Northwest **Power** and **Conservation** Council

December 6, 2022

MEMORANDUM

TO: **Council Members**

FROM: **Kevin Smit**

SUBJECT: **Letter to DOE Regarding Water Heating Efficiency Standard**

PROPOSED ACTION:

Staff recommends the Council submit a letter of support to a proposal regarding a set of recommendations on amended energy conservation standards for consumer water heaters. The recommendations (see attached) were submitted to DOE on October 21, 2022, by a group of public and private sector organizations ("joint stakeholders")[1].

SIGNIFICANCE:

Water heating represents a significant portion of the electricity consumption in the nation and the Pacific Northwest[2]. Heat pump water heaters use one-third to one-half the amount of electricity than electric resistance water heaters and the Northwest utility programs have been running programs to incentivize heat pump water heaters for decades. The proposed recommendations support a federal efficiency standard that would require a move from electric resistance water heating to heat pump water heating for most applications in the residential sector.

BUDGETARY/ECONOMIC IMPACTS: None

[1] American Council for and Energy-Efficient Economy, Appliance Standards Awareness Project, Bradford White Corporation, Consumer Federation of America, Natural Resources Defense Council, Northwest Energy Efficiency Alliance, Rheem Manufacturing.
[2] In the Northwest in 2022, water heating consumed 11,363 GWh/yr of electricity. This is 16 percent of the residential electricity consumption and 6.1% of our total system load.

BACKGROUND

The Department of Energy (DOE) is currently working to revise its energy conservation standards for consumer water heaters and has requested comments on both the test procedures and the preliminary technical support document (TSD).[3] This TSD provides the analytical foundation for the new standard and insights into the likely recommended actions by DOE. The TSD shows efficiency level one (the lowest efficiency) is a resistance storage water heater, and efficiency level 2 is a heat pump water heater with relatively high efficiency levels (i.e., 3.3 -3.47 EUF). The joint stakeholders have reviewed these data and have developed efficiency recommendations that may appeal to a broader group and could result in fewer loopholes and less resistance from constituents. This recommendation has been submitted in order to influence DOE ahead of the Notice of Proposed Rulemaking (NOPR) which is expected to be released early next year.

The proposed recommendations allow for a relatively lower efficiency threshold (2.0 – 2.3 UEF[4]) for heat pump water heaters, especially in the smaller size category (20-55 gallons). This is proposed because at the high efficiency levels of around 3 UEF it would be difficult for a manufacturer to develop small water heaters (e.g., 30 gallon) that would reach this efficiency level.[5] The lower efficiency level proposed by the joint stakeholders allow more room for manufacturers to innovate and enables the market to adopt heat pump technology at lower costs.

A companion to the electric resistance water heater recommendation is to also recommend strong efficiency levels for gas storage and instantaneous water heaters.

ALTERNATIVES

In the alternative to proceeding as recommended by staff, the Council could choose not to support this recommendation. The Council can subsequently comment on the NOPR, expected early next year.

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[3] U.S. DOE. 2022. Preliminary Analysis Technical Support Document: Energy Efficiency Program for Consumer Products and Commercial and Industrial Equipment: Consumer Water Heaters. 7 March. Docket # EERE-2017- BT-STD-0019. https://www.regulations.gov/document/EERE-2017-BT-STD-0019-0018.

[4] The Uniform Energy Factor (UEF) is DOE's metric for communicating the efficiency of water heaters and is a measure of the energy produced divided by the energy input. The higher the UEF the more efficient the water heater. Electric resistance water heaters typically have UEF values in the 0.95 range while heat pump water heaters are in the 2.0 – 3.5 range.

[5] Efficiency levels for heat pump water heaters increase with storage tank size. Currently, there are no heat pump water heaters with sizes below 45 gallons.

October 21, 2022
Via Electronic Mail

American Council for an Energy-Efficient Economy
Appliance Standards Awareness Project
Bradford White Corporation
Consumer Federation of America
Natural Resources Defense Council
Northwest Energy Efficiency Alliance
Rheem Manufacturing

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

Re: Docket No. EERE–2017–BT–STD–0019 / RIN 1904–AD91, Joint Stakeholder Comments on Energy Conservation Standards for Consumer Water Heaters

Dear Ms. Hegarty,

A coalition of public and private sector organizations ("joint stakeholders") has successfully developed a set of recommendations on amended energy conservation standards for consumer water heaters (Docket No. EERE–2017–BT–STD–0019 / RIN 1904–AD91). The joint stakeholders collectively include water heater manufacturers, energy efficiency organizations, environmental groups, and consumer organizations. We are pleased to present this thoughtful proposal to the Department of Energy (DOE) that, if adopted, will transition the majority of electric storage water heaters to heat pump technology and make important incremental steps to improve gas-fired water heater efficiency. These recommendations are expected to result in significant reductions in national water heating energy use and their associated greenhouse gas emissions, save consumers money on their utility bills, and provide manufacturers more business certainty with room to innovate. Moreover, it offers manufacturers, consumers, and professional installers flexibility for certain applications where heat pump technology is not currently a viable replacement option.

The joint stakeholders primarily used DOE's preliminary technical support document (TSD)[1] as the basis for the recommended standards levels, employing the current test procedure[2] with

[1] U.S. DOE. 2022. *Preliminary Analysis Technical Support Document: Energy Efficiency Program for Consumer Products and Commercial and Industrial Equipment: Consumer Water Heaters.* 7 March. Docket # EERE-2017-BT-STD-0019. https://www.regulations.gov/document/EERE-2017-BT-STD-0019-0018.
[2] 10 C.F.R. § 430. Subpart B, Appendix E. 2014. *Uniform Test Method for Measuring the Energy Consumption of Water Heaters.* 11 July. https://www.ecfr.gov/current/title-10/chapter-II/subchapter-D/part-430/subpart-B#Appendix-E-to-Subpart-B-of-Part-430.

DOE's proposed changes outlined in the notice of proposed rulemaking (NOPR).[3] Our recommendations for amended standards for electric storage, gas-fired storage, and gas-fired instantaneous water heaters can be summarized as follows:

Electric Storage. We recommend that most electric storage waters with rated storage volumes ≥ 20 gallons to 120 gallons be required to meet minimum uniform energy factor (UEF) levels currently obtainable only with heat pump technology. The recommended minimum UEF levels for these recommended heat pump levels range from 2.0 to 2.5, depending upon DOE rated storage volume. The limited exceptions to heat pump requirements are 1) small (≤ 30 gallon) electric storage water heaters designed for low use, and 2) 30 to 35-gallon electric storage water heaters designed for low use that are also no more than 36 inches high. The first exception addresses small, low-use water heaters where cost-effective heat pump technologies do not yet exist. The latter height-limited exception is generally intended for water heaters in space-constrained installations, typically multifamily. We recommend that the standards for these two exception groups remain unchanged.

Gas-fired Storage. We recommend that for gas-fired storage water heaters with rated storage volumes ≥ 20 gallons and ≤ 55 gallons, DOE adopt UEF levels associated with Efficiency Level (EL) 2 in the preliminary TSD, which scales with water heater rated storage volume.[4]

Gas-fired Instantaneous. We recommend that for gas-fired instantaneous water heaters with a DOE rated storage volume of < 2 gallons and an input rating > 50,000 BTU per hour, DOE adopt UEF values of 0.91 for the medium draw pattern and 0.93 for the high draw pattern, consistent with EL 2 in the preliminary TSD.[5]

Attachment A (Joint Stakeholder Recommendations Regarding Amended Energy Conservation Standards for Consumer Water Heaters) details this proposal. Attachment B provides the calculation methodology for the estimated benefits of the joint stakeholder recommendations.

In the next three sections, we describe the joint stakeholders, summarize the joint comment rationale and process, and provide justification for the standards recommendations in Attachment A.

1. The Joint Stakeholders

The joint stakeholders represent a broad coalition of water heater manufacturers, energy efficiency organizations, environmental groups, and consumer organizations. Most have been active stakeholders in DOE water heater standards for decades, and together they represent a broad spectrum of interests and points of view. Collectively, this coalition has extensive experience in water heater research and product development, water heater test procedures and

[3] U.S. DOE. 2022. *Test procedure for Consumer Water Heaters and Residential-Duty Commercial Water Heaters, Notice of proposed rulemaking (NOPR) and request for comment.* Federal Register Vol. 87, 11 January. p. 1554. https://www.regulations.gov/document/EERE-2019-BT-TP-0032-0022.
[4] U.S. DOE. 2022. *Preliminary Analysis Technical Support Document: Energy Efficiency Program for Consumer Products and Commercial and Industrial Equipment: Consumer Water Heaters.* 7 March. Docket # EERE-2017-BT-STD-0019. p. 5-44, Table 5.14.1. https://www.regulations.gov/document/EERE-2017-BT-STD-0019-0018.
[5] Ibid. p. ES-5.

efficiency standards, electric and gas utility incentive programs, market transformation activities, and consumer advocacy. An overview of each joint stakeholder follows.

The American Council for an Energy-Efficient Economy (ACEEE), a nonprofit research organization, develops transformative policies to reduce energy waste and combat climate change. With our independent analysis, we aim to build a vibrant and equitable economy – one that uses energy more productively, reduces costs, protects the environment, and promotes the health, safety, and well-being of everyone. ACEEE has been a leader for four decades in the design and operation of efficient buildings. Throughout this time, ACEEE has had experience evaluating the energy savings potential and cost-effectiveness of government and industry standards, working with a wide range of stakeholders to advance energy efficient products.

The Appliance Standards Awareness Project (ASAP) organizes and leads a broad-based coalition effort that works to advance, win, and defend new appliance, equipment, and lighting standards that cut emissions that contribute to climate change and other environmental and public health harms, save water, and reduce economic and environmental burdens for low- and moderate-income households.

Bradford White Corporation is a full-line manufacturer of residential, commercial, and industrial water heaters, boilers, and storage tanks. The company maintains headquarters in Ambler, Pennsylvania, and has manufacturing facilities in Middleville, Michigan; Niles, Michigan; and Rochester, New Hampshire; and distribution and training centers in Halton Hills, Ontario, Canada. In 2022, Bradford White became a three-time ENERGY STAR Partner of the Year Award winner for Sustained Excellence from the U.S. Environmental Protection Agency and the U.S. Department of Energy. Bradford White continues to expand its portfolio of energy efficient water and space heating products as part of its overall commitment to sustainability.

The Consumer Federation of America is a national organization of more than 250 nonprofit consumer groups that was founded in 1968 to advance the consumer interest through research, advocacy, and education.

The Natural Resources Defense Council (NRDC) is an international nonprofit environmental organization with more than 3 million members and online activists. Since 1970, our lawyers, scientists, and other environmental specialists have worked to protect the world's natural resources, public health, and the environment. NRDC has offices in New York City, Washington, D.C., Los Angeles, San Francisco, Chicago, Bozeman, MT, and Beijing.

The Northwest Energy Efficiency Alliance (NEEA) is a non-profit organization working to encourage the development and adoption of energy-efficient products, practices, and services. Funded by regional utilities, NEEA is a collaboration of 140 utilities and efficiency organizations working together to advance energy efficiency in the Northwest on behalf of more than 13 million consumers. This unique partnership has helped make the Northwest region a national leader in energy efficiency.

Rheem is an industry leader in total heating, cooling, refrigeration and water heating solutions and one of the few global brands with product offerings covering residential and commercial

heating, cooling, conventional and hybrid storage water heaters (HPWH), tankless water heaters, solar water heating systems, pool and spa heaters, commercial boilers, residential hydronic and geothermal systems, commercial refrigeration products, indoor air quality accessories, and replacement parts for all categories. Rheem is headquartered in Atlanta, Georgia, and has U.S. based manufacturing facilities in Alabama, Arkansas, California, Connecticut, and North Carolina. The company also operates distribution facilities throughout the US, Canada, and many other countries around the world.

2. Joint Comment Rationale and Process

The joint stakeholders entered discussions on consumer water heater standards after informal conversations between parties illuminated a set of mutual goals: to achieve a DOE standard that would shift most of the electric storage market to heat pump technology and increase efficiency levels for gas-fired water heaters, while also providing continued performance for consumers, flexibility for more challenging installations, and a more certain business environment for manufacturers. Additionally, joint stakeholders sought approaches that would reduce the risk of unconventional installations of electric resistance water heaters.

In the past, DOE has encouraged stakeholders to undertake informal discussions which could result in a consensus agreement. Notable examples of past joint stakeholder recommendations include:

- 2010 Agreement on Minimum Federal Efficiency Standards, Smart Appliances, Federal Incentives and Related Matters for Specified Appliances[6]
- 2010 Joint Stakeholders Comments on Energy Conservation Standards for Residential Central Air Conditioners, Heat Pumps and Residential Furnaces[7]
- 2012 Joint Stakeholder Proposal on Energy Conservation Standards for Electric Motors[8]
- 2018 Joint Stakeholder Proposal for Energy Conservation Standards for Dedicated-Purpose Pool Pump Motors[9]

[6] Association of Home Appliance Manufacturers (AHAM) and ACEEE. 2010. *Agreement on Minimum Federal Efficiency Standards, Smart Appliances, Federal Incentives and Related Matters for Specified Appliances.* July 30. https://appliance-standards.org/sites/default/files/Agreement%20Text%20July%2030%2C%202010.PDF.

[7] Air-Conditioning, Heating, and Refrigeration Institute (AHRI) et al. 2010. *Joint Stakeholders Comments on Energy Conservation Standards for Residential Central Air Conditioners, Heat Pumps (Docket No. EERE-2008-BT-STD-0006/RIN 1904-AB47) and Residential Furnaces (Docket No. EE–RM/STD–01–350/RIN 1904–AA78).* January 15. https://appliance-standards.org/sites/default/files/Furnace_AC_HP_Agreement_Text.pdf.

[8] National Electrical Manufacturers Association (NEMA) et al. 2012. *Joint Petition to Adopt Joint Stakeholder Proposal as It Relates to the Rulemaking on Energy Conservation Standards for Electric Motors (Docket No. EERE–2010–BT–STD–0027).* August 15. https://appliance-standards.org/sites/default/files/Motors%20Joint%20Petition_Aug_2012.pdf.

[9] Association of Pool & Spa Professionals et al. 2018. *Joint Statement of Joint Stakeholder Proposal for Energy Conservation Standards for Dedicated-Purpose Pool Pump Motors (Docket No. EERE-2017-BT-STD-0048).* August 14. https://appliance-standards.org/sites/default/files/Joint_Proposal_on_DedicatedPurpose_Pool_Pump_Motors_Final.pdf.

- 2022 Joint Statement of Joint Stakeholder Proposal on Recommended Energy Conservation Standards and Test Procedure for Consumer Room Air Cleaners[10]

Development of these joint stakeholder recommendations on amended water heater standards occurred from June to October 2022, both online and in person. Discussions first focused on the scope of the recommendations and then proceeded to the details of the proposed energy conservation standards levels.

3. Justification for Joint Stakeholder Recommendations

The joint stakeholders strongly encourage DOE to adopt the recommendations in Attachment A for these key reasons:

They would result in substantial energy savings. We estimate the recommendations would result in approximately 27 quadrillion BTUs (quads) of full-fuel-cycle (FFC) energy savings over thirty years. Estimated thirty-year energy savings are substantial for both fuels: more than 24 FFC quads of electricity and 3 FFC quads of gas are projected to be saved. These savings would be greater than those achieved by any DOE standard to date, including the 2015 direct final rule for commercial rooftop units, which at the time was the largest energy savings achieved in a single standard issued by DOE.[11] Our calculations are based on DOE's assumptions in the preliminary TSD; Attachment B provides a detailed methodology.

They are expected to be highly cost effective. In just the first year the standards take effect, we estimate that households replacing an electric storage water heater that just meets the current standards would save an average of $185. Households with gas-fired storage water heaters would save $17 per year, and those with gas-fired instantaneous water heaters would save $31 per year. The lifetime cost savings are expected to significantly outweigh the expected increase in installed cost. Attachment B details these calculations, which are based on DOE's assumptions in the preliminary TSD.

They prioritize solutions focused on the consumer and professional installer experience. The recommended UEF levels allow for manufacturer flexibility in water heater design, balancing energy efficiency, consumer utility, and cost for consumers and installers. Installation impacts on low-income consumers and multifamily housing (which can have space-constrained, smaller water heaters) were carefully considered as well. For example, the recommended UEF levels for electric storage water heaters enable some electric resistance products to remain in limited areas of the market where incremental costs for the consumer are currently more difficult to justify due to low use patterns and small tank size (rated storage volume).

They allow electric resistance only for a limited set of electric storage applications. Electric resistance exceptions are recommended only for a portion of water heaters designed with a low

[10] AHAM et al. 2022. *Joint Statement of Joint Stakeholder Proposal on Recommended Energy Conservation Standards and Test Procedure for Consumer Room Air Cleaners.* August 23. https://www.regulations.gov/comment/EERE-2021-BT-STD-0035-0016.

[11] U.S. DOE. 2015. *Energy Department Announces Largest Energy Efficiency Standard in History.* 17 December. https://www.energy.gov/articles/energy-department-announces-largest-energy-efficiency-standard-history.

draw pattern (low use). These include 1) small (≤ 30 gallon) electric water heaters and 2) 30 to 35-gallon electric water heaters that are also no more than 36 inches high. This limited set of electric resistance applications retains product for existing installations that have significant design and installation challenges for heat pump water heaters. Retaining electric resistance UEF levels for this limited set is expected to maintain product availability for the replacement of existing water heaters found in space-constrained locations.

They are designed to mitigate the risk of unconventional installations of electric resistance storage water heaters. The recommendations significantly constrain the rated storage volume, first hour rating (FHR), and overall height (for 30 to 35-gallon water heaters) to reduce the risk of installers and consumers installing electric resistance storage units where a heat pump water heater could be used instead. The joint stakeholders recommend heat pump levels (2.0 to 2.5 UEF) for all water heaters with medium and high draw patterns to ensure that households with higher hot water use transition to heat pump technology. Finally, the recommended UEF levels for heat pumps provide manufacturers room to innovate, especially as it relates to minimizing cost differentials between heat pump and electric resistance models. Supporting reductions in the upfront cost barriers associated with heat pump models will ultimately promote their adoption.

They maintain competition in the marketplace. The recommendations are specifically designed to maintain product design diversity in the marketplace for all manufacturers of consumer water heaters.

Conclusion

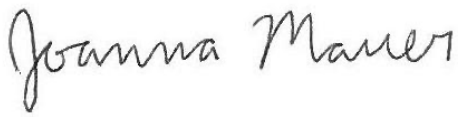
The joint stakeholders appreciate DOE's consideration of the recommendations in Attachment A for amended energy conservation standards for consumer water heaters. Together representing a broad coalition of manufacturers, energy efficiency organizations, environmental groups, and consumer organizations, we encourage DOE to adopt them because they:

- would yield very large (more than 27 quads) of energy savings,
- are expected to result in significant benefits for consumers,
- prioritize the consumer and professional installer experience,
- maintain electric resistance only for a limited set of electric storage applications,
- mitigate the risk of unconventional installations of electric resistance storage water heaters, and
- maintain competition in the marketplace.

Thank you for considering our joint stakeholder recommendations (Attachment A) and these comments.

Sincerely,

Michael Waite
Senior Manager, Buildings Program
American Council for an Energy-Efficient Economy

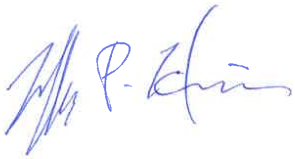


Joanna Mauer
Technical Advocacy Manager
Appliance Standards Awareness Project

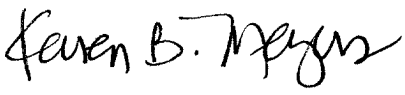
Eric Truskoski
Senior Director
Government and Regulatory Affairs
Bradford White Corporation

Richard Eckman
Energy Advocate
Consumer Federation of America

Joe Vukovich
Staff Attorney
Climate and Clean Energy Program
Natural Resources Defense Council



Jeff Harris
Chief Transformation Officer
Northwest Energy Efficiency Alliance



Karen Meyers
Vice President Government Affairs
Rheem Manufacturing

Attachments: A – Joint Stakeholder Recommendations
B – Joint Stakeholder Calculation Methodology for Benefits

Attachment A

Joint Stakeholder Recommendations Regarding Amended Energy Conservation Standards for Consumer Water Heaters (Docket No. EERE–2017–BT–STD–0019 / RIN 1904–AD91)

September 29, 2022

Introduction

This attachment outlines joint stakeholder recommendations to DOE for amended energy conservation standards for electric storage water heaters, gas-fired storage water heaters, and gas-fired instantaneous water heaters. Due to the timing of the discussions relative to DOE's release of the test procedure supplemental notice of proposed rulemaking (SNOPR)[1] on July 14, 2022, it was infeasible for the joint stakeholders to consider possible uniform energy factor (UEF) and first hour rating (FHR) changes associated with test procedure changes outlined in the SNOPR. Therefore, the joint stakeholders' recommended UEF levels are based on the current test procedure[2] with DOE's proposed changes outlined in the notice of proposed rulemaking (NOPR) on the test procedure[3] released on January 11, 2022.

Detailed recommendations are provided in three sections below:

1. Joint Stakeholder Recommendation for Electric Storage Water Heaters
2. Joint Stakeholder Recommendation for Gas-fired Storage Water Heaters
3. Joint Stakeholder Recommendation for Gas-fired Instantaneous Water Heaters

1. Joint Stakeholder Recommendation for Electric Storage Water Heaters

We recommend that DOE adopt standards for electric storage water heaters at the UEF levels shown in Table 1 below. First, we recommend that DOE retain the current UEF levels for a limited set of low draw pattern (< 51 gallons FHR) water heaters, including:

- water heaters with rated storage volumes ≥ 20 and ≤ 30 gallons, and
- water heaters with rated storage volumes > 30 and ≤ 35 and a height of 36 inches or less.

Next, we recommend that DOE update the standards for all other electric storage water heaters. For all other water heaters with DOE rated storage volumes ≤ 35 gallons, we recommend a UEF of 2.0. For all water heaters with DOE rated storage volumes > 35 to ≤ 55 gallons, we recommend a UEF of 2.3. Finally, for all water heaters with DOE rated storage volumes > 55 to 120 gallons, we recommend a UEF of 2.5.

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[1] U.S. DOE. 2022. *Test Procedure for Consumer Water Heaters and Residential-Duty Commercial Water Heaters, Supplemental notice of proposed rulemaking (SNOPR) and request for comment.* Federal Register Vol. 87, 14 July. p. 42270. https://www.regulations.gov/document/EERE-2019-BT-TP-0032-0042.

[2] 10 C.F.R. § 430. Subpart B, Appendix E. 2014. *Uniform Test Method for Measuring the Energy Consumption of Water Heaters.* 11 July. https://www.ecfr.gov/current/title-10/chapter-II/subchapter-D/part-430/subpart-B#Appendix-E-to-Subpart-B-of-Part-430.

[3] U.S. DOE. 2022. *Test procedure for Consumer Water Heaters and Residential-Duty Commercial Water Heaters, Notice of proposed rulemaking (NOPR) and request for comment.* Federal Register Vol. 87, 11 January. p. 1554. https://www.regulations.gov/document/EERE-2019-BT-TP-0032-0022.

Table 1. Recommended Levels for Electric Storage Water Heaters

<table>
<tr><th rowspan="2">Draw Pattern</th><th rowspan="2">First Hour Rating (FHR)</th><th colspan="4">DOE Rated Storage Volume</th></tr>
<tr><th>≥ 20 to ≤ 30 gallons</th><th>> 30 to ≤ 35 gallons</th><th>> 35 to ≤ 55 gallons</th><th>> 55 to 120 gallons</th></tr>
<tr><td>Low</td><td>≥ 18 to < 51 gallons</td><td>Current Standard*</td><td>Height ≤ 36 inches: Current Standard*
Height > 36 inches: 2.0 UEF</td><td rowspan="3">2.3 UEF</td><td rowspan="3">2.5 UEF</td></tr>
<tr><td>Medium</td><td>≥ 51 to < 75 gallons</td><td rowspan="2">2.0 UEF</td><td rowspan="2">2.0 UEF</td></tr>
<tr><td>High</td><td>≥ 75 gallons</td></tr>
</table>

*Current Standard: UEF = 0.9254 – 0.0003 x V_r, where V_r is the DOE rated storage volume

2. Joint Stakeholder Recommendation for Gas-fired Storage Water Heaters

For gas-fired storage water heaters with:

- standard, low NO_x, and ultra-low NO_x burners, and
- rated storage volumes greater than or equal to 20 gallons and less than or equal to 55 gallons,

we recommend Efficiency Level 2 (EL 2) described in DOE's preliminary technical support document (TSD)[4] (Table 2 below). DOE's preliminary TSD analysis with representative units yielded a UEF of 0.59 for the low draw pattern, a UEF of 0.64 for the medium draw pattern, and a UEF of 0.68 for the high draw pattern for EL 2.[5]

[4] U.S. DOE. 2022. *Preliminary Analysis Technical Support Document: Energy Efficiency Program for Consumer Products and Commercial and Industrial Equipment: Consumer Water Heaters.* 7 March. Docket # EERE-2017-BT-STD-0019. p. 5-44, Table 5.14.1. https://www.regulations.gov/document/EERE-2017-BT-STD-0019-0018.
[5] Ibid. p. ES-5.

Table 2. Recommended Levels for Gas-fired Storage Water Heaters

Draw Pattern	First Hour Rating (FHR)	DOE Rated Storage Volume ≥ 20 to ≤ 55 gallons
Low	≥ 18 to < 51 gallons	UEF = 0.6451 – 0.0019 * V_r
Medium	≥ 51 to < 75 gallons	UEF = 0.7046 – 0.0017 * V_r
High	≥ 75 gallons	UEF = 0.7424 – 0.0013 * V_r

Note: V_r = DOE rated storage volume. These recommended levels are for gas-fired storage water heaters including standard, low NO_x, and ultra-low NO_x burners. The levels shown are equivalent to DOE's preliminary TSD Efficiency Level 2 (EL2).

3. Joint Stakeholder Recommendation for Gas-fired Instantaneous Water Heaters

For gas-fired instantaneous water heaters with a DOE rated storage volume of less than 2 gallons and an input rating greater than 50,000 BTU per hour, we recommend a UEF of 0.91 for the medium draw pattern and a UEF of 0.93 for the high draw pattern (EL 2 in DOE's preliminary TSD)[6] as shown in Table 3 below.

Table 3. Recommended Levels for Gas-fired Instantaneous Water Heaters

Draw Pattern	Recommended Efficiency Level
Medium	0.91 UEF
High	0.93 UEF

Note: These recommended levels are for gas-fired instantaneous water heaters with a DOE rated storage volume of < 2 gallons and an input rating of > 50,000 BTU per hour. The levels shown are equivalent to DOE's preliminary TSD Efficiency Level 2 (EL2).

[6] Ibid. p. 5-48, Table 5.14.5.

Attachment B

Calculation Methodology for Benefits of Joint Stakeholder Recommendations

October 7, 2022

SUMMARY

We estimate that adopting the joint stakeholder recommendations would result in approximately 27.3 quads of full-fuel-cycle (FFC) energy savings over 30 years of sales. The estimated savings from the recommended standards for electric storage water heaters are 24.1 quads; savings from gas-fired storage and instantaneous water heaters are 3.2 quads (savings relative to the no-new-standards case). Additionally, electric storage, gas-fired storage, and gas-fired instantaneous water heaters that meet the recommended standards are expected to save consumers $185 per year, $17 per year, and $31 per year, respectively in energy costs (cost savings relative to the current standard level). These estimates were developed with the methodology summarized herein and (in practice) may be slightly higher or lower given the impacts of various assumptions used and changes in market conditions over time.

SCOPE

The product scope used to estimate energy savings for electric storage, gas-fired storage, and gas-fired instantaneous water heaters is discussed in two sections below.

Electric Storage Water Heaters

The product scope used to calculate the electric storage water heater energy savings was developed based on the U.S. Department of Energy's (DOE's) preliminary Technical Support Document (TSD), and therefore is somewhat constrained by the approach taken in that analysis.[1] Because of this, the product scope used to develop estimates herein approximates—but does not perfectly match—the recommendations of the joint stakeholders. The following scope assumptions were used to develop the estimates for electric storage water heaters: [2]

- All products in the 30-gallon category, regardless of draw pattern, remain electric resistance at current standards levels.
- All products in the 40- and 50-gallon categories move to a minimum uniform energy factor (UEF) of 2.3.
- We assume all products larger than the 50-gallon category deliver no additional savings.

[1] U.S. DOE. 2022. *Preliminary Analysis Technical Support Document: Energy Efficiency Program for Consumer Products and Commercial and Industrial Equipment: Consumer Water Heaters.* 7 March. Docket # EERE-2017-BT-STD-0019. https://www.regulations.gov/document/EERE-2017-BT-STD-0019-0018.

[2] Note that the underlying market data used in the preliminary TSD, from the Residential Energy Consumption Survey (RECS), classifies sizes at 30-, 40-, and 50-gallon increments. No finer gradations are available in the market model; therefore, our analysis is necessarily restricted to the 10-gallon increments. Furthermore, there is no height data in the preliminary TSD, and so we were not able to adjust energy savings based on that parameter.

Gas-fired Storage and Gas-fired Instantaneous
Because the joint stakeholder recommendations are identical to EL2 in the preliminary TSD, we directly reference energy savings from the TSD for gas-fired water heaters.[3]

METHODOLOGY

Electric Storage Water Heaters

Baseline Unit Energy Consumption (UEC)
For the purposes of this analysis, we used energy use estimates from the preliminary TSD based on the medium draw pattern. According to Table ES.3.27 in the preliminary TSD, the baseline UEC for ≥ 20 gallons to ≤ 55 gallons electric storage water heaters in the medium draw pattern is 3,197 kWh per year.

Recommended Standards Level Unit Energy Consumption (UEC)
The UEC for electric storage water heaters just meeting the recommended standards level was calculated by adapting results from the TSD to reflect a UEF of 2.3.

Specifically, the UEC was calculated by solving for parameters not directly provided in the TSD, including the energy use of the backup resistance element in a heat pump water heater, the input energy use of the heat pump only, and the recovery efficiency. Like the baseline UEC, we used the medium draw pattern for the purposes of this analysis. Equations (Eqns) used to derive the UEC for a UEF of 2.3 are described below.

UEC is the sum of the heat pump (Q_{in_hp}) and electric resistance (Q_{er}) energy use:

$$Q_{in\_total} = Q_{er} + Q_{in\_hp} \quad \text{(Eqn 1)}$$

The electric resistance energy used by the water heater, Q_{er}, can be solved by using known values from the TSD in the following way:

$$Q_{er} = (Q_{output\_total} - RE_{hp} * Q_{in\_total})/(1 - RE_{hp}) \quad \text{(Eqn 2)}$$

where
Q_{er} is the total resistance heat input (and output)
Q_{output_total} is the total heat output of the heat pump and resistance elements
Q_{in_total} is the total input energy
RE_{hp} is the heat pump recovery efficiency

We assume standby losses associated with EL1 are the same as those at EL2 and EL3. Therefore, we used the total electric resistance input energy (also equal to output) from EL1—an electric

[3] U.S. DOE. 2022. *Preliminary Analysis Technical Support Document: Energy Efficiency Program for Consumer Products and Commercial and Industrial Equipment: Consumer Water Heaters.* 7 March. Docket # EERE-2017-BT-STD-0019. Tables ES.3.3, ES.3.4, and ES.3.8. https://www.regulations.gov/document/EERE-2017-BT-STD-0019-0018.

resistance only case—for these other ELs. Table ES.3.27 in the preliminary TSD shows that the baseline annual electricity use (or Q_{output_total}) for electric storage water heaters in the medium draw pattern with rated storage volumes ≥ 20 to ≤ 55 gallons is 3,197 kWh per year. Given the same draw patterns, ambient conditions, and standby losses, each water heater (regardless of efficiency level) produces the same amount of heat. At EL2 (which reflects a heat pump water heater):

Q_{in_total} = 1,248 kWh per year (Table ES.3.27)

RE_{hp} = 360% (Table 7.3.7)

Plugging in these values for EL2 to Eqn 2, Q_{er} = 498 kWh per year.

DOE's analysis for the preliminary TSD assumed that backup resistance heat usage periods occur regardless of heat pump efficiency. Similarly, we assumed that the resistance use will be constant for all heat pump water heaters.

The heat pump portion of the energy use (Q_{in_hp}) can be calculated for a given efficiency level and RE_{hp} using the following equation:

$$Q_{in\_hp} = (Q_{output\_total} - Q_{er})/ RE_{hp} \quad \text{(Eqn 3)}$$

$$RE_{hp} = UEF + 0.25 \quad \text{(Eqn 4)}\ [4]$$

For a UEF of 2.3, Eqn 3 for Q_{in_hp} yields 1,058 kWh per year. Finally, using Eqn 1, the UEC (Q_{in_total}) for a UEF of 2.3 is 1,557 kWh per year.

Unit Energy Savings (UES) and Unit Cost Savings

For electric storage water heaters, the UES for the recommended standard level (2.3 UEF) relative to the baseline is 1,640 kWh per year. We leverage a modified version of the TSD methodology to estimate that space heating fuel use increases by 0.73 MMBtu per year.

The average per-unit annual energy cost savings associated with a UEF of 2.3 relative to the baseline was calculated using the UES and marginal energy costs from Table 8.3.3 in the preliminary TSD. Per-unit energy cost savings for electric storage water heaters were estimated at $185 per year.

Cumulative National Energy Savings (FFC Quads)

The total quads saved over 30 years of sales was calculated by adjusting results from the preliminary TSD analysis to conform as much as possible with the recommended standards. Two adjustments were made:

1. energy savings were counted only for 40- and 50-gallon water heaters (30-gallon water heaters remained at the current standards levels), and

[4] Table 7.3.7 of the preliminary TSD suggests the recovery efficiency is ¼ point higher than the UEF.

2. recommended standard levels (2.3 UEF) were applied.

First, we adjust the preliminary TSD energy savings numbers to account for 30-gallon products remaining at current standards levels. According to Table 7.3.3 in the preliminary TSD, electric storage water heaters of 30 gallons represent about 50% of all units in the low draw pattern and about 4% of units in the medium draw pattern. Therefore, the energy savings shown in Table ES.3.41 for EL 2 would decrease by about 4 quads and 1 quad in the low and medium draw pattern categories, respectively.

We then calculated the savings for the recommended standard levels by adjusting the energy savings associated with EL 2 in the preliminary TSD to reflect a UEF of 2.3. The key metric used was kWh per year saved per quad saved for a given EL. Using the per-unit energy savings at EL2 relative to DOE's no-new-standards case (1,793 kWh per year)[5] and the total quad savings at EL2 with the 30-gallon product category removed (28.7 quads), every 62.4 kWh in per-unit annual energy savings saves 1 quad over 30 years of sales.

To determine FFC savings, the per-unit UES for the recommended standard levels relative to the no-new-standards case (1,509 kWh per year) were divided by 62.4 kWh per year per quad to arrive at 24.1 FFC quads saved over 30 years of sales for electric storage water heaters.

Gas-fired Storage and Instantaneous Water Heaters

Baseline Unit Energy Consumption (UEC)
For the purposes of this analysis, we used energy use estimates from the preliminary TSD based on the medium draw pattern for gas-fired storage water heaters and the high draw pattern for gas-fired instantaneous water heaters. According to Table ES.3.27 in the preliminary TSD, the baseline annual fuel use is 17.2 MMBtu per year for gas-fired storage water heaters in the medium draw pattern and 13.1 MMBtu per year for gas-fired instantaneous water heaters in the high draw pattern. The baseline annual electricity use for gas-fired instantaneous water heaters is 48.5 kWh per year (and 0 kWh per year for gas-fired storage).

Recommended Standards Level Unit Energy Consumption (UEC)
Like the baseline UEC, we used the medium draw pattern for gas-fired storage water heaters and a high draw pattern for gas-fired instantaneous water heaters. According to Table ES.3.27 of the preliminary TSD, at EL2, the UEC is 15.5 MMBtu per year and 5 kWh per year for storage and 11.3 MMBtu per year and 44.9 kWh per year for instantaneous.

Unit Energy Savings (UES) and Unit Cost Savings
For gas-fired storage water heaters, the UES of products meeting EL 2 (relative to the baseline UEC) is 1.7 MMBtu per year, accompanied by a 5 kWh per year increase in electricity use. Also relative to the baseline UEC, the UES for gas-fired instantaneous water heaters is 1.8 MMBtu per year accompanied by a decrease in electricity use of 3.6 kWh per year.

[5] The no-new-standards case is reflected in Table 8.4.1 in the preliminary TSD.

The average per-unit annual energy cost savings associated with EL 2 were calculated relative to the baseline using the UES and marginal energy costs from Table 8.3.3. Per-unit energy cost savings are expected to be $17 per year for gas-fired storage water heaters and $31 per year for gas-fired instantaneous water heaters.

Cumulative National Energy Savings (FFC Quads)

According to Table ES.3.41 from the preliminary TSD, at EL2, the full-fuel-cycle national energy savings are 2.4 quads for gas-fired storage water heaters and 0.8 quads for gas-fired instantaneous water heaters. The total quad savings for gas-fired water heaters are thus 3.2 quads.

Northwest **Power** and **Conservation** Council

December 14, 2022

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

Re: Docket No. EERE–2017–BT–STD–0019, 2022-10-21 Joint stakeholder recommendations for amended energy conservation standards for consumer water heaters

Dear Ms. Hegarty,

The Northwest Power and Conservation Council (Council) is an interstate compact agency (i.e., government agency) formed in 1981 by the states of Idaho, Montana, Oregon, and Washington as authorized by Congress in the Pacific Northwest Electric Power Planning and Conservation Act of 1980 (Northwest Power Act). The Northwest Power Act charged the Council with developing a regional power and conservation plan to assure the Pacific Northwest an adequate, efficient, economical, and reliable power supply. The Northwest Power Act designated cost-effective energy efficiency as the priority resource to be relied upon to meet future power needs.

The Council is writing to the U.S. Department of Energy (DOE) to **strongly support the recommendations of the coalition of public and private sector organizations ("joint stakeholders") who developed a set of recommendations on amended energy conservation standards for consumer water heaters** (Docket No. EERE–2017–BT–STD–0019, 2022-10-21 Joint stakeholder recommendations for amended energy conservation standards for consumer water heaters). We agree these recommendations will result in significant reductions in national water heating energy use and the associated greenhouse gas emissions, save consumers money on their utility bills, and provide manufacturers more business certainty with room to innovate.

851 S.W. Sixth Avenue, Suite 1100
Portland, Oregon 97204-1348
www.nwcouncil.org

Bill Edmonds
Executive Director

503-222-5161
800-452-5161

Water heating consumed 11,363 GWh/yr of electricity in the Northwest in 2022. This is 16 percent of the residential electricity consumption and 6.1% of our total system load. The joint stakeholder proposal would ensure that most of this water heating load is served by heat pump water heater technology while minimizing loopholes and workarounds.

Thank you for considering the joint stakeholder recommendations and this letter of support. We urge DOE to incorporate these recommendations into the next stage of consumer water heating rulemaking and to finalize this standard in a timely manner.

Sincerely,

Guy Norman
Chair
Northwest Power and Conservation Council