market Share *(%)* | UEF* | Market Share *(%)* | UEF* | Market Share *(%)* |
| **Gas-Fired Instantaneous Water Heaters, <2 gal and >50,000 Btu/h** | | | | | | |
| 0 | | | 0.81 | 30% | 0.81 | 30% |
| 1 | | | 0.87 | 8% | 0.89 | 8% |
| 2 | | | 0.91 | 48% | 0.93 | 47% |
| 3 | | | 0.92 | 6% | 0.95 | 7% |
| 4 | | | 0.93 | 8% | 0.96 | 8% |

* UEF at the representative rated capacity.

[89] AHRI. Confidential Instantaneous Gas-fired Water Heater Shipments Data from 2004-2007 to LBNL. March 3, 2008.
[90] ENERGY STAR. Unit Shipments data 2010-2021. multiple reports. (Available at: *www.energystar.gov/partner_resources/products_partner_resources/brand_owner_resources/unit_shipment_data*) (Last accessed August 29, 2024).
[91] BRG Building Solutions. The North American Heating & Cooling Product Markets (2023 Edition). 2023.
[92] U.S. Department of Energy's Compliance Certification Database is available at *regulations.doe.gov/certification-data* (last accessed August 29, 2024).
[93] Air Conditioning Heating and Refrigeration Institute. Consumer's Directory of Certified Efficiency Ratings for Heating and Water Heating Equipment. May 16, 2023. (Available at *www.ahridirectory.org*) (Last accessed August 29, 2024).

The LCC Monte Carlo simulations draw from the efficiency distributions and assign an efficiency to the gas-fired instantaneous water heater purchased by each sample household in the no-new-standards case according to these distributions.

Finally, DOE considered the 2019 AHCS survey,[94] which includes questions to recent purchasers of HVAC equipment regarding the perceived efficiency of their equipment (Standard, High, and Super High Efficiency), as well as questions related to various household and demographic characteristics. DOE did not find similar data for consumer water heaters, but believes that the HVAC data is relevant to other larger appliances such as consumer water heaters since they similarly represent large energy end uses. From these data, DOE found that households with larger square footage exhibited a higher fraction of High- or Super-High efficiency equipment installed. The fraction of respondents with "super high efficiency" equipment was larger by approximately 5 percent for larger households and correspondingly smaller for smaller households. DOE therefore used the AHCS data to adjust its water heater efficiency distributions as follows: (1) the market share of higher efficiency equipment for households under 1,500 sq. ft. was decreased by 5 percentage points; and (2) the market share of condensing equipment for households above 2,500 sq. ft. was increased by 5 percentage points. Other household and demographic characteristics in the survey did not exhibit any statistical correlations with efficiency.

DOE acknowledges that economic factors may play a role when consumers, commercial building owners, or builders decide on what type of water heater to install.

[94] Decision Analysts, 2019 American Home Comfort Studies (Available at: *www.decisionanalyst.com/syndicated/homecomfort/*) (Last accessed August 29, 2024).

However, assignment of water heater efficiency for a given installation based solely on economic measures such as life-cycle cost or simple payback period does not fully and accurately reflect actual real-world installations. There are a number of market failures discussed in the economics literature that illustrate how purchasing decisions with respect to energy efficiency are unlikely to be perfectly correlated with energy use, as described below. While this literature is not specific to water heaters, DOE finds that the method of assignment simulates behavior in the water heater market, where market failures and other consumer preferences result in purchasing decisions not being perfectly aligned with economic interests, more realistically than relying only on apparent cost-effectiveness criteria derived from the limited information in CBECS or RECS. DOE further emphasizes that its approach does not assume that all purchasers of water heaters make economically irrational decisions (*i.e.*, the lack of a correlation is not the same as a negative correlation). As part of the sample assignment, some homes or buildings with large hot water use will be assigned higher efficiency water heaters, and some homes or buildings with particularly low hot water use will be assigned baseline water heaters. By using this approach, DOE acknowledges the variety of market failures and other consumer behaviors present in the water heater market, and does not assume certain market conditions unsupported by the available evidence.

First, consumers are motivated by more than simple financial trade-offs. There are consumers who are willing to pay a premium for more energy-efficient products because they are environmentally conscious.[95] There are also several behavioral factors

[95] Ward, D. O., Clark, C. D., Jensen, K. L., Yen, S. T., & Russell, C. S. (2011): "Factors influencing willingness-to pay for the ENERGY STAR® label," *Energy Policy*, *39*(3), 1450-1458. (Available at: *www.sciencedirect.com/science/article/abs/pii/S0301421510009171*) (Last accessed January 5, 2024).

that can influence the purchasing decisions of complicated multi-attribute products, such as water heaters. For example, consumers (or decision makers in an organization) are highly influenced by choice architecture, defined as the framing of the decision, the surrounding circumstances of the purchase, the alternatives available, and how they're presented for any given choice scenario.[96] The same consumer or decision maker may make different choices depending on the characteristics of the decision context (*e.g.*, the timing of the purchase, competing demands for funds), which have nothing to do with the characteristics of the alternatives themselves or their prices. Consumers or decision makers also face a variety of other behavioral phenomena including loss aversion, sensitivity to information salience, and other forms of bounded rationality.[97] R.H. Thaler, who won the Nobel Prize in Economics in 2017 for his contributions to behavioral economics, and Sunstein point out that these behavioral factors are strongest when the decisions are complex and infrequent, when feedback on the decision is muted and slow, and when there is a high degree of information asymmetry.[98] These characteristics describe almost all purchasing situations of appliances and equipment, including water heaters. The installation of a new or replacement water heater is done infrequently, as evidenced by the mean lifetime for water heaters. Additionally, it would take at least one full water heating season for any impacts on operating costs to be fully apparent. Further, if the purchaser of the water heater is not the entity paying the energy

---

[96] Thaler, R.H., Sunstein, C.R., and Balz, J.P. (2014). "Choice Architecture" in *The Behavioral Foundations of Public Policy*, Eldar Shafir (ed).

[97] Thaler, R.H., and Bernartzi, S. (2004). "Save More Tomorrow: Using Behavioral Economics in Increase Employee Savings," *Journal of Political Economy* 112(1), S164-S187. *See also* Klemick, H., et al. (2015) "Heavy-Duty Trucking and the Energy Efficiency Paradox: Evidence from Focus Groups and Interviews," *Transportation Research Part A: Policy & Practice*, 77, 154-166. (providing evidence that loss aversion and other market failures can affect otherwise profit-maximizing firms).

[98] Thaler, R.H., and Sunstein, C.R. (2008). Nudge: Improving Decisions on Health, Wealth, and Happiness. New Haven, CT: Yale University Press.

costs (*e.g.*, a building owner and tenant), there may be little to no feedback on the purchase. Additionally, there are systematic market failures that are likely to contribute further complexity to how products are chosen by consumers, as explained in the following paragraphs.

The first of these market failures—the split-incentive or principal-agent problem—is likely to affect water heaters more than many other types of appliances. The principal-agent problem is a market failure that results when the consumer that purchases the equipment does not internalize all of the costs associated with operating the equipment. Instead, the user of the product, who has no control over the purchase decision, pays the operating costs. There is a high likelihood of split incentive problems in the case of rental properties where the landlord makes the choice of what water heater to install, whereas the renter is responsible for paying energy bills In the LCC sample, for gas-fired instantaneous water heaters, approximately 10 percent of households are renters. Given the greater market share of instantaneous water heaters in new construction compared to other water heater product classes, this fraction of renters is lower than the national average (which is approximately one third). For low-income households (see section IV.I of this document and chapter 11 of the final rule TSD), however, the fraction of renters increases to 38 percent of households. The principle-agent problem can also impact homeowners. For example, in new construction, builders influence the type of water heater used in many homes but do not pay operating costs. Finally, contractors install a large share of water heaters in replacement situations, and they can exert a high degree of influence over the type of water heater purchased based on which products they are familiar with.

In addition to the split-incentive problem, there are other market failures that are likely to affect the choice of water heater efficiency made by consumers. For example, emergency replacements of essential equipment such as water heaters are strongly biased toward like-for-like replacement (*i.e.*, replacing the non-functioning equipment with a similar or identical product). Time is a constraining factor during emergency replacements and it may not be possible to consider the full range of available options on the market. The consideration of alternative product options is far more likely for planned replacements and installations in new construction.

Additionally, Davis and Metcalf[99] conducted an experiment demonstrating that the nature of the information available to consumers from EnergyGuide labels posted on air conditioning equipment results in an inefficient allocation of energy efficiency across households with different usage levels. Their findings indicate that households are likely to make decisions regarding the efficiency of the climate control equipment of their homes that do not result in the highest net present value for their specific usage pattern (*i.e.*, their decision is based on imperfect information and, therefore, is not necessarily optimal).

In part because of the way information is presented, and in part because of the way consumers process information, there is also a market failure consisting of a systematic bias in the perception of equipment energy usage, which can affect consumer

[99] Davis, L. W., and G. E. Metcalf (2016): "Does better information lead to better choices? Evidence from energy-efficiency labels," *Journal of the Association of Environmental and Resource Economists*, 3(3), 589-625. (Available at: *www.journals.uchicago.edu/doi/full/10.1086/686252*) (Last accessed January 5, 2024).

choices. Attari, et al.[100] show that consumers tend to underestimate the energy use of large energy-intensive appliances but tend to overestimate the energy use of small appliances. Water heaters are one of the largest energy-consuming end-uses in a home. Therefore, it is likely that consumers systematically underestimate the energy use associated with water heater, resulting in less cost-effective water heater purchases.

These market failures may affect a sizeable share of the consumer population. A study by Houde[101] indicates that there is a significant subset of consumers that appear to purchase appliances without taking into account their energy efficiency and operating costs at all, though subsequent studies using alternative methodologies have highlighted other consumer groups who are to some extent responsive to local energy prices with their appliance purchases.[102] The extent to which consumers are perceptive of energy prices and product efficiency when making appliance purchasing decisions is a topic of ongoing research.

Although consumer gas-fired instantaneous water heaters are predominantly installed in the residential sector, some are also installed in commercial buildings (6 percent of projected shipments; see chapter 9 of the final rule TSD). There are market failures relevant to consumer gas-fired instantaneous water heaters installed in commercial applications as well. It is often assumed that because commercial and

[100] Attari, S. Z., M.L. DeKay, C.I. Davidson, and W. Bruine de Bruin (2010): "Public perceptions of energy consumption and savings." *Proceedings of the National Academy of Sciences* 107(37), 16054-16059 (Available at: *www.pnas.org/content/107/37/16054*) (Last accessed January 5, 2024).
[101] Houde, S. (2018): "How Consumers Respond to Environmental Certification and the Value of Energy Information," *The RAND Journal of Economics*, 49 (2), 453-477 (Available at: *onlinelibrary.wiley.com/doi/full/10.1111/1756-2171.12231*) (Last accessed January 5, 2024).
[102] Houde, S. and Meyers, E. (2021). "Are consumers attentive to local energy costs? Evidence from the appliance market," Journal of Public Economics, 201 (Available at: *sciencedirect.com/science/article/pii/S004727272100116X*) (Last accessed March 7, 2024).

industrial customers are businesses that have trained or experienced individuals making decisions regarding investments in cost-saving measures, some of the commonly observed market failures present in the general population of residential customers should not be as prevalent in a commercial setting. However, there are many characteristics of organizational structure and historic circumstance in commercial settings that can lead to underinvestment in energy efficiency.

First, a recognized problem in commercial settings is the principal-agent problem, where the building owner (or building developer) selects the equipment and the tenant (or subsequent building owner) pays for energy costs.[103, 104] Indeed, more than a quarter of commercial buildings in the CBECS 2018 sample are occupied at least in part by a tenant, not the building owner (indicating that, in DOE's experience, the building owner in some cases is not responsible for paying energy costs). Additionally, some commercial buildings have multiple tenants. There are other similar misaligned incentives embedded in the organizational structure within a given firm or business that can impact the choice of a water heater. For example, if one department or individual within an organization is responsible for capital expenditures (and therefore equipment selection) while a separate department or individual is responsible for paying the energy bills, a market failure similar to the principal-agent problem can result.[105] Additionally,

---

[103] Vernon, D., and Meier, A. (2012). "Identification and quantification of principal–agent problems affecting energy efficiency investments and use decisions in the trucking industry," *Energy Policy*, 49, 266-273.
[104] Blum, H. and Sathaye, J. (2010). "Quantitative Analysis of the Principal-Agent Problem in Commercial Buildings in the U.S.: Focus on Central Space Heating and Cooling," Lawrence Berkeley National Laboratory, LBNL-3557E. (Available at: *escholarship.org/uc/item/6p1525mg*) (Last accessed January 5, 2024).
[105] Prindle, B., Sathaye, J., Murtishaw, S., Crossley, D., Watt, G., Hughes, J., and de Visser, E. (2007). "Quantifying the effects of market failures in the end-use of energy," Final Draft Report Prepared for

managers may have other responsibilities and often have other incentives besides operating cost minimization, such as satisfying shareholder expectations, which can sometimes be focused on short-term returns.[106] Decision-making related to commercial buildings is highly complex and involves gathering information from and for a variety of different market actors. It is common to see conflicting goals across various actors within the same organization as well as information asymmetries between market actors in the energy efficiency context in commercial building construction.[107]

Second, the nature of the organizational structure and design can influence priorities for capital budgeting, resulting in choices that do not necessarily maximize profitability.[108] Even factors as simple as unmotivated staff or lack of priority-setting and/or a lack of a long-term energy strategy can have a sizable effect on the likelihood that an energy efficient investment will be undertaken.[109] U.S. tax rules for commercial

---

International Energy Agency. (Available from International Energy Agency, Head of Publications Service, 9 rue de la Federation, 75739 Paris, Cedex 15 France).

[106] Bushee, B. J. (1998). "The influence of institutional investors on myopic R&D investment behavior," *Accounting Review*, 305-333.
DeCanio, S.J. (1993). "Barriers Within Firms to Energy Efficient Investments," *Energy Policy*, 21(9), 906–914. (explaining the connection between short-termism and underinvestment in energy efficiency).

[107] International Energy Agency (IEA). (2007). Mind the Gap: Quantifying Principal-Agent Problems in Energy Efficiency. OECD Pub. (Available at: *www.iea.org/reports/mind-the-gap*) (Last accessed January 5, 2024)

[108] DeCanio, S. J. (1994). "Agency and control problems in US corporations: the case of energy-efficient investment projects," *Journal of the Economics of Business*, 1(1), 105-124.
Stole, L. A., and Zwiebel, J. (1996). "Organizational design and technology choice under intrafirm bargaining," *The American Economic Review*, 195-222.

[109] Rohdin, P., and Thollander, P. (2006). "Barriers to and driving forces for energy efficiency in the non-energy intensive manufacturing industry in Sweden," *Energy*, 31(12), 1836-1844.
Takahashi, M and Asano, H (2007). "Energy Use Affected by Principal-Agent Problem in Japanese Commercial Office Space Leasing," In *Quantifying the Effects of Market Failures in the End-Use of Energy*. American Council for an Energy-Efficient Economy. February 2007.
Visser, E and Harmelink, M (2007). "The Case of Energy Use in Commercial Offices in the Netherlands," In *Quantifying the Effects of Market Failures in the End-Use of Energy*. American Council for an Energy-Efficient Economy. February 2007.
Bjorndalen, J. and Bugge, J. (2007). "Market Barriers Related to Commercial Office Space Leasing in Norway," In *Quantifying the Effects of Market Failures in the End-Use of Energy*. American Council for an Energy-Efficient Economy. February 2007.

buildings may incentivize lower capital expenditures, since capital costs must be depreciated over many years, whereas operating costs can be fully deducted from taxable income or passed through directly to building tenants.[110]

Third, there are asymmetric information and other potential market failures in financial markets in general, which can affect decisions by firms with regard to their choice among alternative investment options, with energy efficiency being one such option.[111] Asymmetric information in financial markets is particularly pronounced with regard to energy efficiency investments.[112] There is a dearth of information about risk and volatility related to energy efficiency investments, and energy efficiency investment metrics may not be as visible to investment managers,[113] which can bias firms towards

---

Schleich, J. (2009). "Barriers to energy efficiency: A comparison across the German commercial and services sector," *Ecological Economics*, 68(7), 2150-2159.
Muthulingam, S., et al. (2013). "Energy Efficiency in Small and Medium-Sized Manufacturing Firms," *Manufacturing & Service Operations Management*, 15(4), 596-612. (Finding that manager inattention contributed to the non-adoption of energy efficiency initiatives).
Boyd, G.A., Curtis, E.M. (2014). "Evidence of an 'energy management gap' in US manufacturing: Spillovers from firm management practices to energy efficiency," *Journal of Environmental Economics and Management*, 68(3), 463-479.
[110] Lovins, A. (1992). Energy-Efficient Buildings: Institutional Barriers and Opportunities. (Available at: *rmi.org/insight/energy-efficient-buildings-institutional-barriers-and-opportunities/*) (Last accessed January 5, 2024).
Fazzari, S. M., Hubbard, R. G., Petersen, B. C., Blinder, A. S., and Poterba, J. M. (1988). "Financing constraints and corporate investment," *Brookings Papers on Economic Activity*, 1988(1), 141-206.
Cummins, J. G., Hassett, K. A., Hubbard, R. G., Hall, R. E., and Caballero, R. J. (1994). "A reconsideration of investment behavior using tax reforms as natural experiments," *Brookings Papers on Economic Activity*, 1994(2), 1-74.
DeCanio, S. J., and Watkins, W. E. (1998). "Investment in energy efficiency: do the characteristics of firms matter?" *Review of Economics and Statistics*, 80(1), 95-107.
Hubbard R.G. and Kashyap A. (1992). "Internal Net Worth and the Investment Process: An Application to U.S. Agriculture," *Journal of Political Economy*, 100, 506-534.
[112] Mills, E., Kromer, S., Weiss, G., and Mathew, P. A. (2006). "From volatility to value: analysing and managing financial and performance risk in energy savings projects," *Energy Policy*, 34(2), 188-199.
Jollands, N., Waide, P., Ellis, M., Onoda, T., Laustsen, J., Tanaka, K., and Meier, A. (2010). "The 25 IEA energy efficiency policy recommendations to the G8 Gleneagles Plan of Action," *Energy Policy*, 38(11), 6409-6418.
[113] Reed, J. H., Johnson, K., Riggert, J., and Oh, A. D. (2004). "Who plays and who decides: The structure and operation of the commercial building market," U.S. Department of Energy Office of Building Technology, State and Community Programs. (Available at: *www1.eere.energy.gov/buildings/publications/pdfs/commercial_initiative/who_plays_who_decides.pdf*) (Last accessed January 5, 2024).

more certain or familiar options. This market failure results not because the returns from energy efficiency as an investment are inherently riskier, but because information about the risk itself tends not to be available in the same way it is for other types of investment, like stocks or bonds. In some cases energy efficiency is not a formal investment category used by financial managers, and if there is a formal category for energy efficiency within the investment portfolio options assessed by financial managers, they are seen as weakly strategic and not seen as likely to increase competitive advantage.[114] This information asymmetry extends to commercial investors, lenders, and real-estate financing, which is biased against new and perhaps unfamiliar technology (even though it may be economically beneficial).[115] Another market failure known as the first-mover disadvantage can exacerbate this bias against adopting new technologies, as the successful integration of new technology in a particular context by one actor generates information about cost-savings, and other actors in the market can then benefit from that information by following suit; yet because the first to adopt a new technology bears the risk but cannot keep to themselves all the informational benefits, firms may inefficiently underinvest in new technologies.[116]

In sum, the commercial and industrial sectors face many market failures that can result in an under-investment in energy efficiency. This means that discount rates

---

[114] Cooremans, C. (2012). "Investment in energy efficiency: do the characteristics of investments matter?" *Energy Efficiency*, 5(4), 497-518.
[115] Lovins 1992, op. cit.
The Atmospheric Fund. (2017). Money on the table: Why investors miss out on the energy efficiency market. (Available at: *taf.ca/publications/money-table-investors-energy-efficiency-market/*) (Last accessed January 5, 2024).
[116] Blumstein, C. and Taylor, M. (2013). Rethinking the Energy-Efficiency Gap: Producers, Intermediaries, and Innovation. Energy Institute at Haas Working Paper 243. (Available at: *haas.berkeley.edu/wp-content/uploads/WP243.pdf*) (Last accessed January 5, 2024).

implied by hurdle rates[117] and required payback periods of many firms are higher than the appropriate cost of capital for the investment.[118] The preceding arguments for the existence of market failures in the commercial and industrial sectors are corroborated by empirical evidence. One study in particular showed evidence of substantial gains in energy efficiency that could have been achieved without negative repercussions on profitability, but the investments had not been undertaken by firms.[119] The study found that multiple organizational and institutional factors caused firms to require shorter payback periods and higher returns than the cost of capital for alternative investments of similar risk Another study demonstrated similar results with firms requiring very short payback periods of 1-2 years in order to adopt energy-saving projects, implying hurdle rates of 50 to 100 percent, despite the potential economic benefits.[120] For small businesses, the payback periods for higher efficiency gas-fired instantaneous water heaters are typically 7 to 8 years on average, longer than the usual requirement of 1 to 2 years, which ultimately discounts the significant long-term savings from these higher efficiency products. A number of other case studies similarly demonstrate the existence of market failures preventing the adoption of energy-efficient technologies in a variety of

[117] A hurdle rate is the minimum rate of return on a project or investment required by an organization or investor. It is determined by assessing capital costs, operating costs, and an estimate of risks and opportunities.

[118] DeCanio 1994, op. cit.

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

[120] Andersen, S.T., and Newell, R.G. (2004). "Information programs for technology adoption: the case of energy-efficiency audits," *Resource and Energy Economics*, 26, 27-50.

commercial sectors around the world, including office buildings,[121] supermarkets,[122] and the electric motor market.[123]

The existence of market failures in the residential and commercial sectors is well supported by the economics literature and by a number of case studies. Although these studies are not specifically targeted to the water heater market, they cover decision-making generally and the impact of energy efficiency, operating costs, and future savings/expenditures on those decisions, all of which apply to the purchase of a consumer gas-fired instantaneous water heater. DOE is not aware of any market failure studies specifically and narrowly focused on gas-fired instantaneous water heaters and so relies on the available literature discussed above. If DOE developed an efficiency distribution that assigned water heater efficiency in the no-new-standards case solely according to energy use or economic considerations such as life-cycle cost or payback period, the resulting distribution of efficiencies within the building sample would not reflect any of the market failures or behavioral factors above. DOE thus concludes such a distribution would not be representative of the water heater market.

AGA *et al.* stated that DOE's model makes several assumptions that significantly impact its outcomes. According to AGA *et al.*, DOE does not account for regional

---

[121] Prindle 2007, op. cit.
Howarth, R.B., Haddad, B.M., and Paton, B. (2000). "The economics of energy efficiency: insights from voluntary participation programs," *Energy Policy*, 28, 477-486.
[122] Klemick, H., Kopits, E., Wolverton, A. (2017). "Potential Barriers to Improving Energy Efficiency in Commercial Buildings: The Case of Supermarket Refrigeration," *Journal of Benefit-Cost Analysis*, 8(1), 115-145.
[123] de Almeida, E.L.F. (1998). "Energy efficiency and the limits of market forces: The example of the electric motor market in France", *Energy Policy*, 26(8), 643-653.
Xenergy, Inc. (1998). United States Industrial Electric Motor Systems Market Opportunity Assessment. (Available at: *www.energy.gov/sites/default/files/2014/04/f15/mtrmkt.pdf*) (Last accessed January 5, 2024).

variations when implementing a national market share for each product level, and bases installation on square footage rather than other household attributes such as the number of bathrooms, bedrooms, or inhabitants. (AGA *et al.*, No. 1439 at p. 7)

Rinnai asserted that installations of condensing and non-condensing units vary regionally and DOE should account for this in the model instead of using national market share for each product level and assuming an increased likelihood a consumer purchases a more efficient option based on square footage. (Rinnai, No. 1443 at p.18)

In response, DOE notes that the market share data for gas-fired instantaneous water heaters are not available at a regional or State level. Manufacturer and industry associations did not provide any regional or State-level shipments data by efficiency level to be incorporated into the analyses. There is similarly no data set DOE is aware of, nor that any stakeholder pointed to, that correlates gas-fired instantaneous water heater efficiency to household attributes or consumer demographics. DOE therefore used national-level data to estimate the market share by efficiency level for gas-fired instantaneous water heaters. However, RECS 2020 is a nationally representative survey of energy consumption and incorporates regional variation with respect to household attributes, water heater usage, water inlet temperature, and energy consumption. Therefore, the LCC analysis does include regional variation with respect to housing characteristics, sample location, labor cost (and therefore installation cost), and estimates of water heating usage. The total costs are therefore not based solely on square footage, but rather on multiple household attributes. Square footage is used to adjust the national efficiency distribution based on the observed consumer behavior that larger homes are more likely to invest in more efficient water heating equipment, as discussed above.

Rinnai objected to DOE's use of the Monte Carlo method for estimating energy savings, which Rinnai argues overstates benefits by ignoring rational consumer choice. Rinnai further stated that this error is compounded by not analyzing product switching. (Rinnai, No. 1443 at pp. 22-23)

In response, DOE notes that there are a multitude of market failures present in the water heater market that can influence the efficiency of water heater chosen by consumers in the absence of new standards, as discussed above. DOE is not ignoring rational consumer choice, rather the methodology acknowledges the range in consumer behavior present in the market, including those who make equipment choices that minimize their costs. Those consumers are indeed reflected in the analysis, along with other consumers who do not or cannot make choices that minimize their costs for a variety of reasons. With respect to switching to other types of water heaters, as discussed in greater detail in section IV.F.10 of this document, the LCC savings over a longer product lifetime, other attributes of instantaneous water heaters valued by consumers, logistical barriers to switching in some housing contexts, and marginal installed cost differences will minimize the incentives for consumers to switch to alternative water heater product classes rather than simply adopting a standards-compliant gas-fired instantaneous water heater. DOE therefore concludes that the likelihood of an adopted standard for gas-fired instantaneous water heaters driving any significant product class switching to be negligible.

AGA *et al.* commented that DOE's assignment methodology is unreasonable and simulates extreme and unreasonable purchasing behavior as well as skews the result of

DOE's analysis. They contended that economic considerations do influence purchasing behavior yet DOE's assignment methodology assumes that economic considerations never matter. (AGA *et al.*, No. 1439 at pp. 8-9)

In response, DOE has never stated that economic considerations never matter. This is a mischaracterization of the analysis. DOE acknowledges the full range of consumer behaviors in the water heater market and the analysis is modeled to reflect this range. As discussed below, the model produces a variety of outcomes including a significant fraction of consumers who choose an efficiency level that minimizes their life-cycle costs in the absence of new standards. These are consumers that the commenter would characterize as "reasonable" and they are reflected in the total sample. However, DOE also acknowledges that other groups of consumers exist who face a variety of market failures, preventing from choosing an efficiency level that minimizes their life-cycle costs in the absence of new standards.

DOE's focus on a limited number of variables in projecting the efficiency assignment in the no-new-standards case reflects the limits that constrain consumer decision-making. A full life-cycle analysis requires a variety of inputs, such as product prices, product energy consumption, energy prices, maintenance and repair costs, product lifetime, and discount rates. All of these figures are—by their nature—forward looking, predictive, and, therefore, subject to uncertainty. To account for uncertainty and variability in specific inputs, such as equipment lifetime and discount rate, DOE uses a distribution of values, with probabilities attached to each value.

In terms of how consumers make purchase decisions in the real world, a typical consumer has neither the expertise nor the time to review information about discount rates, projected price trends, or the host of other variables included in DOE's own calculations. Instead, consumers generally rely on the appliances recommended by contractors, who typically prefer to install appliances that are in stock and with which they are familiar. That is particularly true in emergency replacement situations, such as when an appliance and a replacement must be obtained and installed quickly. Consumer decisions, therefore, do not necessarily involve an exhaustive review of all variables that may affect long-run costs, but instead primarily reflect the prevalence of existing units in the relevant market.

There are many reasons to conclude that this imperfect decision-making environment leads consumers to purchase fewer condensing gas-fired instantaneous water heaters than would be economically justified. Studies show that consumers tend to undervalue energy efficiency and that a subset appear to purchase appliances without taking into account their energy efficiency and operating costs at all.

The market failures that generally affect energy-related decisions are particularly pernicious in the context of consumer water heaters. As discussed elsewhere in this document, landlords, contractors, and developers often make the choice of what appliance to install but do not benefit from the lower operating costs associated with condensing units (or suffer from the higher utility bills associated with non-condensing units).

As courts have found, EPCA itself recognizes that consumers do not invariably select appliances that are cost-justified in the long-term, but instead, the statute reflects Congress's "concern[] over the tendency of consumers to reject efficiency-improving appliances with long payback periods." *Natural Res. Def. Council, Inc. v. Herrington*, 768 F.2d 1355, 1405 (D.C. Cir. 1985). Indeed, "[n]umerous witnesses [before Congress] . . . testified that the average consumer looks for a payback from higher purchase prices within 3 years." *Id.* (quotation marks omitted). This propensity to focus on the short term is especially unfortunate here, where the benefits of condensing units extend for two decades or more. By authorizing DOE to amend efficiency standards, Congress acted in part to rectify this and other distortions in appliance markets. See *id*. (noting that "Congress viewed this consumer behavior as a kind of market failure").

In promulgating EPCA (Pub. L. No. 94-163, 89 Stat. 871 (1975)), Congress itself expressed a view that markets are not perfect, enacting the statute to promote national "energy conservation," including by improving the energy efficiency of certain "major appliances" and "consumer products." (42 U.S.C. 6201(4), (5)) Congress initially established a voluntary, market-based program for achieving that goal (*see* § 325, 89 Stat. 923-26), but it soon amended EPCA to require mandatory energy conservation standards (*see* National Energy Conservation Policy Act, Pub. L. No. 95-619, tit. IV, pt. 2, § 422, 92 Stat. 3206, 3259-62 (1978)), and Congress has continued to amend EPCA over time to revise those standards and to advance the goal of energy conservation.

The use of the efficiency assignment methodology of the gas-fired instantaneous water heater efficiency in the no-new-standards case in the LCC model is a methodological approach that reflects the full range of consumer behaviors in this market, including consumers who make informed and beneficial cost-minimizing decisions and other consumers who, due to the market failures discussed, do not or cannot make such perfectly beneficial decisions. The methodology is further constrained by shipments data by efficiency level; it must produce an overall distribution that matches the available market data. For example, for the gas-fired instantaneous water heater consumer sample at the adopted standard level (EL 2), DOE's methodology results in the following groups of consumers:

(1) Consumers who, in the absence of standards, choose a lower efficiency product with a lower life-cycle cost based on their surveyed hot water usage. These consumers are making an optimal choice from the perspective of cost savings in the model in the no-new-standards case. These are consumers who are choosing a baseline non-condensing gas-fired instantaneous water heater (EL 0) or consumers choosing a condensing gas-fired instantaneous water heater with the lowest efficiency (EL 1). With amended standards, they are made to purchase a more efficient product at EL 2 and therefore experience a net cost in the standards case. (15 percent of the gas-fired instantaneous water heater sample.) These consumers represent nearly half of all consumers choosing EL 0 in the no-new-standards case, therefore the efficiency assignment model is already assigning minimum-cost choices to this fraction of consumers in the no-new-standards case.

(2) Consumers who, in the absence of standards, choose a higher efficiency product that also lowers their life-cycle cost compared to the baseline efficiency product. These are consumers who are choosing a condensing gas-fired instantaneous

water heater with higher efficiency, including at the adopted standard level (EL 2, EL 3, and EL 4). These consumers are making a cost-minimizing choice in the model in the no-new-standards case. With amended standards, these consumers are not impacted because they are already purchasing a standards-compliant product. (34 percent of the gas-fired instantaneous water heater sample.) The efficiency assignment model is already assigning minimum-cost choices to this fraction of consumers in the no-new-standards case.

(3) Consumers who, in the absence of standards, choose a lower efficiency product that does not minimize the life-cycle cost. These are consumers who are choosing a baseline non-condensing gas-fired instantaneous water heater (EL 0) or consumers choosing a condensing gas-fired instantaneous water heater with the lowest efficiency (EL 1). The market failures discussed above apply to these consumers, preventing them from making the choice that minimizes their life-cycle costs in the no-new-standards case. With amended standards, they are made to purchase a more efficient product at EL 2 that ultimately results in a lower life-cycle cost. These consumers experience a net benefit as a result of the standard. (23 percent of the gas-fired instantaneous water heater sample)

(4) Consumers who, in the absence of standards, choose a higher efficiency product that does not lower their life-cycle cost compare to the baseline or lower efficiency product. These are consumers who are choosing a condensing gas-fired instantaneous water heater with higher efficiency, including at the adopted standard level (EL 2, EL 3, and EL 4). Although these consumers are choosing a higher efficiency product in the no-new-standards case, they may have incomplete

knowledge of the energy consumption of the equipment or may value environmental features such as efficiency more heavily, resulting in a choice of a higher efficiency product that does not lower life-cycle cost compared to a baseline or lower efficiency product. With amended standards, these consumers are not impacted because they are already purchasing a standards-compliant product. (29 percent of the gas-fired instantaneous water heater sample)

DOE's methodological approach is a proxy that ultimately reflects a diversity of scenarios for consumers and therefore the range of outcomes that will result from this diversity. The approach already reflects market share outcomes with some degree of market efficiency and optimal decision-making among some consumers, but the approach also acknowledges a number of factors that hinder perfect decision-making for others. Furthermore, the model produces an overall distribution of efficiency that matches the available shipments data.

Although DOE's efficiency assignment methodology does not explicitly model consumer decision making, nor does it take a stance on the rationality or irrationality of specific consumers, DOE believes that the approach would be consistent with a model in which some share of consumers make optimal cost-minimizing decisions, and some consumers – in the face of market failures – do not. The use of an assignment of gas-fired instantaneous water heater efficiency is a methodological approach that reflects the full range of consumer behaviors in this market, including consumers who make beneficial decisions that minimize their costs and consumers who, due to market failures, do not or cannot make such beneficial decisions, both of which occur in reality. Within those constraints, DOE then assigns product efficiencies to consumers in the LCC, consistent with the economics literature discussed above, to reflect neither purely rational nor purely irrational decision-making.

DOE's analytical approach reflects some degree of market efficiency. An alternative approach which assumes consumer behavior is based solely on cost outcomes, for example by ranking LCCs and using those to assign efficiencies, is not evidenced by the scientific literature surveyed above or by any data submitted in the course of this rulemaking. This approach depends on the assumption, for example, that homeowners know—as a rule—the efficiency of their homes' water heater and water heating energy use, such that they always make water heating investments accordingly. Similarly, this approach assumes that, faced with a water heater failure, homeowners will always select as a replacement the most economically beneficial available model. Given the work documenting market failures in the energy efficiency contexts described above, DOE believes that such assumptions would bias the outcome of the analysis to the least favorable results. DOE's approach, by contrast, recognizes that assumptions like these hold for some consumers some of the time—but not all consumers and not at all times.

As part of the assignment, some households or buildings with large water heating loads will be assigned higher-efficiency water heaters in the no-new-standards case, and some households or buildings with particularly low water heating loads will be assigned baseline water heaters—i.e., the lowest cost investments.

Regarding the role of contractors, DOE notes that they can exert a high degree of influence over the type of water heater purchased. DOE acknowledges that they can serve as an information mediator. However, it is possible for a contractor to also influence the decision toward a familiar like-for-like replacement, for example, or perhaps the quickest replacement option available (*e.g.*, based on equipment availability). Ultimately, there are multiple actors involved in the decision-making process which results in complex purchasing behavior.

As DOE has noted, there is a complex set of behavioral factors, with sometimes opposing effects, affecting the water heater market. It is impractical to model every consumer decision incorporating all of these effects at this extreme level of granularity given the limited available data. Given these myriad factors, DOE estimates the resulting distribution of such a model would be very scattered with high variability. It is for this reason DOE utilizes a probability distribution (after accounting for market share constraints) to approximate these effects. This is the standard methodological approach used on all of DOE's prior rules. The methodology is not an assertion of economic irrationality, but instead, it is a methodological approximation of complex consumer behavior. The analysis is neither necessarily biased toward high or low energy savings. The methodology does not preferentially assign lower-efficiency gas-fired instantaneous water heaters to households in the no-new-standards case where savings from the rule would be greatest, nor does it preferentially assign lower-efficiency gas-fired instantaneous water heaters to households in the no-new-standards case where savings from the rule would be smallest. However, it is worth noting that energy use could be improperly estimated if preferences for energy efficiency are correlated with demand for hot water. Some consumers were assigned the water heaters that they would have chosen if they had engaged in perfect economic thinking. Others were assigned less-efficient water heaters even where a more-efficient water heater would eventually result in life-cycle savings, simulating scenarios where, for example, various market failures prevent consumers from realizing those savings. Still others were assigned water heaters that were more efficient than one would expect simply from life-cycle costs analysis, reflecting, say, "green" behavior, whereby consumers ascribe independent value to minimizing harm to the environment.

DOE cites the available economic literature of which it is aware on this subject, supporting the existence of the various market failures in other appliance markets which would give rise to such a distribution, and has requested more data or studies on this topic in the May 2020 RFI, March 2022 preliminary analysis, and July 2023 NOPR. DOE is not aware of any specific study regarding how consumer water heaters (and their efficiency) are purchased.

DOE acknowledges that in the LCC, there are a handful of outcomes with large benefits as a consequence of the assignment methodology. Nevertheless, the median results (instead of the average results) from the LCC continue to show positive LCC savings at the adopted standard levels. However, for gas-fired instantaneous water heaters, DOE considered a sensitivity analysis that eliminated these outcomes with large benefits. Under certain combinations of parameters, particularly in new construction, the total installed cost of a condensing, higher efficiency gas-fired instantaneous water heater can be lower than a non-condensing baseline gas-fired instantaneous water heater (due to the differing vent lengths and material costs). With assignment methodology used by DOE (and the constraints of the market data by efficiency level), there are a handful of individual gas-fired instantaneous water heater LCC consumers assigned a baseline non-condensing gas-fired instantaneous water heater even though a higher efficiency product would cost less. This is a rare outcome and only occurs for approximately 2.5 percent of the sample. In the sensitivity analysis, DOE removed these outlier consumers from the analysis in case they may be overly biasing the overall results. This sensitivity scenario therefore eliminates any instance of a consumer assigned EL 0 even though EL 2 would cost less to install. The resulting average LCC savings are reduced to $87 across the rest of the entire gas-fired instantaneous water heater consumer sample, with 15 percent of consumers experiencing a net cost, 20 percent experiencing a net savings, and 65 percent of consumers not impacted by the rule. Although the average LCC savings are reduced in this sensitivity analysis, and slightly more consumers are negatively impacted by the adopted standards, the average (and median) LCC savings remain positive and there continue to be significant energy and environment savings. DOE continues to conclude that the adopted standard level for gas-fired instantaneous water heaters is economically justified even in this sensitivity analysis that eliminates outlier results.[124]

In summary, DOE's efficiency assignment methodology produces overall results that are consistent with the observed distribution of efficiency across products as seen in the shipments data. The methodology also results in a share of consumers being assigned product efficiencies that minimize their life-cycle costs in the absence of standards. This represents consumers making informed decisions regarding the efficiency of their products, without amended standards. These consumers will be negatively impacted by the adopted standard levels and the analysis accounts for these impacts. However, the

[124] These sensitivity results can be found in the LCC Results spreadsheet, available at *www.regulations.gov/docket/EERE-2017-BT-STD-0019* (docket reference)

methodology also acknowledges that some consumers are unable to minimize the life-cycle costs of their products for a variety of reasons discussed in the economics literature (*e.g.*, renters with no say in the products purchased for their household). Even for motivated and informed consumers, the information and data required to ultimately make the best product choice that minimizes life-cycle cost is complex and time-consuming. As a result, there are a subset of consumers for whom adopting more stringent standard levels will result in life-cycle savings. DOE's methodology reflects some degree of market efficiency in terms of consumer choice of product efficiency, but it also reflects a variety of observed effects that inhibit perfect market efficiency. This is representative of the water heater market. On the whole, when accounting for both consumers negatively impacted by, as well as those benefiting from, amended standards, DOE's analysis demonstrates that there are economically justified savings.

9. Payback Period Analysis

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

The inputs to the PBP calculation for each efficiency level are the change in total installed cost of the product and the change in the first-year annual operating expenditures relative to the baseline. DOE refers to this as a "simple PBP" because it does not consider changes over time in operating cost savings.  The PBP calculation uses the same inputs as the LCC analysis when deriving first-year operating costs.

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

10. Accounting for Product Switching

For the preliminary analysis, DOE did not account for product switching under potential standards.  For the July 2023 NOPR and this final rule, DOE maintained the same approach and did not include any product switching with respect to gas-fired instantaneous water heaters in its analysis.  DOE assumes that any product switching as a result of the adopted standards is likely to be minimal.

As discussed in the specific examples in the following paragraphs and in Section 9.4 of the final rule TSD, the costs to switch to another product class can be higher than simply purchasing a standards-compliant product in the same product class.  When faced with the need to replace a gas-fired instantaneous water, a consumer can either install a standards-compliant product of the same product class as they originally had, or consider a switch to a standards-compliant product of an alternative product class. Similarly, when faced with the need to install a consumer water heater in new construction, the consumer can choose from available standards-compliant products across various product classes. As part of considering which water heater to purchase, consumers look at the first cost, the installation cost, expected energy savings, and the amenities provided by the water heaters such as the location within the residence and the amount of hot water the water heater could deliver.

In consumer hot water heater replacement scenarios, shipments data demonstrate purchasers mostly replace their existing water heater with the same product class when purchase price is similar (*see* section 9.3.1 of chapter 9 of the TSD for details). In the case of gas-fired instantaneous water heaters, other product classes often cost more to switch to and install than a standards-compliant gas-fired instantaneous water heater (as discussed below). Even if, for a given household, another product class costs less, DOE expects other factors (including logistical barriers, lower LCC savings, shorter product lifetimes, and other attributes consumers value in instantaneous water heaters) to limit product-switching. Because of the higher cost in some scenarios, consumer preferences, and other limitations on product-switching, DOE concludes it is extremely unlikely that consumers would choose to switch product classes specifically in response to these amended standards. In the absence of amended standards, some consumers choose to switch for reasons other than simply cost, and that is reflected in historical market trends that are incorporated into the analysis. However, for the purposes of the analysis, the issue is whether *more* consumers would switch due to the higher incremental costs of standards-compliant products.  DOE concludes that this is very unlikely and therefore market trends will be unaffected.

DOE compared the costs of a consumer switching from a baseline non-condensing gas-fired instantaneous water heater to three potential replacement options (standards-compliant gas-fired instantaneous water heater, baseline gas-fired storage water heater under the recently updated standard, and baseline electric storage water heater under the recently updated standard), in both residential new construction and replacement scenarios for existing households.  In the new construction scenario, the analysis shows that average total installed costs are typically lowest for a standards-compliant gas-fired instantaneous water heater. In the replacement scenario, the factors considered in DOE's analysis show that average total installed costs are lower in some cases and marginally higher in others. However, switching to an alternative option also involves several additional costs to accommodate the alternative water heater, including new venting, electrical upgrades, and potential relocation of the water heater. Accordingly, even if, for a given household, a potential replacement option other than a standards-compliant gas-fired instantaneous water heater is cheaper to install, DOE expects that other factors will limit consumer incentives for product switching: logistical barriers arising from different physical and space requirements as described below, the greater LCC savings of a gas-fired instantaneous water heater, the longer lifetime of a gas-fired instantaneous water heater, and consumer preferences for instantaneous water heater attributes such as limitless hot water supply.  DOE notes many consumers have already switched from a gas-fired storage to a gas-fired instantaneous water heater despite the high costs of doing so (to replace all the venting and potentially relocate the water heater), and does not expect this trend to reverse as a result of the amended standards.

In the hypothetical case of a consumer switching from a gas-fired instantaneous water heater to an electric storage water heater when replacing a water heater in an existing household, there are likely additional installation costs necessary to add an electrical connection since this type of water heater typically requires high wattage. These are costs above and beyond the normal equipment and installation costs. In some cases, it may be possible to install a 120-volt heat pump storage water heater with minimal additional installation costs, particularly if there is a standard electrical outlet nearby already. In most cases, however, a standard 240-volt electrical storage water heater would be installed. To do so, the consumer would need to add a 240-volt circuit to either an existing electrical panel or upgrade the entire panel if there is insufficient room for the additional amperage. The installation of a new 240-volt circuit by a qualified electrician will be at least several hundred dollars. Panel upgrade costs are significant and can be approximately $750 – $2,000 to upgrade to a 200-amp electrical panel.[125] Older homes and homes with gas-fired space heating (*e.g.*, homes with gas furnaces) are more likely to need an electrical panel upgrade in order to install an electric storage water heater, given the relatively modest electrical needs of the home at the time of construction. The average total installed cost of a replacement standards-compliant electric storage water heater is $1,913,[126] therefore the average total costs to switch to an

[125] For example, see: *www.homeadvisor.com/cost/electrical/upgrade-an-electrical-panel/#upgrade* (last accessed August 29, 2024).

[126] These results are available in the May 2024 final rule LCC Results spreadsheet (EERE-2017-BT-STD-0019-1424), where LCC results are available separately for replacements and new construction. Available at: www.regulations.gov/document/EERE-2017-BT-STD-0019-1424 (last accessed: Aug. 29, 2024).

electric storage water heater, after accounting for electrical upgrade costs, easily exceed the average replacement cost of a standards-compliant gas-fired instantaneous water heater ($2,499). Given the significant additional installation costs for nearly all homes potentially switching to an electric water heater, DOE estimates that very few consumers would switch from gas-fired instantaneous water heaters to electric water heaters as a result of an energy conservation standard, especially at the adopted standard at TSL 2. When including the above additional costs, the average total installed cost to switch to an electric water heater is higher than the standards-compliant gas-fired instantaneous water heater. Instantaneous water heaters also provide differing utility to consumers compared to storage water waters (*e.g.*, limitless hot water) and thus these products are not perfect substitutes. Additionally, storage water heaters require more space than a gas-fired instantaneous water heater and may require relocating the water heater, incurring even greater costs. Switching from a gas-fired instantaneous water heater to an electrical water heater is especially unlikely in the case of an emergency replacement where time is a critical factor. When a water heater fails, consumers typically have limited time to make a decision on what new water heater to purchase and rely upon replacing the water heater with one that is similar to the one that failed. Consumers are unlikely to invest in switching fuels to a water heater that utilizes a different fuel source in the emergency replacement scenario. See section 9.4 of the final rule TSD for a summary comparison of costs.

In the hypothetical case of a consumer switching from a gas-fired instantaneous water heater to a gas-fired storage water heater when replacing a water heater in an existing household, there are additional installation costs necessary as well. The vast majority of gas-fired storage water heaters ("GSWHs") utilize non-condensing technology that utilizes Category I type B metal vent material, whereas gas-fired instantaneous water heaters require Category III or Category IV venting material, depending on the existing efficiency level. Regarding existing non-condensing gas-fired instantaneous water heaters, A.O. Smith and Rinnai noted that these utilize Category III venting (A.O. Smith, No. 1182 at p. 15; Rinnai, No. 1443 at p. 12). Condensing gas-fired instantaneous water heaters require Category IV venting. Switching from a gas-fired instantaneous water heater to a baseline GSWH would therefore require replacing the venting regardless of the existing efficiency of the gas-fired instantaneous water heater. Replacing the venting system would result in significant additional installation costs if a consumer opted to switch to a GSWH. The most comparable cost for this scenario is the average cost to install a GSWH in new construction ($2,095),[127] which requires all-new venting, however this estimate does not include removal and disposal costs for the old equipment or potentially relocating the water heater. GSWHs and gas-fired instantaneous water heaters have very different physical dimensions and space requirements, with GSWHs being significantly larger water heaters. Switching from a gas-fired instantaneous water heater to a GSWH may not always be possible in the available space and may require even larger costs to accommodate a GSWH (*e.g.*, relocating the water heater in the home). This may be particularly acute in smaller households where space is at a premium (*e.g.*, townhomes). All of these additional costs can easily exceed many

[127] These results are available in the May 2024 final rule LCC Results spreadsheet (EERE-2017-BT-STD-0019-1424), where LCC results are available separately for replacements and new construction. Available at: www.regulations.gov/document/EERE-2017-BT-STD-0019-1424 (last accessed: Aug. 29, 2024).

hundreds of dollars, if not higher, depending on need to relocate the water heater.[128] Therefore, the total cost to switch to a GSWH can exceed the cost to simply replace with a standards-compliant gas-fired instantaneous water heater ($2,499). This situation is the same as exists today, prior to the amendment of standards for either gas-fired instantaneous water heaters or for GSWHs. The cost differential is very similar between the two and the market share of instantaneous water heaters is growing relative to storage tank water heaters, not the reverse. See section 9.4 of the final rule TSD for a summary comparison of costs.

Furthermore, the average lifetime of a gas-fired instantaneous water heater is approximately 20 years, compared to approximately 14.5 years for GSWHs, which results in a total annualized cost of ownership for instantaneous water heaters that is even lower compared to GSWHs. Instantaneous water heaters also provide differing utility to consumers (*e.g.*, limitless hot water) and thus these products are not perfect substitutes. These attributes are clearly valued by consumers, given the recent increasing market share of gas-fired instantaneous water heaters. Consumers that have already paid the costs to switch from an existing GSWH to a gas-fired instantaneous water heater in the absence of any amended standard are highly unlikely to switch back to a GSWH due to amended standards and pay all of those extra costs again.

As a result of all the cost and other considerations above, DOE estimates that it is highly unlikely that consumers would switch from gas-fired instantaneous water heaters

[128] As an example of such costs, Table 8D.5.66 in the final rule TSD estimates permitting, removal, and disposal costs of $260. Section 8D.3.5.3 (3) of the May 2024 final rule TSD estimates that relocation costs in the case of electric storage water heaters could range up to $2,000. Relocating GSWHs would incur similar costs to accommodate all-new water and gas lines in a relocation. Available at: www.regulations.gov/document/EERE-2017-BT-STD-0019-1416 (last accessed: Aug. 29, 2024).

to GSWHs when needing to replace their existing water heater, specifically as a result of the incremental costs of an energy conservation standard, particularly in the case of an emergency replacement.

Even if some small subset of existing gas-fired instantaneous water heater consumers opt to switch to GSWHs instead of replacing their gas-fired instantaneous water heaters with a more efficient unit as a result of the adopted standards, despite the additional costs in doing so, those consumers would still need to switch to a more efficient GSWH at the newly adopted standard level. 89 FR 37778. While this would result in a marginal increase in energy consumption and life-cycle costs for these consumers, those increases are smaller than if the consumers switched to a previous baseline GSWH. Furthermore, these marginal increases would be outweighed by the energy savings and life cycle savings of the remaining consumers of gas-fired instantaneous water heaters. For example, even if 10 percent of gas-fired instantaneous water heater consumers elected to switch to GSWHs despite the costs, the percentage of consumers experiencing a net cost would increase by at most 10 percent and the average LCC savings for gas-fired instantaneous water heater consumers would still be positive, which would not change the conclusion of economic justification. It would likely take approximately half of the GIWH purchasers to choose a gas storage water heater instead of a GIWH in order for the economic justification to come into question, which is not a plausible scenario given the facts and analysis concerning the costs associated with switching as presented above.

In new construction, the average total installed costs are different because new venting is always required if installed indoors, however the location of the water heater can be optimized to limit those venting costs for gas-fired instantaneous water heaters. Water heaters can also be installed outdoors in some cases. In today's market, the total installed cost of a gas-fired instantaneous water heater in new construction is typically less than a GSWH, a factor in the increasing market share of gas-fired instantaneous water heaters seen in recent historical shipments (as described in section IV.G) and projected in the no-new-standards case. With newly adopted standards for both GSWHs and gas-fired instantaneous water heaters, the average total installed cost (including all venting) of a minimally standards-compliant GSWH in residential new construction is $2,095,[129] which is similar to and slightly higher than a minimally compliant gas-fired instantaneous water heater in residential new construction at the amended standard level ($2,070). The adopted standard levels for both GSWHs and gas-fired instantaneous water heaters therefore preserve this market dynamic and gas-fired instantaneous water heaters will continue to have total installed costs that are similar to or lower on average in new construction compared to GSWHs. Furthermore, gas-fired instantaneous water heaters have longer lifetimes (representing a more cost-effective investment) and additional features (such as a smaller footprint and endless hot water supply) that will continue to be attractive to some builders and consumers. As a result, DOE estimates that the existing trend of increasing gas-fired instantaneous water heater market share in new construction will continue.

[129] These results are available in the May 2024 final rule LCC Results spreadsheet (EERE-2017-BT-STD-0019-1424), where LCC results are available separately for replacements and new construction. The total installed costs for baseline models (reflecting the current minimally compliant models) are similarly less for gas-fired instantaneous water heaters compared to GSWHs. Available at: www.regulations.gov/document/EERE-2017-BT-STD-0019-1424 (last accessed: Aug. 29, 2024).

In existing installations of GSWHs, there are significant costs to switch from a GSWH to a gas-fired instantaneous water heater, since new venting is required. In today's market, however, some consumers are electing to make that switch despite the extra costs, because instantaneous water heaters have certain attributes that consumers value (*e.g.*, smaller footprint, endless supply of hot water). Even with the adopted standard for gas-fired instantaneous water heaters, the relative incremental cost will be similar because DOE also recently adopted a revised standard for GSWH in a May 2024 final rule, so costs for both product classes will increase. 89 FR 37778. For example, the average total installed cost of a pre-standard baseline GSWH in a residential replacement installation was estimated to be $1,376 in the May 2024 final rule, whereas the average total installed cost of a baseline gas-fired instantaneous water heater in a residential replacement installation is estimated to be $2,282.[130] Therefore, switching to baseline gas-fired instantaneous water heaters in existing GSWH installations in today's market already represents a significant additional cost, estimated to be $906 on average, nearly twice the cost of simply replacing a GSWH with another GSWH. Despite this extra cost, the market share of gas-fired instantaneous water heaters in replacement installations is increasing. With newly adopted standards for both product classes, the average installed costs in residential replacement installations for minimally compliant products are estimated to be $1,523 and $2,499 for GSWHs and gas-fired instantaneous water heaters, respectively, with a difference of $976. Therefore, there is still a significant additional cost to switch after the adoption of new standards, just as in today's market. However,

[130] Separate LCC results for residential vs. commercial buildings and replacement installations vs. new construction are available in the LCC results spreadsheets. The May 2024 final rule LCC results spreadsheet is available at: www.regulations.gov/document/EERE-2017-BT-STD-0019-1424 (last accessed Sept. 17, 2024).

instantaneous water heaters will continue to have the same attributes and features that some consumers prefer and those consumers will continue to make the switch when replacing their existing storage water heaters, despite the costs of doing so. The adopted standard level for gas-fired instantaneous water heaters is unlikely to significantly disrupt this existing market dynamic because there was already a high cost to switch from existing GSWHs to gas-fired instantaneous water heaters.

Even if a small subset of existing GSWH consumers, who would have switched to gas-fired instantaneous water heaters in the no-new-standards case, instead remain with GSWHs as a result of the adopted standards, the adopted rule for gas-fired instantaneous water heaters will still result in significant energy savings even though the overall energy savings might be incrementally lower than estimated in this final rule analysis. In this hypothetical scenario, even if the market growth of gas-fired instantaneous water heaters slows down and more consumers remain with GSWHs, there are still energy and LCC savings for gas-fired instantaneous water heaters, the rule as a whole saves a significant amount of energy, and therefore the conclusion of economic justification remains unchanged.

DOE received comments from stakeholders who were concerned that, if DOE were to adopt more stringent standards for gas-fired instantaneous water heaters compared to the standards adopted for gas-fired storage water heaters, consumers would opt for gas-fired storage water heaters instead of gas-fired instantaneous water heaters, which could have negative impacts to the outcome of this rulemaking.

TPPF stated that consumers recognize the differences between condensing and non-condensing products, which leads consumers to purchase products at different price points. Because condensing products are more expensive, TPPF stated, consumers will instead opt for non-condensing gas-fired storage water heaters, and these economic tradeoffs illustrate that condensing and non-condensing water heaters are not interchangeable. (TPPF, No. 1153 at pp. 3–4)

Rinnai stated their expectation that most would-be consumers of non-condensing tankless water heaters would instead purchase less efficient gas-fired storage water heaters if the proposed standards are finalized. Rinnai asserted that, because DOE does not adequately account for such product switching, DOE’s analysis overstates LCC and energy savings for gas-fired instantaneous water heaters. Rinnai estimated that at least 80 percent of their current non-condensing gas-fired instantaneous water heater sales would switch to non-condensing gas-fired storage water heaters as a result of the proposed rule. Rinnai added that based on their calculations, if 31 percent of the market switched, there would be a net loss of 0.4 percent in energy savings and 0.04 percent in emissions reductions as compared to the manufacturer’s analysis of a no-new-standards case scenario over the first 20 years the proposed rule goes into effect. (Rinnai, No. 1186 at pp. 2–18)

The Attorney General of GA commented that condensing and non-condensing gas-fired tankless water heaters are highly efficient and reduce standby heat loss as compared to traditional storage-type units. The Attorney General of GA commented that both types (condensing and non-condensing) of tankless water heaters require less energy and have higher lifespans than units with tanks, and both types currently satisfy DOE’s minimum efficiency requirement. (Attorney General of GA, No. 1026 at p. 1) In response to the July 2024 NODA, Commenters from the U.S. House of Representatives claimed that the "unique design" of non-condensing gas-fired instantaneous water heaters yields a longer appliance life-cycle by heating water only on demand, limiting exposure to corrosive elements. (U.S. House of Representatives, No. 1445 at p. 1)

DOE agrees with the commenters that instantaneous water heaters are different from storage water heaters because they heat water on demand; however, this ability is not unique to non-condensing gas-fired products. "Tankless" models are instantaneous water heaters with very little storage volume. They are equipped with sensors that activate the heating process based on water flow to produce hot water on demand. Endless hot water is a feature that is valued by some consumers, as indicated by the recent increasing market share of gas-fired instantaneous water heaters. Furthermore, DOE's analysis shows that gas-fired instantaneous water heaters can have longer lifetimes than gas-fired storage water heaters. The estimated average lifetime for a gas-fired instantaneous water heater is about 20 years, whereas gas-fired storage water heaters operate for about 14 to 15 years. This is one reason why there has been a historical trend of increasing shipments of gas-fired instantaneous water heaters— both non-condensing and condensing— and why it is reasonable to expect consumers to continue opting for gas-fired instantaneous water heaters in a scenario where standards are set at a condensing efficiency level.

Rinnai noted that the efficiency levels for gas-fired instantaneous water heaters proposed in the July 2023 NOPR represent a much larger increase from existing standards than the proposed efficiency levels for gas-fired storage water heaters. (Rinnai, No. 1186 at pp. 6–7) Commenters from the U.S. House of Representatives expressed concern that the efficiency level for the proposed standards for gas-fired storage water heaters are less stringent than the efficiency level proposed for gas tankless water heaters. Commenters from the U.S. House of Representatives asserted that this efficiency difference would restrict consumer choice and increase prices. (U.S. House of Representatives, No. 1025 at pp. 1–2) Commenters from the U.S. House of Representatives reiterated these concerns in response to the July 2024 NODA, claiming that the proposed standards would eliminate non-condensing gas-fired instantaneous water heaters from the market. The U.S. House of Representatives stated that the proposed standards would leave condensing gas-fired instantaneous water heaters, which are significantly more expensive, and gas-fired storage water heaters, which have significantly higher emissions profiles, on the market. (U.S. House of Representatives, No. 1445 at p. 1) Commenters from the U.S. House of Representatives claimed that the proposed standards would harm consumers who rely on the size, cost, and flexibility of gas-fired instantaneous water heaters. (U.S. House of Representatives, No. 1445 at p. 1)

CNGC urged DOE to reconsider the implications on both consumers and manufacturers, stating that if efficiency standards exceed 91 percent, it becomes technologically infeasible to produce non-condensing gas-fired tankless water heaters at their current affordable price, leaving consumers to choose less-efficient storage water heaters and undermine environmental goals. (CNGC, No. 648 at p. 1) CHPK and Huntsville Utilities also stated that the unattainable energy efficiency requirements for gas-fired instantaneous water heaters utilizing non-condensing technology would discourage consumers from investing in tankless models, and instead they would purchase less-efficient water heaters. (CHPK, No. 1008 at pp. 1–2; Huntsville Utilities, No. 1176 at p. 1) The Attorney General of GA commented that the proposed standards are feasible only for condensing units and would make tankless water heaters unaffordable for many consumers. The Attorney General of GA added that the proposed rulemaking will effectively eliminate non-condensing gas-fired tankless water heaters and leave consumers with a choice between less-efficient storage water heaters, or more expensive condensing tankless water heaters, and suggested that if consumers are incentivized to purchase inefficient storage water heaters, the rule will violate DOE's requirement that any new or amended standards must result in a significant conservation of energy. (Attorney General of GA, No. 1026 at pp. 1–2)

DOE recognizes that total installed cost is a significant factor in consumer decision-making when purchasing a new water heater. In this final rule, DOE has incorporated specific feedback from stakeholders to improve its life-cycle cost analysis with respect to installation cost estimates. As discussed above, DOE concludes that, based on costs, consumers who already have gas-fired instantaneous water heaters would not switch to a gas-fired storage water heater when making a replacement. Secondly, in new construction, installing a gas-fired instantaneous water heater is still less expensive on average than installing a gas-fired storage water heater with the adoption of amended standards. Thirdly, consumers switching from gas-fired storage water heaters to gas-fired instantaneous water heaters in the no-new-standards case will require a change to the venting configuration regardless of whether the gas-fired instantaneous water heater is non-condensing or condensing. The choice to switch from a storage water heater to an instantaneous water heater in the no-new-standards case is influenced by other factors beyond just cost. Based on its assessments of total installed costs in the life-cycle cost analysis, DOE has determined that it is unlikely for consumers to stop switching from gas-fired storage water heaters to gas-fired instantaneous water heaters only as a result of the adopted rule. Even if that premise was true, where a fraction of consumers in the amended standards case, as compared to the no-new-standards case, opted to stay with storage water heaters instead of switching to instantaneous water heaters, DOE would still find economic justification with the adopted rule. A majority of consumers would have to forgo adopting instantaneous water heaters in the standards case for the rule to result in an increase in energy consumption, a scenario DOE has determined to not be remotely plausible given the discussion of total installed costs above.

The Attorney General of TN commented that the proposed rulemaking does not consider the loss of consumer utility that could occur from the implementation of these standards, particularly consumers' needs for different types of water heaters (*i.e.*, condensing versus non-condensing) depending on the configuration of their home. The Attorney General of TN commented that by reducing market availability for non-condensing, gas-fired, instantaneous water heaters in favor of less affordable electric-powered water heaters, the proposed rulemaking would lead consumers to purchase less-efficient non-condensing gas-storage water heaters. (Attorney General of TN, No. 1149 at p. 3)

In the July 2023 NOPR, DOE explained why non-condensing versus condensing gas-fired appliances do not constitute a consumer utility for which the Department can justify separate standards. 88 FR 49058, 49079. This determination is discussed further in section IV.A.1 of this document.

NPGA, APGA, AGA, and Rinnai stated that DOE misunderstands the consumer water heater market due to its claim that consumers do not make decisions based on rational economic terms, but conceded that many water heater decisions are made in emergencies where price and immediate availability are the strongest factors in decision-making. According to NPGA, APGA, AGA, and Rinnai, DOE rejects the idea that consumers would switch products across various product classes and does not evaluate associated market shifts, and by failing to understand that by limiting or eliminating the market for non-condensing instantaneous water heaters, consumers may choose to switch to a non-condensing gas-fired storage water heaters, resulting in a lower UEF and enhanced emissions from their water heater and has not accounted for installation costs of this potential product class switch. (NPGA, APGA, AGA, and Rinnai, No. 441 at p. 3)

In response, DOE notes that its assessment is based on the comparison of total installed costs needed to switch from product class to product class, as noted above. The total costs to switch product classes in response to an amended standard are higher than simply purchasing a compliant product in the same product class. Therefore, DOE estimates no switching in response to an amended standard as a result of incremental costs. DOE does not reject the idea that this may happen in the no-new-standards case for reasons other than just total cost. Indeed, the shipments projection accounts for recent market trends that show growing consumer demand for gas-fired instantaneous water heaters compared to GSWHs. Consumers are valuing instantaneous water heater features beyond just cost. DOE estimates that this trend will not substantively change in the standards case, given that cost comparison between GSWHs and gas-fired instantaneous water heaters is similar, whether at baseline ELs or at the adopted ELs.

Commenting on the July 2023 NOPR, Ecotemp commented that product switching, from tankless to tank water heaters is likely to happen as a result of this rule and DOE not modeling that possibility is missing a huge consumer base doing exactly that. (Ecotemp, No. 1092 at p. 2) NMHC and NAA stated that DOE fails to properly evaluate the impacts of market unavailability that forces product switching with the example of the elimination of non-condensing tankless water heaters from the proposed standard potentially requiring a non-condensing gas storage water heater over a traditional replacement of non-condensing tankless water heaters, and the 25 percent drop in efficiency associated with these products. NMHC and NAA stated that this rule will result in greater use of electric water heaters in replacement of existing gas water heaters which will require more interconnectivity, changes to power systems, and upgrades to electrical infrastructure. (NMHC and NAA, No. 996 at p. 5)

In response, DOE notes that existing market trends are incorporated into the shipments analysis and projection. To the extent that some product classes are becoming more prevalent in certain types of buildings, that is reflected in the no-new-standards case shipments projection. With respect to switching from a tankless to storage tank water heater, as summarized above, , DOE determines that minimal switching would happen to either a gas-fired storage or electric storage water heater. As DOE has discussed above, the costs to switch product classes in response to amended standards are larger than simply purchasing standards-compliant products within the same product classes. Therefore, DOE estimates that no additional switching will occur beyond existing market trends.

Atmos Energy argued that because the cost to fuel switch is high, DOE fails to "acknowledge the equally prohibitive costs that will be associated with high efficiency gas appliances as a result of this proposal and the lack of gas-fired replacements in the market." (Atmos Energy, No. 1183 at p. 6). Rinnai argued that DOE has failed to take into account substitution effects in replacement markets, especially in regards to non-condensing gas-fired instantaneous water heater. Rinnai argued that in particular the lack of consideration of non-condensing gas-fired instantaneous water heater to gas storage water heater (due to lack of condensing gas-fired instantaneous water heater option) is not being represented. (Rinnai, No. 1186 at pp. 30-31) As discussed above, DOE estimates that switching away from gas-fired instantaneous water heaters as a result of the rule is likely to be negligible, due to the high installation costs of such switching, (costs that are acknowledged to be high by Atmos Energy in their comment). DOE finds no evidence that there would be a lack of condensing gas-fired instantaneous water heater models available in the standards case for replacements. Many such models for gas-fired instantaneous water heaters are currently available on the market by multiple manufacturers. See chapter 8 and appendix 8D of the final rule TSD for detailed description of the installation costs.

Rinnai stated that the July 2024 NODA declares that no consumers would switch between product categories, including to gas storage water heaters, an assumption that Rinnai stated would contradict historic market data and evidence of consumer purchasing behavior. According to Rinnai, gas tankless water heaters are taking market share from gas tank sales, with GSWH sales declining at the same time gas-fired instantaneous water heater sales have increased. Rinnai speculated that this may be due to consumer purchasing decisions due to the increased cost to purchase and install gas-fired instantaneous water heater. Rinnai also note that by removing non-condensing gas-fired instantaneous water heater options, consumers may be less inclined to replace an existing GWSH with an even more expensive condensing gas-fired instantaneous water heater unit. Rinnai stated that DOE's position that consumers purchasing gas tankless water heaters will never consider buying a gas tank in contrary to observable market behavior. (Rinnai, No. 1443, at p. 2 and pp. 5-8)

In contrast, the Joint Advocates supported DOE's conclusion that the proposed standards for gas-fired instantaneous water heaters would not result in any significant product switching among consumers. The Joint Advocates commented that, contrary to one manufacturer's assumption, such an outcome is highly unlikely for the following reasons: (1) gas-fired instantaneous water heaters are already significantly more expensive than gas storage water heaters and that the total installed cost of a gas-fired instantaneous water heater that just meets the current standard is 41 percent higher than that of a gas storage water heater; (2) the cost differential between gas storage and gas-fired instantaneous water heaters would remain essentially unchanged at the proposed standard level (i.e., the estimated total installed cost of gas-fired instantaneous water heaters would remain at 41 percent higher than gas storage water heaters); (3) consumers with an existing gas-fired instantaneous water heater would be unlikely to replace it with a gas storage water heater due to space and venting issues; and (4) DOE data show that 70 percent of current gas-fired instantaneous water heater sales are already at condensing levels and more than 60 percent of current sales meet EL 2. For these reasons, the Joint Advocates supported DOE's determination that additional consumer product switching is unlikely as a result of amended standards for gas-fired instantaneous water heaters. (Joint Advocates, No. 1444 at pp. 2-3)

A.O. Smith agreed with DOE's conclusion that condensing standards for gas-instantaneous water heaters would not shift shipments away from tankless products due to significant cost for changing venting system. The commenter also noted that approximately 65 percent of shipments are already condensing products and it suggests that consumers are already voluntarily opting for condensing tankless products despite their higher initial costs over non-condensing tankless products. (A.O. Smith, No. 1440 at p. 6)

In response, DOE acknowledges that historic and present-day market trends show an increasing demand for gas-fired instantaneous water heaters over GSWHs. This overall trend is incorporated into the shipments analysis and shipment projections, as discussed in section IV.G of this document. However, this market dynamic is occurring in the absence of any new energy conservation standard for gas-fired instantaneous water heaters. In new construction, instantaneous water heaters are becoming popular in large part because the total installed cost of a gas-fired instantaneous water heater is, on average, similar to or less than a GSWH, since new venting is required in either case and the venting length can be very short for gas-fired instantaneous water heaters. Even with the adopted standard level, gas-fired instantaneous water heaters will continue to be similar to or less expensive to install in new construction, on average, and therefore the standard is highly unlikely to cause significant product switching to GSWHs. Furthermore, instantaneous water heaters also provide differing utility to consumers (*e.g.*, limitless hot water, smaller footprint) compared to storage water heaters. These attributes are clearly valued by consumers, given the recent increasing market share of gas-fired instantaneous water heaters.

11. Analytical Results

Rinnai stated that the Department has proposed new minimum efficiency standards for twelve separate categories of consumer gas-fired instantaneous water heaters but the Department provided only one life-cycle-cost analysis for them. (Rinnai, No. 1186 at p. 34)

In response, DOE clarifies that for two types of gas-fired instantaneous water heaters (and each of their four their associated draw patterns), DOE is only updating the rating metric to the UEF descriptor and the adopted standards do not constitute an increase in stringency. This applies to 8 of the 12 categories the commenter identified. For gas-fired instantaneous water heaters with less than 2 gallons of effective storage volume and rated inputs greater than 50,000 Btu/h, DOE conducted an analysis, as presented in this final rule, to determine whether amended UEF standards would be appropriate and justified. Two of the four draw patterns have no products and no market share in today's market and thus there is no analysis to conduct. For the remaining two draw patterns (medium and high draw), they are fully analyzed as part of DOE's rulemaking analysis and incorporated into the LCC consumer sample. DOE assigned a draw pattern to the sampled household or building based on the market split of two draw patterns. The analytical results are a weighted average representing the economic impact to the market as a whole combing the two draw patterns. Additionally, the published analytical results spreadsheet contains the breakdown of the results by draw patterns.

Commenting on the July 2023 NOPR, Rinnai argued that the density distribution of its LCC analysis for gas-fired instantaneous water heaters shows heavily skewed distributions which can be attributed to high impact outliers. Rinnai argued that because the mean is being used to determine feasibility, it moves the LCC results away from its central tendencies and typical savings/costs for consumers. Rinnai argued that DOE should do a sensitivity analysis on gas-fired instantaneous water heater to defend the impact of the proposal. (Rinnai, No. 1186 at p. 21) Rinnai argued that small changes in estimates of installation costs or maintenance costs for condensing gas-fired instantaneous water heaters could result in negative average LCC savings. Rinnai argued this sensitivity warrants not enacting the standard for gas-fired instantaneous water heaters. (Rinnai, No. 1186 at p. 22

Rinnai noted that the LCC probability distribution contains a long tail with many consumers experiencing higher LCC values than the average value. Rinnai suggested that DOE should produce results using "different averaging" to better understand the impact of different data populations. Rinnai stated that DOE should consider the distribution in consumer trade-offs between upfront costs and long-term savings, as well as the overall costs that many consumers will face across different scenarios, to provide more accurate insights on consumer behavior, purchasing decisions, and impacts on cost savings and energy savings. (Rinnai, No. 1443 at pp. 20-21) In response, DOE clarifies that it uses probability distributions for a number of input variables that are reasonably expected to exhibit natural variation and diversity in practice (*e.g.*, lifetime, repair cost, installation costs). These probability distributions are modeling diversity and are representative of the real world. In contrast, DOE addresses input uncertainty primarily with the use of sensitivity scenarios. To determine whether the conclusions of the analysis are robust, DOE performed several sensitivity scenarios with more extreme versions of these input variables (*e.g.*, high/low economic growth and energy price scenarios, alternative price trend scenarios, alternative mean lifetime scenarios). The relative comparison of potential standard levels in the analysis remains the same throughout these sensitivity scenarios, confirming that the conclusion of economic justification is robust despite some input uncertainty. Furthermore, DOE provides a range of statistics in the LCC spreadsheet, including median values and values at various percentiles for many intermediate variables, as well as the full data output table for all 10,000 samples. For example, the 25$^{th}$ and 75$^{th}$ percentiles of average LCC savings for all ELs are available in the LCC spreadsheet. DOE also provides a distribution of impacts, including consumers with a net benefit, net cost, and not impacted by the rule in the LCC spreadsheet and in chapter 8 of the final rule TSD.

DOE develops probabilities for as many inputs to the LCC analysis as possible, to reflect the distribution of impacts as comprehensively as possible. For example, DOE develops probabilities for building sampling, installation costs, lifetime, discount rate, and efficiency distribution, among other inputs. If there are insufficient data with respect to a specific input parameter to create a robust probability distribution, DOE will utilize a single input parameter. Such approach is neither arbitrary nor capricious; it is informed by the available data.

The installation and maintenance cost estimates are the result of a significant research and cite multiple sources, as discussed at length in section IV.F.2 and appendix 8D of the final rule TSD. DOE has incorporated feedback from various stakeholders and revised those costs for this final rule. There is no basis to expect installation costs are under- or overestimated and therefore creating sensitivity scenarios based on hypothetical adjustments to those costs is unwarranted.

As discussed in section IV.F.8, DOE also conducted a sensitivity analysis for gas-fired instantaneous water heaters in which certain positive outlier outcomes were replaced. While the average (and median) LCC savings are reduced in this sensitivity analysis, they are still positive.[131]

DOE provides stakeholders with the opportunity to provide accurate data to represent a breadth of operating conditions, prices, and use cases. In the absence of stakeholder provided information, DOE makes a good-faith effort to collect reliable data from various sources and summarize assumptions on the missing parameters. The Monte Carlo simulation and its large number of samples (10,000 for each product class) ensures that the results converge to a representative average. For some inputs whose uncertainty is not well characterized, such as future equipment prices or economic growth conditions, DOE performed a series of sensitivity analyses to ensure that the results of the analysis are not strongly dependent on those inputs and that the conclusions of the analysis remain the same. As a result, DOE's conclusion of economic justification is robust to a broad range of sensitivity scenarios which capture the uncertainty inherent in economic projections.

Rinnai claimed that the LCC savings at the EL 2 in the July 2024 NODA are minimal (approximately $5 a year), while imposing substantial costs on a large

[131] This sensitivity result can be found in the LCC Results spreadsheet, available at XXXX.

percentage of consumers. Rinnai claimed that the July 2024 NODA results are based on flawed and inaccurate data and assumptions and Rinnai's analysis shows the LCC savings would be negative at the proposed EL if DOE adjusted venting installation costs. (Rinnai, No. 1443 at pp.10, 18-19 and 25) In response, DOE has individually responded to Rinnai's specific comments to the venting installation cost methodology in section IV.F.2. DOE reviewed the analytical method for this final rule and based on the results the LCC savings are still in support of the proposed efficiency level.

*G. Shipments Analysis*

DOE uses projections of annual product shipments to calculate the national impacts of potential amended or new energy conservation standards on energy use, NPV, and future manufacturer cash flows.[132] The shipments model takes an accounting approach, tracking market shares of products and the vintage of units in the stock. Stock accounting uses product shipments as inputs to estimate the age distribution of in-service product stocks for all years. The age distribution of in-service product stocks is a key input to calculations of both the NES and NPV, because operating costs for any year depend on the age distribution of the stock.

DOE developed shipment projections based on historical data and an analysis of key market drivers for each product. DOE estimated consumer gas-fired instantaneous water heater shipments by projecting shipments in three market segments: (1) replacement of existing consumer gas-fired instantaneous water heaters; (2) new housing; and (3) new owners in buildings that did not previously have a consumer gas-fired

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

instantaneous water heater or existing gas-fired instantaneous water heater owners that are adding an additional consumer gas-fired instantaneous water heater.[133]

To project gas-fired instantaneous water heater replacement shipments, DOE developed retirement functions from gas-fired instantaneous water heater lifetime estimates and applied them to the existing products in the housing stock, which are tracked by vintage. DOE calculated replacement shipments using historical shipments and lifetime estimates. Annual historical shipments sources are: (1) AHRI data submittals;[134] (2) the BRG Building Solutions 2023 report;[135] (3) ENERGY STAR unit shipments data;[136] and (4) the 2010 Heating Products Final Rule. In addition, DOE adjusted replacement shipments by taking into account demolitions, using the estimated changes to the housing stock from *AEO2023*.

To project shipments to the new housing market, DOE used the *AEO2023* housing starts and commercial building floor space projections to estimate future numbers of new homes and commercial building floor space. DOE then used data from U.S. Census Characteristics of New Housing,[137,138] Home Innovation Research Labs

---

[133] The new owners primarily consist of households that add or switch to a different water heater option during a major remodel. Because DOE calculates new owners as the residual between its shipments model compared to historical shipments, new owners also include shipments that historically switch away from water heater product class to another.
[134] AHRI. Confidential Instantaneous Gas-fired Water Heater Shipments Data from 2004-2007 to LBNL. March 3, 2008.
[135] BRG Building Solutions. The North American Heating & Cooling Product Markets (2023 Edition). 2023.
[136] ENERGY STAR. Unit Shipments data 2010-2021. multiple reports. Available at *www.energystar.gov/partner_resources/products_partner_resources/brand_owner_resources/unit_shipment_data* (last accessed August 29, 2024).
[137] U.S. Census. Characteristics of New Housing from 1999-2022. Available at *www.census.gov/construction/chars/* (last accessed August 29, 2024).
[138] U.S. Census. Characteristics of New Housing (Multi-Family Units) from 1973-2022. Available at *www.census.gov/construction/chars/mfu.html* (last accessed August 29, 2024).

Annual Builder Practices Survey,[139] RECS 2020, AHS 2021, and CBECS 2018 to estimate new construction water heater saturations for consumer gas-fired instantaneous water heaters.[140]

DOE estimated shipments to the new owners' market based on residual shipments from the calculated replacement and new construction shipments compared to historical shipments in the last 5 years (2018–2023 for this final rule). DOE compared this with data from the Decision Analysts' 2002 to 2022 American Home Comfort Study[141] and 2023 BRG data, which showed similar historical fractions of new owners. DOE used the last 10 years (2013–2022) of modeled new owner data to project trend into future years from 2023-2059. If the resulting fraction of new owners is negative, DOE assumed that it was primarily due to equipment switching or non-replacement and added this number to replacements (thus reducing the replacements value).

For the preliminary analysis and July 2023 NOPR, assumptions regarding future policies encouraging electrification of households and electric water heating were speculative at that time, so such policies were not incorporated into the shipments projection.

---

[139] Home Innovation Research Labs (independent subsidiary of the National Association of Home Builders ("NAHB"). Annual Builder Practices Survey (2015-2019). Available at *www.homeinnovation.com/trends_and_reports/data/new_construction* (last accessed August 29, 2024).
[140] Note that DOE does not project housing regionally. New housing is therefore assumed to grow in the same regional distribution as the current data would suggest.
[141] Decision Analysts, 2002, 2004, 2006, 2008, 2010, 2013, 2016, 2019, and 2022 American Home Comfort Study. Available at *www.decisionanalyst.com/syndicated/homecomfort/* (last accessed August 29, 2024).

DOE acknowledges, however, that ongoing electrification policies at the Federal, State, and local levels are likely to encourage installation of electric water heaters in new homes and adoption of electric water heaters in homes that currently use gas-fired water heaters. For example, the Inflation Reduction Act includes incentives for heat pump water heaters and electrical panel upgrades. However, there are many uncertainties about the timing and impact of these policies that make it difficult to fully account for their likely impact on gas and electric water heater market shares in the time frame for this analysis (*i.e.*, 2030 through 2059). Nonetheless, DOE's shipments projections account for impacts that are most likely in the relevant time frame. The assumptions are described in chapter 9 and appendix 9A of the final rule TSD. The changes result in a decrease in gas-fired instantaneous water heater shipments in the no-new-standards case in 2030 compared to the preliminary analysis. DOE acknowledges that electrification policies may result in a larger decrease in shipments of gas-fired instantaneous water heaters than projected in this final rule, especially if stronger policies are adopted in coming years. However, this would occur in the no-new amended standards case and thus would only reduce the energy savings estimated in this adopted rule. For example, if incentives and rebates shifted 5 percent of shipments in the no-new amended standards case from gas-fired instantaneous water heaters to heat pump electric storage water heaters, then the energy savings estimated for gas-fired instantaneous water heaters in this adopted rule would decline by approximately 5 percent. The estimated consumer impacts are likely to be similar, however, except that the percentage of consumers with no impact at a given efficiency level would increase. DOE notes that the economic justification for the adopted rule would not change if DOE included the impact of incentives and rebates in the no-new-standards case, even if the absolute magnitude of the savings were to decline.

DOE does not estimate that a significant market shift away from instantaneous water heaters would occur, given that the relative comparison of prices between gas-fired instantaneous and storage water heaters will remain similar. See section IV.F.10 for a detailed discussion.

1. Impact of Repair vs. Replace

DOE estimated a fraction of consumer gas-fired instantaneous water heater replacement installations that choose to repair their equipment, rather than replace their equipment in the new standards case. The approach captures not only a decrease in consumer gas-fired instantaneous water heater replacement shipments, but also the energy use from continuing to use the existing consumer gas-fired instantaneous water heater and the cost of the repair. DOE assumes that the demand for water heating is inelastic and, therefore, that no household or commercial building will forgo either repairing or replacing their equipment (either with a new consumer gas-fired instantaneous water heater or a suitable water heating alternative).

For details on DOE's shipments analysis and the repair option, see chapter 9 of the final rule TSD.

*H. National Impact Analysis*

The NIA assesses the national energy savings ("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.[142] ("Consumer" in this context refers to consumers of the product being regulated.) DOE calculates the NES and NPV for the potential standard levels considered based on projections of annual product shipments, along with the annual energy consumption and total installed cost data from the energy use and LCC analyses. For the present analysis, DOE projected the energy savings, operating cost savings, product costs, and NPV of consumer benefits over the lifetime of consumer gas-fired instantaneous water heaters sold from 2030 through 2059.

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

DOE uses a spreadsheet model to calculate the energy savings and the national consumer costs and savings from each TSL. Interested parties can review DOE's analyses by changing various input quantities within the spreadsheet. The NIA spreadsheet model uses typical values (as opposed to probability distributions) as inputs.

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

Table IV.12 summarizes the inputs and methods DOE used for the NIA analysis for the final rule.  Discussion of these inputs and methods follows the table.  See chapter 10 of the final rule TSD for further details.

**Table IV.12 Summary of Inputs and Methods for the National Impact Analysis**

| Inputs | Method |
|---|---|
| Shipments | Annual shipments from shipments model. |
| Compliance Date of Standard | 2030 |
| Efficiency Trends | No-new-standards case: Based on historical data.<br>Standard cases: Roll-up in the compliance year and then DOE estimated growth in shipment-weighted efficiency in all the standards cases. |
| 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.<br>Incorporates projection of future product 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 values do not change with efficiency level. |
| Energy Price Trends | *AEO2023* projections (to 2050) and extrapolation thereafter. |
| Energy Site-to-Primary and FFC Conversion | A time-series conversion factor based on *AEO2023*. |
| Discount Rate | Three and seven percent. |
| Present Year | 2024 |

1. Product Efficiency Trends

A key component of the NIA is the trend in energy efficiency projected for the no-new-standards case and each of the standards cases.  Section IV.F.8 of this document describes how DOE developed an energy efficiency distribution for the no-new-standards case (which yields a shipment-weighted average efficiency) for the year of anticipated compliance with an amended standard.  To project the trend in efficiency absent amended standards for consumer gas-fired instantaneous water heaters over the entire shipments projection period, DOE used available historical shipments data and manufacturer input. The approach is further described in chapter 10 of the final rule TSD.

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 (2030). In this scenario, the market shares of products in the no-new-standards case that do not meet the standard under consideration would “roll up” to meet the new standard level, and the market share of products above the standard would remain unchanged.

To develop standards case efficiency trends after 2030, DOE used historical shipment data and current consumer gas-fired instantaneous water heater model availability by efficiency level (see chapter 8). DOE estimated growth in shipment-weighted efficiency by assuming that the implementation of ENERGY STAR’s performance criteria and other incentives would gradually increase the market shares of higher efficiency water heaters. Using historical BRG shipments data and ENERGY STAR criteria, DOE estimated the annual increase in market share for condensing units between 2015 – 2022 and assumed the increasing trend would continue would continue over the shipments projection period.  DOE notes that at present, most gas-fired instantaneous water heater models already achieve EL 2 or higher.

## 2. National Energy Savings

The national energy savings analysis involves a comparison of national energy consumption of the considered products between each potential standards case (“TSL”) and the case with no new or amended energy conservation standards.  DOE calculated the national energy consumption by multiplying the number of units (stock) of each product (by vintage or age) by the unit energy consumption (also by vintage). DOE calculated annual NES based on the difference in national energy consumption for the no-new-standards case and for each higher efficiency standard case. DOE estimated energy consumption and savings based on site energy and converted the electricity consumption and savings to primary energy (*i.e.*, the energy consumed by power plants to generate site electricity) using annual conversion factors derived from *AEO2023*. For natural gas, primary energy is the same as site energy. Cumulative energy savings are the sum of the NES for each year over the timeframe of the analysis.

Use of higher-efficiency products is sometimes associated with a direct rebound effect, which refers to an increase in utilization of the product due to the increase in efficiency. DOE examined a 2009 review of empirical estimates of the rebound effect for various energy-using products.[143] This review concluded that the econometric and quasi-experimental studies suggest a mean value for the direct rebound effect for household water heating of around 10 percent. DOE also examined a 2012 ACEEE paper[144] and a 2013 paper by Thomas and Azevedo.[145] Both of these publications examined the same studies that were reviewed by Sorrell, as well as Greening *et al.*,[146] and identified methodological problems with some of the studies. The studies believed to be most

---

[143] Steven Sorrell, *et al.*, Empirical Estimates of the Direct Rebound Effect: A Review, 37 *Energy Policy* 1356–71 (2009). Available at *www.sciencedirect.com/science/article/pii/S0301421508007131* (last accessed August 29, 2024).
[144] Steven Nadel, "The Rebound Effect: Large or Small?" ACEEE White Paper (August 2012). Available at *www.aceee.org/files/pdf/white-paper/rebound-large-and-small.pdf* (last accessed August 29, 2024).
[145] Brinda Thomas and Ines Azevedo, Estimating Direct and Indirect Rebound Effects for U.S. Households with Input–Output Analysis, Part 1: Theoretical Framework, 86 *Ecological Econ*. 199–201 (2013). Available at *www.sciencedirect.com/science/article/pii/S0921800912004764*) (last accessed August 29, 2024).
[146] Lorna A. Greening, *et al.*, Energy Efficiency and Consumption—The Rebound Effect—A Survey, 28 *Energy Policy* 389–401 (2002). Available at *www.sciencedirect.com/science/article/pii/S0301421500000215* (last accessed August 29, 2024).

reliable by Thomas and Azevedo show a direct rebound effect for water heating products in the 1-percent to 15-percent range, while Nadel concludes that a more likely range is 1 to 12 percent, with rebound effects sometimes higher for low-income households that could not afford to adequately heat their homes prior to weatherization. DOE applied a rebound effect of 10 percent for consumer gas-fired instantaneous water heaters used in residential applications based on studies of other residential products and the value used for consumer water heaters in the 2010 Final Rule for Heating Products, and 0 percent for consumer water heaters in commercial applications, which also matches EIA's National Energy Modeling System ("NEMS") for residential and commercial water heating and is consistent with other recent energy conservation standards rulemakings.[147, 148, 149, 150] The calculated NES at each efficiency level is therefore reduced by 10 percent in residential applications. DOE also included the rebound effect in the NPV analysis by accounting for the additional net benefit from increased consumer gas-fired instantaneous water heaters usage, as described in section IV.H.3 of this document.

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

---

[147] *See www.eia.gov/outlooks/aeo/nems/documentation/* (last accessed August 29, 2024)
[148] DOE. Energy Conservation Program for Certain Industrial Equipment: Energy Conservation Standards for Small, Large, and Very Large Air-Cooled Commercial Package Air Conditioning and Heating Equipment and Commercial Warm Air Furnaces; Direct final rule. 81 FR 2419 (Jan. 15, 2016). Available at *www.regulations.gov/document/EERE-2013-BT-STD-0021-0055* (last accessed August 29, 2024).
[149] DOE. Energy Conservation Program: Energy Conservation Standards for Residential Boilers; Final rule. 81 FR 2319 (Jan. 15, 2016). Available at *www.regulations.gov/document/EERE-2012-BT-STD-0047-0078* (last accessed August 29, 2024).
[150] DOE. Energy Conservation Program: Energy Conservation Standards for Commercial Packaged Boilers; Final Rule. 85 FR 1592 (Jan. 10, 2020). Available at *www.regulations.gov/document/EERE-2013-BT-STD-0030-0099* (last accessed August 29, 2024).

FFC measures of energy use and greenhouse gas and other emissions in the national impact analyses and emissions analyses included in future energy conservation standards rulemakings. 76 FR 51281 (Aug. 18, 2011). After evaluating the approaches discussed in the August 18, 2011 notice, DOE published a statement of amended policy in which DOE explained its determination that EIA's National Energy Modeling System ("NEMS") is the most appropriate tool for its FFC analysis and its intention to use NEMS for that purpose. 77 FR 49701 (Aug. 17, 2012). NEMS is a public domain, multi-sector, partial equilibrium model of the U.S. energy sector[151] that EIA uses to prepare its *Annual Energy Outlook.* The FFC factors in corporate 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.

Rinnai claimed that DOE has not adequately explained how national energy savings at the proposed level increased to 0.52 quads in the July 2024 NODA from 0.4 quads in the NOPR. (Rinnai, No. 1443 at p. 8)

For the July 2023 NOPR, DOE incorporated RECS 2015 as the basis of the building sample development and energy use determination, while for July 2024 NODA, DOE incorporated RECS 2020 as the basis of the building sample development and energy use determination and updated the analyses accordingly (see section IV.E of this document). The updated RECS includes a much larger sample size and higher water

[151] 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/documentation/* (last accessed August 29, 2024).

usage and energy consumption estimates on average for consumer gas-fired instantaneous water heaters. Using RECS 2020 for the sample development and energy use determination therefore results in larger differences in annual energy consumption between higher efficiency levels and lower efficiency levels. Because the estimates of national energy savings are based on the differences in annual energy consumption between higher efficiency levels and lower efficiency levels, the estimated national primary energy savings increased from approximately 0.45 quads to approximately 0.52 quads. Rinnai claims the national energy savings and associated emission reductions are overstated because DOE did not properly account for consumers switching to gas-fired storage water heaters as a response to the standard which would increase overall energy consumption of water heaters. Rinnai projects that an additional savings of 0.61 quads and reductions of 39 million metric tons in $CO_2$ emissions are possible if non-condensing gas-fired instantaneous water heaters are allowed to stay on the market. Rinnai requested DOE analyze product substitution and the impact of various scenarios on energy savings and emission reductions (Rinnai, No. 1443 at pp. 8-9, 26) Rinnai believes that would-be purchasers of non-condensing gas-fired instantaneous water heaters would likely purchase gas-fired storage water heaters rather than condensing gas-fired instantaneous water heaters. Rinnai states that if 30 percent of would-be purchasers opted for gas-fired storage water heaters instead, there would be no energy savings by the standard. Rinnai believes that fewer people are purchasing gas-fired instantaneous water heater in 2023 due to inflation, implying that gas-fired instantaneous water heater purchasers are price-sensitive. (also Rinnai, No. 1435, at p. 2, 4, 10-11, 14-15)

DOE estimates that it is highly unlikely that consumers would switch from gas-fired instantaneous water heaters to gas-fired storage water heaters specifically as a result of the incremental costs of an energy conservation standard because the differential costs between the two products will remain similar (see section IV.F.10 for an expanded discussion). Therefore, product switching as a result of the proposed standards is likely to be negligible. DOE's estimates of national energy savings and associated emission reductions appropriately reflect current data and market trends. Any potential energy savings that might occur from consumers switching from gas-fired storage water heaters to gas-fired instantaneous water heaters, in the absence of new standards, is already incorporated into the no-new-standards case. And because DOE estimates that switching is unlikely to be impacted as a result of amended standards, these potential energy savings are present in both the standards and no-new-standards cases. The commenter's projection of additional energy savings and emissions reduction if non-condensing gas-fired instantaneous water heaters are allowed to stay on the market is a misunderstanding of DOE's estimates of national energy savings and associated emission reductions.

3. Net Present Value Analysis

The inputs for determining the NPV of the total costs and benefits experienced by consumers are (1) total annual installed cost, (2) total annual operating costs (energy costs and repair and maintenance costs), and (3) a discount factor to calculate the present value of costs and savings. DOE calculates net savings each year as the difference between the no-new-standards case and each standards case in terms of total savings in operating costs versus total increases in installed costs. DOE calculates operating cost savings over the lifetime of each product shipped during the projection period.

As discussed in section IV.F.1 of this document, DOE used constant prices as the default price assumption to project future consumer gas-fired instantaneous water heater prices. However, DOE also developed consumer gas-fired instantaneous water heater price trends based on historical PPI data. To evaluate the effect of uncertainty regarding the price trend estimates, DOE investigated the impact of different product price projections on the consumer NPV for the considered TSLs for consumer gas-fired instantaneous water heaters. In addition to the default constant price trend, DOE considered two product price sensitivity cases: (1) a price decline case and (2) price increase case based on PPI data. The derivation of these price trends and the results of these sensitivity cases are described in appendix 10C 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 residential energy price changes in the Reference case from *AEO2023*, which has an end year of 2050. To estimate price trends after 2050, the 2046–2050 average was used for all years. As part of the NIA, DOE also analyzed scenarios that used inputs from variants of the *AEO2023* Reference case that have lower and higher economic growth. Those cases have lower and higher energy price trends compared to the Reference case. NIA results based on these cases are presented in appendix 10C of the final rule TSD.

In considering the consumer welfare gained due to the direct rebound effect, DOE accounted for change in consumer surplus attributed to additional water heating from the purchase of a more efficient unit. Overall consumer welfare is generally understood to be enhanced from rebound. The net consumer impact of the rebound effect is included in the calculation of operating cost savings in the consumer NPV results. See appendix 10E of the final rule TSD for details on DOE's treatment of the monetary valuation of the rebound effect.

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.[152] The discount rates for the determination of NPV are in contrast to the discount rates used in the LCC analysis, which are designed to reflect a consumer's perspective. The 7-percent real value is an estimate of the average before-tax rate of return to private capital in the U.S. economy. The 3-percent real value represents the "social rate of time preference," which is the rate at which society discounts future consumption flows to their present value.

*I. Consumer Subgroup Analysis*

In analyzing the potential impact of new or amended energy conservation standards on consumers, DOE evaluates the impact on identifiable subgroups of consumers that may be disproportionately affected by a new or amended national

[152] U.S. Office of Management and Budget. *Circular A-4: Regulatory Analysis*. Available at *www.whitehouse.gov/omb/information-for-agencies/circulars* (last accessed Mar. 5, 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 August 29, 2024).

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. For this final rule, DOE analyzed the impacts of the considered standard levels on three subgroups: (1) low-income households, (2) senior-only households, and (3) small businesses. The analysis used subsets of the RECS 2020 sample composed of households and CBECS 2018 sample composed of commercial buildings that meet the criteria for the three subgroups. DOE used the LCC and PBP spreadsheet model to estimate the impacts of the considered efficiency levels on these subgroups. Chapter 11 of the final rule TSD describes the consumer subgroup analysis.

1. Low-income Households

Low-income households, as defined by the poverty thresholds from the U.S. Bureau of the Census, are significantly more likely to be renters or live in subsidized housing units and less likely to be homeowners. DOE notes that in these cases, the landlord purchases the equipment and may pay the gas bill as well. RECS 2020 includes data on whether a household pays for the gas bill, allowing DOE to categorize households appropriately in the analysis.[153] For this consumer subgroup analysis, DOE considers the impact on the low-income household narrowly, excluding any costs or benefits that are accrued by either a landlord or subsidized housing agency. This allows DOE to determine whether low-income households are disproportionately affected by an

[153] RECS 2020 includes a category for households that pay only some of the gas bill. For the low-income consumer subgroup analysis, DOE assumes that these households pay 50 percent of the gas bill, and, therefore, would receive 50 percent of operating cost benefits of an amended energy conservation standard.

amended energy conservation standard in a more representative manner. By contrast, for the main LCC results for the whole consumer sample, all costs and benefits are accrued by the user of the product.

DOE finds no evidence that significant rental cost increases would occur due to an amended standard. Rental prices are largely dictated by supply and demand of housing in individual locations, not the sum of equipment costs in those rentals, such that two similar rentals could have widely differing prices. Furthermore, a landlord would be responsible for replacing an end-of-life gas-fired instantaneous water heater in the no-new-standards case as well yet the rent is unlikely to increase simply because of this regular maintenance. The installation costs estimated in the LCC already include any potential replacement of venting for gas-fired instantaneous water heaters. Finally, even if a landlord were to fully pass on the incremental costs due to amended standards, those costs would presumably be spread out over a monthly rent spanning many years, possibly the lifetime of the water heater, resulting in relatively small monthly rent increases. It is for these reasons that the low-income subgroup analyzes impacts assuming renters do not bear installation and equipment costs. However, as described in section IV.F, for the overall LCC analysis, DOE makes the simplifying assumption that all installation and equipment costs are paid for by the consumer of the equipment, including renters. Therefore, the main LCC results do assume that landlords pass on all costs and yet the analysis still finds that the rule is economically justified. The main LCC and the consumer subgroup analysis are therefore two boundary conditions with respect to costs and benefits accrued by renters.

The majority of low-income households that experience a net cost at higher efficiency levels are homeowner households, as opposed to renters. These households typically have lower hot water use. Unlike renters, homeowners would bear the full cost of installing a new water heater. For these households, a potential rebate program to reduce the total installed costs would be effective in lowering the percentage of low-income consumers with a net cost. DOE understands that the landscape of low-income consumers with a gas-fired instantaneous water heater may change before the compliance date of amended energy conservation standards, if finalized. For example, point-of-sale rebate programs are being considered that may moderate the impact on low-income consumers to help offset the total installed cost of a higher efficiency gas-instantaneous water heater. Currently, DOE is aware that the Inflation Reduction Act will likely include incentives for certain water heaters, although the specific implementation details have yet to be finalized. Point-of-sale rebates or weatherization programs could also reduce the total number of low-income consumers that would be impacted because the household no longer has a water heater to upgrade.

Responding to the July 2023 NOPR, Atmos Energy argued the elimination of non-condensing instantaneous water heaters will cause consumers to switch to less efficient options. Atmos Energy and ECSC argued that non-condensing instantaneous water heaters require less space and changing to a condensing alternative (or electric alternatives) will cost significantly more. Atmos Energy and ECSC argued that this elimination will impact low-income/multi-family/small home consumers disproportionately. (Atmos Energy, No. 1183 at pp. 2-3; ECSC, No. 1185 at pp. 1-2) As DOE has discussed in section IV.F.10 of this document, it is very unlikely that consumers would switch from existing non-condensing instantaneous water heaters to storage water heaters in response to amended standards. The costs to do so would exceed the costs of simply installing a standards-compliant condensing instantaneous water heater. Furthermore, both a standards-compliant instantaneous water heater and a non-condensing instantaneous water heater require less space compared to a storage water heater.

Additionally, DOE does not expect the existing market trends of consumers switching from storage to instantaneous water heaters (in the no-new-standards case) would be impacted by an amended standard, as any incremental cost for a condensing instantaneous water heater would be small compared to the overall costs to switch from a storage to an instantaneous water heater.

Commenters from the U.S. House of Representatives stated that the proposed rulemaking imposes an unattainable standard for non-condensing, gas-fired tankless water heaters, and expressed concern that it would discourage budget-conscious consumers from investing in tankless models, negatively impacting Georgia manufacturing companies. (U.S. House of Representatives, No. 1205 at p. 1) Commenters from the U.S. House of Representatives reiterated these comments in response to the July 2024 NODA. (U.S. House of Representatives, No. 1445 at p. 1)

In response to the affordability concerns, DOE acknowledges that the average installed cost of gas-fired instantaneous water heaters at EL 2 is estimated to increase by $231 compared to current baseline efficiency levels. However, as discussed in Chapter 11 of the TSD, low-income households make up only 3.2 percent of the market for gas-fired instantaneous water heaters, and of these approximately 38 percent are renters who would likely benefit from the increased efficiency through energy savings without bearing the full burden of installation costs. DOE estimates that at EL 2 low-income consumers of gas-fired instantaneous water heaters will experience on average lifecycle cost savings of $248, with only 6.5 percent of low-income consumers experiencing a net cost. DOE acknowledges that a small proportion of low-income homeowners may experience higher installation costs for condensing gas-fired instantaneous water heaters. However, DOE estimates that the energy savings benefits across the low-income subgroup outweigh these costs. *See* section V.B.1.b for detailed results.

2. Senior-Only Households

Senior-only households are households with occupants who are all at least 65 years of age. RECS 2020 includes information on the age range of household occupants, allowing for the identification of senior-only households from the sample Senior-only households comprised 23.5 percent of the country's households. In estimating the LCC impacts to senior-only households, it is assumed that any residual value of a long-lived product is capitalized in the value of the home.

3. Small Business Subgroup

DOE identified small businesses in CBECS 2018 using threshold levels for maximum number of employees within each building principal building activity.

GRA commented that the proposed standards will discourage restaurants from investing in tankless models and instead choose less efficient water heating solutions and add constraints for restaurant operating with limited space availability. GRA stated that many restaurants rely on gas-fired tankless water heaters due to their space saving attributes and the proposed standards would disproportionately limit the options of small businesses, resulting in higher costs and reduced efficiency. (GRA, No. 449 at p. 1)

As DOE has discussed in section IV.F.10, it is very unlikely that businesses would switch from existing non-condensing instantaneous water heaters to storage water heaters in response to amended standards. The costs to do so would exceed the costs of simply installing a standards-compliant condensing instantaneous water heater. Additionally, DOE does not expect the existing market trends of businesses investing in or switching from storage to instantaneous water heaters (in the no-new-standards case) would be impacted by an amended standard, as any incremental cost for a condensing instantaneous water heater would be small compared to the overall costs to switch from a storage to an instantaneous water heater. If a business is considering investing in a tankless model, they are doing so for space-saving or energy saving reasons that remain valid with a condensing tankless water heater.

### *J. Manufacturer Impact Analysis*

#### 1. Overview

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

The quantitative part of the MIA primarily relies on the GRIM, an industry cash flow model with inputs specific to this rulemaking.  The key GRIM inputs include data on the industry cost structure, unit production costs, product shipments, manufacturer markups, and investments in R&D and manufacturing capital required to produce compliant products.  The key GRIM outputs are the INPV, which is the sum of industry annual cash flows over the analysis period, discounted using the industry-weighted average cost of capital, and the impact to 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 between a no-new-standards case and the various standards cases (*i.e.*, “TSLs”).  To capture the uncertainty relating to manufacturer pricing strategies following amended standards, the GRIM estimates a range of possible impacts under different manufacturer markup scenarios.

The qualitative part of the MIA addresses manufacturer characteristics and market trends.  Specifically, the MIA considers such factors as a potential standard’s impact on manufacturing capacity, competition within the industry, the cumulative impact of other DOE and non-DOE regulations, and impacts on manufacturer subgroups.  The complete MIA is outlined in chapter 12 of the 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 gas-fired instantaneous water heater manufacturing industry based on the market and technology assessment, preliminary manufacturer interviews, and publicly-available information. This included a top-down analysis of gas-fired instantaneous water heater 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 gas-fired instantaneous water heater manufacturing industry, including company filings of form 10-K from the SEC,[154] corporate annual reports, the U.S. Census Bureau's *Quarterly Survey of Plant Capacity Utilization*,[155] U.S. Census Bureau's *Annual Survey of Manufactures* ("*ASM*"),[156] and reports from D&B Hoovers.[157]

In Phase 2 of the MIA, DOE prepared a framework industry cash-flow analysis to quantify the potential impacts of amended energy conservation standards. The GRIM uses several factors to determine a series of annual cash flows starting with the announcement of the standard and extending over a 30-year period following the compliance date of the standard. These factors include annual expected revenues, costs of sales, SG&A and R&D expenses, taxes, and capital expenditures. In general, energy

[154] U.S. Securities and Exchange Commission. Company Filings. Available at *www.sec.gov/search-filings* (last accessed August 29, 2024).
[155] The U.S. Census Bureau. Quarterly Survey of Plant Capacity Utilization. (2007-2019). Available at *www.census.gov/programs-surveys/qpc/data/tables.html* (last accessed August 29, 2024).
[156] U.S. Census Bureau's Annual Survey of Manufactures. (2021). Available at: *www.census.gov/programs-surveys/asm/data/tables.html* (last accessed January 18, 2024).
[157] The D&B Hoovers login is available at *app.dnbhoovers.com* (last accessed August 29, 2024).

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 gas-fired instantaneous water heaters 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 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 an amended energy conservation standard. The GRIM spreadsheet uses the inputs to arrive at a series of annual cash flows, beginning in 2024 (the base year of the analysis) and continuing to 2059. DOE calculated INPVs by summing the stream of annual discounted cash flows during this period. For manufacturers of gas-fired instantaneous water heaters, DOE used a real discount rate of 9.6 percent, which was derived from industry financials and then modified according to feedback received during manufacturer interviews.

The GRIM calculates cash flows using standard accounting principles and compares changes in INPV between the no-new-standards case and each standards case. The difference in INPV between the no-new-standards case and a standards case represents the financial impact of the new or amended energy conservation standard on manufacturers. As discussed previously, DOE developed critical GRIM inputs using a number of sources, including publicly available data, results of the engineering analysis, results of the shipments analysis, and information gathered from industry stakeholders during the course of manufacturer interviews. The GRIM results are presented in section V.B.2 of this document. Additional details about the GRIM, the discount rate, and other financial parameters can be found in chapter 12 of the final rule TSD.

a. Manufacturer Production Costs

Manufacturing more efficient products is typically more expensive than manufacturing baseline products due to the use of more complex components, which are typically more costly than baseline components. The changes in the MPCs of covered products can affect the revenues, gross margins, and cash flow of the industry.

As discussed in section IV.C.1 of this document, DOE conducted a market analysis of currently available models listed in DOE's CCD to determine which efficiency levels were most representative of the current distribution of gas-fired instantaneous water heaters available on the market. DOE also completed physical teardowns of commercially available units to determine which design options manufacturers may use to achieve certain efficiency levels. In this final rule, DOE developed efficiency levels with a combination of the efficiency-level and design-option approaches. DOE requested comments from stakeholders and conducted interviews with manufacturers in advance of the July 2023 NOPR concerning these initial efficiency levels, which have been updated based on the feedback DOE received. For a complete description of the MPCs, *see* section IV.C.1 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 2059 (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. Capital and Product Conversion Costs

New or amended energy conservation standards could cause manufacturers to incur conversion costs to bring their production facilities and product designs into compliance. DOE evaluated the level of conversion-related expenditures that would be needed to comply with each considered efficiency level for gas-fired instantaneous water heaters. For the MIA, DOE classified these conversion costs into two major groups: (1) capital conversion costs, and (2) product conversion costs. Capital conversion costs are investments in property, plant, and equipment necessary to adapt or change existing production facilities such that new compliant product designs can be fabricated and assembled. Product conversion costs are investments in research, development, testing, marketing, and other non-capitalized costs necessary to make product designs comply with new or amended energy conservation standards.

In the July 2023 NOPR and the July 2024 NODA, DOE relied on manufacturer feedback to evaluate the level of capital and product conversion costs that gas-fired instantaneous water heater manufacturers would likely incur to meet each analyzed efficiency level. 88 FR 49058, 49127-49128; 89 FR 59692, 59699-59700. During confidential interviews, DOE asked manufacturers to estimate the capital conversion costs (*e.g.*, changes in production processes, equipment, and tooling), needed to meet the various efficiency levels. DOE also asked manufacturers to estimate the redesign effort and engineering resources required at various efficiency levels to quantify the product conversion costs. DOE then estimated industry-level conversion costs by scaling feedback from OEMs by the estimated number of manufacturers that would need to make these investments at each TSL.

At lower TSLs, manufacturer feedback and a review of the market indicate that most manufacturers already have sufficient condensing production capacity and offer range of models that meet the required efficiency levels. Thus, DOE modeled low-levels of capital and product conversion costs for most manufacturers at TSL 1 and TSL 2. As TSLs increase in stringency, DOE expects most manufacturers would need to add production capacity as fewer shipments currently meet the required levels and product designs increase in complexity. DOE also expects product conversion costs would increase at higher TSLs since fewer manufacturers currently offer fewer models that meet the efficiency levels required. For the July 2024 NODA, DOE refined its conversion cost estimates to reflect feedback submitted by Rinnai in response to the July 2023 NOPR. (Rinnai, No. 1186 at p. 23) DOE incorporated Rinnai's estimate of $15 million[158] required to retrofit its Griffin, GA factory to produce condensing gas-fired instantaneous water heaters into its conversion cost estimates at TSL 1 and modeled additional incremental investments to reach higher TSLs, consistent with manufacturer feedback from confidential interviews. DOE incorporated Rinnai's estimate to convert its U.S. production facility in its analysis to avoid underestimating the potential investments

[158] Rinnai's public comment in response to the July 2023 NOPR (Rinnai No. 1186 at p. 23 and p. 51, which corresponds to p. 13 of Attachment A) cited two different estimates: $15 million (p. 23) and a range of $3 and $9 million (p. 51). To avoid underestimating potential investments, DOE incorporated the higher estimate of $15 million provided by Rinnai.

required to meet potential amended standards. Alternatively, Rinnai could choose to maintain condensing capabilities in its existing facilities in Japan, in which case industry conversion costs would be lower.

For this final rule, DOE updated its conversion cost estimates from 2022$ to 2023$ but otherwise maintained its conversion cost methodology used in the July 2024 NODA.

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 amended standard. The conversion cost figures used in the GRIM can be found in section V.B.2 of this document. For additional information on the estimated 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 efficiency level. Modifying these manufacturer markups in the standards case yields different sets of impacts on manufacturers. For the MIA, DOE modeled two standards-case manufacturer markup scenarios to represent uncertainty regarding the potential impacts on prices and profitability for manufacturers following the implementation of amended energy conservation standards: (1) a preservation of gross margin percentage scenario, and (2) a preservation of operating profit scenario. These scenarios lead to different manufacturer markup values that, when applied to the MPCs, result in varying revenue and cash flow impacts.

Under the preservation of gross margin percentage scenario, DOE applied a single uniform "gross margin percentage" across all efficiency levels, which assumes that manufacturers would be able to maintain the same amount of profit as a percentage of revenues at all efficiency levels within a product class. As MPCs increase with efficiency, this scenario implies that the per-unit dollar profit will increase. DOE estimated a gross margin percentage of 31 percent for gas-fired instantaneous water heaters.[159] Manufacturers tend to believe it is optimistic to assume that they would be able to maintain the same gross margin percentage as their production costs increase, particularly for minimally efficient products. Therefore, this scenario represents a high bound to industry profitability under an amended energy conservation standard.

Under the preservation of operating profit scenario, DOE modeled a situation in which manufacturers are not able to increase per-unit operating profit in proportion to increases in MPCs. In the preservation of operating profit scenario, as the cost of production goes up under a standards case, manufacturers are generally required to reduce their manufacturer markups to a level that maintains base-case operating profit. DOE implemented this 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 compliance date of

[159] The gross margin percentage of 31 percent is based on a manufacturer markup of 1.45.

the amended standards. The implicit assumption behind this scenario is that the industry can only maintain its operating profit in absolute dollars after the standard.

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

In response to the July 2023 NOPR, Rinnai stated that DOE's review of manufacturer impacts did not account for the direct impact of the rulemaking on Rinnai's manufacturing facility located in Griffin, Georgia, which is tooled and optimized for production of non-condensing gas-fired instantaneous water heaters. Rinnai commented that the Griffin facility cost $70 million to build. Rinnai estimates that should the Griffin plant close, it would lead to a loss of gross profit between $30 million to $36 million, annually, and a write-off of $2 million in capital expenditures that could not be repurposed. Rinnai asserted that it would require more than $15 million.[160] to repurpose its Griffin facility to produce condensing gas-fired instantaneous water heaters, which may be cost prohibitive given current product capacity in Japan. Additionally, Rinnai asserted that it was not contacted by DOE as part of this rulemaking. Rinnai commented that the levels proposed in the July 2023 NOPR would make its new Griffin production facility largely obsolete and lead to eliminating 122 jobs. (Rinnai No. 1186 at pp. 22–23) Rinnai noted that of its roughly 72 gas-fired instantaneous models on the market, 32 meet the proposed 0.91 UEF standard for gas-fired instantaneous water heaters, meaning that

[160] Rinnai's submission (Rinnai No. 1186 at p. 23 and p. 51, which corresponds to p. 13 of Attachment A) cited two different estimates: $15 million (p. 23) and a range of $3 and $9 million (p. 51). To avoid underestimating potential investments, DOE references the higher estimate provided by Rinnai.

more than half of its models would be eliminated from the market. (Rinnai, No. 1186 at pp. 4–5)

In response to the July 2024 NODA, Rinnai questioned DOE's assumption that it would convert its Griffin, Georgia manufacturing facility to produce condensing gas-fired instantaneous water heaters. Rinnai restated that it has overseas manufacturing capacity for condensing gas-fired instantaneous water heaters, and the need to expand that capacity would depend on an assessment of market demand. Rinnai commented that under a condensing-level standard, it is not realistic to assume Rinnai would maintain current sales levels (*i.e.*, prospective purchasers may choose condensing products from competitors rather than Rinnai). Rinnai requested that DOE publish a GRIM to support and substantiate its MIA. (Rinnai No. 1443 at pp. 21-22)

The Governor of Georgia stated that the standards proposed in the July 2023 NOPR could negatively impact the non-condensing gas-fired instantaneous water heater industry in the State of Georgia and could harm domestic manufacturing jobs. (Governor of Georgia, No. 1157 at pp. 1–3) The Attorney General of GA stated that the standards proposed in the July 2023 NOPR, if adopted, would have a negative economic impact on the State of Georgia, which is host to a large new facility optimized for manufacturing non-condensing units. The Attorney General of GA added that the proposed rulemaking could eliminate manufacturing jobs in Georgia, particularly jobs held by female and minority workers. (Attorney General of GA, No. 1026 at pp. 1–2) Commenters from the U.S. House of Representatives added that the proposed rulemaking would have a negative economic impact on the State of Georgia, which is home to the largest domestic assembly facility for non-condensing gas-fired instantaneous water heaters. (U.S. House of Representatives, No. 1205 at p. 1) Commenters from the U.S. House of Representatives reiterated this comment in response to the July 2024 NODA. (U.S. House of Representatives, No. 1445 at p. 1)

CNGC noted that investments made by Rinnai, a member of its coalition, would be put at risk if the standards were adopted as proposed in the July 2023 NOPR. (CNGC No. 648 at p. 1) Gas Association Commenters further highlighted Rinnai's concerns, citing Rinnai's recently opened facility in Griffin, Georgia, which exclusively makes non-condensing gas-fired instantaneous water heaters, as potentially being off-shored.

Regarding the potential impact to domestic production employment due to amended standards, DOE understands that Rinnai recently invested approximately $70 million to develop its new Georgia manufacturing facility dedicated to non-condensing gas-fired instantaneous water heaters.[161] DOE acknowledges that converting the manufacturing facility to produce condensing gas-fired instantaneous water heaters is feasible but would require additional investment. Currently, Rinnai imports their condensing gas-fired instantaneous water heaters from Japan, while producing only the non-condensing models domestically. Rinnai's decision of whether to repurpose its Georgia facility likely depends on a range of factors, such as its parent company's (Rinnai Corporation) willingness to make further capital investments, the role of the U.S.

[161] Rinnai cites a total investment of $70 million in the Georgia facility in its public comment in response to the July 2023 NOPR (Rinnai, No. 1186 at p. 23), stating the facility opened in 2022 (*Id.* at p. 1). Construction of the Georgia facility began in 2020. Press Release available at: *www.rinnai.us/announcements/rinnai-america-breaks-ground-on-new-factory* (last accessed August 6, 2024).

water heater market in Rinnai Corporation's overall business strategy, and U.S. demand for gas-fired instantaneous water heaters. A review of Rinnai Corporation's public financial statements indicates that it has invested approximately $823 million in capital expenditures globally in fiscal year 2021 through fiscal year 2024, projecting a further outlay of approximately $148 million in capital expenditures globally in fiscal year 2025.[162] Based on information detailed in Rinnai's corporate annual report, Rinnai identifies the United States as a key foreign market for growth.[163] In fiscal year 2024, U.S. water heater sales accounted for nearly 20 percent of Rinnai Corporation's worldwide water heater sales.[164] Consistent with historical trends and market data cited by stakeholders,[165] DOE projects that the domestic gas-fired instantaneous water heater market will continue to grow in the no-new-standards and standards cases. Furthermore, DOE expects that the portion of condensing gas-fired instantaneous water heater will increase. In 2024 (the reference year), DOE estimates that domestic gas-fired instantaneous water heater shipments totaled 1.26 million (representing approximately 12 percent of the overall domestic consumer water heater market), with condensing gas-fired instantaneous water heaters accounting for 67 percent of shipments. In 2030 (the compliance year), in the absence of the amended standards, DOE expects that shipments

[162] Rinnai Corporation's public financial statements are available at: *www.rinnai.co.jp/en/ir/* (last accessed September 27, 2024). DOE converted these values from Japanese Yen to U.S. Dollars using the U.S. Department of the Treasury's exchange rate as of June 30, 2024, available at: *https://fiscaldata.treasury.gov/datasets/treasury-reporting-rates-exchange/treasury-reporting-rates-of-exchange* (last accessed September 27, 2024).
[163] Rinnai's Medium-Term Business Plan 2021-2025 is available at: *www.rinnai.co.jp/en/ir/document/pdf/202103outlook.pdf*. (p. 15) (last accessed August 6, 2024).
[164] Rinnai Corporation's "Financial Results of Fiscal 2024, ended March 31, 2024 Reference Data" is available at: *www.rinnai.co.jp/en/ir/document/pdf/202403reference.pdf*. (p. 4) (May 9, 2024) (Last accessed September 27, 2024).
[165] Rinnai commented in response to the July 2024 NODA "Since their introduction in 2004, gas tankless water heaters have grown to 10 percent of the water heater market in the U.S. and are projected to grow to 12 percent by 2027." (*See* Rinnai, No. 1443 at p. 1)

of gas-fired instantaneous water heaters would total 1.43 million (representing approximately 14 percent of the overall domestic consumer water heater market), with condensing gas-fired instantaneous water heaters accounting for 70 percent of shipments. In 2030, with the amended standards in place (*i.e.*, TSL 2), DOE expects that shipments of gas-fired instantaneous water heaters would still total approximately 1.43 million, with the share of condensing gas-fired instantaneous water heaters rising to 100 percent. As discussed in section IV.F.10 of this document, DOE did not include any product switching with respect to gas-fired instantaneous water heaters in its analysis as DOE determined that any product switching as a result of the adopted standards is likely to be minimal. As discussed in section IV.G.1 of this document, DOE's shipments analysis accounts for the fraction of consumers that would choose to repair their gas-fired instantaneous water heater rather than replace their gas-fired instantaneous water heater in the standards cases.

DOE previously analyzed the potential changes in direct employment in the July 2023 NOPR. 88 FR 49058, 49145-49147. For the July 2024 NODA, DOE revised its direct employment analysis to account for Rinnai's new domestic production facility dedicated to manufacturing gas-fired instantaneous water heaters. 89 FR 59692, 59697. (*See* Rinnai, No. 1186 at p. 1) DOE is not currently aware of other domestic production facilities of gas-fired instantaneous water heaters. Therefore, in the July 2024 NODA, DOE estimated that approximately 20 percent of gas-fired instantaneous water heaters are currently produced in the United States. DOE derived this value by using its shipments analysis and market share feedback from Rinnai's comments to the July 2023 NOPR.[166] (*Id.*) DOE maintained the 20 percent estimate for this final rule analysis. For the July 2024 NODA, DOE relied on the employment figures provided in Rinnai's comments in response to the July 2023 NOPR to estimate the potential range of direct employment impacts in 2030 (the analyzed compliance year) at higher efficiency levels. In the July 2024 NODA, DOE modeled the domestic employment impacts ranging from a reduction of 128 production workers to an increase of 75 production workers at TSL 1 through TSL 4 in 2030. Based on revised employment estimates provided by Rinnai in response to the July 2024 NODA, DOE updated its estimate of domestic production workers from 128 to 190[167] in 2030 but otherwise maintained its direct employment methodology. (Rinnai No. 1443 at p. 1) Therefore, for this final rule, DOE models a lower-bound decrease of 190 domestic production workers and an upper-bound increase in domestic direct employment of 62 percent (an increase of approximately 117 production workers, for a total of 307 domestic production workers) at TSL 1 through TSL 4 in 2030. DOE notes that the direct employment analysis is intended to establish a realistic range of potential impacts to domestic employment under amended standards, given the best public information available at this time. As Rinnai noted in their comment, if Rinnai does not maintain current sales levels under a condensing-level standard, the change in

[166] In 2023, DOE estimates that approximately 0.41 million out of the 1.22 million gas-fired instantaneous water heater unit shipments are non-condensing. In response to the July 2023 NOPR, Rinnai commented that its domestic market share of non-condensing gas-fired instantaneous water heaters is 60 percent: $(60\% \times 0.41\,million) \div 1.22\,million = 20\%$.

[167] Rinnai commented that it currently employs 183 full-time employees and 49 temporary employees at its Griffin, Georgia plant. DOE's shipments analysis indicates shipments of non-condensing gas-fired instantaneous water heaters in the no-new-standards case will increase by approximately 4 percent from 2024 to 2030 (the compliance year). $(183\,employees \times 1.04) = 190\,employees$

employment may be lower than the maximum increase estimated. *See* section V.B.2.b of this document for additional details on the direct employment analysis.

Regarding the potential investment required to convert Rinnai's newly built domestic production facility, DOE incorporated Rinnai's feedback provided in response to the July 2023 NOPR into its conversion cost model for the July 2024 NODA and this final rule. Although DOE cannot be certain whether or not Rinnai would invest in repurposing its U.S. manufacturing facility, DOE incorporated Rinnai's feedback into its industry conversion cost estimates to avoid underestimating the potential investments industry would incur as a result of amended standards. Should Rinnai choose to maintain condensing capabilities in its existing facilities in Japan, the industry conversion costs would be lower. DOE updated its conversion cost estimates from 2022$ to 2023$ for this final rule but otherwise maintained its methodology from the July 2024 NODA. *See* section IV.J.2.c and section V.B.2.a of this document and chapter 12 of the final rule TSD for additional information on conversion costs.

Regarding Rinnai's assertion that it was not contacted to provide feedback in advance of the July 2023 NOPR, DOE notes that manufacturer outreach and interviews are conducted by DOE's contractors under nondisclosure agreements. As such, information surrounding manufacturer outreach and participation is kept as confidential by DOE's contractors and cannot be disclosed.

Regarding Rinnai's request to review the GRIM, DOE notes that a copy of the GRIM developed for this final rule analysis is available for download at: *www.regulations.gov/docket/EERE-2017-BT-STD-0019/document.*

In response to the July 2023 NOPR, AHRI stated that it supported the inclusion of amortization of product conversion costs under standards into the projected MSP in a recent rulemaking for microwave ovens, and urges DOE to use this methodology in all rulemakings.[168] AHRI further asked DOE to explain the justification for amortizing conversion costs in one instance but not in all. (AHRI, No. 1167 at pp. 20-21)

DOE models different manufacturer markup scenarios to assess the potential impacts on prices and profitability for manufacturers following the implementation of amended energy conservation standards. The analyzed scenarios lead to different manufacturer markup values that, when applied to the manufacturer production costs, result in varying revenue and cash flow impacts. These scenarios are meant to reflect the potential range of financial impacts for manufacturers of the specific covered product or equipment. The analyzed manufacturer markup scenarios vary by rulemaking because they are informed by manufacturer feedback and reflect the market for the specific product type.

For the July 2023 NOPR and the July 2024 NODA, DOE applied a preservation of gross margin percentage scenario to reflect an upper bound to industry profitability under amended standards and a preservation of operating profit scenario to reflect a lower

[168] Technical Support Document: Energy Efficiency Program For Commercial And Industrial Equipment: Microwave Ovens. Available at *www.regulations.gov/document/EERE-2017-BT-STD-0023-0022*.

bound of industry profitability under amended standards. 88 FR 49058, 49128; 89 FR 59692, 59700. For gas-fired instantaneous water heaters, manufacturing more efficient products is generally more expensive than manufacturing baseline or minimally efficient products, as reflected by the MPCs estimated in the engineering analysis (*see* section IV.C.1 of this document). Under the preservation of gross margin scenario for gas-fired instantaneous water heaters, incremental increases in MPCs at higher efficiency levels result in an increase in per-unit dollar profit per unit sold. As shown in Table V.6, under the preservation of gross margin scenario, the standards case INPV *increases* relative to the no-new-standards case INPV at all analyzed TSLs, resulting in a *positive* change in INPV at TSL 1–TSL 4. This implies that the increase in cashflow from the higher MSP outweighs the estimated conversion costs at each of the considered TSLs. In other words, under the preservation of gross margin scenario, the gas-fired instantaneous water heater industry more than recovers conversion costs incurred as a result of amended standards. The approach used in the microwave ovens rulemaking (*i.e.*, a conversion cost recovery scenario) modeled a scenario in which manufacturers recover investments such that INPV in the standards cases are *equal* to the INPV in the no-new-standards case, resulting in no change in INPV at the considered TSLs. 88 FR 39912, 39935. Thus, if DOE applied a conversion cost recovery scenario in this rulemaking, the potential change in INPV at each considered TSL would be within the range of estimated impacts resulting from the preservation of gross margin scenario and preservation of operating profit scenario. As such, DOE maintained the two standards-case manufacturer markup scenarios used in the July 2023 NOPR for this final rule as they most appropriately reflect the upper (least severe) and lower (more severe) impacts to manufacturer profitability under amended standards.

In response to the July 2023 NOPR, AHRI submitted written comments regarding cumulative regulatory burden. AHRI urged DOE to consider the high volume of regulatory activity that directly affects manufacturers of consumer water heaters, including gas-fired instantaneous water heaters, and expressed concern that DOE was rushing to publish recent rulemakings, risking significant revision that will prolong uncertainty, confuse consumers, and potentially undermine broader policy goals. AHRI cited standards and test procedure rulemakings for other covered products and equipment, as well as low and zero NOx actions by California Air Resources Board ("CARB") and individual air quality management districts. (AHRI, No. 1167 at pp. 7-9)

In response to the July 2023 NOPR, BWC commented that the impact of cumulative regulatory burden experienced by manufacturers is not limited to conversion costs, but also to the preparations manufacturers must undergo in order to respond to proposed rules. BWC further stated that DOE has promulgated several major rulemakings that will directly impact the products that BWC manufactures, in addition to actions undertaken by other governments and programs, and that the ability of manufacturers to draw on outside resources for assistance will be severely limited by the concurrent needs of many manufacturers across rulemakings, particularly in the case of third-party laboratories. BWC stated that due to the burden this rulemaking will place on third-party laboratories, as well as the general burden of multiple concurrent ongoing regulatory actions, BWC strongly disagreed with DOE's decision not to consider test rulemakings as part of its analysis. (BWC, No. 1164 at pp. 24-26) BWC also stated that, due to concurrent regulatory actions regarding energy efficiency at both the State and Federal levels, it disagreed with DOE's conclusion in section VI.B.5 of the July 2023 NOPR that there are no rules or regulations that duplicate, overlap, or conflict with this proposed rule and encouraged DOE to account for all of these issues, ideally allowing manufacturers more time to review and respond to DOE rulemakings when requested. (BWC, No. 1164 at p. 24)

With respect to comments regarding the regulatory burden, DOE recognizes that the gas-fired instantaneous water heater industry is subject to regulations from Federal, State, and local entities. DOE analyzes and considers the impact on manufacturers of multiple product/equipment-specific Federal regulatory actions. Specifically, DOE analyzes cumulative regulatory burden pursuant to section 13(g) of Appendix A. 10 CFR part 430, subpart C, appendix A, section 13(g); 10 CFR 431.4. DOE notes that regulations that are not yet finalized 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, which have 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.

Regarding AHRI's comment about ultra-low NOx and zero NOx regulations, DOE notes that in its analysis of cumulative regulatory burden, DOE considers Federal, product specific regulations that have compliance dates within 3 years of one another. DOE is not aware of any Federal or State ultra-low NOx or zero NOx regulations specific to gas-fired instantaneous water heaters with compliance dates within the 7-year cumulative regulatory burden timeframe (2027–2033).[169] DOE notes that certain localities (*i.e.*, California Air Districts) have adopted regulations requiring ultra-low NOx consumer water heaters. DOE accounts for the portion of ultra-low NOx shipments in its analysis. DOE notes that two California Air Districts–the Bay Area[170] and South Coast[171] Air Quality Management Districts have adopted amendments to eliminate NOx emissions from certain gas-fired instantaneous water heaters beginning in 2031 and 2026, respectively. There are currently no natural gas-fired instantaneous water heaters on the market that would meet the zero NOx standards, though manufacturers may choose to develop them.

Regarding BWC's request that DOE not discount the costs for stakeholders to review rulemakings, although DOE appreciates that monitoring and responding to rulemakings does impose costs for stakeholders, DOE believes that this is outside the scope of analysis for individual product rulemakings. Because EPCA requires DOE to establish and maintain the energy conservation program for consumer products and to periodically propose new and amended standards (or propose that standards for products do not need to be amended) and test procedures, DOE considers this rulemaking activity to be part of the analytical baseline (*i.e.*, in the no-new-standards case and the standards

---

[169] CARB has stated that it is committed to explore developing and proposing zero-emission GHG standards for new space and water heaters sold in California as part of the 2022 State Strategy for the State Implementation Plan adopted in September 2022. However, at the time of issuance, CARB has not adopted such standards for gas-fired instantaneous water heaters. Additional information is available at: *https://ww2.arb.ca.gov/our-work/programs/building-decarbonization/zero-emission-space-and-water-heater-standards/meetings-workshops*. (Last accessed Aug. 7, 2024).

[170] Available at: *www.baaqmd.gov/~/media/dotgov/files/rules/reg-9-rule-4-nitrogen-oxides-from-fan-type-residential-central-furnaces/2021-amendments/documents/20230315_rg0906-pdf.pdf?rev=436fcdb037324b0b8f0c981d869e684d&sc_lang=en.* (Last accessed Aug. 7, 2024).

[171] Available at: *www.aqmd.gov/docs/default-source/rule-book/recent-rules/r1146_2-060724.pdf?sfvrsn=8* (Last accessed Aug. 29, 2024).

case). That is, these activities (*e.g.*, reviewing proposed rules or proposed determinations) would exist regardless of the regulatory option that DOE adopts through a rulemaking and would be independent from the conversion costs required to adapt product designs and manufacturing facilitates to meet an amended standard.

In response to the July 2024 NODA, Rheem stated that they agreed with a 70 percent market share estimate for condensing gas-fired instantaneous water heaters and gradual shift towards condensing models. Rheem indicated that most manufacturers already possess the design and manufacturing capabilities necessary to produce products across the full range of efficiencies. Rheem stated that while a condensing-level standard at EL 2 or EL 3 would require manufactures to repurpose and retool assembly lines, a standard consistent with EL 2 (*i.e.*, TSL 2) would be less disruptive compared to higher efficiency levels, which would require a fully modulating burner design and higher investment. Rheem generally agreed with the conclusions of the manufacturer impact analysis but stated that they did not believe the additional energy savings at EL 3 compared to EL 2 were great enough to justify the greater cost to manufacturers. (Rheem No. 1436 at p. 3)

Regarding the need for manufacturers to repurpose and retool assembly lines, DOE accounted for the capital and product conversion costs associated with increasing production of condensing gas-fired instantaneous water heaters in its analysis. Consistent with Rheem's comment, DOE's analysis estimates that conversion costs would be higher at EL 3 and EL 4 compared to EL 2. *See* section IV.J.2.c and section V.B.2.a of this document and chapter 12 of the final rule TSD for additional information on conversion costs.  In this final rule, DOE is adopting TSL 2.  *See* section V.C of this document for a discussion of the benefits and burdens of the TSLs considered.

The Joint Advocates commented that DOE's analysis for the July 2024 NODA shows that the potential impacts on gas-fired instantaneous water heater manufacturers at EL 2 and higher would be modest and that, specifically, the potential impact on INPV at EL 2 ranges from a loss of 2.7 percent to a gain of 3.2 percent. (Joint Advocates, No. 1444 at pp. 1-2)  The Joint Advocates commented that the proposed standards for gas-fired instantaneous water heaters could increase U.S. manufacturing jobs because the labor content required to produce a condensing gas-fired instantaneous water heater is approximately 59 percent more than that required to produce a non-condensing gas-fired instantaneous water heater. (Joint Advocates, No. 1444 at p. 2)

Regarding the potential impacts on gas-fired instantaneous water heater manufacturers, for this final rule, the estimated change in INPV at TSL 2 ranges from a loss of 2.8 percent to a gain of 3.4 percent.  *See* section V.B.2.a of this document for additional information on the MIA results.  Regarding the potential impacts to direct employment, for this final rule, DOE models a lower-bound decrease of 190 production workers and an upper-bound increase in domestic direct employment of 62 percent (an increase of approximately 117 production workers, for a total of 307 domestic production workers) at TSL 1 through TSL 4 in 2030.  *See* section V.B.2.b of this document for additional information on DOE's direct employment analysis.

*K. Emissions Analysis*

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

The analysis of electric power sector emissions of $CO_2$, $NO_X$, $SO_2$, and Hg uses emissions intended to represent the marginal impacts of the change in electricity consumption associated with amended or new standards. The methodology is based on results published for the *AEO*, including a set of side cases that implement a variety of efficiency-related policies. The methodology is described in appendix 13A in the final rule TSD. The analysis presented in this final rule uses projections from *AEO2023*. Power sector emissions of $CH_4$ and $N_2O$ from fuel combustion are estimated using Emission Factors for Greenhouse Gas Inventories published by the EPA..[172]

The on-site operation of consumer gas-fired instantaneous water heaters involves combustion of fossil fuels and results in emissions of $CO_2$, $NO_X$, $SO_2$, $CH_4$, and $N_2O$ where these products are used. Site emissions of these gases were estimated using

[172] Available at *www.epa.gov/sites/production/files/2021-04/documents/emission-factors_apr2021.pdf* (last accessed August 29, 2024).

Emission Factors for Greenhouse Gas Inventories and, for $NO_X$ and $SO_2$, emissions intensity factors from an EPA publication.[173]

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 national impact analysis.

1. Air Quality Regulations Incorporated in DOE's Analysis

DOE's no-new-standards case for the electric power sector reflects the *AEO*, which incorporates the projected impacts of existing air quality regulations on emissions. *AEO2023* reflects, to the extent possible, laws and regulations adopted through mid-November 2022, including the emissions control programs discussed in the following paragraphs the emissions control programs discussed in the following paragraphs, and the Inflation Reduction Act.[174]

[173] U.S. Environmental Protection Agency. External Combustion Sources. In *Compilation of Air Pollutant Emission Factors*. AP-42. Fifth Edition. Volume I: Stationary Point and Area Sources. Chapter 1. Available at *www.epa.gov/air-emissions-factors-and-quantification/ap-42-compilation-air-emissions-factors#Proposed/* (last accessed August 29, 2024).
[174] 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 August 29, 2024).

$SO_2$ emissions from affected electric generating units ("EGUs") are subject to nationwide and regional emissions cap-and-trade programs. Title IV of the Clean Air Act sets an annual emissions cap on $SO_2$ for affected EGUs in the 48 contiguous States and the District of Columbia ("D.C."). (42 U.S.C. 7651 *et seq.*) $SO_2$ emissions from numerous States in the eastern half of the United States are also limited under the Cross-State Air Pollution Rule ("CSAPR"). 76 FR 48208 (Aug. 8, 2011). CSAPR requires these States to reduce certain emissions, including annual $SO_2$ emissions, and went into effect as of January 1, 2015.[175] The *AEO* incorporates implementation of CSAPR, including the update to the CSAPR ozone season program emission budgets and target dates issued in 2016. 81 FR 74504 (Oct. 26, 2016). Compliance with CSAPR is flexible among EGUs and is enforced through the use of tradable emissions allowances. Under existing EPA regulations, 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.[176] 77 FR 9304 (Feb. 16,

[175] CSAPR requires States to address annual emissions of $SO_2$ and $NO_X$, precursors to the formation of fine particulate matter ("$PM_{2.5}$") pollution, in order to address the interstate transport of pollution with respect to the 1997 and 2006 $PM_{2.5}$ National Ambient Air Quality Standards ("NAAQS"). CSAPR also requires certain States to address the ozone season (May-Sept.) 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).

[176] 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.

2012). The final rule establishes power plant emission standards for mercury, acid gases, and non-mercury metallic toxic pollutants. Because of the emissions reductions under the MATS, it is unlikely that excess $SO_2$ emissions allowances resulting from the lower electricity demand would be needed or used to permit offsetting increases in $SO_2$ emissions by another regulated EGU. Therefore, energy conservation standards that decrease electricity generation will generally reduce $SO_2$ emissions. DOE estimated $SO_2$ emissions reduction using emissions factors based on *AEO2023*.

CSAPR also established limits on $NO_X$ emissions for numerous States in the eastern half of the United States. Energy conservation standards would have little effect on $NO_X$ emissions in those States covered by CSAPR emissions limits if excess $NO_X$ emissions allowances resulting from the lower electricity demand could be used to permit offsetting increases in $NO_X$ emissions from other EGUs. In such case, NOx emissions would remain near the limit even if electricity generation goes down. Depending on the 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 NOx 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 products 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 benefits of reducing GHG emissions, the July 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, 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 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" that was presented as Supplementary Material to the RIA.[177] The 2023 SC-GHG estimates incorporate recent research addressing recommendations of the Natural Academies of Science, Engineering, and Medicine (National Academies), responses to public comments on an earlier sensitivity analysis using draft SC-GHG estimates included in EPA's December 2022 proposal in the oil and natural gas sector standards of performance rulemaking, and comments from a 2023 external peer review of the accompanying technical report.[178]

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

[177] https://www.epa.gov/system/files/documents/2023-12/eo12866_oil-and-gas-nsps-eg-climate-review-2060-av16-final-rule-20231130.pdf; https://www.epa.gov/system/files/documents/2023-12/epa_scghg_2023_report_final.pdf (last accessed July 3, 2024)
[178] https://www.epa.gov/system/files/documents/2023-12/epa_scghg_2023_report_final.pdf (last accessed July 3, 2024)

available evidence, are most appropriate for particular analytical contexts, and best facilitate sound decision-making" consistent with OMB Circular A-4 and applicable law.[179]

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.[180] 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 understanding of the state of the science.

Based on this review, in the July 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 values and the 2021 interim SC-GHG estimates. 89 FR 59693, 59700. In this final rule, DOE has not made a final decision regarding that preliminary assessment or adoption of the updated 2023 SC-GHG

[179] https://www.whitehouse.gov/wp-content/uploads/2023/12/IWG-Memo-12.22.23.pdf (last accessed July 3, 2024)

[180] Valuing Climate Damages: Updating Estimation of the Social Cost of Carbon Dioxide | The National Academies Press. (available at: nap.nationalacademies.org/catalog/24651/valuing-climate-damages-updating-estimation-of-the-social-cost-of) (last accessed July 3, 2024)

estimates, as such a decision is not necessary for purposes of this rule. DOE will continue to decide, for each particular analytical context, whether to rely on, present for presentation purposes, or use in some other way, the updated 2023 SC-GHG values, the 2021 interim SC-GHG estimates, or both. 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 itis 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 interim 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 July 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 or across all DOE analyses. 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.

AHRI disagreed with DOE's use of 2023 SC-GHG estimates in its analysis to justify proposed energy conservation standards. AHRI stated that adoption of 2023 SC-GHG methodologies introduces complexity, uncertainty, and traceability issues. AHRI recommended that DOE provide guidance on how 2023 SC-GHG methodologies were applied and offer comparison to the analysis performed in the July 2023 NOPR (AHRI, No. 1437 p. 3).

Rinnai disagreed with DOE's preliminary decision to adopt 2023 SC-GHG methodologies, which they claim introduce challenges regarding the traceability of the data, the complexity and uncertainty of the new estimates, validation of the long-term costs and benefits of GHG emissions and the ability to compare the July 2024 NODA and July 2023 NOPR results. Rinnai further states that if the DOE updates the SC-GHG methodology, the update should be performed for all water heater product classes to reflect a fair comparison. (Rinnai, No. 1443 at p. 10)

In response, DOE reiterates that it would promulgate the same standards in this final rule even in the absence of the benefits of the GHG reductions achieved by the rule because the adopted standards for gas-fired instantaneous water heaters are economically justified even without including such benefits.  DOE would also promulgate the same standards in this final rule using either the 2021 interim SC-GHG estimates or the 2023 SC-GHG estimates.  In this rule, DOE is presenting SC-GHG results using both the interim 2021 SC-GHG estimates and the updated 2023 SC-GHG estimates.

In the July 2024 NODA, DOE preliminarily agreed with EPA's assessment that the updates implemented in the 2023 SC-GHG estimates reflect the best available science and address recommendations from the National Academies. DOE acknowledges commenters' concerns regarding uncertainty of the new estimates, but notes that the 2021 interim SC-GHG estimates are also uncertain and that uncertainty is inherent in all complex cost estimates that quantify physical impacts and translate them into dollar values.

DOE further notes that EPA accounted for uncertainty in various aspects of the 2023 SC-GHG estimates in each of the modules and comprehensively discussed these sources of uncertainty in the Final SC-GHG Report and supporting literature. (See, e.g., EPA Report at p. 77; EPA RTC A-1-7). According to EPA, the updated approaches taken in the methodology behind the 2023 SC-GHG estimates were specifically chosen because they allow for a more explicit representation of uncertainty. Moreover, the treatment of uncertainty was a key focus of the peer review process. Several peer reviewers commended EPA on its comprehensive approach to incorporating uncertainty (EPA Peer Review Summary Report, pgs. 26, 31, 33, etc.). and EPA responded to peer review comments on remaining questions about uncertainty by expanding and clarifying the discussion around uncertainty in each module (throughout Section 2) and added Appendix A.8 and Table A.8.1 to further account for uncertainty.

Because, in this rule, DOE is presenting both the interim 2021 SC-GHG estimates and the 2023 SC-GHG estimates, the comment contending that the updated 2023 SC-GHG estimates are less traceable or less transparent than the 2021 interim SC-GHG estimates are no longer relevant. Insofar as this comment objects to DOE even referring to the 2023 SC-GHG methodologies and using them for presentation purposes, however, we note that EPA developed these estimates through a process that included an initial draft with sensitivity analyses, independent peer review, responses to peer review and comments, available documentation associated with the underlying inputs and a public docket that includes all the studies and reports cited in the analysis. (See e.g., EPA's

“Report on the Social Cost of Greenhouse Gases: Estimates Incorporating Recent Scientific Advances” | US EPA; EPA RTC A-7-4).

Because, in this rule, DOE is presenting both the interim 2021 SC-GHG estimates and the 2023 SC-GHG estimates, the comments that adding an additional, updated estimate of the SC-GHG benefits impairs the public or the industry’s ability to compare the July 2024 NODA and July 2023 NOPR results with the final rule are not relevant.

Finally, the commenter asserted that DOE should update the SC-GHG values for all water heater product classes to reflect a fair comparison. As stated above, because DOE is presenting both the interim 2021 SC-GHG estimates and the 2023 SC-GHG estimates for this rule, this comment is not relevant.

BWC stated that the 2023 SC-GHG estimates are a significant step forward in quantifying the social cost of greenhouse gases. BWC further commented that given the permanence of any minimum energy conservation standards that are established by DOE under EPCA, it is essential that the Department first finalize a robust, consistent, and objective approach towards accurately calculating SC-GHG before allowing this metric to economically justify more stringent standards that would otherwise not yield a positive net present value. BWC also questioned the consistency of the methodologies going forward and the extent that peer experts were able to review and participate in the process. (BWC, No. 1441 at p. 3–4)

DOE appreciates commenter’s statement that the 2023 SC-GHG estimates are an important step forward in the monetization of greenhouse gas emissions.

With respect to the commenter's concerns about peer review, DOE notes again that the 2023 SC-GHG estimates were subjected to independent peer review in line with EPA's Peer Review Handbook 4th Edition, 2015. This process was conducted by an independent contractor and involved two separate comment periods for outside experts. EPA reported that the peer reviewers commended the agency on its development of this update and labeled it a much-needed improvement in estimating the SC-GHG. (EPA Report at p. 3; EPA RTC A-7-11).

Regarding the commenter's concerns about the consistency of the methodologies going forward (BWC, No. 1441 at p. 3–4), DOE reiterates that it is presenting climate benefits using both sets of SC-GHG estimates and that, in future rulemakings, DOE will continue to evaluate the applicability in context and use its professional judgment to apply the SC-GHG estimates that are most appropriate to use at that time.

Finally, DOE reiterates that it would promulgate the same standards in this final rule even in the absence of the benefits of the GHG reductions achieved by the rule. DOE would also promulgate the same standards in this final rule, using either the 2021 interim SC-GHG estimates, rather than the 2023 SC-GHG estimates. Thus, DOE did not, in fact, rely on either the 2023 SC-GHG estimates or the 2021 interim SC-GHG estimates "to economically justify more stringent standards that would otherwise not yield a positive net present value," as the commenter suggests because the adopted standards for gas-fired instantaneous water heaters are economically justified even without including such benefits.

DOE's derivations of the $SC\text{-}CO_2$, $SC\text{-}N_2O$, and $SC\text{-}CH_4$ 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 $SC\text{-}CO_2$ 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.13 in 5-year increments from 2020 to 2050. The 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 products still operating after 2080, but a lack of available $SC\text{-}CO_2$ estimates for emissions years beyond 2080 prevents DOE from monetizing these potential benefits in this analysis.

**Table IV.13. Annual $SC\text{-}CO_2$ 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.14 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,[181] is presented in appendix 14A of the final rule TSD. These estimates are based on methods, assumptions, and parameters identical to the estimates published by the IWG (which were based on EPA modeling), and include values for 2051 to 2070.

**Table IV.14. 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 of the 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

[181] *See* EPA, *Revised 2023 and Later Model Year Light-Duty Vehicle GHG Emissions Standards: Regulatory Impact Analysis*, Washington, D.C., December 2021. Available at *nepis.epa.gov/Exe/ZyPDF.cgi?Dockey=P1013ORN.pdf* (last accessed Dec. 03, 2024).

the values in all of the 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 2023SC-GHG estimates published by the EPA. Table IV.15 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.15. Annual SC-$CH_4$ and SC-$N_2O$ Values Based on 2023 SC-GHG Estimates, 2020–2050 (2020$ per Metric Ton)**

| Emissions Year | SC-CH4 | | | SC-N2O | | |
|---|---|---|---|---|---|---|
| | 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.16 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.16. 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 the EPA's Benefits Mapping and Analysis Program.[182] 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 also estimated the monetized value of $NO_X$ and $SO_2$ emissions reductions from site use of natural gas in consumer gas-fired instantaneous water heaters using benefit per ton estimates from the EPA's Benefits Mapping and Analysis Program. Although none of the sectors covered by EPA refers specifically to residential and commercial buildings, the sector called "area sources" would be a reasonable proxy for residential and commercial buildings.[183] The EPA document provides high and low

[182] U.S. Environmental Protection Agency. *Estimating the Benefit per Ton of Reducing Directly-Emitted PM2.5, PM2.5 Precursors and Ozone Precursors from 21 Sectors*. Available at *www.epa.gov/benmap/estimating-benefit-ton-reducing-directly-emitted-pm25-pm25-precursors-and-ozone-precursors* (last accessed August 29, 2024

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

estimates for 2025 and 2030 at 3- and 7-percent discount rates.[184] DOE used the same linear interpolation and extrapolation as it did with the values for electricity generation.

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

*M. Utility Impact Analysis*

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

[184] "Area sources" are a category in the 2018 document from EPA but are not used in the 2021 document cited above. *See*: *www.epa.gov/sites/default/files/2018-02/documents/sourceapportionmentbpttsd_2018*.pdf.

conservation standards. The utility analysis also estimates the impact on gas utilities in terms of projected changes in natural gas deliveries to consumers for each TSL.

BWC expressed concerns that DOE overestimated the impact of this metric in the analysis presented in the July 2024 NODA pointing to Table III.9, which demonstrates electric utility impact results indicating a substantial decrease in electric load for both installed capacity, as well as electric generation. BWC contended that since gas-fired instantaneous water heaters utilize very little electric energy, they question how adopting more stringent energy conservation standards for these products could impact electric load demand to such a significant extent. (BWC, No. 1441 at p. 4)

In response, DOE notes that the changes listed in Table III.9 of the July 2024 NODA in installed capacity and generation are significantly smaller than total US electric capacity which is over a million Megawatts. Additionally, DOE notes that results for EL 1 through 3 results in an increase in installed capacity as denoted by parentheses.

*N. Employment Impact Analysis*

DOE considers employment impacts in the domestic economy as one factor in selecting a standard. Employment impacts from new or amended energy conservation standards include both direct and indirect impacts. Direct employment impacts are any changes in the number of employees of manufacturers of the products subject to standards. The MIA addresses those impacts. Indirect employment impacts are changes in national employment that occur due to the shift in expenditures and capital investment caused by the purchase and operation of more-efficient appliances. Indirect employment impacts from standards consist of the net jobs created or eliminated in the national economy, other than in the manufacturing sector being regulated, caused by (1) reduced spending by consumers on energy, (2) reduced spending on new energy supply by the utility industry, (3) increased consumer spending on the products to which the new standards apply and other goods and services, and (4) the effects of those three factors throughout the economy.

One method for assessing the possible effects on the demand for labor of such shifts in economic activity is to compare sector employment statistics developed by the Labor Department's Bureau of Labor Statistics ("BLS"). BLS regularly publishes its estimates of the number of jobs per million dollars of economic activity in different sectors of the economy, as well as the jobs created elsewhere in the economy by this same economic activity. Data from BLS indicate that expenditures in the utility sector generally create fewer jobs (both directly and indirectly) than expenditures in other sectors of the economy.[185] 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.[186] 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

[185] *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 August 19, 2024)

[186] *See* U.S. Department of Commerce–Bureau of Economic Analysis. *Regional Input-Output Modeling System (RIMS II) User's Guide*. Available at: *www.bea.gov/resources/methodologies/RIMSII-user-guide* (last accessed Jan. 18, 2024).

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").[187] ImSET is a special-purpose version of the "U.S. Benchmark National Input-Output" ("I-O") model, which was designed to estimate the national employment and income effects of energy-saving technologies. The ImSET software includes a computer- based I-O model having structural coefficients that characterize economic flows among 187 sectors most relevant to industrial, commercial, and residential building energy use.

DOE notes that ImSET is not a general equilibrium forecasting model, and that there are uncertainties involved in projecting employment impacts, especially changes in the later years of the analysis. Because ImSET does not incorporate price changes, the employment effects predicted by ImSET may over-estimate actual job impacts over the long run for this rule. Therefore, DOE used ImSET only to generate results for near-term timeframes (2030–2034), where these uncertainties are reduced. For more details on the employment impact analysis, see chapter 16 of the final rule TSD.

[187] 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.

## V. Analytical Results and Conclusions

The following section addresses the results from DOE's analyses with respect to the considered energy conservation standards for consumer gas-fired instantaneous water heaters. It addresses the TSLs examined by DOE, the projected impacts of each of these levels if adopted as energy conservation standards for consumer gas-fired instantaneous water heaters, 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 products and equipment by grouping individual efficiency levels for each class into TSLs. Use of TSLs allows DOE to identify and consider manufacturer cost interactions between the product classes, to the extent that there are such interactions, and price elasticity of consumer purchasing decisions that may change when different standard levels are set.

In the analysis conducted for this final rule, DOE analyzed the benefits and burdens of four TSLs for consumer gas-fired instantaneous water heaters. These TSLs are equivalent to each of the ELs analyzed by DOE with results presented in this document. TSL 1 represents a transition from non-condensing to condensing technology (*i.e.*, through the addition of a secondary condensing heat exchanger). TSL 2 represents an intermediate condensing efficiency which can be achieved using larger heat exchangers. TSL 3 represents a further improvement by the use of a heat exchanger with even more surface area, such as a flat-plate heat exchanger design, and is the efficiency level required to meet the EPA's ENERGY STAR specification criteria. Finally, TSL 4 represents the max-tech efficiency, which may be achieved by use of fully modulating burners and further improvements to the heat exchanger. 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 consumer gas-fired instantaneous water heaters.

**Table V.1 Trial Standard Levels for Consumer Gas-fired Instantaneous Water Heaters**

| **Product Class** | **Trial Standard Level** | | | |
|---|---|---|---|---|
| | **1** | **2** | **3** | **4** |
| | **Efficiency Level** | | | |
| Gas-fired Instantaneous Water Heaters ($V_{eff}$ < 2 gal, Rated Input > 50,000 Btu/h) | 1 | 2 | 3 | 4 |

*B. Economic Justification and Energy Savings*

1. Economic Impacts on Individual Consumers

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

a. Life-Cycle Cost and Payback Period

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

Table V.2 and Table V.3 show the LCC and PBP results for the TSLs considered. In the first table, the simple payback is measured relative to the baseline product. In the second table, the impacts are measured relative to the efficiency distribution in the no-new-standards case in the compliance year (*see* section IV.F.8 of this document). Because some consumers purchase products with higher efficiency in the no-new-standards case, the average savings are less than the difference between the average LCC of the baseline product and the average LCC at each TSL. The savings refer only to consumers who are affected by a standard at a given TSL. Those who already purchase a product with efficiency at or above a given TSL are not affected. Consumers for whom the LCC increases at a given TSL experience a net cost.

**Table V.2 Average LCC and PBP Results for Gas-fired Instantaneous Water Heaters ($V_{eff}$ < 2 gal, Rated Input > 50,000 Btu/h)**

| Efficiency Level | Average Costs *2023$* | | | | Simple Payback *years* | Average Lifetime *years* |
|---|---|---|---|---|---|---|
| | Installed Cost | First Year's Operating Cost | Lifetime Operating Cost | LCC | | |
| 0 | 2,087 | 303 | 4,571 | 6,659 | -- | 20.0 |
| 1 | 2,304 | 285 | 4,339 | 6,644 | 12.6 | 20.0 |
| 2 | 2,318 | 277 | 4,210 | 6,528 | 8.9 | 20.0 |
| 3 | 2,334 | 273 | 4,154 | 6,487 | 8.3 | 20.0 |
| 4 | 2,424 | 270 | 4,107 | 6,531 | 10.3 | 20.0 |

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

**Table V.3 Average LCC Savings Relative to the No-New-Standards Case for Gas-fired Instantaneous Water Heaters ($V_{eff}$ < 2 gal, Rated Input > 50,000 Btu/h)**

| Trial Standard Level | Efficiency Level | Life-Cycle Cost Savings | |
|---|---|---|---|
| | | Average LCC Savings* *2023$* | Percent of Consumers that Experience Net Cost |
| 1 | 1 | (1) | 17.5 |
| 2 | 2 | 112 | 15.2 |
| 3 | 3 | 90 | 25.0 |
| 4 | 4 | 39 | 56.2 |

* The savings represent the average LCC for affected consumers.
Parentheses indicate negative (-) values

b. Consumer Subgroup Analysis

In the consumer subgroup analysis, DOE estimated the impact of the considered TSLs on low-income households, senior-only households, and small businesses. Table V.4 compares the average LCC savings and PBP at each efficiency level for the consumer subgroups with similar metrics for the entire consumer sample for consumer gas-fired instantaneous water heaters. In most cases, the average LCC savings and PBP for low-income households and senior-only households at the considered efficiency levels are not substantially different from the average for all households. Chapter 11 of the final rule TSD presents the complete LCC and PBP results for the subgroups.

**Table V.4 Comparison of LCC Savings and PBP for Consumer Subgroups and All Households; Gas-fired Instantaneous Water Heaters ($V_{eff}$ < 2 gal, Rated Input > 50,000 Btu/h)**

| TSL | Low-Income Households | Senior-Only Households | Small Businesses | All Households |
|---|---|---|---|---|
| Average LCC Savings (2023$) | | | | |
| 1 | 141 | (38) | (158) | (1) |
| 2 | 248 | 80 | (51) | 112 |
| 3 | 152 | 75 | 10 | 90 |
| 4 | 123 | 18 | (44) | 39 |
| Simple Payback Period (years) | | | | |
| 1 | 9.9 | 13.5 | 10.2 | 12.6 |
| 2 | 7.1 | 9.6 | 7.2 | 8.9 |
| 3 | 6.6 | 8.9 | 6.6 | 8.3 |
| 4 | 7.9 | 10.9 | 7.8 | 10.3 |
| Consumers with Net Cost (%) | | | | |
| 1 | 8.2 | 20.0 | 24.5 | 17.5 |
| 2 | 6.5 | 16.6 | 25.7 | 15.2 |
| 3 | 11.0 | 26.4 | 43.1 | 25.0 |
| 4 | 31.8 | 57.5 | 67.0 | 56.2 |
| Consumers with Net Benefit (%) | | | | |
| 1 | 17.1 | 8.9 | 7.1 | 12.5 |
| 2 | 26.2 | 21.4 | 17.1 | 22.5 |
| 3 | 67.0 | 57.5 | 44.9 | 59.9 |
| 4 | 55.0 | 33.7 | 27.6 | 35.6 |

Note: Numbers in parentheses indicate a negative number.

c. Rebuttable Presumption Payback

As discussed in section III.F.2, EPCA establishes a rebuttable presumption that an energy conservation standard is economically justified if the increased purchase cost for a product that meets the standard is less than three times the value of the first-year energy savings resulting from the standard. In calculating a rebuttable presumption payback period for each of the considered TSLs, DOE used discrete values, and, as required by EPCA, based the energy use calculation on the DOE test procedures for consumer gas-fired instantaneous water heaters. In contrast, the PBPs presented in section V.B.1.a of this document use averages that were calculated using distributions that reflect the range of energy use in the field.

Table V.5 presents the rebuttable-presumption payback periods for the considered TSLs for consumer gas-fired instantaneous water heaters. While DOE examined the rebuttable-presumption criterion, it considered whether the standard levels considered for this rule are economically justified through a more detailed analysis of the economic impacts of those levels, pursuant to 42 U.S.C. 6295(o)(2)(B)(i), that considers the full range of impacts to the consumer, manufacturer, Nation, and environment. The results of that analysis serve as the basis for DOE to definitively evaluate the economic justification for a potential standard level, thereby supporting or rebutting the results of any preliminary determination of economic justification.

**Table V.5 Rebuttable-Presumption Payback Periods**

| **TSL** | **1** | **2** | **3** | **4** |
|---|---|---|---|---|
| | *years* | | | |
| Gas-fired Instantaneous Water Heaters | 11.0 | 7.9 | 7.4 | 9.2 |

2. Economic Impacts on Manufacturers

DOE performed an MIA to estimate the impact of amended energy conservation standards on manufacturers of gas-fired instantaneous water heaters. 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. The following tables summarize the estimated financial impacts (represented by changes in INPV) of potential amended energy conservation standards on manufacturers of gas-fired instantaneous water heaters, as well as the conversion costs that DOE estimates manufacturers of gas-fired instantaneous water heaters would incur at each TSL.

As discussed in section IV.J.2.d of this document, DOE modeled two scenarios to evaluate a range of cash flow impacts on the gas-fired instantaneous water heater industry: (1) the preservation of gross margin percentage scenario and (2) the preservation of operating profit scenario. Under the preservation of gross margin percentage scenario, DOE applied a single uniform "gross margin percentage" across all efficiency levels. As MPCs increase with efficiency, this scenario implies that the per-unit dollar profit would also increase. DOE assumed a "gross margin percentage" of 31 percent for gas-fired instantaneous water heaters.[188] This gross margin percentage (and the corresponding manufacturer markup) is the same as the one that DOE used in the engineering analysis and the no-new-standards case of the GRIM. Because this scenario assumes that a manufacturer's absolute dollar markup would increase as MPCs increase in the standards cases, it represents the upper bound to industry profitability under potential amended energy conservation standards.

[188] The gross margin percentage of 31 percent is based on a manufacturer markup of 1.45.

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 products, operating profit does not change in absolute dollars and decreases as a percentage of revenue.

Each of the modeled manufacturer markup scenarios results in a unique set of cash flows and corresponding industry values at each TSL.  In the following discussion, the INPV results refer to the difference in industry value between the no-new-standards case and each standards case resulting from the sum of discounted cash flows from 2024 through 2059.  To provide perspective on the short-run cash flow impact, DOE includes in the discussion of results a comparison of free cash flow between the no-new-standards case and the standards case at each TSL in the year before amended standards are required.

**Table V.6 Manufacturer Impact Analysis for Gas-fired Instantaneous Water Heaters under the Preservation of Gross Margin Scenario**

| | Units | No-New-Standards Case | Trial Standard Level* | | | |
|---|---|---|---|---|---|---|
| | | | 1 | 2 | 3 | 4 |
| **INPV** | *2023$ millions* | 1,193.9 | 1,234.0 | 1,234.4 | 1,217.6 | 1,275.2 |
| **Change in INPV** | *2023$ millions* | - | 40.1 | 40.5 | 23.7 | 81.2 |
| | % | - | 3.4 | 3.4 | 2.0 | 6.8 |
| **Free Cash Flow (2029)** | *2023$ millions* | 91.7 | 84.6 | 82.9 | 65.2 | 65.2 |
| **Change in Free Cash Flow (2029)** | *2023$ millions* | - | (7.1) | (8.8) | (26.5) | (26.5) |
| | % | - | (7.8) | (9.6) | (28.9) | (28.9) |
| **Product Conversion Costs** | *2023$ millions* | - | 2.5 | 3.7 | 4.8 | 4.8 |
| **Capital Conversion Costs** | *2023$ millions* | - | 13.9 | 16.7 | 55.3 | 55.3 |
| **Total Investment Required**** | *2023$ millions* | - | 16.5 | 20.4 | 60.1 | 60.1 |

* Numbers in parentheses indicate a negative number.
**Numbers may not sum exactly due to rounding.

**Table V.7 Manufacturer Impact Analysis for Gas-fired Instantaneous Water Heaters under the Preservation of Operating Profit Scenario**

| | Units | No-New-Standards Case | Trial Standard Level* | | | |
|---|---|---|---|---|---|---|
| | | | 1 | 2 | 3 | 4 |
| **INPV** | *2023$ millions* | 1,193.9 | 1,171.1 | 1,160.2 | 1,132.1 | 1,119.5 |
| **Change in INPV** | *2023$ millions* | - | (22.9) | (33.7) | (61.8) | (74.5) |
| | % | - | (1.9) | (2.8) | (5.2) | (6.2) |
| **Free Cash Flow (2029)** | *2023$ millions* | 91.7 | 84.6 | 82.9 | 65.2 | 65.2 |
| **Change in Free Cash Flow (2029)** | *2023$ millions* | - | (7.1) | (8.8) | (26.5) | (26.5) |
| | % | - | (7.8) | (9.6) | (28.9) | (28.9) |
| **Product Conversion Costs** | *2023$ millions* | - | 2.5 | 3.7 | 4.8 | 4.8 |
| **Capital Conversion Costs** | *2023$ millions* | - | 13.9 | 16.7 | 55.3 | 55.3 |
| **Total Investment Required**** | *2023$ millions* | - | 16.5 | 20.4 | 60.1 | 60.1 |

* Numbers in parentheses indicate a negative number.
**Numbers may not sum exactly due to rounding.

At TSL 1, DOE estimates that impacts on INPV would range from -$22.9 million to $40.1 million, or a change in INPV of -1.9 percent to 3.4 percent. At TSL 1, industry free cash flow is $84.6 million, which is a decrease of $7.1 million, or a drop of 7.8 percent, compared to the no-new-standards case value of $91.7 million in 2029, the year leading up to the standards year. Approximately 70 percent of gas-fired instantaneous water heater shipments are expected to meet TSL 1 by the analyzed 2030 compliance date in the no-new-standards case.

TSL 1 would set the energy conservation standard for gas-fired instantaneous water heaters at EL 1. Compared to the non-condensing design considered at baseline, the design options analyzed at TSL 1 includes a tube design condensing heat exchanger. Out of the 12 gas-fired instantaneous water heater OEMs identified, 11 offer models that meet TSL 1. These 11 manufacturers currently offer 84 unique basic models, accounting for 61 percent of model listings, that meet this TSL. Based on feedback from manufacturer interviews and a review of the market, DOE does not expect that most manufacturers would need to add production capacity or incur significant capital conversion costs to meet this level. However, in response to the July 2023 NOPR, one manufacturer commented that its U.S. production facility is currently optimized to produce non-condensing models. Converting this U.S. production facility to produce condensing gas-fired instantaneous water heaters would require significant investment. To avoid underestimating the potential investments required to meet levels that may necessitate condensing technology (*i.e.*, TSL 1 through TSL 4), DOE incorporated the expected investments required to convert its U.S. production facility to accommodate production of condensing gas-fired instantaneous water heaters. DOE does not expect that there would be notable product conversion costs at this TSL since most manufacturers offer a range of models that already meet this level. DOE estimates that industry would incur approximately $13.9 million in capital conversion costs and $2.5 million in product conversions at TSL 1. Industry conversion costs total $16.5 million.

At TSL 1, the shipment-weighted average MPC for gas-fired instantaneous water heaters increases by 9.4 percent relative to the no-new-standards case shipment-weighted average MPC for gas-fired instantaneous water heaters in 2030. In the preservation of gross margin percentage scenario, the increase in cashflow from the higher MSP outweighs the $16.5 million in conversion costs, causing a positive change in INPV at TSL 1 under this scenario.

Under the preservation of operating profit scenario, manufacturers earn the same per-unit operating profit as would be earned in the no-new-standards case, but manufacturers do not earn additional profit from their investments. In this scenario, the manufacturer markup decreases in 2030. This reduction in the manufacturer markup and the $16.5 million in conversion costs incurred by manufacturers cause a slightly negative change in INPV at TSL 1 under the preservation of operating profit scenario. *See* section IV.J.2.d of this document for a discussion of the manufacturer markup scenarios.

At TSL 2, DOE estimates that impacts on INPV would range from -$33.7 million to $40.5 million, or a change in INPV of -2.8 percent to 3.4 percent. At TSL 2, industry free cash flow is $82.9 million, which is a decrease of $8.8 million, or a drop of 9.6 percent compared to the no-new-standards case value of $91.7 million in 2029, the year leading up to the standards year. Approximately 62 percent of gas-fired instantaneous water heater shipments are expected to meet TSL 2 by the analyzed 2030 compliance date in the no-new-standards case.

TSL 2 would set the energy conservation standard for gas-fired instantaneous water heaters at EL 2. The design options analyzed at TSL 2 include increasing the tube design condensing heat exchanger area relative to TSL 1. Of the 12 gas-fired instantaneous water heater OEMs, 10 manufacturers offer models that meet TSL 2. These 10 OEMs currently offer 71 unique basic models, accounting for 51 percent of model listings, that meet this TSL. As with TSL 1, DOE does not expect that most manufacturers would need to add production capacity (or incur notable capital conversion costs) to meet this level. However, the larger condensing heat exchanger that manufacturers may implement to meet TSL 2 could necessitate some capital investments to optimize production lines. Similar to TSL 1, DOE does not expect that there would be significant product conversion costs at this level since most manufacturers already offer a range of models that meet TSL 2. DOE estimates that industry would incur approximately $16.7 million in capital conversion costs and $3.7 million in product conversions at TSL 2. Industry conversion costs total $20.4 million.

At TSL 2, the shipment-weighted average MPC for gas-fired instantaneous water heaters increases by 9.8 percent relative to the no-new-standards case shipment-weighted average MPC for gas-fired instantaneous water heaters in 2030. In the preservation of gross margin percentage scenario, the increase in cashflow from the higher MSP outweighs the $20.4 million in conversion costs, causing a positive change in INPV at TSL 2 under this scenario.

Under the preservation of operating profit scenario, manufacturers earn the same per-unit operating profit as would be earned in the no-new-standards, but manufacturers do not earn additional profit from their investments. In this scenario, the manufacturer markup decreases in 2030. This reduction in the manufacturer markup and the $20.4 million in conversion costs incurred by manufacturers cause a slightly negative change in INPV at TSL 2 under the preservation of operating profit scenario.

At TSL 3, DOE estimates that impacts on INPV would range from -$61.8 million to $23.7 million, or a change in INPV of -5.2 percent to 2.0 percent. At TSL 3, industry free cash flow is $65.2 million, which is a decrease of $26.5 million, or a drop of 28.9 percent, compared to the no-new-standards case value of $91.7 million in 2029, the year leading up to the standards year. Approximately 16 percent of gas-fired instantaneous water heater shipments are expected to meet TSL 3 by the analyzed 2030 compliance date in the no-new-standards case.

TSL 3 would set the energy conservation standard for gas-fired instantaneous water heaters at EL 3. The design options analyzed at TSL 3 include a more efficient heat exchanger design (*i.e.*, replacing a tube condensing heat exchanger with a flat plate condensing heat exchanger) and increasing the condensing heat exchanger area relative to TSL 2. Of the 12 gas-fired instantaneous water heater OEMs, 10 manufacturers offer models that meet TSL 3. These 10 manufacturers currently offer 48 unique basic models, accounting for 34 percent of model listings, that meet this TSL. Based on feedback from manufacturer interviews and public comments, DOE understands that implementing the larger, improved condensing heat exchanger technology would increase the complexity of the manufacturing process compared to the tube design condensing heat exchanger technology analyzed at TSL 1 and TSL 2.

At this level, most manufacturers would need to add additional assembly lines to meet demand, which would require a large capital investment. The investment required to add production capacity would vary by manufacturer as it depends on floor space availability in and around existing manufacturing plants. Compared to TSL 1 and TSL 2, manufacturers offer fewer models that meet the required efficiency levels. Manufacturers without any models that meet TSL 3 would need to develop new gas-fired instantaneous water heater products with more complex, efficient condensing heat exchanger designs. Manufacturers with gas-fired instantaneous water heaters that meet TSL 3 may need to allocate technical resources to provide a full range of product offerings since most manufacturers currently only offer a handful of models that meet TSL 3. DOE estimates that manufacturers would incur approximately $55.3 million in capital conversion costs and $4.8 million in product conversions at TSL 3. Industry conversion costs total $60.1 million.

At TSL 3, the shipment-weighted average MPC for gas-fired instantaneous water heaters increases by 11.2 percent relative to the no-new-standards case shipment-weighted average MPC for gas-fired instantaneous water heaters in 2030. In the preservation of gross margin percentage scenario, the increase in cashflow from the higher MSP outweighs the $60.1 million in conversion costs, causing a slightly positive change 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 2030. This reduction in the manufacturer markup and the $60.1 million in conversion costs incurred by manufacturers cause a negative change in INPV at TSL 3 under the preservation of operating profit scenario.

At TSL 4, DOE estimates that impacts on INPV would range from -$74.5 million to -$81.2 million, or a change in INPV of -6.2 percent to 6.8 percent. At TSL 4, industry free cash flow is $65.2 million, which is a decrease of $26.5 million, or a drop of 28.9 percent, compared to the no-new-standards case value of $91.7 million in 2029, the year leading up to the standards year. Approximately 8 percent of gas-fired instantaneous water heater shipments are expected to meet TSL 4 by the analyzed 2030 compliance date in the no-new-standards case.

TSL 4 would set the energy conservation standard for gas-fired instantaneous water heaters at EL 4 (*i.e.*, max-tech). The design options analyzed at TSL 4 include replacing the step-modulating burner with a fully modulating burner and increasing the condensing heat exchanger area relative to TSL 3. Of the 12 gas-fired instantaneous water heaters, five manufacturers offer models that meet this TSL. These five manufacturers currently offer 19 unique basic models, accounting for 14 percent of model listings, that meet this TSL. As with TSL 3, DOE understands that implementing the larger, improved condensing heat exchanger design would add a significant amount of complexity to the manufacturing process compared to the tube design condensing heat exchanger technology at TSL 1 and TSL 2. As such, DOE expects similar capital conversion costs at TSL 3 and TSL 4. At max-tech, fewer manufacturers offer fewer models that meet the required efficiencies compared to TSL 3. DOE estimates that manufacturers would incur approximately $55.3 million in capital conversion costs and $4.8 million in product conversions at TSL 4. Industry conversion costs total $60.1 million.

At TSL 4, the shipment-weighted average MPC for gas-fired instantaneous water heaters increases by 20.1 percent relative to the no-new-standards case shipment-weighted average MPC for gas-fired instantaneous water heaters in 2030. The increase in cashflow from the higher MSP outweighs the $60.1 million in conversion costs, causing a positive change 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, but manufacturers do not earn additional profit from their investments. In this scenario, the manufacturer markup decreases in 2030. This reduction in the manufacturer markup and the $60.1 million in conversion costs incurred by manufacturers cause a negative change in INPV at TSL 4 under the preservation of operating profit scenario.

b. Direct Impacts on Employment

To quantitatively assess the potential impacts of amended energy conservation standards on direct employment in the gas-fired instantaneous water heater industry, DOE used feedback from stakeholder comments, the engineering analysis, and shipments analysis 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.

In the July 2023 NOPR, DOE estimated that approximately 70 percent of consumer water heaters subject to the proposed amended standards were produced domestically. Of that 70 percent, DOE estimated that all gas-fired instantaneous water heaters, which currently account for 12 percent of the overall consumer water heater market, were produced outside of the United States. For the July 2024 NODA, DOE revised its direct employment analysis to account for Rinnai's new domestic production facility dedicated to manufacturing non-condensing gas-fired instantaneous water heaters. In the July 2024 NODA, DOE estimated that approximately 20 percent of gas-fired instantaneous water heaters were produced domestically. DOE derived this value by using its shipments analysis and public market share feedback.[189] (Rinnai No. 1186 at p. 1) DOE maintained the 20 percent estimate from the July 2024 NODA for this final rule.

In addition to Rinnai's market share feedback, DOE relied on the employment figures provided in Rinnai's comments in response to the July 2023 NOPR to estimate the potential range of direct employment impacts in 2030 (the analyzed compliance year) in the July 2024 NODA. Rinnai's comments indicated that there were 122 domestic production workers dedicated to manufacturing non-condensing gas-fired instantaneous water heaters in 2023. (Rinnai No. 1186 at p. 1) Using results of the shipments analysis, DOE projected that there would be approximately 128 domestic production workers in 2030 (the analyzed compliance year) in the no-new-standards case.

[189] In 2023, DOE estimates that approximately 0.41 million out of the 1.22 million gas-fired instantaneous water heater unit shipments are non-condensing. In response to the July 2023 NOPR, Rinnai commented that its domestic market share of non-condensing gas-fired instantaneous water heaters is 60 percent: $(60\% \times 0.41\,million) \div 1.22\,million = 20\%$.

To establish a conservative lower bound, DOE assumed domestic manufacturers would shift production to foreign countries at efficiency levels that would likely necessitate condensing technology. The upper bound domestic direct employment estimate corresponds to a potential increase in the number of domestic workers that would result from amended energy conservation standards if manufacturers continue to produce the same scope of covered products within the United States after compliance takes effect (*i.e.*, 20 percent of gas-fired instantaneous water heater shipments continue to be manufactured domestically). Results of DOE's engineering and product teardown analyses indicate that additional labor is required (on a per-unit basis) to produce a condensing gas-fired instantaneous water heater compared to a non-condensing gas-fired instantaneous water heater. As such, DOE modeled an increase in domestic direct employment in the upper bound scenario.

For this final rule, DOE updated its estimate of domestic production workers of gas-fired instantaneous water heaters from 128 to 190.[190] in 2030 based on stakeholder comments in response to the July 2024 NODA but otherwise maintained its direct employment methodology. (Rinnai No. 1443 at p. 1) DOE estimates that in the absence of new or amended energy conservation standards for consumer water heaters there

[190] Rinnai commented that it currently employs 183 full-time employees and 49 temporary employees at its Griffin, Georgia plant. DOE's shipments analysis indicates shipments of non-condensing gas-fired instantaneous water heaters in the no-new-standards case will increase by approximately 4 percent from 2024 to 2030 (the compliance year). $(183 \times 1.04) = 190$

would be 3,859 domestic production employees for the *overall* consumer water heater market in 2030.[191]

For the conservative lower bound of direct employment impacts for this final rule, DOE models a decrease of domestic direct employment of 190 production workers at TSL 1 through TSL 4 in 2030. This lower bound reflects the scenario where Rinnai chooses to continue to source condensing gas-fired instantaneous water heaters from Japan. In response to the July 2023 NOPR and July 2024 NODA, Rinnai commented that due to the large upfront investment required to repurpose its Georgia facility to accommodate production of condensing gas-fired instantaneous water heaters and its current production capacity of condensing gas-fired instantaneous water heaters in Japan, it is possible that manufacturing could shift overseas. (Rinnai No. 1186 at p. 23; Rinnai No. 1443 at pp. 21–22)

For the upper bound of direct employment impacts, using a shipment-weighted average, DOE estimates that the labor content required to produce a condensing gas-fired instantaneous water heater is approximately 62 percent more than the labor content required to produce a non-condensing gas-fired instantaneous water heater. *See* chapter 12 of the final rule TSD for the estimated labor content by efficiency level. Therefore, DOE models an upper-bound increase in domestic direct employment of 62 percent (an

[191] In support of the May 2024 Final Rule, DOE estimated that the total domestic direct employment for gas-fired storage, oil-fired storage, and electric storage water heaters would be 4,110 in 2030 in the no-new-standards case, representing 3,669 production workers and 441 non-production workers. 89 FR 37778, 37900–37901. *See* the May 2024 Final Rule GRIM available for download at*: www.regulations.gov/document/EERE-2017-BT-STD-0019-1422*. (3,669 + 190 = 3,859 domestic production workers in 2030, absent standards)

increase of approximately 117 production workers, for a total of 307 domestic production workers) at TSL 1 through TSL 4 in 2030.

Additional details on the analysis of direct employment, as well as the estimated labor content for each efficiency level, can be found in chapter 12 of the final rule TSD. Additionally, the employment impacts discussed in this section are independent of the employment impacts from the broader U.S. economy, which are documented in chapter 16 of the final rule TSD.

c. Impacts on Manufacturing Capacity

Nearly all gas-fired instantaneous water heater OEMs currently offer condensing gas-fired instantaneous water heater models. Of the 12 manufacturers identified, 11 manufacturers already offer a range of condensing gas-fired instantaneous water heater models that meet TSL 1. DOE estimates that condensing gas-fired instantaneous water heaters account for 67 percent of current shipments. For a condensing-level standard, most manufacturers would have to repurpose and retool assembly lines to produce only condensing models since the manufacturing processes (*e.g.*, production of secondary heat exchangers) differ between condensing and non-condensing gas-fired instantaneous water heater models. Manufacturer feedback indicates that most manufacturers could meet TSL 1 and TSL 2 without adding new production lines. However, at TSL 3 and TSL 4, DOE expects most manufacturers would have to add production lines due to increased complexity and incorporation of a larger, more efficient heat exchanger design. Additionally, while most shipments already meet TSL 2, fewer shipments meet TSL 3 or TSL 4. Currently, 60 percent of shipments meet TSL 2 whereas 15 percent and 8 percent of shipments meet TSL 3 and TSL 4, respectively. However, at TSL 2 (the adopted level), DOE expects that manufacturers would be able to add capacity and adjust product designs in the five-year period between the announcement year of the amended standard and the compliance year of the amended standard.

d. Impacts on Subgroups of Manufacturers

As discussed in section IV.J of this document, using average cost assumptions to develop an industry cash flow estimate may not be adequate for assessing differential impacts among manufacturer subgroups. Small manufacturers, niche manufacturers, and manufacturers exhibiting a cost structure substantially different from the industry average could be affected disproportionately. DOE used the results of the industry characterization to group manufacturers exhibiting similar characteristics. Consequently, DOE identified small business manufacturers as a subgroup for a separate impact analysis.

For the small business subgroup analysis, DOE applied the small business size standards published by the U.S. Small Business Administration ("SBA") to determine whether a company is considered a small business. The size standards are codified at 13 CFR part 121. To be categorized as a small business under North American Industry Classification System ("NAICS") code 335220, "Major Household Appliance Manufacturing," a gas-fired instantaneous water heater manufacturer and its affiliates may employ a maximum of 1,500 employees. The 1,500-employee threshold includes all employees in a business's parent company and any other subsidiaries. Based on this classification, DOE did not identify any manufacturers that qualify as a domestic small business.

The small business subgroup analysis is discussed in more detail in chapter 12 of the final rule TSD. DOE examines the potential impacts of this final rule on small business manufacturers in section VI.B of this document.

e. Cumulative Regulatory Burden

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

For the cumulative regulatory burden analysis, DOE examined Federal, product-specific regulations that could affect gas-fired instantaneous water heater manufacturers and that take effect approximately 3 years before or after the estimated compliance date (2027 to 2033). This information is presented in Table V.8.

**Table V.8 Compliance Dates and Expected Conversion Expenses of Federal Energy Conservation Standards Affecting Gas-fired Instantaneous Water Heater Original Equipment Manufacturers**

| 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*** |
|---|---|---|---|---|---|
| Consumer Pool Heaters 88 FR 34624 (May 30, 2023) | 20 | 3 | 2028 | \$48.4 (2021\$) | 1.5% |
| Consumer Boilers† 88 FR 55128 (August 14, 2023) | 24 | 8 | 2030 | \$98.0 (2022\$) | 3.6% |
| Commercial Refrigerators, Refrigerator-Freezers, and Freezers† 88 FR 70196 (October 10, 2023) | 83 | 1 | 2028 | \$226.4 (2022\$) | 1.6% |
| Dehumidifiers† 88 FR 76510 (November 6, 2023) | 20 | 1 | 2028 | \$6.9 (2022\$) | 0.4% |
| Consumer Furnaces 88 FR 87502 (December 18, 2023) | 14 | 3 | 2029 | \$162.0 (2022\$) | 1.8% |
| Refrigerators, Refrigerator-Freezers, and Freezers 89 FR 3026 (January 17, 2024) | 63 | 2 | 2029 and 2030‡ | \$830.3 (2022\$) | 1.3% |
| Consumer Conventional Cooking Products 89 FR 11434 (February 14, 2024) | 35 | 1 | 2028 | \$66.7 (2022\$) | 0.3% |
| Consumer Clothes Dryers 89 FR 18164 (March 12, 2024) | 19 | 2 | 2028 | \$180.7 (2022\$) | 1.4% |
| Residential Clothes Washers 89 FR 19026 (March 15, 2024) | 22 | 2 | 2028 | \$320.0 (2022\$) | 1.8% |
| Dishwashers 89 FR 31398 (April 24, 2024) | 21 | 2 | 2027 | \$126.9 (2022\$) | 2.1% |
| Consumer Water Heaters 89 FR 37778 (May 6, 2024) | 16 | 4 | 2029 | \$239.8 (2022\$) | 1.9% |
| Miscellaneous Refrigeration Products 89 FR 38762 (May 7, 2024) | 49 | 1 | 2029 | \$130.7 (2022\$) | 2.9% |

| | | | | | |
|---|---|---|---|---|---|
| Air-Cooled Unitary Air Conditioners and Heat Pumps<br>89 FR 44052<br>(May 20, 2024) | 9 | 1 | 2029 | $288.0<br>(2022$) | 2.1% |
| Walk-in Coolers and Freezers†† | 87 | 1 | 2028 | $91.5<br>(2023$) | 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 gas-fired instantaneous water heaters 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 product 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 timeframe over which conversion costs are made and lasts from the publication year of the final rule to the compliance year of the energy conservation standard. The conversion period typically ranges from 3 to 5 years, depending on the rulemaking.
† These rulemakings are at the NOPR stage, and all values are subject to change until finalized through publication of a final rule.
‡ 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 the 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.*

### 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 amended standards for consumer gas-fired instantaneous water heaters, DOE compared their energy consumption under the no-new-standards case to their anticipated energy consumption under each TSL. The savings are measured over the entire lifetime of products purchased during the 30-year period that begins in the year of anticipated compliance with amended standards (2030–2059). Table V.9 presents DOE's projections of the NES for each TSL considered for consumer gas-fired instantaneous water heaters. The savings were calculated using the approach described in section IV.H.2 of this document.

**Table V.9 Cumulative National Energy Savings for Consumer Gas-Fired Instantaneous Water Heaters; 30 Years of Shipments (2030–2059)**

| | **Trial Standard Level** | | | |
|---|---|---|---|---|
| | **1** | **2** | **3** | **4** |
| | ***quads*** | | | |
| Primary Energy | | | | |
| Gas-fired Instantaneous Water Heaters | 0.32 | 0.52 | 0.76 | 0.97 |
| FFC Energy | | | | |
| Gas-fired Instantaneous Water Heaters | 0.35 | 0.58 | 0.85 | 1.07 |

OMB Circular A-4[192] requires agencies to present analytical results, including separate schedules of the monetized benefits and costs that show the type and timing of benefits and costs. Circular A-4 also directs agencies to consider the variability of key elements underlying the estimates of benefits and costs. For this rulemaking, DOE undertook a sensitivity analysis using 9 years, rather than 30 years, of product shipments. The choice of a 9-year period is a proxy for the timeline in EPCA for the review of certain energy conservation standards and potential revision of and compliance with such revised standards.[193] The review timeframe established in EPCA is generally not

[192] U.S. Office of Management and Budget. *Circular A-4: Regulatory Analysis*. Available at: *www.whitehouse.gov/omb/information-for-agencies/circulars* (last accessed August 29, 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 August 29, 2024).
[193] 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

synchronized with the product lifetime, product manufacturing cycles, or other factors specific to consumer gas-fired instantaneous water heaters. 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.10. The impacts are counted over the lifetime of consumer gas-fired instantaneous water heaters purchased during the period 2030–2038.

**Table V.10 Cumulative National Energy Savings for Consumer Gas-Fired Instantaneous Water Heaters; 9 Years of Shipments (2030–2038)**

| | **Trial Standard Level** | | | |
|---|---|---|---|---|
| | **1** | **2** | **3** | **4** |
| | ***quads*** | | | |
| Primary Energy | | | | |
| Gas-fired Instantaneous Water Heaters | 0.10 | 0.16 | 0.21 | 0.27 |
| FFC Energy | | | | |
| Gas-fired Instantaneous Water Heaters | 0.11 | 0.17 | 0.24 | 0.30 |

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 consumer gas-fired instantaneous water heaters. In accordance with OMB Circular A-4, DOE calculated NPV using both a 7-percent and a 3-percent real discount rate. Table V.11 shows the consumer NPV results

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

with impacts counted over the lifetime of products purchased during the period 2030–2059.

**Table V.11 Cumulative Net Present Value of Consumer Benefits for Consumer Gas-Fired Instantaneous Water Heaters; 30 Years of Shipments (2030–2059)**

| **Discount Rate** | **Trial Standard Level** | | | |
|---|---|---|---|---|
| | **1** | **2** | **3** | **4** |
| | ***billion 2023$*** | | | |
| 3 percent discount rate | | | | |
| Gas-fired Instantaneous Water Heaters | 1.26 | 3.06 | 4.89 | 4.50 |
| 7 percent discount rate | | | | |
| Gas-fired Instantaneous Water Heaters | 0.24 | 0.87 | 1.45 | 0.98 |

The NPV results based on the aforementioned 9-year analytical period are presented in Table V.12. The impacts are counted over the lifetime of products purchased during the period 2030–2038. As mentioned previously, such results are presented for informational purposes only and are not indicative of any change in DOE's analytical methodology or decision criteria.

**Table V.12 Cumulative Net Present Value of Consumer Benefits for Consumer Gas-Fired Instantaneous Water Heaters; 9 Years of Shipments (2030–2038)**

| **Discount Rate** | **Trial Standard Level** | | | |
|---|---|---|---|---|
| | **1** | **2** | **3** | **4** |
| | ***billion 2023$*** | | | |
| 3 percent discount rate | | | | |
| Gas-fired Instantaneous Water Heaters | 0.44 | 1.09 | 1.66 | 1.50 |
| 7 percent discount rate | | | | |
| Gas-fired Instantaneous Water Heaters | 0.10 | 0.41 | 0.66 | 0.43 |

The previous results reflect the use of a default trend to estimate the change in price for consumer gas-fired instantaneous water heaters over the analysis period (*see* section IV.F.1 of this document). DOE also conducted a sensitivity analysis that considered one scenario with a lower rate of price decline than the reference case and one scenario with a higher rate of price decline than the reference case. The results of these alternative cases are presented in appendix 10C of the final rule TSD. In the high-price-decline case, the NPV of consumer benefits is higher than in the default case. In the low-price-decline case, the NPV of consumer benefits is lower than in the default case.

c. Indirect Impacts on Employment

DOE estimates that amended energy conservation standards for consumer gas-fired instantaneous water heaters will reduce energy expenditures for consumers of those products, with the resulting net savings being redirected to other forms of economic activity. These expected shifts in spending and economic activity could affect the demand for labor. As described in section IV.N of this document, DOE used an input/output model of the U.S. economy to estimate indirect employment impacts of the TSLs that DOE considered. There are uncertainties involved in projecting employment impacts, especially changes in the later years of the analysis. Therefore, DOE generated results for near-term timeframes (2030–2034), 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 Products

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 gas-fired instantaneous water heaters under consideration in this rulemaking. Manufacturers of these products currently offer units that meet or exceed the adopted standards.

### 5. Impact of Any Lessening of Competition

DOE considered any lessening of competition that would be likely to result from 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 NOPR and the TSD for review. In its assessment letter responding to DOE, DOJ concluded that the proposed energy conservation standards for gas-fired instantaneous water heaters are unlikely to substantially lessen 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. Chapter 15 in 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 gas-fired instantaneous water heaters is expected to yield environmental benefits in the form of reduced emissions of certain air pollutants and GHG. Table V.13 provides DOE's estimate of cumulative emissions reductions expected to result from the TSLs considered in this rulemaking. In the case of mercury, negative values (denoted in parenthesis) indicate a slight increase in emissions due to slightly higher electricity use at those TSLs. The emissions were calculated using the multipliers discussed in section IV.K. DOE reports annual emissions reductions for each TSL in chapter 13 of the final rule TSD.

**Table V.13 Cumulative Emissions Reduction for Gas-fired Instantaneous Water Heaters Shipped During the Period 2030–2059**

| | Trial Standard Level | | | |
|---|---|---|---|---|
| | **1** | **2** | **3** | **4** |
| **Electric Power Sector and Site Emissions** | | | | |
| $CO_2$ (*million metric tons*) | 17 | 28 | 40 | 47 |
| $CH_4$ (*thousand tons*) | 0.3 | 0.6 | 0.8 | 1.1 |
| $N_2O$ (*thousand tons*) | 0.03 | 0.06 | 0.08 | 0.11 |
| $SO_2$ (*thousand tons*) | 0.04 | 0.10 | 0.17 | 0.75 |
| $NO_X$ (*thousand tons*) | 15 | 25 | 35 | 41 |
| Hg (*tons*) | (0.0004) | (0.0004) | (0.0003) | 0.0035 |
| **Upstream Emissions** | | | | |
| $CO_2$ (*million metric tons*) | 2 | 4 | 6 | 7 |
| $CH_4$ (*thousand tons*) | 244 | 397 | 575 | 669 |
| $N_2O$ (*thousand tons*) | 0.00 | 0.01 | 0.01 | 0.01 |
| $SO_2$ (*thousand tons*) | 0.01 | 0.02 | 0.03 | 0.04 |
| $NO_X$ (*thousand tons*) | 38 | 62 | 89 | 104 |
| Hg (*tons*) | (0.0000) | (0.0000) | (0.0000) | 0.0000 |
| **Total FFC Emissions** | | | | |
| $CO_2$ (*million metric tons*) | 19 | 32 | 46 | 54 |
| $CH_4$ (*thousand tons*) | 244 | 398 | 576 | 671 |
| $N_2O$ (*thousand tons*) | 0.04 | 0.06 | 0.09 | 0.12 |
| $SO_2$ (*thousand tons*) | 0.05 | 0.12 | 0.20 | 0.79 |
| $NO_X$ (*thousand tons*) | 53 | 86 | 125 | 145 |
| Hg (*tons*) | (0.0004) | (0.0004) | (0.0003) | 0.0035 |

Note: Totals may not equal sums due to rounding. Negative values refer to an increase in emissions.

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 gas-fired instantaneous water heaters. Section IV.L of this document discusses the estimated SC-$CO_2$ values that DOE used. Table V.14 and Table V.15 present the value of $CO_2$ emissions reduction at each TSL for each of the SC-$CO_2$ cases. The time-series of annual values is presented for the selected TSL in chapter 14 of the final rule TSD.

**Table V.14 Present Value of $CO_2$ Emissions Reduction for Gas-fired Instantaneous Water Heaters Shipped During the Period 2030–2059 (2023 estimates of SC-GHG)**

| TSL | Near-term Ramsey Discount Rate | | |
|---|---|---|---|
| | 2.5% | 2.0% | 1.5% |
| | billion 2023$ | | |
| 1 | 2.2 | 3.8 | 6.8 |
| 2 | 3.5 | 6.1 | 11.0 |
| 3 | 5.1 | 8.8 | 15.9 |
| 4 | 6.0 | 10.3 | 18.7 |

**Table V.15 Present Value of $CO_2$ Emissions Reduction for Gas-fired Instantaneous Water Heaters Shipped During the Period 2030–2059 (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 | 0.2 | 0.7 | 1.1 | 2.2 |
| 2 | 0.3 | 1.2 | 1.8 | 3.5 |
| 3 | 0.4 | 1.7 | 2.6 | 5.1 |
| 4 | 0.4 | 2.0 | 3.1 | 5.9 |

As discussed in section IV.LIV.L.2, 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 gas-fired instantaneous water heaters. Table V.16 and Table V.17 present the value of the $CH_4$ emissions reduction at each TSL, and Table V.18 and Table V.19 present the value of the $N_2O$ emissions reduction at each TSL. The time-series of annual values is presented for the selected TSL in chapter 14 of the final rule TSD.

**Table V.16 Present Value of Methane Emissions Reduction for Gas-fired Instantaneous Water Heaters Shipped During the Period 2030–2059 (2023 estimates of SC-GHG)**

| TSL | Near-term Ramsey Discount Rate | | |
|---|---|---|---|
| | **2.5%** | **2.0%** | **1.5%** |
| | **billion 2023$** | | |
| 1 | 0.4 | 0.6 | 0.9 |
| 2 | 0.7 | 1.0 | 1.4 |
| 3 | 1.0 | 1.4 | 2.0 |
| 4 | 1.2 | 1.6 | 2.4 |

**Table V.17 Present Value of Methane Emissions Reduction for Gas-fired Instantaneous Water Heaters Shipped During the Period 2030–2059 (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 | 0.1 | 0.3 | 0.4 | 0.8 |
| 2 | 0.2 | 0.5 | 0.7 | 1.3 |
| 3 | 0.2 | 0.7 | 1.0 | 1.8 |
| 4 | 0.3 | 0.8 | 1.1 | 2.1 |

**Table V.18 Present Value of Nitrous Oxide Emissions Reduction for Gas-fired Instantaneous Water Heaters Shipped During the Period 2030–2059 (2023 estimates of SC-GHG)**

| TSL | Near-term Ramsey Discount Rate | | |
|---|---|---|---|
| | **2.5%** | **2.0%** | **1.5%** |
| | **billion 2023$** | | |
| 1 | 0.001 | 0.002 | 0.003 |
| 2 | 0.002 | 0.003 | 0.006 |
| 3 | 0.003 | 0.005 | 0.008 |
| 4 | 0.004 | 0.006 | 0.011 |

**Table V.19 Present Value of Nitrous Oxide Emissions Reduction for Gas-fired Instantaneous Water Heaters Shipped During the Period 2030–2059 (2021 Interim SC-GHG estimates)**

| TSL | SC-$N_2O$ Case | | | |
|---|---|---|---|---|
| | Discount Rate and Statistics | | | |
| | 5% Average | 3% Average | 2.5% Average | 3% 95th percentile |
| | *billion 2023$* | | | |
| 1 | 0.0001 | 0.0005 | 0.0008 | 0.0014 |
| 2 | 0.0002 | 0.0008 | 0.0013 | 0.0022 |
| 3 | 0.0003 | 0.0012 | 0.0019 | 0.0032 |
| 4 | 0.0004 | 0.0016 | 0.0025 | 0.0043 |

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 gas-fired instantaneous water heaters. The dollar-per-ton values that DOE used are discussed in section IV.L of this document. Table V.20 presents the present value for $NO_X$ emissions reduction for each TSL calculated using 7-percent and 3-percent discount rates, and Table V.21 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.20 Present Value of $NO_X$ Emissions Reduction for Gas-fired Instantaneous Water Heaters Shipped During the Period 2030–2059**

| TSL | 7% Discount Rate | 3% Discount Rate |
|---|---|---|
| | ***million 2023$*** | |
| 1 | 554 | 1,650 |
| 2 | 892 | 2,675 |
| 3 | 1,260 | 3,830 |
| 4 | 1,468 | 4,481 |

**Table V.21 Present Value of $SO_2$ Emissions Reduction for Gas-fired Instantaneous Water Heaters Shipped During the Period 2030–2059**

| EL | 7% Discount Rate | 3% Discount Rate |
|---|---|---|
| | ***million 2023$*** | |
| 1 | 0.04 | 0.22 |
| 2 | 0.9 | 2.9 |
| 3 | 1.9 | 5.9 |
| 4 | 12.9 | 39.1 |

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 impact of the change in Hg emissions because the change 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)) No other factors were considered in this analysis.

8. Summary of Economic Impacts

Table V.22 and Table V.23 present 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 products and are measured for the lifetime of products shipped during the period 2030–2059. 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 gas-fired instantaneous water heaters shipped during the period 2030–2059.

**Table V.22 Consumer NPV Combined with Present Value of Climate Benefits and Health Benefits (2023 SC-GHG estimates)**

| Category of Climate Benefits | TSL 1 | TSL 2 | TSL 3 | TSL 4 |
|---|---|---|---|---|
| ***Using 3% Discount Rate for Consumer NPV and Health Benefits (billion 2023$)*** | | | | |
| 2.5% Near-term Ramsey DR | 5.5 | 10.0 | 14.8 | 16.2 |
| 2.0% Near-term Ramsey DR | 7.3 | 12.8 | 18.9 | 21.0 |
| 1.5% Near-term Ramsey DR | 10.6 | 18.2 | 26.7 | 30.1 |
| ***Using 7% Discount Rate for Consumer NPV and Health Benefits (billion 2023$)*** | | | | |
| 2.5% Near-term Ramsey DR | 3.4 | 6.0 | 8.8 | 9.6 |
| 2.0% Near-term Ramsey DR | 5.1 | 8.9 | 12.9 | 14.4 |
| 1.5% Near-term Ramsey DR | 8.4 | 14.2 | 20.7 | 23.5 |

**Table V.23 Consumer NPV Combined with Present Value of Climate Benefits and Health Benefits (2021 Interim SC-GHG estimates)**

| Category of Climate Benefits | TSL 1 | TSL 2 | TSL 3 | TSL 4 |
|---|---|---|---|---|
| ***Using 3% Discount Rate for Consumer NPV and Health Benefits (billion 2023$)*** | | | | |
| 5% Average SC-GHG case | 3.2 | 6.2 | 9.3 | 9.7 |
| 3% Average SC-GHG case | 3.9 | 7.4 | 11.1 | 11.8 |
| 2.5% Average SC-GHG case | 4.5 | 8.3 | 12.3 | 13.3 |
| 3% 95th percentile SC-GHG case | 5.9 | 10.6 | 15.6 | 17.1 |
| ***Using 7% Discount Rate for Consumer NPV and Health Benefits (billion 2023$)*** | | | | |
| 5% Average SC-GHG case | 1.1 | 2.2 | 3.3 | 3.2 |
| 3% Average SC-GHG case | 1.8 | 3.4 | 5.1 | 5.2 |
| 2.5% Average SC-GHG case | 2.4 | 4.3 | 6.3 | 6.7 |
| 3% 95th percentile SC-GHG case | 3.8 | 6.6 | 9.6 | 10.5 |

*C. Conclusion*

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

For this final rule, DOE considered the impacts of amended standards for gas-fired instantaneous water heaters at each TSL, beginning with the maximum technologically feasible level, to determine whether that level was economically justified.

Where the max-tech level was not justified, DOE then considered the next most efficient level and undertook the same evaluation until it reached the highest efficiency level that is both technologically feasible and economically justified and saves a significant amount of energy.

To aid the reader as DOE discusses the benefits and/or burdens of each TSL, tables in this section present a summary of the results of DOE's quantitative analysis for each TSL. In addition to the quantitative results presented in the tables, DOE also considers other burdens and benefits that affect economic justification. These include the impacts on identifiable subgroups of consumers who may be disproportionately affected by a national standard and impacts on employment.

DOE also notes that the economics literature provides a wide-ranging discussion of how consumers trade off upfront costs and energy savings in the absence of government intervention. Much of this literature attempts to explain why consumers appear to undervalue energy efficiency improvements. There is evidence that consumers undervalue future energy savings as a result of: (1) a lack of information; (2) a lack of sufficient salience of the long-term or aggregate benefits; (3) a lack of sufficient savings to warrant delaying or altering purchases; (4) excessive focus on the short term, in the form of inconsistent weighting of future energy cost savings relative to available returns on other investments; (5) computational or other difficulties associated with the evaluation of relevant tradeoffs; and (6) a divergence in incentives (for example, between renters and owners, or builders and purchasers). Having less than perfect foresight and a high degree of uncertainty about the future, consumers may trade off these types of investments at a higher than expected rate between current consumption and uncertain future energy cost savings.

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 a product in the standards case, this decreases sales for product manufacturers, and the impact on manufacturers attributed to lost revenue is included in the MIA. Second, DOE accounts for energy savings attributable only to products actually used by consumers in the standards case; if a standard decreases the number of products purchased by consumers, this decreases the potential energy savings from an energy conservation standard. DOE provides estimates of shipments and changes in the volume of product purchases in chapter 9 of the final rule TSD. However, DOE's current analysis does not explicitly control for heterogeneity in consumer preferences, preferences across subcategories of products or specific features, or consumer price sensitivity variation according to household income.. [194]

While DOE is not prepared at present to provide a fuller quantifiable framework for estimating the benefits and costs of changes in consumer purchase decisions due to an energy conservation standard, DOE is committed to developing a framework that can support empirical quantitative tools for improved assessment of the consumer welfare impacts of appliance standards. DOE has posted a paper that discusses the issue of consumer welfare impacts of appliance energy conservation standards, and potential

[194] P.C. Reiss and M.W. White. Household Electricity Demand, Revisited. *Review of Economic Studies*. 2005. 72(3): pp. 853–883. doi: *10.1111/0034-6527.00354*.

enhancements to the methodology by which these impacts are defined and estimated in the regulatory process.[195] DOE welcomes comments on how to more fully assess the potential impact of energy conservation standards on consumer choice and how to quantify this impact in its regulatory analysis in future rulemakings. General considerations for consumer welfare and preferences as well as the special cases of complementary goods are areas DOE plans to explore in a forthcoming RFI related to the agency's updates to its overall analytic framework.

1. Benefits and Burdens of TSLs Considered for Gas-fired Instantaneous Water Heater Standards

Table V.24 and Table V.25 summarize the quantitative impacts estimated for each TSL for gas-fired instantaneous water heaters with effective storage volumes less than 2 gallons and with rated inputs greater than or equal to 50,000 Btu/h. The national impacts are measured over the lifetime of gas-fired instantaneous water heaters purchased during the 30-year period that begins in the anticipated year of compliance with amended standards (2030–2059). 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 final rule in the absence of the estimated benefits from reductions in GHG emissions, including the estimates published by EPA in December 2023 or the Interim Estimates presented by the

[195] Sanstad, A. H. *Notes on the Economics of Household Energy Consumption and Technology Choice*. 2010. Lawrence Berkeley National Laboratory. Available at: *www1.eere.energy.gov/buildings/appliance_standards/pdfs/consumer_ee_theory.pdf* (last accessed September 12, 2024).

Interagency Working Group in 2021. The efficiency levels contained in each TSL are described in section V.A of this document.

**Table V.24 Summary of Analytical Results for Gas-fired Instantaneous Water Heaters TSLs: National Impacts**

| Category | TSL 1 | TSL 2 | TSL 3 | TSL 4 |
|---|---|---|---|---|
| **Cumulative FFC National Energy Savings** | | | | |
| Quads | 0.35 | 0.58 | 0.85 | 1.07 |
| **Cumulative FFC Emissions Reductions** | | | | |
| $CO_2$ (*million metric tons*) | 19 | 32 | 46 | 54 |
| $CH_4$ (*thousand tons*) | 244 | 398 | 576 | 671 |
| $N_2O$ (*thousand tons*) | 0.04 | 0.06 | 0.09 | 0.12 |
| $SO_2$ (*thousand tons*) | 0.05 | 0.12 | 0.20 | 0.79 |
| $NO_X$ (*thousand tons*) | 53 | 86 | 125 | 145 |
| Hg (*tons*) | (0.0004) | (0.0004) | (0.0003) | 0.0035 |
| **Present Value of Benefits and Costs *(3% discount rate, billion 2023$)*** | | | | |
| Consumer Operating Cost Savings | 2.6 | 4.5 | 6.7 | 8.6 |
| Climate Benefits* (2023 SC-GHG estimates) | 4.4 | 7.1 | 10.2 | 12.0 |
| Climate Benefits* (2021 interim SC-GHG estimates) | 1.0 | 1.7 | 2.4 | 2.8 |
| Health Benefits** | 1.6 | 2.7 | 3.8 | 4.5 |
| Total Benefits† (2023 SC-GHG estimates) | 8.6 | 14.3 | 20.8 | 25.1 |
| Total Benefits† (2021 interim SC-GHG estimates) | 5.3 | 8.9 | 12.9 | 15.9 |
| Consumer Incremental Product Costs‡ | 1.4 | 1.5 | 1.8 | 4.1 |
| Consumer Net Benefits | 1.3 | 3.1 | 4.9 | 4.5 |
| Total Net Benefits† (2023 SC-GHG estimates) | 7.3 | 12.8 | 18.9 | 21.0 |
| Total Net Benefits† (2021 interim SC-GHG estimates) | 3.9 | 7.4 | 11.1 | 11.8 |
| **Present Value of Benefits and Costs *(7% discount rate, billion 2023$)*** | | | | |
| Consumer Operating Cost Savings | 1.0 | 1.7 | 2.4 | 3.1 |
| Climate Benefits* (2023 SC-GHG estimates) | 4.4 | 7.1 | 10.2 | 12.0 |
| Climate Benefits* (2021 interim SC-GHG estimates) | 1.0 | 1.7 | 2.4 | 2.8 |
| Health Benefits** | 0.6 | 0.9 | 1.3 | 1.5 |
| Total Benefits† (2023 SC-GHG estimates) | 5.9 | 9.6 | 13.9 | 16.5 |
| Total Benefits† (2021 interim SC-GHG estimates) | 2.5 | 4.2 | 6.0 | 7.3 |
| Consumer Incremental Product Costs‡ | 0.7 | 0.8 | 1.0 | 2.1 |
| Consumer Net Benefits | 0.2 | 0.9 | 1.5 | 1.0 |
| Total Net Benefits† (2023 SC-GHG estimates) | 5.1 | 8.9 | 12.9 | 14.4 |
| Total Net Benefits† (2021 interim SC-GHG estimates) | 1.8 | 3.4 | 5.1 | 5.2 |

Note: This table presents the costs and benefits associated with gas-fired instantaneous water heaters shipped during the period 2030–2059. These results include benefits to consumers which accrue after 2059 from the products shipped during the period 2030–2059. Parentheses indicate negative (-) values.
* Climate benefits are calculated using different estimates of the SC-$CO_2$, SC-$CH_4$ and SC-$N_2O$. 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. 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 estimate and the average SC-GHG with 3-percent discount rate for the 2021 interim SC-GHG estimate.
‡ Costs include incremental equipment costs as well as installation costs.

**Table V.25 Summary of Analytical Results for Gas-fired Instantaneous Water Heater TSLs: Manufacturer and Consumer Impacts**

| Category | TSL 1 | TSL 2 | TSL 3 | TSL 4 |
|---|---|---|---|---|
| **Manufacturer Impacts** | | | | |
| Industry NPV (million 2023$) (No-new-standards case INPV = 1,193.9) | 1,171.1 to 1,234.0 | 1,160.2 to 1,234.4 | 1,132.1 to 1,217.6 | 1,119.5 to 1,275.2 |
| Industry NPV (% change) | (1.9) to 3.4 | (2.8) to 3.4 | (5.2) to 2.0 | (6.2) to 6.8 |
| **Consumer Average LCC Savings (2023$)** | | | | |
| Gas-fired Instantaneous Water Heater | (1) | 112 | 90 | 39 |
| **Consumer Simple PBP (years)** | | | | |
| Gas-fired Instantaneous Water Heater | 12.6 | 8.9 | 8.3 | 10.3 |
| **Percent of Consumers that Experience a Net Cost** | | | | |
| Gas-fired Instantaneous Water Heater | 17.5 | 15.2 | 25.0 | 56.2 |

Parentheses indicate negative (-) values

DOE first considered TSL 4, which represents the max-tech efficiency level analyzed for gas-fired instantaneous water heaters with current UEF-based standards. At TSL 4, the design option pathway includes the use of high-efficiency flat-plate condensing heat exchangers and fully modulating burners. TSL 4 would require extensive changes to the way manufacturers currently produce gas-fired instantaneous water heaters. At TSL 4, approximately 8 percent of shipments are expected to meet the required efficiency levels by 2030 in the no-new-standards case; therefore, a significant ramp-up in manufacturing capacity would be needed to support the market transition.

TSL 4 would save an estimated 1.07 quads of energy, an amount DOE considers significant. Under TSL 4, the NPV of consumer benefit would be $0.98 billion using a discount rate of 7 percent, and $4.50 billion using a discount rate of 3 percent.

The cumulative emissions reductions at TSL 4 are 54 Mt of $CO_2$, 671 thousand tons of $CH_4$, 0.12 thousand tons of $N_2O$, 145 thousand tons of $NO_X$, 0.79 thousand tons of $SO_2$, and 0.0035 tons of Hg. The estimated monetary value of the climate benefits from reduced GHG emissions at TSL 4 is $12.0 billion (associated with the average SC-GHG at a 2-percent near Ramsey discount rate using the 2023 SC-GHG estimates) or $2.8 billion (associated with the average SC-GHG at a 3-percent discount rate using the 2021 interim SC-GHG estimates). The estimated monetary value of the health benefits from reduced $SO_2$ and $NO_X$ emissions at TSL 4 is $1.5 billion using a 7-percent discount rate and $4.5 billion using a 3-percent discount rate.

Using a 7-percent discount rate for consumer benefits and costs, health benefits from reduced $SO_2$ and $NO_X$ emissions, and the 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 $14.4 billion (using the 2023 SC-GHG estimates) or $5.2 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 $21.0 billion (using the 2023 SC-GHG estimates) or $11.8 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, consumers will experience an average LCC savings of $39, which includes the cost of purchasing and installing a more expensive model with fully modulating burner technology. The fraction of consumers experiencing a net LCC cost is 56.2 percent.

At TSL 4, the projected change in INPV ranges from a decrease of $74.5 million to an increase of $81.2 million, which corresponds to a decrease of 6.2 percent and an increase of 6.8 percent, respectively. The range of impacts is driven primarily by the ability of manufacturers to recover their investments. DOE estimates that industry would need to invest $60.1 million to comply with standards set at TSL 4. At this level, given the greater complexity and assembly time of max-tech models, most manufacturers would need to add production lines to meet demand, which would require large capital investments and updates to the factory floor. The investment required to add production capacity would vary by manufacturer as it depends on floor space availability in and around existing manufacturing plants. Manufacturers would also need to upgrade their facilities to accommodate the production of models with large, high-efficiency condensing heat exchangers and fully modulating burners. DOE understands that implementing larger, improved condensing heat exchanger designs would add a significant amount of complexity to the manufacturing process. Feedback from confidential interviews and public comments indicate that it would require notable investment to incorporate fully modulating burners into their gas-fired instantaneous water heater designs. Of the 12 gas-fired instantaneous water heater OEMs, five OEMs offer 19 models that meet TSL 4 (which represents approximately 14 percent of gas-fired instantaneous water heater basic model listings).

The Secretary concludes that at TSL 4 for gas-fired instantaneous water heaters, the benefits of energy savings, positive NPV of consumer benefits, emissions reductions, and estimated monetary value of the emissions reductions would be outweighed by economic impacts to manufacturers (driven by the ramp-up in scale and offerings needed to support max-tech efficiencies), and a majority of consumers would experience a net cost (56.2 percent). At TSL 4, most manufacturers would need to add production lines to meet demand, which would require large capital expenditures. DOE projects that only 8 percent of shipments would meet TSL 4 efficiencies by 2030 in the no-new-standards case. Consequently, the Secretary has concluded that TSL 4 is not economically justified.

DOE then considered TSL 3, which represents the next highest efficiency level analyzed for gas-fired instantaneous water heaters with current UEF-based standards and represents efficiencies that can meet the current ENERGY STAR specification. At TSL 3, the design option pathway includes the use of high-efficiency flat-plate condensing heat exchangers. TSL 3 may also require changes to the way manufacturers currently produce gas-fired instantaneous water heaters since many designs on the market today use tube heat exchangers. At TSL 3, approximately 16 percent of shipments are expected to meet the required efficiency levels by 2030 in the no-new-standards case.

TSL 3 would save an estimated 0.85 quads of energy, an amount DOE considers significant. Under TSL 3, the NPV of consumer benefit would be $1.45 billion using a discount rate of 7 percent, and $4.89 billion using a discount rate of 3 percent.

The cumulative emissions reductions at TSL 3 are 46 Mt of $CO_2$, 576 thousand tons of $CH_4$, 0.09 thousand tons of $N_2O$, 125 thousand tons of $NO_X$, 0.20 thousand tons of $SO_2$, and an increase of 0.0003 tons of Hg. The estimated monetary value of the climate benefits from reduced GHG emissions at TSL 3 is $10.2 billion (associated with the average SC-GHG at a 2-percent near-term Ramsey discount rate using the 2023 SC-GHG estimates) or $2.4 billion (associated with the average SC-GHG at a 3-percent discount rate using the 2021 interim SC-GHG estimates). The estimated monetary value of the health benefits from reduced $SO_2$ and $NO_X$ emissions at TSL 3 is $1.3 billion using a 7-percent discount rate and $3.8 billion using a 3-percent discount rate.

Using a 7-percent discount rate for consumer benefits and costs, health benefits from reduced $SO_2$ and $NO_X$ emissions, and the 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 $12.9 billion (using the 2023 SC-GHG estimates) or $5.1 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 3 is $18.9 billion (using the 2023 SC-GHG estimates) or $11.1 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, consumers will experience an average LCC savings of $90, which includes the cost of purchasing and installing a more expensive condensing model. The fraction of consumers experiencing a net LCC cost is 25.0 percent.

At TSL 3, the projected change in INPV ranges from a decrease of $61.8 million to an increase of $23.7 million, which corresponds to a decrease of 5.2 percent and an increase of 2.0 percent, respectively. As with TSL 4, the range of impacts is driven primarily by the ability of manufacturers to recover their investments. DOE estimates that industry must invest $60.1 million to comply with standards set at TSL 3. At this level, DOE expects manufacturers would implement the same high-efficiency heat exchanger design as at max-tech and increase the condensing heat exchanger area relative to lower efficiency levels but not to the extent as required at max-tech. Given the greater complexity and assembly time of high-efficiency models, most manufacturers would need to add production lines to meet demand, which would require capital investments and potential updates to the factory floor. The investment required to add production capacity would vary by manufacturer as it depends on floor space availability in and around existing manufacturing plants. Manufacturers would also need to upgrade their facilities to accommodate the production of models with high-efficiency condensing heat exchangers. Additionally, while TSL 3 is technologically feasible using traditional step-modulating burner designs, DOE received information from several manufacturers indicating that, at this efficiency level, some manufacturers may opt to redesign their models to take advantage of alternative burner configurations (*e.g.*, down-firing) or even fully-modulating designs— designs which may provide a benefit of better condensate management at such a high efficiency.

The Secretary concludes that at TSL 3 for gas-fired instantaneous water heaters, the benefits of energy savings, positive NPV of consumer benefits, emissions reductions, and estimated monetary value of the emissions reductions would be outweighed by economic impacts to manufacturers (driven by the potential conversion costs for production equipment and tooling, as well as the ramp-up in production necessary for all model lines to meet this efficiency). At TSL 3, most manufacturers would need to add production lines to meet demand. Consequently, the Secretary has concluded that TSL 3 is not economically justified.

DOE then considered TSL 2, which represents the next highest efficiency level analyzed for gas-fired instantaneous water heaters with current UEF-based standards. TSL 2 also aligns with the Joint Stakeholder Recommendation efficiency level. At TSL 2, the design option pathway includes the use of condensing heat exchangers. At TSL 2, approximately 62 percent of shipments are expected to meet the required efficiency levels by 2030 in the no-new-standards case, which is a significant increase from TSL 3 and TSL 4.

TSL 2 would save an estimated 0.58 quads of energy, an amount DOE considers significant. Under TSL 2, the NPV of consumer benefit would be $0.87 billion using a discount rate of 7 percent, and $3.06 billion using a discount rate of 3 percent.

The cumulative emissions reductions at TSL 2 are 32 Mt of $CO_2$, 398 thousand tons of $CH_4$, 0.06 thousand tons of $N_2O$, 86 thousand tons of $NO_X$, 0.12 thousand tons of $SO_2$, and an increase of 0.0004 tons of Hg. The estimated monetary value of the climate benefits from reduced GHG emissions at TSL 2 is $7.1 billion (associated with the average SC-GHG at a 2-percent near-term Ramsey discount rate using the 2023 SC-GHG estimates) or $1.7 billion (associated with the average SC-GHG at a 3-percent discount rate using the 2021 interim SC-GHG estimates). The estimated monetary value of the health benefits from reduced $SO_2$ and $NO_X$ emissions at TSL 3 is $0.9 billion using a 7-percent discount rate and $2.7 billion using a 3-percent discount rate.

Using a 7-percent discount rate for consumer benefits and costs, health benefits from reduced $SO_2$ and $NO_X$ emissions, and the 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 2 is $8.9 billion (using the 2023 SC-GHG estimates) or $3.4 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 2 is $12.8 billion (using the 2023 SC-GHG estimates) or $7.4 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 2, consumers will experience an average LCC savings of $112 which includes the cost of purchasing and installing a more expensive condensing model. The fraction of consumers experiencing a net LCC cost is 15.2 percent.

At TSL 2, the projected change in INPV ranges from a decrease of $33.7 million to an increase of $40.5 million, which corresponds to a decrease of 2.8 percent and an increase of 3.4 percent, respectively. DOE estimates that industry must invest $20.4 million to comply with standards set at TSL 2.

At higher TSLs, the primary driver of high conversion costs is the required capital investment to meet market demand for high-efficiency condensing gas-fired instantaneous water heaters. However, at TSL 2, industry has extensive experience producing gas-fired instantaneous water heater models that meet this level, and, furthermore, this TSL was strongly supported by a coalition of industry stakeholders, including manufacturers. DOE believes that having major manufacturers and the industry trade association sign on to the Joint Stakeholder Recommendation is a testament to industry’s ability to ramp up capacity to produce volumes necessary to support a transition to condensing efficiencies at TSL 2. Based on manufacturer feedback, DOE does not expect that most manufacturers would need to add production lines at this level. All 12 gas-fired instantaneous water heater OEMs currently manufacture condensing gas-fired instantaneous water heater models. Of these 12 OEMs, 10 OEMs currently manufacture condensing gas-fired instantaneous water heater models that meet this level. Collectively, these 10 OEMs offer 71 unique basic models that meet TSL 2 (which represent approximately 51 percent of gas-fired instantaneous water heater basic model listings). Furthermore, these 10 OEMs account for the majority of gas-fired instantaneous water heater sales, representing over 95 percent of industry shipments.

After considering the analysis and weighing the benefits and burdens, the Secretary has concluded that standards set at TSL 2 for gas-fired instantaneous water heaters would be economically justified. At this TSL, the average LCC savings for consumers are expected to be positive. 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. These national benefits vastly outweigh the costs. The standard levels at TSL 2 are economically justified even without weighing the estimated monetary value of emissions reductions. When those emissions reductions are included— representing $7.1 billion in climate benefits (associated with the average SC-GHG at a 2-percent near-term Ramsey discount rate using the 2023 SC-GHG estimates) or $1.7 billion in climate benefits (associated with the average SC-GHG at a 3-percent discount rate using the 2021 interim SC-GHG estimate), and $0.9 billion (using a 7-percent discount rate) or $2.7 billion (using a 3-percent discount rate) in health benefits— the rationale becomes stronger still. In addition, DOE considered that TSL 2 is representative of the Joint

Stakeholder Recommendation. More specifically, DOE believes the Joint Stakeholder agreement from a cross-section group of stakeholders provides DOE with a good indication of stakeholder views on this rulemaking and some assurance that industry can transition to these levels. And, as indicated by DOE's analysis, the market will see significant benefits at this efficiency level.

Accordingly, the Secretary has concluded that TSL 2 would offer the maximum improvement in efficiency that is technologically feasible and economically justified, and would result in significant conservation of energy. Lastly, TSL 2 represents the recommended standard levels submitted by Joint Stakeholders to DOE, providing further support for standard levels set at TSL 2, a factor the Secretary considers significant.

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 at higher TSLs, larger fractions of consumers experience increased costs greater than operating savings, and manufacturer investments to meet consumer demand would be significantly higher.

Therefore, based on the above considerations, DOE adopts the conservation standards for consumer water heaters at TSL 2 for those product classes where there are existing applicable UEF standards. For the remaining product classes, DOE adopts converted standards in the UEF metric based on the amended appendix E test procedure. The amended energy conservation standards for gas-fired instantaneous water heaters, which are expressed as UEF, are shown in Table V.26.

**Table V.26 Amended Energy Conservation Standards for Gas-fired Instantaneous Water Heaters**

| Product Class | Effective Storage Volume ($V_{eff}$)* and Input Rating | Draw Pattern | UEF* |
|---|---|---|---|
| Gas-fired Instantaneous Water Heater | <2 gal and ≤50,000 Btu/h | Very Small | 0.64 |
| | | Low | 0.64 |
| | | Medium | 0.64 |
| | | High | 0.64 |
| | <2 gal and >50,000 Btu/h | Very Small | 0.89 |
| | | Low | 0.91 |
| | | Medium | 0.91 |
| | | High | 0.93 |
| | ≥2 gal and ≤200,000 Btu/h | Very Small | 0.2534 - (0.0018 x $V_{eff}$) |
| | | Low | 0.5226 - (0.0022 x $V_{eff}$) |
| | | Medium | 0.5919 - (0.0020 x $V_{eff}$) |
| | | High | 0.6540 - (0.0017 x $V_{eff}$) |

* $V_{eff}$ is the Effective Storage Volume (in gallons), as determined pursuant to 10 CFR 429.17.

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 products that meet the adopted standards (consisting primarily of operating cost savings from using less energy), minus increases in product purchase costs; and (2) the annualized monetary value of the climate and health benefits.

Table V.27 shows the annualized values for gas-fired instantaneous water heaters analyzed under TSL 2, expressed in 2023$. The results under the primary estimate are as follows.

Using a 7-percent discount rate for consumer benefits and costs and health benefits from reduced $NO_X$ and $SO_2$ emissions, and 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 gas-fired instantaneous water heaters is $88 million per year in increased equipment installed costs, while the estimated annual benefits are $187 million from reduced equipment operating costs, $349 million in climate benefits (using the 2023 SC-GHG estimates) or $98 million in climate benefits (using the 2021 interim SC-GHG estimates), and $101 million in health benefits. In this case, the net benefit amounts to $549 million per year (using the 2023 SC-GHG estimates) or $297 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 $NO_X$ 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 cost of the adopted standards for gas-fired instantaneous water heaters is $87 million per year in increased equipment costs, while the estimated annual benefits are $268 million in reduced operating costs, $349 million in climate benefits (using the 2023 SC-GHG estimates) or $98 million in climate benefits (using the 2021 interim SC-GHG estimates), and $158 million in health benefits. In this case, the net benefit amounts to $689 million per year (using the 2023 SC-GHG estimates) or $437 million per year (using the 2021 interim SC-GHG estimates).

**Table V.27 Annualized Benefits and Costs of the Adopted Energy Conservation Standards for Gas-fired Instantaneous Water Heaters at TSL 2 Shipped During the Period 2030–2059 ($V_{eff}$ < 2 gal, Rated Input > 50,000 Btu/h)**

| | Million 2023$/year | | |
|---|---|---|---|
| | **Primary Estimate** | **Low-Net-Benefits Estimate** | **High-Net-Benefits Estimate** |
| **3% discount rate** | | | |
| **Consumer Operating Cost Savings** | 268 | 249 | 288 |
| **Climate Benefits* (2023 SC-GHG estimates)** | 349 | 344 | 355 |
| **Climate Benefits* (2021 interim SC-GHG estimates)** | 98 | 96 | 100 |
| **Health Benefits**** | 158 | 156 | 161 |
| **Total Benefits† (2023 SC-GHG estimates)** | 776 | 749 | 804 |
| **Total Benefits† (2021 interim SC-GHG estimates)** | 525 | 502 | 548 |
| **Consumer Incremental Product Costs‡** | 87 | 86 | 89 |
| **Net Benefits† (2023 SC-GHG estimates)** | 689 | 663 | 715 |
| **Net Benefits† (2021 interim SC-GHG estimates)** | 437 | 416 | 459 |
| **Change in Producer Cashflow (INPV)‡‡** | (3) – 4 | (3) – 4 | (3) – 4 |
| **7% discount rate** | | | |
| **Consumer Operating Cost Savings** | 187 | 174 | 200 |
| **Climate Benefits* (2023 SC-GHG estimates)** | 349 | 344 | 355 |
| **Climate Benefits* (2021 interim SC-GHG estimates)** | 98 | 96 | 100 |
| **Health Benefits**** | 101 | 99 | 102 |

| | Million 2023$/year | | |
|---|---|---|---|
| | **Primary Estimate** | **Low-Net-Benefits Estimate** | **High-Net-Benefits Estimate** |
| **Total Benefits† (2023 SC-GHG estimates)** | 637 | 616 | 658 |
| **Total Benefits† (2021 interim SC-GHG estimates)** | 386 | 369 | 402 |
| **Consumer Incremental Product Costs‡** | 88 | 87 | 90 |
| **Net Benefits† (2023 SC-GHG estimates)** | 549 | 530 | 568 |
| **Net Benefits† (2021 interim SC-GHG estimates)** | 297 | 283 | 312 |
| **Change in Producer Cashflow (INPV)‡‡** | (3) – 4 | (3) – 4 | (3) – 4 |

Note: These results include consumer, climate, and health benefits that accrue after 2059 from the products shipped during the period 2030–2059. The Primary, Low Net Benefits, and High Net Benefits Estimates utilize projections of energy prices from the *AEO2023* Reference case, Low Economic Growth case, and High Economic Growth case, respectively. In addition, incremental equipment costs reflect a medium decline rate in the Primary Estimate, a low decline rate in the Low Net Benefits Estimate, and a high decline rate in the High Net Benefits Estimate. The methods used to derive projected price trends are explained in sections IV.F.1 and IV.H.3 of this document. Note that the Benefits and Costs may not sum to the Net Benefits due to rounding.
* Climate benefits are calculated using 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 2-percent near-term Ramsey discount rate for the 2023 estimate and the average SC-GHG with 3-percent discount rate for the 2021 interim SC-GHG estimate.
‡ Costs include incremental equipment costs as well as installation costs.
‡‡ Operating Cost Savings are calculated based on the life-cycle costs analysis and national impact analysis as discussed in detail below. *See* sections IV.F and IV.H of this document. DOE's national impacts analysis includes all impacts (both costs and benefits) along the distribution chain beginning with the increased costs to the manufacturer to manufacture the product and ending with the increase in price experienced by the consumer. DOE also separately conducts a detailed analysis on the impacts on manufacturers (*i.e.*, MIA). *See* section IV.J of this document. In the detailed MIA, DOE models manufacturers' pricing decisions based on assumptions regarding investments, conversion costs, cashflow, and margins. The MIA produces a range of impacts, which is the rule's expected impact on the INPV. The change in INPV is the present value of all changes in industry cash flow, including changes in production costs, capital expenditures, and manufacturer profit margins. The annualized change in INPV is calculated using the industry weighted average cost of capital value of 9.6 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 gas-fired instantaneous water heaters, the annualized change in INPV ranges from -$3 million

to $4 million. DOE accounts for that range of likely impacts in analyzing whether a TSL is economically justified. *See* section V.C of this document. DOE is presenting the range of impacts to the INPV under two manufacturer markup scenarios: the Preservation of Gross Margin scenario, which is the manufacturer markup scenario used in the calculation of Consumer Operating Cost Savings in this table; and the Preservation of Operating Profit scenario, where DOE assumed manufacturers would not be able to increase per-unit operating profit in proportion to increases in manufacturer production costs. DOE includes the range of estimated annualized change in INPV in the above table, drawing on the MIA explained further in section IV.J of this document to provide additional context for assessing the estimated impacts of this 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 (2023 SC-GHG estimates) for this final rule, the annualized net benefits would range from $686 million to $693 million at 3-percent discount rate and would range from $546 million to $553 million at 7-percent discount rate. Parentheses indicate negative () values.

### 3. Compliance Dates

As discussed in section II.A of this document, DOE is conducting this rulemaking in satisfaction of the lookback review provisions and the UEF metric provisions in EPCA. *See* 42 U.S.C. 6295(m) and 6295(e)(5), respectively. Per EPCA, an amendment of standards prescribed under 42 U.S.C. 6295(m) is applicable to water heaters manufactured after the date that is 5 years after the publication of a final rule amending standards. (42 U.S.C. 6295(m)(4)(A)(ii)) Hence, the compliance date for amended standards pertaining to gas-fired instantaneous water heaters is 5 years from the publication of this final rule.

## 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 reviewed this final rule under the provisions of the Regulatory Flexibility Act and the procedures and policies published on February 19, 2003. DOE certifies that this final rule would not have a significant economic impact on a substantial number of small entities. As such, DOE has not prepared a FRFA for the products that are the subject of this rulemaking. The factual basis of this certification is set forth in the following paragraphs.

For manufacturers of gas-fired instantaneous water heaters, 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 gas-fired instantaneous water heaters is classified under NAICS 335220, "Major Household Appliance Manufacturing." The SBA sets a threshold of 1,500 employees or fewer for an entity to be considered as a small business for this category. For manufacturers of gas-fired instantaneous water heaters, 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 gas-fired instantaneous water heaters is classified under NAICS 335220, "Major Household Appliance Manufacturing." The SBA sets a threshold of

1,500 employees or fewer for an entity to be considered as a small business for this category.

To estimate the number of companies that could be small business manufacturers of gas-fired instantaneous water heaters, DOE conducted a market survey using public information and subscription-based company reports to identify potential small business manufacturers. DOE reviewed DOE's Compliance Certification Database,[196] Air-Conditioning, Heating, and Refrigeration Institute's Directory of Certified Product Performance,[197] California Energy Commission's Modernized Appliance Efficiency Database System,[198] the ENERGY STAR Product Finder dataset,[199] and individual company websites, to create a list of companies that manufacture, produce, or import the products covered by this rulemaking. DOE then consulted publicly available data, such as manufacturer websites, manufacturer specifications and product literature, import/export logs (*e.g.*, bills of lading from ImportYeti[200]), and basic model numbers, to identify original equipment manufacturers ("OEMs") of covered gas-fired instantaneous water heaters. DOE relied on public information and market research tools (*e.g.*, reports from D&B Hoovers[201]) to determine company structure, location, headcount, and annual revenue. DOE screened out companies that do not manufacture the equipment covered

---

[196] U.S. Department of Energy's Compliance Certification Database is available at *regulations.doe.gov/certification-data* (last accessed July 19, 2024).
[197] Air-Conditioning, Heating and Refrigeration Institute's Directory of Certified Product Performance is available at *https://ahridirectory.org/search/searchhome?Returnurl=%2f* (last accessed July 23, 2024)
[198] California Energy Commission's Modernized Appliance Efficiency Database System is available at *cacertappliances.energy.ca.gov/Pages/Search/AdvancedSearch.aspx* (last accessed July 19, 2024).
[199] ENERGY STAR Product Finder is available at *www.energystar.gov/productfinder* (last accessed July 22, 2024).
[200] ImportYeti, LLC. ImportYeti is available at: *www.importyeti.com/* (Last accessed July 30, 2024).
[201] The Dun & Bradstreet subscription login is available at *app.dnbhoovers.com* (last accessed July 30, 2024).

by this rulemaking, do not meet the SBA's definition of a "small business," or are foreign-owned and operated.

DOE identified 12 OEMs of gas-fired instantaneous water heaters subject to more stringent standards. Of these 12 OEMs, DOE did not identify any domestic OEMs that meet SBA's definition of a "small business." Given the lack of small, domestic OEMs with a direct compliance burden, DOE concludes that this final rule would not have "a significant impact on a substantial number of small entities."

DOE has transmitted the certification and supporting statement of factual basis to the Chief Counsel for Advocacy of the SBA for review under 5 U.S.C. 605(b).

In response to the July 2023 NOPR, the Gas Association Commenters and NPGA, APGA, AGA, and Rinnai submitted comments noting that DOE identified only two small businesses, neither of which produce gas-fired water heaters. As a result, these commenters stated that DOE has no data on small businesses that produce gas-fired water heaters relative to redesign costs, product availability, or whether the proposed efficiency levels could cause small businesses to exit the market. (Gas Association Commenters No. 1181, pp. 38–39; NPGA, APGA, AGA, and Rinnai, No. 441 at p. 5) NPGA, APGA, AGA, and Rinnai asserted that the July 2023 NOPR fails to comply with Executive Order 13272, "Proper Consideration of Small Entities in Agency Rulemaking," and must be addressed. (NPGA, APGA, AGA, and Rinnai, No. 441 at p. 5)

For the IRFA conducted in support of the July 2023 NOPR, which proposed standards for covered consumer water heaters, DOE identified one small domestic OEM of oil-fired storage water heaters and one small domestic OEM of electric storage water heaters. For this certification, DOE refreshed its product database to include up-to-date information on gas-fired instantaneous water heaters marketed for the United States. Based on its comprehensive review of the gas-fired instantaneous water heater market, DOE maintains its finding from the IRFA that there are no small, domestic OEMs that manufacture gas-fired instantaneous water heaters. As such, DOE does not expect that the standards adopted in this final rule would directly impact small businesses that manufacture gas-fired instantaneous water heaters.

DOE did not receive written comments in response to the July 2024 NODA that specifically addressed the potential impacts on small businesses.

*C. Review Under the Paperwork Reduction Act*

Manufacturers of gas-fired instantaneous water heaters 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 gas-fired instantaneous water heaters, 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 gas-fired instantaneous water heaters. (*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 products 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. 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 *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 gas-fired instantaneous water heater 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 gas-fired instantaneous water heaters, 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 **preamble** 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), this final rule establishes amended energy conservation standards for gas-fired instantaneous water heaters that are designed to achieve the maximum improvement in energy efficiency that DOE has determined to be both technologically feasible and economically justified, as required by 6295(o)(2)(A) and 6295(o)(3)(B). A full discussion of the alternatives considered by DOE is presented in chapter 17 of the TSD for this final rule.

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

Section 654 of the Treasury and General Government Appropriations Act, 1999 (Pub. L. No. 105-277) requires Federal agencies to issue a Family Policymaking Assessment for any proposed rule or policy that may affect family well-being. 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.

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 proposed 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. Families 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 low-income households, average LCC savings and PBP at the considered efficiency levels are improved (*i.e.*, higher LCC savings and lower PBP) as compared to the average for all households. Further, the standards will also result in climate and health benefits for families.

*I. Review Under Executive Order 12630*

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

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

Section 515 of the Treasury and General Government Appropriations Act, 2001 (44 U.S.C. 3516, note) provides for Federal agencies to review most disseminations of information to the public under information quality guidelines established by each agency pursuant to general guidelines issued by OMB. OMB's guidelines were published at 67 FR 8452 (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 amended energy conservation standards for gas-fired instantaneous water heaters, 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.[202] 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.[203]

*M. Congressional Notification*

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

[202] 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 August 29, 2024).
[203] The report is available at: *www.nationalacademies.org/our-work/review-of-methods-for-setting-building-and-equipment-performance-standards*.

## 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 430

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

**Signing Authority**

This document of the Department of Energy was signed on December 16, 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 16, 2024.

Jeffrey M. Marootian

Digitally signed by Jeffrey M. Marootian
Date: 2024.12.16 15:52:53 -05'00'

Jeffrey Marootian
Principal Deputy Assistant Secretary for
Energy Efficiency and Renewable Energy
U.S. Department of Energy

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

## PART 430 - ENERGY CONSERVATION PROGRAM FOR CONSUMER PRODUCTS

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

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

2. Amend §430.32 by:

a. Revising paragraph (d)(3); and

b. Adding paragraph(d)(4).

The addition and revision read as follows.

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

* * * * *

(d) * * *

(3) The uniform energy factor of water heaters manufactured on or after ***[INSERT DATE 5 YEARS FROM PUBLICATION OF THIS FINAL RULE]*** shall not be less than the following:

| Product Class | Effective Storage Volume ($V_{eff}$)* and Input Rating | Draw Pattern | UEF* |
|---|---|---|---|
| Gas-fired Instantaneous Water Heater | <2 gallons (“gal”) and ≤50,000 Btu/h | Very Small | 0.64 |
| | | Low | 0.64 |
| | | Medium | 0.64 |
| | | High | 0.64 |
| | <2 gal and >50,000 Btu/h | Very Small | 0.89 |
| | | Low | 0.91 |
| | | Medium | 0.91 |
| | | High | 0.93 |
| | ≥2 gal and ≤200,000 Btu/h | Very Small | 0.2534 - (0.0018 x $V_{eff}$) |
| | | Low | 0.5226 - (0.0022 x $V_{eff}$) |
| | | Medium | 0.5919 - (0.0020 x $V_{eff}$) |
| | | High | 0.6540 - (0.0017 x $V_{eff}$) |

* $V_{eff}$ is the Effective Storage Volume (in gallons), as determined pursuant to §429.17 of this chapter.

(4) The provisions of paragraph (d) of this section are separate and severable from one another. Should a court of competent jurisdiction hold any provision(s) of paragraph (d) of this section to be stayed or invalid, such action shall not affect any other provision of paragraph (d) of this section.

*     *     *     *     *