[6450-01-P]

DEPARTMENT OF ENERGY

10 CFR Part 430

[EERE–2017–BT–STD–0019]

RIN 1904-AD91

Energy Conservation Program: Energy Conservation Standards for Consumer Water Heaters

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

ACTION: Request for information.

SUMMARY: The U.S. Department of Energy ("DOE") is initiating an effort to determine whether to amend the current energy conservation standards for consumer water heaters. This request for information ("RFI") solicits information from the public to help DOE determine whether amended standards for consumer water heaters would result in significant energy savings and whether such standards would be technologically feasible and economically justified. DOE welcomes written comments from the public on any subject within the scope of this document (including topics not raised in this RFI).

DATES: Written comments and information are requested and will be accepted on or before **[INSERT DATE 45 DAYS AFTER DATE OF PUBLICATION IN THE *FEDERAL REGISTER*]**.

ADDRESSES: Interested persons are encouraged to submit comments using the Federal eRulemaking Portal at *http://www.regulations.gov*. Follow the instructions for submitting comments. Alternatively, interested persons may submit comments, identified by docket number EERE–2017–BT–STD–0019, by any of the following methods:

1. *Federal eRulemaking Portal*: *http://www.regulations.gov*. Follow the instructions for submitting comments.

2. *Email*: *ConsumerWaterHeaters2017STD0019@ee.doe.gov*. Include the docket number EERE-2017-BT-STD-0019 in the subject line of the message.

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

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

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

Docket: The docket for this activity, which includes *Federal Register* notices, comments, and other supporting documents/materials, is available for review at *http://www.regulations.gov*. All documents in the docket are listed in the *http://www.regulations.gov* index. However, some documents listed in the index, such as those containing information that is exempt from public disclosure, may not be publicly available.

The docket webpage can be found at: *https://www.regulations.gov/docket?D=EERE-2017-BT-STD-0019*. The docket webpage contains instructions on how to access all documents, including public comments, in the docket. See section III for information on how to submit comments through *http://www.regulations.gov*.

FOR FURTHER INFORMATION CONTACT:

Ms. Catherine Rivest, U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, Building Technologies Office, EE–5B, 1000 Independence Avenue SW., Washington, DC, 20585–0121. Telephone: (202) 586-7335. Email: *ApplianceStandardsQuestions@ee.doe.gov*.

Mr. Eric Stas, U.S. Department of Energy, Office of the General Counsel, GC-33, 1000 Independence Avenue SW., Washington, DC, 20585–0121. Telephone: (202) 586–5827. Email: *Eric.Stas@hq.doe.gov*.

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

SUPPLEMENTARY INFORMATION:

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I. Introduction

Consumer water heaters are included in the list of "covered products" for which DOE is authorized to establish and amend energy conservation standards and test procedures. (42 U.S.C. 6292(a)(4)) DOE's energy conservation standards for consumer water heaters are prescribed in title 10 of the Code of Federal Regulations ("CFR") part 430, section 32(d). The following sections discuss DOE's authority to establish and amend energy conservation standards for consumer water heaters, as well as relevant background information regarding DOE's evaluation of energy conservation standards for this product.

A. Authority and Background

The Energy Policy and Conservation Act, as amended ("EPCA")[1], Public Law 94-163 (42 U.S.C. 6291-6317, as codified), among other things, authorizes DOE to regulate the energy efficiency of a number of consumer products and industrial equipment. Title III, Part B[2] of EPCA established the Energy Conservation Program for Consumer Products Other Than Automobiles. These products include consumer water heaters, the subject of this document. (42 U.S.C. 6292(a)(4)) EPCA prescribed energy conservation standards for these products and

[1] All references to EPCA in this document refer to the statute as amended through America's Water Infrastructure Act of 2018, Public Law 115–270 (Oct. 23, 2018).
[2] For editorial reasons, upon codification in the U.S. Code, Part B was redesignated Part A.

directed DOE to conduct two cycles of rulemakings to determine whether to amend these standards. (42 U.S.C. 6295(e)(1) and (4))

Under EPCA, DOE's energy conservation program consists essentially of four parts: (1) testing, (2) labeling, (3) 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 waivers of Federal preemption in limited instances for particular State laws or regulations, in accordance with the procedures and other provisions set forth under 42 U.S.C. 6297(d).

DOE completed the first of these rulemaking cycles on January 17, 2001 by publishing amended performance standards for consumer water heaters. 66 FR 4474 (establishing amended standards to apply starting on January 20, 2004) ("January 2001 Final Rule"). Additionally, DOE completed a second rulemaking cycle to amend the standards for consumer water heaters by publishing a final rule on April 16, 2010. 75 FR 20112 (establishing amended standards to apply starting on April 16, 2015) ("April 2010 Final Rule"). As directed by EPCA (42 U.S.C. 6295(e)(4)(E)), on July 11, 2014, DOE published a final rule amending the test procedure for

consumer water heaters to change the efficiency metric from energy factor ("EF") to uniform energy factor ("UEF"). 79 FR 40542. The existing EF-based energy conservation standards were then translated from EF to UEF in a separate DOE conversion factor final rule that established a method for converting EF to UEF for water heater basic models that were previously in existence. 81 FR 96204 (Dec. 29, 2016) ("December 2016 Conversion Factor Final Rule"). The current energy conservation standards are located at 10 CFR 430.32(d). The currently applicable DOE test procedures for consumer water heaters appear at 10 CFR part 430, subpart B, appendix E ("Appendix E").

EPCA also requires that, not later than 6 years after the issuance of any final rule establishing or amending a standard, DOE evaluate the energy conservation standards for each type of covered product, including those at issue here, and publish either a notice of determination that the standards 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)) EPCA further provides that, not later than 3 years after the issuance of a final determination not to amend standards, DOE must publish either a notice of determination that standards for the product do not need to be amended, or a NOPR including new proposed energy conservation standards (proceeding to a final rule, as appropriate). (42 U.S.C. 6295(m)(3)(B)) DOE must make the analysis on which the determination is based publicly available and provide an opportunity for written comment. (42 U.S.C. 6295(m)(2)) In making a determination, DOE must evaluate whether more-stringent standards would: (1) yield a significant savings in energy

use; (2) be technologically feasible; and (3) be cost-effective under 42 U.S.C. 6295(o)(2)(B)(i)(II). (42 U.S.C. 6295(m)(1)(A))

DOE is publishing this RFI to collect data and information to inform its decision consistent with its obligations under EPCA.

B. Rulemaking Process

DOE must follow specific statutory criteria for prescribing new or amended standards for covered products. EPCA requires that any new or amended energy conservation standard be designed to achieve the maximum improvement in energy or water efficiency that is technologically feasible and economically justified. (42 U.S.C. 6295(o)(2)(A)) To determine whether a standard is economically justified, EPCA requires that DOE determine whether the benefits of the standard exceed its burdens by considering, to the greatest extent practicable, the following seven factors:

(1) The economic impact of the standard on the manufacturers and consumers of the affected products;
(2) The savings in operating costs throughout the estimated average life of the product compared to any increases in the initial cost, or maintenance expenses;
(3) The total projected amount of energy and water (if applicable) savings likely to result directly from the standard;
(4) Any lessening of the utility or the performance of the products likely to result from the standard;

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

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

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

(42 U.S.C. 6295(o)(2)(B)(i)(I)–(VII))

DOE fulfills these and other applicable requirements by conducting a series of analyses throughout the rulemaking process. Table I.1 shows the individual analyses that are performed to satisfy each of the requirements within EPCA.

Table I.1 EPCA Requirements and Corresponding DOE Analysis

EPCA Requirement	Corresponding DOE Analysis
Significant Energy Savings	• Shipments Analysis • National Impact Analysis • Energy and Water Use Determination
Technological Feasibility	• Market and Technology Assessment • Screening Analysis • Engineering Analysis
Economic Justification:	
1. Economic impact on manufacturers and consumers	• Manufacturer Impact Analysis • Life-Cycle Cost and Payback Period Analysis • Life-Cycle Cost Subgroup Analysis • Shipments Analysis
2. Lifetime operating cost savings compared to increased cost for the product	• Mark-ups for Product Price Determination • Energy and Water Use Determination • Life-Cycle Cost and Payback Period Analysis
3. Total projected energy savings	• Shipments Analysis • National Impact Analysis
4. Impact on utility or performance	• Screening Analysis • Engineering Analysis
5. Impact of any lessening of competition	• Manufacturer Impact Analysis
6. Need for national energy and water conservation	• Shipments Analysis • National Impact Analysis
7. Other factors the Secretary considers relevant	• Employment Impact Analysis • Utility Impact Analysis • Emissions Analysis • Monetization of Emission Reductions Benefits • Regulatory Impact Analysis

As detailed throughout this RFI, DOE is publishing this document seeking input and data from interested parties to aid in the development of the technical analyses on which DOE will

ultimately rely to determine whether (and if so, how) to amend the standards for consumer water heaters.

II. Request for Information and Comments

In the following sections, DOE has identified a variety of issues on which it seeks input to aid in the development of the technical and economic analyses regarding whether amended standards for consumer water heaters may be warranted. Additionally, DOE welcomes comments on other issues relevant to the conduct of this rulemaking that may not specifically be identified in this document. In particular, DOE notes that under Executive Order 13771, "Reducing Regulation and Controlling Regulatory Costs," Executive Branch agencies such as DOE are directed to manage the costs associated with the imposition of expenditures required to comply with Federal regulations. See 82 FR 9339 (Feb. 3, 2017). Consistent with that Executive Order, DOE encourages the public to provide input on measures DOE could take to lower the cost of its energy conservation standard rulemakings, recordkeeping and reporting requirements, and compliance and certification requirements applicable to consumer water heaters while remaining consistent with the requirements of EPCA.

In addition, DOE seeks comment on whether there have been sufficient technological or market changes since the most recent standards update that may justify a new rulemaking to consider more-stringent standards. Specifically, DOE seeks data and information that could enable the agency to determine whether DOE should propose a "no new standard" determination because a more-stringent standard: (1) would not result in a significant savings of energy; (2) is

not technologically feasible; (3) is not economically justified, or (4) any combination of the foregoing.

Finally, DOE notes that it recently published an RFI on the emerging smart technology appliance and equipment market. 83 FR 46886 (Sept. 17, 2018). In that RFI, DOE sought information to better understand market trends and issues in the emerging market for appliances and commercial equipment that incorporate smart technology. DOE's intent in issuing the RFI was to ensure that DOE did not inadvertently impede such innovation in fulfilling its statutory obligations in setting efficiency standards for covered products and equipment. DOE seeks comments, data, and information on the issues presented in that RFI as they may be applicable to consumer water heaters.

A. Products Covered by This Analysis

This RFI covers those products that meet the definitions for consumer water heaters, as codified at 10 CFR 430.2. The definitions for consumer water heaters were most recently amended in a standards final rule that defined the term "grid-enabled water heater." 80 FR 48004 (August 11, 2015).

Generally, DOE defines a "water heater," consistent with EPCA's definition, as a product which utilizes oil, gas, or electricity to heat potable water for use outside the heater upon demand, including—

(a) Storage type units which heat and store water at a thermostatically controlled temperature, including gas storage water heaters with an input of 75,000 Btu per hour or less, oil storage water heaters with an input of 105,000 Btu per hour or less, and electric storage water heaters with an input of 12 kilowatts or less;

(b) Instantaneous type units which heat water but contain no more than one gallon of water per 4,000 Btu per hour of input, including gas instantaneous water heaters with an input of 200,000 Btu per hour or less, oil instantaneous water heaters with an input of 210,000 Btu per hour or less, and electric instantaneous water heaters with an input of 12 kilowatts or less; and

(c) Heat pump type units, with a maximum current rating of 24 amperes at a voltage no greater than 250 volts, which are products designed to transfer thermal energy from one temperature level to a higher temperature level for the purpose of heating water, including all ancillary equipment such as fans, storage tanks, pumps, or controls necessary for the device to perform its function.

10 CFR 430.2; (42 U.S.C. 6291(27))

In addition, at 10 CFR 430.2, DOE further defines several specific categories of consumer water heaters, as follows:

(1) "Electric instantaneous water heater" means a water heater that uses electricity as the energy source, has a nameplate input rating of 12 kW or less, and contains no more than one gallon of water per 4,000 Btu per hour of input.

(2) “Electric storage water heater” means a water heater that uses electricity as the energy source, has a nameplate input rating of 12 kW or less, and contains more than one gallon of water per 4,000 Btu per hour of input.

(3) “Gas-fired instantaneous water heater” means 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.

(4) “Gas-fired storage water heater” means a water heater that uses gas as the main energy source, has a nameplate input rating of 75,000 Btu/h or less, and contains more than one gallon of water per 4,000 Btu per hour of input.

(5) “Grid-enabled water heater” means an electric resistance water heater that—

(a) Has a rated storage tank volume of more than 75 gallons;

(b) Is manufactured on or after April 16, 2015;

(c) Is equipped at the point of manufacture with an activation lock and;

(d) Bears a permanent label applied by the manufacturer that—

(i) Is made of material not adversely affected by water;

(ii)Is attached by means of non-water-soluble adhesive; and

(iii)Advises purchasers and end-users of the intended and appropriate use of the product with the following notice printed in 16.5 point Arial Narrow Bold font: “IMPORTANT INFORMATION: This water heater is intended only for use as part of an electric thermal storage or demand response program. It will not provide adequate hot water unless enrolled in such a program and activated by your utility company or another program

operator. Confirm the availability of a program in your local area before purchasing or installing this product."

(6) "Oil-fired instantaneous water heater" means a water heater that uses oil as the main energy source, has a nameplate input rating of 210,000 Btu/h or less, and contains no more than one gallon of water per 4,000 Btu per hour of input.

(7) "Oil-fired storage water heater" means a water heater that uses oil as the main energy source, has a nameplate input rating of 105,000 Btu/h or less, and contains more than one gallon of water per 4,000 Btu per hour of input.

As stated in section I of this RFI, EPCA prescribed energy conservation standards for all consumer water heaters (*i.e.*, those that meet the definition of "water heater" above). For the purpose of this RFI and the evaluation of potential amended energy conservation standards, DOE is considering all consumer water heaters, as defined by EPCA.

DOE previously established a separate product class and definition for "tabletop water heaters," which required such products to be in a rectangular box enclosure designed to slide into a kitchen countertop space with typical dimensions of 36 inches high, 25 inches deep, and 24 inches wide. 66 FR 4474, 4497 (Jan. 17, 2001) The definition of "tabletop water heater" was established in appendix E, but a subsequent relocation of definitions removed that definition from appendix E without re-establishing it in 10 CFR 430.2.

Issue A.1 DOE requests feedback on whether the previous definition for "tabletop water heater" is still appropriate, whether such products should continue to be considered separately

from other classes of consumer water heaters, and whether such definition should be added to the list of definitions in 10 CFR 430.2.

B. Test Procedure

DOE's existing test procedures for consumer water heaters are set forth at 10 CFR part 430, subpart B, Appendix E – Uniform Test Method for Measuring the Energy Consumption of Water Heaters. DOE's consumer water heater test procedure provides methods for determining the first-hour rating ("FHR"), maximum gallons per minute ("max GPM"), and UEF for consumer gas-fired, oil-fired, and electric storage and instantaneous water heaters. As stated in section I.A of this document, the test procedure for consumer water heaters was updated in July 2014 to transition from the EF metric to the UEF metric, and to expand the scope of the test method to cover all covered consumer water heaters, as well as certain commercial water heaters (*i.e.*, those meeting the definition of a "residential-duty commercial water heater"). 79 FR 40542 (July 11, 2014). The major difference between the EF and UEF metrics is that the EF test consists of six hot water draws of equal volume and flow rate followed by a standby period for all water heaters, while the UEF test procedure consists of varying draw patterns depending on the delivery capacity of the consumer water heater, which include between 9 and 14 draws of varying volumes and flow rates. Due to the difference in draw pattern as well as other differences established in the UEF test method (*e.g.*, changes to the set point temperature and method for setting the thermostat) the EF and UEF values are not directly comparable. For this evaluation of potential amended energy conservation standards, DOE will use UEF as the basis for its analysis.

C. Market and Technology Assessment

The market and technology assessment that DOE routinely conducts when analyzing the impacts of a potential new or amended energy conservation standard provides information about the consumer water heater industry that will be used in DOE's analysis throughout the rulemaking process. DOE uses qualitative and quantitative information to characterize the structure of the industry and market. DOE identifies manufacturers, estimates market shares and trends, addresses regulatory and non-regulatory initiatives intended to improve energy efficiency or reduce energy consumption, and explores the potential for efficiency improvements in the design and manufacturing of consumer water heaters. DOE also reviews product literature, industry publications, and company websites. Additionally, DOE considers conducting interviews with manufacturers to improve its assessment of the market and available technologies for consumer water heaters.

1. Product Classes

When evaluating and establishing energy conservation standards, DOE may divide covered products into product classes by the type of energy used, or by capacity or other performance-related features that justify a different standard. (42 U.S.C. 6295(q)) In making a determination whether capacity or another performance-related feature justifies a different standard, DOE must consider such factors as the utility of the feature to the consumer and other factors DOE deems appropriate. (*Id*.)

For consumer water heaters, the current energy conservation standards specified at 10 CFR 430.32(d) vary based on fuel type (gas-fired, oil-fired, or electric), product category

(storage, instantaneous, tabletop, grid-enabled), stored volume, and capacity (draw pattern).

The December 2016 Conversion Factor Final Rule converted the EF-based energy conservation standards established in the January 2001 and April 2010 Final Rules to ratings based on the UEF metric. 81 FR 96204 (Dec. 29, 2016). Table II.1 describes the product classes and which standards apply to each range of rated storage volume and input rate.

Table II.1 Description of Applicable Energy Conservation Standards

Product Class	**Rated Storage Volume**	**Draw Pattern***	**Energy Conservation Standard****
Gas-fired Storage Water Heater	< 20 gal	-	$EF = 0.6200 - 0.0019 \times V_r$
	≥ 20 gal and ≤ 55 gal	Very Small	$UEF = 0.3456 - 0.0020 \times V_r$
		Low	$UEF = 0.5982 - 0.0019 \times V_r$
		Medium	$UEF = 0.6483 - 0.0017 \times V_r$
		High	$UEF = 0.6920 - 0.0013 \times V_r$
	> 55 gal and ≤ 100 gal	Very Small	$UEF = 0.6470 - 0.0006 \times V_r$
		Low	$UEF = 0.7689 - 0.0005 \times V_r$
		Medium	$UEF = 0.7897 - 0.0004 \times V_r$
		High	$UEF = 0.8072 - 0.0003 \times V_r$
	> 100 gal	-	$EF = 0.6200 - 0.0019 \times V_r$
Oil-fired Storage Water Heater	≤ 50 gal	Very Small	$UEF = 0.2509 - 0.0012 \times V_r$
		Low	$UEF = 0.5330 - 0.0016 \times V_r$
		Medium	$UEF = 0.6078 - 0.0016 \times V_r$
		High	$UEF = 0.6815 - 0.0014 \times V_r$
	> 50 gal	-	$EF = 0.5900 - 0.0019 \times V_r$
Electric Storage Water Heater	< 20 gal	-	$EF = 0.9300 - 0.00132 \times V_r^{\dagger}$
	≥ 20 gal and ≤ 55 gal	Very Small	$UEF = 0.8808 - 0.0008 \times V_r$
		Low	$UEF = 0.9254 - 0.0003 \times V_r$
		Medium	$UEF = 0.9307 - 0.0002 \times V_r$
		High	$UEF = 0.9349 - 0.0001 \times V_r$
	> 55 gal and ≤ 120 gal	Very Small	$UEF = 1.9236 - 0.0011 \times V_r$
		Low	$UEF = 2.0440 - 0.0011 \times V_r$
		Medium	$UEF = 2.1171 - 0.0011 \times V_r$

		High	UEF = 2.2418 - 0.0011 x V_r
	> 120 gal	-	EF = 0.9300 - 0.00132 x V_r †
Tabletop Storage	< 20 gal		EF = 0.9300 - 0.00132 x V_r †
	≥ 20 gal and ≤ 120 gal	Very Small	UEF = 0.6323 - 0.0058 x V_r
		Low	UEF = 0.9188 - 0.0031 x V_r
		Medium	UEF = 0.9577 - 0.0023 x V_r
		High	UEF = 0.9884 - 0.0016 x V_r
	> 120 gal		EF = 0.9300 - 0.00132 x V_r †
Gas-fired Instantaneous Water Heater	< 2 gal and > 50,000 Btu/h	Very Small	UEF = 0.80
		Low	UEF = 0.81
		Medium	UEF = 0.81
		High	UEF = 0.81
	≥ 2 gal or ≤ 50,000 Btu/h	-	EF = 0.6200 - 0.0019 x V_r
Oil-fired Instantaneous Water Heater	All	-	EF = 0.5900 - 0.0019 x V_r
Electric Instantaneous Water Heater	< 2 gal	Very Small	UEF = 0.91
		Low	UEF = 0.91
		Medium	UEF = 0.91
		High	UEF = 0.92
	≥ 2 gal	-	EF = 0.9300 - 0.00132 x V_r
Grid-Enabled Water Heater	> 75 gal	Very Small	UEF = 1.0136 - 0.0028 x V_r
		Low	UEF = 0.9984 - 0.0014 x V_r
		Medium	UEF = 0.9853 - 0.0010 x V_r
		High	UEF = 0.9720 - 0.0007 x V_r

* Draw patterns vary based on hot water delivery capacity in the UEF test procedure, while the EF test procedure relies on a single draw pattern for all water heaters. As a result, UEF values and UEF energy conservation standards are different based on the draw pattern, while EF values and energy conservation standards are not.
** Energy conservation standards based on EF were established by EPCA. Energy conservation standards based on UEF were established in the April 2010 Final Rule (75 FR 20112 (April 16, 2010)) and translated to equivalent UEF standards in the December 2016 Conversion Factor Final Rule (81 FR 96204 (Dec. 29, 2016)).
† EPCA initially established an energy conservation standard at 0.95 - .00132 x V_r for electric storage water heaters. In the test procedure and energy conservation standards final rule that adopted the EF metric, DOE changed the standard to 0.93 - .00132 x V_r to account for the changes to the test method for electric storage water heaters. 55 FR 42162, 42177 (Oct. 17, 1990).

Relevant to the establishment of product classes, EPCA provides that the Secretary may not prescribe an amended or new standard for covered products if the Secretary finds (and publishes such finding) that interested persons have established by a preponderance of the

evidence that the standard is likely to result in the unavailability in the United States in any covered product type (or class) of performance characteristics (including reliability), features, sizes, capacities, and volumes that are substantially the same as those generally available in the United States at the time of the Secretary's finding. 42 U.S.C. 6295(o)(4) Where the Secretary finds such "performance characteristics (including reliability), features, sizes, capacities, and volumes" (collectively referred to hereafter as "features") to exist, the statute provides for the potential of establishing separate product classes. (42 U.S.C. 6295(q)(1))

On November 1, 2018, DOE published for comment a petition for rulemaking submitted by Spire, Inc., the National Gas Supply Association, the National Propane Gas Association, the American Public Gas Association, and the American Gas Association ("Gas Industry Petition"), which in part, raised the question of whether for residential furnaces and commercial water heating equipment (and similarly situated covered products and equipment) non-condensing technology and associated venting constitutes a performance-related "feature" under 42 U.S.C. 6295(o)(4), as would support a separate product/equipment class under 42 U.S.C. 6295(q)(1). 83 FR 54883. The comment period on the notice of petition for rulemaking was originally set to end on January 30, 2019, but DOE received two requests from interested parties seeking an extension of the comment period in order to develop additional data relevant to the petition. DOE granted these requests in a notice published in the *Federal Register* on January 29, 2019, which extended the comment period until March 1, 2019.

On July 11, 2019, following consideration of the Gas Industry Petition, public comments, and other information received on the petition, DOE published a notice of proposed

interpretative rule ("NOPIR"), proposing to revise its interpretation of EPCA's "features" provision in the context of condensing and non-condensing technology used in furnaces, commercial water heating equipment, and similarly situated appliances (where permitted by EPCA). 84 FR 33011, 33020. DOE stated that as compared to products that rely on non-condensing technology, products that use condensing technology may result in more complicated/costly installations, require physical changes to a home that impact aesthetics (*e.g.*, by adding new venting into the living space or decreasing closet or other storage space), and may result in some enhanced level of fuel switching. *Id.* DOE also acknowledged that although energy efficiency improvements may pay for themselves over time, there is a significant increase in first-cost associated with residential furnaces and commercial water heaters using condensing technology, and for consumers with difficult installation situations (*e.g.*, inner-city row houses) there would be the added cost of potentially extensive venting modifications. *Id.* DOE proposed in the July 2019 NOPIR to interpret the statute to provide that adoption of energy conservation standards that would limit the market to natural gas and/or propane furnaces, water heaters, or similarly situated products/equipment (where permitted by EPCA) that use condensing combustion technology would result in the unavailability of a performance related feature within the meaning of 42 U.S.C. 6295(o)(4). 84 FR 33011, 33021 (July 11, 2019). DOE is currently considering the comments received on the July 2019 NOPIR, after which the Department will determine whether and how to proceed with the interpretive rule in response to the Gas Industry Petition.

DOE is evaluating all the product classes for consumer water heaters presented in Table II.1 of this RFI. DOE may also consider additional product classes based on any performance-related features that justify the establishment of a different energy conservation standard, or it may consider consolidating product classes in appropriate cases. (42 U.S.C. 6295(q)) In light of the July 2019 NOPIR, DOE plans to evaluate the effects of treating non-condensing technology and associated venting as a performance-related "feature" under 42 U.S.C. 6295(o)(4), as would support a separate product class for consumer water heaters under 42 U.S.C. 6295(q)(1).

Issue C.1 DOE requests feedback on the current consumer water heater product classes and whether changes to these individual product classes and their descriptions should be made or whether certain classes should be separated or merged. Specifically, with regard to consumer water heaters that use condensing technology and the related venting, DOE requests information and data on potential impacts as compared to consumer water heaters that use non-condensing technology, such as, but not limited to, the complexity/cost of installation, changes to a home's aesthetics, and the potential for fuel switching. DOE also requests comment on other instances where it may be appropriate to separate any of the existing product classes and whether it might reduce any compliance burdens. DOE further requests feedback on whether combining certain classes could impact product utility by eliminating any performance-related features or impact the stringency of the current energy conservation standard for these products.

Issue C.2 DOE seeks information regarding any other new product classes it should consider for inclusion in its analysis. Specifically, DOE requests information on the performance-related features that provide unique consumer utility and data detailing the

corresponding impacts on energy use that would justify separate product classes (*i.e.*, explanation for why the presence of these performance-related features would increase energy consumption).

2. Technology Assessment

In analyzing the feasibility of potential new or amended energy conservation standards, DOE uses information about existing and past technology options and prototype designs to help identify technologies that manufacturers could use to meet and/or exceed a given set of energy conservation standards under consideration. In consultation with interested parties, DOE intends to develop a list of technologies to consider in its analysis. That analysis will initially include a number of the technology options DOE previously considered during its most recent rulemaking for consumer water heaters (*i.e.*, the April 2010 Final Rule). 75 FR 20112, 20136-20145 (April 16, 2010). In addition, DOE conducted preliminary market research by examining manufacturer product literature and published technical literature (*e.g.*, reports, journal articles, or presentations) which identified specific technologies and design options, and DOE will consider these along with any others identified during the rulemaking process, should it determine that a rulemaking is necessary. The technologies DOE has identified to date, including several technology options from the previous rulemaking, are presented in Table II.2 of this RFI. DOE notes that while this list includes all technology options that DOE is aware of with the potential to reduce energy consumption, a number of the technology options would not affect the UEF (*i.e.*, the regulatory metric) as measured by the DOE test procedure even though they may reduce actual energy consumption when installed. DOE has included such technologies in this list for informational purposes only, as technologies that do not affect UEF would not necessarily be

implemented to comply with potential amended energy conservation standards. While some of the technology options that do not increase UEF could still benefit consumers by reducing field energy consumption and/or improving performance, technologies that do not increase UEF would not be considered in an engineering analysis for a rulemaking, should one be initiated. In addition, some technologies may be screened out in the screening analysis, as discussed in section II.D of this RFI.

Table II.2 Potential Technologies for Increasing Efficiency

Description			**Technologies Considered in the April 2010 Final Rule**	**Technologies that Do Not Affect UEF**
Heat traps			X	
Improved insulation	Increased thickness		X	
	Insulation on tank bottom		X	
	Less conductive tank materials (*e.g.*, plastic)		X	
	Foam insulation		X	
	Pipe and fitting insulation			
	Advanced insulation types	Aerogel	X	
		Vacuum panels	X	
		Inert gas-filled panels	X	
Electronic ignition systems	Direct spark ignition		X	
	Intermittent pilot ignition		X	
	Hot surface ignition		X	
Improved burners	Pulse combustion		X	
	Pressurized combustion			
	Side-arm heating		X	
	Two-phase thermosiphon technology		X	
	Modulating burners		X	
	Reduced burner size (slow recovery)		X	
Heat exchanger improvements	Increased heat exchanger surface area		X	
	Enhanced flue baffle		X	
	Submerged combustion chamber		X	
	Multiple flues		X	

	Alternative flue geometry (Helical)		X	
	U-Tube		X	
	Condensing technology		X	
	Direct-fired heat exchange		X	
Improved venting	Flue damper	Powered (external supply)	X	
		Powered (thermopile)		
		Buoyancy	X	
	Direct vent			X
	Concentric direct venting		X	
	Power vent		X	
	Power-direct vent			X
Improved heat pump water heater components	Advanced compressors			
	Centrifugal fans			
	Increased heat exchanger surface area			
	Improved fan motors			
Absorption heat pump water heaters				
Adsorption heat pump water heaters				
Carbon dioxide heat pump water heaters			X	
Thermophotovoltaic and thermoelectric generators			X	
Solar thermal				
Improved controls	Timer controls		X	X
	Modulating controls		X	
	Intelligent and wireless controls and communication		X	X
	Grid interactive capabilities			
Self-cleaning			X	X

Issue C.3 DOE seeks information related to these technologies regarding their applicability to the current market and how these technologies may impact the efficiency of consumer water heaters as measured according to the DOE test procedure. DOE also seeks information on how these technologies may have changed since they were considered in the

April 2010 Final Rule analysis. Specifically, DOE seeks information on the range of efficiencies or performance characteristics for products that are currently equipped with each technology option.

Issue C.4 DOE seeks information on the technologies listed in Table II.2 regarding their market adoption, costs, and any concerns with incorporating them into products (*e.g.*, impacts on consumer utility, potential safety concerns, manufacturing/production/implementation issues).

Issue C.5 DOE seeks comment on other technology options that it should consider for inclusion in its analysis and whether these technologies may impact product features or consumer utility.

D. Screening Analysis

The purpose of the screening analysis is to evaluate the technologies that improve equipment efficiency to determine which technologies will be eliminated from further consideration and which will be passed to the engineering analysis for further consideration.

DOE determines whether to eliminate certain technology options from further consideration based on the following criteria:

(1) *Technological feasibility*. Technologies that are not incorporated in commercial products or in working 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 compliance date of the standard, then that technology will not be considered further.

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

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

10 CFR part 430, subpart C, appendix A, sections 4(a)(4) and 5(b).

Technology options identified in the technology assessment are evaluated against these criteria using DOE analyses and inputs from interested parties (*e.g.*, manufacturers, trade

[3] For example, in the previous rulemaking for consumer water heaters, DOE did not consider reduced burner size due to the associated utility impact. See Chapter 4 of the technical support document for the April 2010 Final Rule (Available at: *https://www.regulations.gov/document?D=EERE-2006-STD-0129-0170*).

organizations, and energy efficiency advocates). Technologies that pass through the screening analysis are referred to as "design options" in the engineering analysis. Technology options that fail to meet one or more of the four criteria are eliminated from consideration.

Table II.3 summarizes the technology options that DOE screened out in the April 2010 Final Rule, as well as the applicable screening criteria.

Table II.3 Previously Screened Out Technology Options from the April 2010 Final Rule

	EPCA Criteria (X = Basis for Screening Out)			
Screened Technology Option	**Technological Feasibility**	**Practicability to Manufacture, Install, and Service**	**Adverse Impact on Product Utility**	**Adverse Impacts on Health and Safety**
Side-Arm Heater	X	X		
Flue Damper (Buoyancy Operated)				X
Directly Fired				X
Condensing Pulse Combustion	X	X		
Advanced Insulation Types	X	X		
Thermophotovoltaic and Thermoelectric Generators	X	X		
U-Tube Flue		X		
Reduced Burner Size			X	
Two-Phase Thermosiphon		X		
Carbon Dioxide ("CO_2") Heat Pump Water		X		

Heater				

Issue D.1 DOE requests feedback on what impact, if any, the four screening criteria described in this section would have on consideration of each of the technology options listed with respect to consumer water heaters. Similarly, DOE seeks information regarding how these same criteria would affect consideration of any other technology options not already identified in this document with respect to their potential use in consumer water heaters.

Issue D.2 With respect to the screened out technology options listed in Table II.3, DOE seeks information on whether these options would, based on current and projected assessments regarding each of them, remain screened out under the four screening criteria described in section II.D of this RFI. With respect to each of these technology options, what steps, if any, could be (or have already been) taken to facilitate the introduction of each option as a means to improve the energy performance of consumer water heaters and the potential to impact consumer utility of the consumer water heaters.

Finally, DOE notes that the four screening criteria do not directly address the propriety status of design options. DOE only considers potential efficiency levels achieved through the use of proprietary designs in the engineering analysis if they are not part of a unique pathway to achieve that efficiency level (*i.e.*, if there are other non-proprietary technologies capable of achieving the same efficiency level).

E. Engineering Analysis

The engineering analysis estimates the cost-efficiency relationship of products at different levels of increased energy efficiency ("efficiency levels"). This relationship serves as the basis for the cost-benefit calculations for consumers, manufacturers, and the Nation. In determining the cost-efficiency relationship, DOE estimates the increase in manufacturer production cost ("MPC") associated with increasing the efficiency of products above the baseline, up to the maximum technologically feasible ("max-tech") efficiency level for each product class.

DOE historically has used the following three methodologies to generate incremental manufacturing costs and establish efficiency levels ("ELs") for analysis: (1) the design-option approach, which provides the incremental costs of adding to a baseline model design options that will improve its efficiency; (2) the efficiency-level approach, which provides the relative costs of achieving increases in energy efficiency levels, without regard to the particular design options used to achieve such increases; and (3) the cost-assessment (or reverse engineering) approach, which provides "bottom-up" manufacturing cost assessments for achieving various levels of increased efficiency, based on detailed data as to costs for parts and materials, labor, shipping/packaging, and investment for models that operate at particular efficiency levels.

1. Representative Product Characteristics

DOE intends to perform a teardown analysis on a set of models with "representative" characteristics to estimate the cost-efficiency relationship for consumer water heaters. For consumer storage-type water heaters, the tank volume significantly affects the energy consumed. That is, it takes more energy to heat a larger volume of water from a given temperature to a

higher temperature. Additionally, the tank surface area increases as tank volume increases and, among other factors, the heat transfer rate is a function of surface area. Therefore, increased surface area increases the rate of heat transfer to the ambient air, which increases standby losses. This is reflected in the existing Federal energy conservation standards, as UEF is a function of the tank storage volume for storage water heaters.

DOE plans to conduct teardowns at specific storage volumes (referred to as representative storage volumes) that are the most common on the market, and extrapolate those results for the entire market. Based on information from the previous consumer water heater rulemaking and a survey of models currently on the market, DOE has preliminarily determined the characteristics of representative units for each product class. In particular, DOE examined the number of models available at distinct rated storage volumes and intends to use the most common storage volume as a representative characteristic in each product class. Storage volume typically does not vary for gas-fired and electric instantaneous water heaters, so DOE conducted a similar review of the available input rates of these instantaneous water heaters. Table II.4 presents the preliminary representative storage volumes and input rates for existing product classes of consumer water heaters.

Table II.4 Preliminary Representative Values by Product Class for Consumer Water Heaters with UEF Standards

Product Class	Distinguishing Characteristics (Rated Storage Volume and Input Rating*)	Currently Planned Representative Value(s)**	Other Potential Representative Values Under Consideration
Gas-fired Storage Water Heater	$\geq$ 20 gal and $\leq$ 55 gal	38 gal, Medium Draw Pattern	48 gal, High Draw Pattern

	> 55 gal and ≤ 100 gal	80 gal,† High Draw Pattern	67 gal, High Draw Pattern
Oil-fired Storage Water Heater	≤ 50 gal	30 gal, High Draw Pattern	48 gal, High Draw Pattern
Electric Storage Water Heater	≥ 20 gal and ≤ 55 gal	46 gal, Medium Draw Pattern	27 gal, Low Draw Pattern or 36 gal, Medium Draw Pattern
	> 55 gal and ≤ 120 gal	80 gal, High Draw Pattern	67 gal, High Draw Pattern
Tabletop Water Heater	≥ 20 gal and ≤ 120 gal	36 gal, Low Draw Pattern	35 gal, Medium Draw Pattern
Gas-fired Instantaneous Water Heater	< 2 gal and > 50,000 Btu/h	0 gal and 199,000 Btu/h, High Draw Pattern	0 gal and 180,000 Btu/h, High Draw Pattern
Electric Instantaneous Water Heater	< 2 gal	0 gal and 3.5 kW,†† Very Small Draw Pattern	None
Grid-Enabled Water Heater	> 75 gal	80 gal, High Draw Pattern	100 gal, High Draw Pattern

* Input rating is only used as a distinguishing characteristic for consumer gas-fired instantaneous water heaters. Models with input rates greater than 50,000 Btu/h currently have UEF standards.
** Storage volumes listed are the rated storage volume as determined under 10 CFR 429.17.
† DOE did not identify any consumer gas-fired storage water heater models with rated storage volume > 55 gal and ≤ 100 gal on the market.
†† The spread of input rates is evenly distributed across range of available inputs (*i.e.*, 0 kW to 12 kW)

Issue E.1 DOE requests feedback on the appropriate representative storage volumes and input capacities for each product class of consumer water heaters. DOE also requests feedback on whether there are additional representative characteristics that should be considered.

The energy conservation standards prescribed by EPCA apply more broadly than those listed in 10 CFR 430.32(d) and do not exclude water heaters based on storage volume or minimum input rate (in the case of consumer gas-fired instantaneous water heaters). (42 U.S.C. 6295(e)(1)) Furthermore, DOE's previous EF test procedure did not cover water heaters listed in Table II.5; however, DOE's updated UEF test procedure does cover these products. Because

these products now have an applicable test procedure and are covered products, DOE is considering them in its analysis. Table II.5 presents these classes and their tentative representative characteristics. For many of these product classes, DOE has been unable to identify any models on the market, and, therefore, no representative values are provided in the table. For these classes, DOE has tentatively concluded that a lack of models indicates there are also no shipments. Thus, there is no potential for energy savings from amended standards for these classes at this time. If DOE ultimately confirms this to be true, DOE plans to merely convert the existing standards from EF to equivalent UEF standards for these product classes.

Table II.5 Preliminary Representative Values for Products Currently Without UEF Standards

Product Class	Distinguishing Characteristics (Rated Storage Volume and Input Rating*)	Currently Planned Representative Value(s)	Other Potential Representative Values Under Consideration
Gas-fired Storage Water Heater	< 20 gal**		
	> 100 gal**		
Oil-fired Storage Water Heater	> 50 gal**		
Electric Storage Water Heater	< 20 gal	19 gal	6 gal, 12 gal, or 19.9 gal
	> 120 gal**		
Tabletop Water Heater	< 20 gal**		
	> 120 gal**		
Gas-fired Instantaneous Water Heater	≥ 2 gal or ≤ 50,000 Btu/h**	20 gal	4 gal
Oil-fired Instantaneous Water Heater	All	5.1 gal	
Electric Instantaneous Water Heater	≥ 2 gal**		

* Input rating is only used as a distinguishing characteristic for consumer gas-fired instantaneous water heaters. Models with input rates greater than 50,000 Btu/h currently have UEF standards.
** DOE was unable to find models on the market in this product class.

Issue E.2 DOE requests feedback on the appropriate representative storage volumes and specifically whether those identified in Table II.5 are reasonable. DOE also seeks feedback on whether products exist in the classes for which DOE was unable to find models on the market, and, if so, relevant information about those products and appropriate representative characteristics.

2. Efficiency Levels

a. Baseline Efficiency Levels

For each established product class, DOE selects a baseline efficiency as a reference point against which any changes resulting from energy conservation standards can be measured. For products with an existing energy conservation standard, the baseline efficiency level is typically the current minimum energy conservation standard. For products that do not have an existing minimum energy conservation standard, DOE considers the least-efficient product on the market as a baseline product. DOE will establish the baseline efficiency level for each product class in terms of UEF. For products where UEF standards are established, DOE will use those standards as the baseline level; for covered consumer water heaters where the standard has not yet been converted to UEF (*i.e.*, water heaters stated as being covered by EF standards from EPCA in Table II.1 of this RFI), DOE will undertake an analysis to translate the EF standard to an equivalent UEF standard, which will serve as the baseline level.[4] The baseline model in each product class represents the characteristics of common or typical products in that class.

[4] For certain categories of consumer water heaters, these translations were not done during the December 2016 conversion factor rulemaking. DOE concluded that to start enforcing standards immediately would have been quite burdensome to industry. Further, DOE received a number of comments regarding the technical merits of the proposed conversions for these products and decided to defer finalizing and implementing UEF standards to allow for further consideration of those comments. 81 FR 96204, 96211 (Dec. 29, 2016).

Typically, a baseline model is one that just meets the current minimum energy conservation standards and provides basic consumer utility.

DOE uses baseline units for comparison in several phases of the analyses, including the engineering analysis, life-cycle cost ("LCC") analysis, payback period ("PBP") analysis, and national impact analysis ("NIA"). In the engineering analysis, to determine the changes in price to the consumer that result from amended energy conservation standards, DOE compares the price of a baseline unit to the price of a unit at each higher efficiency level.

Consistent with this analytical approach, DOE tentatively plans to consider the current minimum energy conservation standards to establish the baseline efficiency levels for each product class. The current standards that rely on UEF are found at 10 CFR 430.32(d). For consumer water heaters not identified at 10 CFR 430.32(d), the standards rely on EF and are set forth at 42 U.S.C. 6295(e)(1). For storage water heaters, the baseline level varies based on the storage volume, and DOE would focus on the baseline efficiency standard for models at the representative storage volume. For the product classes without UEF-based standards (*i.e.*, products listed in Table II.5 of this RFI), DOE would translate the EF-based standards to UEF to determine the baseline level.

DOE has preliminarily identified a technology pathway for each product class. The preliminary baseline technology options that DOE has identified as being representative for each product class are discussed in section II.E.3 of this RFI.

Issue E.3 For the products listed in Table II.5 for this RFI as being covered by EPCA standards but not the included in the December 2016 Conversion Factor Final Rule that converted standards to UEF, DOE requests EF and UEF test data and/or other relevant information that could assist in the development of UEF-based standard levels to serve as the baseline levels.

Issue E.4 DOE requests feedback on the preliminary baseline technology options for each product class. (Note, DOE discusses its preliminary understanding of the technology options used in baseline products in section III.E.3 of this RFI) DOE requests feedback on whether there are any important features of baseline models (other than energy efficiency, storage volume, and input capacity) that should be accounted for in its analysis.

b. Intermediate Energy Efficiency Levels

DOE conducted a survey of the consumer water heater market to determine the designs and efficiencies of products that are currently available to consumers. For each representative product, DOE surveyed various manufacturers' product offerings to identify the efficiency levels that correspond to the highest number of models and the prevailing technologies used to reach those efficiency levels. By identifying the most prevalent energy efficiencies in the range of available products and examining the designs used at those efficiencies, DOE has preliminarily identified a technology path that manufacturers typically use to increase the energy efficiency of consumer water heating products (see section III.E.3 of this RFI).

DOE analyzes intermediate energy efficiency levels between the baseline and max-tech levels for each product class. The intermediate efficiency levels are generally representative of the most commonly available efficiency levels available on the market, and follow technology paths that manufacturers of consumer water heaters commonly use to maintain cost-effective designs while increasing energy efficiency. DOE conducted a preliminary review of manufacturer literature, the Air-Conditioning Heating and Refrigeration Institute ("AHRI") directory of certified product performance,[5] and DOE's compliance certification database to compile efficiency information for a wide range of water heaters available on the market.[6] DOE also reviewed manufacturer literature to assess, to the extent possible, the technologies in use in consumer water heaters. DOE notes that different manufacturers may use different technology pathways to achieve the same efficiency level, and, if it determines that a rulemaking is necessary, the Department would expect to attempt to capture this in the analysis. Section II.E.3 presents the product classes and the respective technology pathways that DOE anticipates analyzing.

Issue E.5 DOE seeks comment on whether there are any key intermediate efficiency levels (in terms of UEF values) that should be considered in the analysis. DOE also seeks comment on common technology pathways to reach higher efficiency levels (*i.e.*, the order in which manufacturers implement energy-saving technologies). (Note, DOE discusses its

[5]AHRI, Directory of Certified Product Performance for Residential Water Heaters. (Available at: https://www.ahridirectory.org/*NewSearch?programId=24&searchTypeId=3*) (Last accessed: Dec.2, 2019).
[6]DOE, Compliance Certification Database (Available at: *https://www.regulations.doe.gov/certification-data/CCMS-4-Water_Heaters.html#q=Product_Group_s%3A%22Water%20Heaters%22*) (Last accessed: Dec.2, 2019).

preliminary understanding of the technology options used in consumer water heaters in section III.E.3 of this RFI.)

c. Maximum Technologically Feasible Efficiency Levels

The maximum available efficiency level is the efficiency level of the highest-efficiency unit currently available on the market. The current maximum available efficiencies are included in Table II.6 of this RFI.

Table II.6 Maximum Efficiency Levels Currently Available at Representative Values

Product Class	Distinguishing Characteristics (Rated Storage Volume and Input Rating*)	Currently Planned Representative Value(s)**	Maximum UEF Currently Available
Gas-fired Storage Water Heater	≥ 20 gal and ≤ 55 gal	38 gal, Medium Draw Pattern	0.68
	> 55 gal and ≤ 100 gal	80 gal, High Draw Pattern	N/A†
Oil-fired Storage Water Heater	≤ 50 gal	30 gal, High Draw Pattern	0.68
Electric Storage Water Heater	≥ 20 gal and ≤ 55 gal	46 gal, Medium Draw Pattern	3.55
	> 55 gal and ≤ 120 gal	80 gal, High Draw Pattern	3.70
Tabletop Water Heater	≥ 20 gal and ≤ 120 gal	36 gal, Low Draw Pattern	0.81
Gas-fired Instantaneous Water Heater	< 2 gal and > 50,000 Btu/h	0 gal and 199,000 Btu/h, High Draw Pattern	0.97
Oil-fired Instantaneous Water Heater	All	5.1 gal	N/A††
Electric Instantaneous Water Heater	< 2 gal	0 gal and 3.5 kW,††† Very Small Draw Pattern	0.98
Grid-Enabled Water Heater	> 75 gal	100 gal, High Draw Pattern	0.93

* Input rating is only used as a distinguishing characteristic for consumer gas-fired instantaneous water heaters. Models with input rates greater than 50,000 Btu/h currently have UEF standards.
** Storage volumes listed are the rated storage volume as determined under 10 CFR 429.17.
† DOE did not identify any consumer gas-fired storage water heater models with rated storage volume > 55 gal and ≤ 100 gal on the market.

[††] There are currently no oil-fired instantaneous water heaters certified in the DOE compliance certification database.
[†††] The spread of input rates is evenly distributed across range of available inputs (*i.e.*, 0 kW to 12 kW).

DOE also determines the maximum technologically feasible (max-tech) improvement in energy efficiency for consumer water heaters. DOE defines a max-tech efficiency level to represent the theoretical maximum possible efficiency if all available design options are incorporated in a model. In many cases, the max-tech efficiency level is not commercially available because it is not economically feasible. Based on DOE's initial review of the consumer water heater market (as discussed in the previous section), DOE has preliminarily identified technology options commonly used to increase efficiency, including those associated with the max-tech efficiency level for each product class. DOE intends to analyze the available efficiency data to determine the UEF values that correspond to the technology options currently used to reach max-tech levels to determine the appropriate max-tech UEF values. DOE describes the technologies currently used to reach the max-tech efficiency levels in section II.E.3 of this RFI.

Issue E.6 DOE seeks input on whether the maximum available efficiency levels are appropriate for potential consideration as possible energy conservation standards for the products at issue – and if not, why not.

Issue E.7 DOE seeks feedback on what design options would be incorporated at a max-tech efficiency level, and the efficiencies associated with those levels. As part of this request, DOE also seeks information as to whether there are limitations on the use of certain

combinations of design options. (Note, DOE discusses its preliminary understanding of the technology options in max-tech products in section III.E.3 of this RFI.)

3. Technology Pathway

DOE plans to consider and analyze various technologies for improving the energy efficiency of consumer water heaters. To accurately represent the current market in its analyses, DOE uses information from publicly-available product literature to determine which technologies are used in commercially-available products. DOE also identifies which technologies manufacturers would be most likely to include in products to meet potential amended energy conservation standards based on current designs observed on the market. DOE's preliminary understanding of the most prevalent technologies to obtain the intermediate and max-tech energy efficiency levels for each product class are described immediately below. DOE may revise the technology pathway for each category of consumer water heater in the preliminary analysis based on stakeholder comments and observations made during teardowns.

a. Gas-fired Storage Water Heaters

As stated previously, DOE conducted a review of the currently-available consumer gas-fired storage water heaters on the market. DOE has observed that the baseline design typically consists of a standing pilot, atmospheric venting, and 2 inches of foam insulation. DOE found that models in the representative volume and draw pattern (40 gallons and medium draw pattern) use similar technology options to those found in the baseline (0.58 UEF) up to 0.61 UEF and can achieve higher efficiencies by increasing insulation thickness or increasing the heat exchange via improvements to the flue and/or baffling. To obtain efficiencies above 0.61 UEF, manufacturers

can make use of the aforementioned options, and also typically remove the standing pilot ignition system in favor of an electronic ignition system and add a flue damper or power venting system, or some combination of these options. The highest efficiency products currently on the market utilize condensing technology. However, gas-fired heat pump water heater designs are currently under development and would likely result in higher efficiencies than those achieved by condensing gas-fired water heaters currently available on the market. In the event of any rulemaking resulting from this RFI, DOE would assess gas-fired heat pump water heater technology using the screening criteria discussed in section II.D to determine whether it is appropriate for consideration in the analysis.

Issue E.8 DOE requests feedback on the specific technologies used to increase efficiency of atmospherically-vented, standing pilot models that have efficiencies between the baseline (0.58 UEF) and 0.61 UEF. Specifically, how much insulation and/or baffling/heat exchange area is used at each level, and are there other design changes that increase the efficiency?

Furthermore, in any rulemaking resulting from this RFI, DOE tentatively intends to consider separately analyzing models that use standard and low-nitrogen oxide ("NO_X") burners from those that use ultra-low-NO_X burners, as was done in the April 2010 Final Rule. However, due to the similarity between these categories of gas-fired storage water heaters, for this RFI, DOE did not identify a separate technology pathway for consumer gas-fired water heaters that use standard and low-NO_X burners from those that use ultra-low-NO_X burners.

Issue E.9 DOE requests feedback on the typical technology pathway for increasing the energy efficiency of consumer gas-fired storage water heaters. DOE is also interested in differences in the design pathway between water heaters with standard and low-NO_X burners and those with ultra-low-NO_X burners. This includes information on the order in which manufacturers would incorporate the different technologies to incrementally improve the efficiencies of products. DOE also requests feedback on whether the increased energy efficiency would lead to other design changes that would not occur otherwise. DOE is also interested in information regarding any potential impact of design options on a manufacturer's ability to incorporate additional functions or attributes in response to consumer demand.

Issue E.10 DOE requests feedback on whether gas-fired heat pump water heaters should be considered as the max-tech design for consumer gas-fired water heaters.

Issue E.11 DOE requests feedback on the thickness of insulation in products currently available on the market and what would be technologically feasible as the maximum insulation thickness. DOE has particular interest in understanding the insulation thickness beyond which an increase in thickness would not produce a noticeable effect on energy efficiency.

b. *Electric Storage Water Heaters*

For consumer electric storage water heaters with a rated storage volume of 50 gallons, the baseline efficiency level is achieved with electric resistance heating elements. To obtain slightly higher efficiencies, increased insulation or optimized geometry could be employed for water heaters using only electric resistance heating elements. For larger increases in efficiency, heat

pump technology is used. From a review of manufacturer literature, DOE was unable to assess specific differences between the less-efficient and more-efficient heat pump water heater designs, up to the max-tech efficiency level. The magnitude of the increase between these levels suggests that improvements to the various heat pump components are responsible for these efficiency level increases. DOE intends to explore these efficiency and design differences further during its testing and teardown analysis.

Issue E.12 DOE requests feedback on the technology pathway for electric storage water heaters. This includes information on the order in which manufacturers would incorporate the different technologies to incrementally improve the efficiencies of products. DOE also requests feedback on whether the increased energy efficiency would lead to other design changes that would not occur otherwise. DOE is also interested in information regarding any potential impact of design options on a manufacturer's ability to incorporate additional functions or attributes in response to consumer demand.

Issue E.13 DOE requests feedback on heat pump components used in heat pump water heaters of varying efficiency, up to the max-tech level.

Issue E.14 DOE requests feedback on the insulation thickness and materials used in electric storage water heaters (both electric resistance and heat pump water heaters).

Issue E.15 DOE requests feedback on the maximum efficiency potential of CO_2 heat pump water heaters.

c. Oil-fired Storage Water Heaters

DOE examined the representative storage volume of 30 gallons for consumer oil-fired storage water heaters. Very few models currently exist on the market compared to the other product classes. DOE found oil-fired storage water heaters at the representative storage volume with rated UEF values up to 0.68. Consumer oil-fired storage water heaters typically incorporate electronic ignition and power venting; therefore, efficiency improvement technologies are likely to include increasing the surface area within the flue, and to a lesser extent increasing the insulation thickness or upgrading the insulation material. Improvements to the flue include increased baffling, multiple flues, and/or multi-pass flues.

Issue E.16 DOE requests feedback on the technology pathway for consumer oil-fired water heaters and in particular the insulation material and thickness currently being used. This includes information on the order in which manufacturers would incorporate the different technologies to incrementally improve the efficiencies of products. DOE also requests feedback on whether the increased energy efficiency would lead to other design changes that would not occur otherwise. DOE is also interested in information regarding any potential impact of design options on a manufacturer's ability to incorporate additional functions or attributes in response to consumer demand.

d. Tabletop Water Heaters

DOE has found that all tabletop water heaters currently on the market have a rated storage volume of either 38 or 40 gallons and a rated UEF of 0.81 and 0.90 in the low and high draw patterns, respectively. Tabletop water heaters use electric resistance elements to heat water

and are contained in a rectangular box enclosure designed to slide into a kitchen countertop space with typical dimensions of 36 inches high, 25 inches deep, and 24 inches wide. 66 FR 4474, 4497 (Jan. 17, 2001). Efficiency improvements, if possible, would most likely be accomplished though upgrading the insulation material and/or increasing the insulation thickness.

Issue E.17 DOE requests feedback on what materials and methods are currently being used to insulate tabletop water heaters, and whether there are any technologies that can be used to improve the energy efficiency of these products. DOE also requests information on potential impacts any such technologies would have on the capacity or other performance-related features of tabletop water heaters.

e. Gas-fired Instantaneous Water Heaters

Currently, all consumer gas-fired instantaneous water heaters, including those at the baseline, appear to use electronic ignition along with power venting. Based on an examination of literature for products currently available in the market, the primary method for increasing the energy efficiency of consumer gas-fired instantaneous water heaters is typically through increasing the heat exchanger surface area. As the heat exchanger surface area increases, heat transfer is improved, resulting in an increase in the efficiency of the unit. In addition, the heat transfer between flue gases and the water can be improved to the point where the flue gases are cooled below the dew point, resulting in condensation within the heat exchanger. Therefore, at higher efficiency levels, manufacturers design heat exchangers for condensing operation that are

capable of managing the condensate, which include materials that can withstand corrosive condensate and methods for condensate disposal.

Issue E.18 DOE requests feedback on its assessment of the technologies used at the baseline for consumer gas-fired instantaneous water heaters, as well as the technologies used to improve efficiency.

f. Electric Instantaneous Water Heaters

Consumer electric instantaneous water heaters use electric resistance heating along with low flow rates to provide hot water, typically for applications with lower demand, such as handwashing. Most electric instantaneous water heaters that DOE identified currently on the market have rated UEF values close to 1. This is likely the result of minimal losses from the electric resistance heating elements, combined with a lack of standby losses due to the low or negligible amount of stored water. Consequently, DOE has not identified any technology options that are currently being used or could be used to improve the energy efficiency of electric instantaneous water heaters.

Issue E.19 DOE requests feedback on the technology options available for improving the energy efficiency of consumer electric instantaneous water heaters, if any.

g. Oil-fired Instantaneous Water Heaters

DOE has found that consumer oil-fired instantaneous water heaters exist on the market. These water heaters use electronic ignition, are direct vented, and force air through the unit.

Currently, EF and UEF values are not available for these water heaters, but the manufacturer literature advertises the "efficiency" as being up to 88 percent for these models.

Issue E.20 DOE requests feedback on the availability of consumer oil-fired instantaneous water heaters and the technology options available to improve UEF.

h. Grid-Enabled Water Heaters

As a preliminary step for this RFI, DOE reviewed the current market for grid-enabled water heaters. Based on a review of product literature for grid-enabled designs, DOE has found that these water heaters use electric resistance heating elements and typically have between two to three inches of foam insulation. Plastic, stainless steel, and stone-lined steel storage tanks are currently available on the market, and these models do not use an anode rod. Glass-lined steel tanks are also available, and these models do use an anode rod. At the 96-gallon representative storage volume, all UEF ratings are at or just above the minimum efficiency standard.

Issue E.21 DOE requests feedback on the technology options available for improving the energy efficiency of grid-enabled water heaters.

4. Manufacturer Production Costs and Manufacturer Selling Prices

As described at the beginning of this section, the main outputs of the engineering analysis are cost-efficiency relationships that describe the estimated increases in manufacturer production cost associated with higher-efficiency products for the analyzed product classes. For the April 2010 Final Rule, DOE developed the cost-efficiency relationships by first identifying specific

efficiency levels and the technologies incorporated at those levels. DOE then performed reverse-engineering analysis to estimate the typical cost at each efficiency level from the baseline to the max-tech. 75 FR 20112, 20141 (April 16, 2010). For this analysis, DOE plans to use a similar approach to that used in the April 2010 Final Rule, by identifying efficiency levels and performing reverse-engineering on models from various manufacturers to identify the technology(ies) implemented at each efficiency level and the cost to achieve that level. DOE plans to use the data gathered in the reverse-engineering analysis to develop the manufacturing cost-efficiency relationship.

Issue E.22 DOE seeks input on the increase in MPC associated with incorporating each particular design option. Specifically, DOE is interested in whether and how the costs estimated for design options in the April 2010 Final Rule have changed since the time of that analysis. DOE also requests information on the investments necessary to incorporate specific design options, including, but not limited to, costs related to new or modified tooling (if any), materials, engineering and development efforts to implement each design option, and manufacturing/production impacts.

To account for manufacturers' non-production costs and profit margin, DOE applies a non-production cost 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. For the April 2010 Final Rule, DOE estimated the manufacturer markups as 1.31 for gas-fired storage water heaters, 1.28 for electric storage water heaters, 1.30 for oil-fired storage

water heaters, and 1.45 for gas-fired instantaneous water heaters. See chapter 5 of the April 2010 Final Rule technical support document ("TSD").[7]

Issue E.23 DOE requests feedback on whether the manufacturer markups of 1.31, 1.28, 1.30, and 1.45 are still appropriate for gas-fired storage water heaters, electric storage water heaters, oil-fired storage water heaters, and gas-fired instantaneous water heaters, respectively.

In addition, for products where changes to the energy conservation standard are likely to cause a large difference in the size of the product, DOE sometimes considers shipping costs incurred by manufacturers to ship the product to their first customer separately from the manufacturer markup. In such cases, manufacturer selling price is calculated as the manufacturer production cost multiplied by the manufacturer markup, and shipping price is added (as shipping cost is not typically marked up). DOE plans to investigate this approach for consumer water heaters to determine how dimensions may change with increasing efficiency and whether such changes would increase the shipping costs for manufacturers.

Issue E.24 DOE requests comment on how the cost to ship a consumer water heater changes with efficiency.

F. Markups Analysis

[7] Available at: *https://www.regulations.gov/document?D=EERE-2006-STD-0129-0149*.

The markups analysis develops appropriate markups (*e.g.*, for wholesalers, contractors, general contractors, mobile home manufacturers, and mobile home dealers) in the distribution chain and sales taxes to convert the MSP derived in the engineering analysis to consumer prices, which are then used in the LCC and PBP analyses and other analyses. At each step in the distribution channel, companies mark up the price of the product to cover business costs and profit margin.

1. Distribution Channels

In generating end-user price inputs for the LCC analysis and NIA, DOE must identify distribution channels (*i.e.*, how the products are moved from the manufacturer to the consumer), and estimate relative sales volumes through each channel.

Markups depends on the distribution channels for a product (*i.e.*, how the product passes through the chain of commerce from the manufacturer to the customer). Two different markets exist for consumer water heating systems: (1) replacements and new owners[8] and (2) new construction. Based on several references, DOE plans to determine the main distribution channels for each water heater product class and the fraction of shipments through each channel.[9]

[8] New owners are defined as existing buildings that acquire a consumer water heater for the first time or get a new category of consumer water heater during the analysis period.

[9] Clear Seas Research, 2019 Mechanical Systems – Water Heater CLEAReport (Dec.2019) (Available at: *https://clearseasresearch.com/product/2019-mechanical-systems-water-heater/*) (Last accessed Dec.2, 2019); A.O. Smith, Autumn 2019 Analyst Presentation (November 2019) (Available at: *http://investor.aosmith.com/events-and-presentations*) (Last accessed Dec. 2, 2019); Northwest Energy Efficiency Alliance ("NEEA"), Water Heater Market Characterization Report (April 2018) (Available at: *https://neea.org/img/documents/water-heater-market-characterization-report.pdf*) (Last accessed Dec.2, 2019); Consortium for Energy Efficiency ("CEE"), Residential Water Heating Initiative (March 2018) (Available at:

a. Replacement and New Owner

For replacement and new owner applications, manufacturers sell mainly to either plumbing distributors or retailers (including retailers that sell online[10]). The four main distribution paths that DOE intends to consider are: (1) a plumbing distributor sells a water heater to a contractor, who then sells it to a consumer and installs it, (2) a retailer sells a water heater to a contractor, who then sells it to a consumer and installs it, (3) a retailer sells a water heater to the consumer, who hires a contractor to install it, or (4) a retailer sells a water heater to the consumer, who self-installs it.[11] In addition, DOE plans to consider distribution channels

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https://library.cee1.org/system/files/library/13557/CEE_ResWaterHeating_Initiative_16Mar2018.pdf) (Last accessed Dec. 2, 2019); Energy Trust of Oregon, Existing Homes Gas Water Heater Market Research Report (Jan 2016) (Available at: *https://energytrust.org/wp-content/uploads/2016/12/Gas_Water_Heater_Market_Research_Report_Public_FINAL_wSR.pdf*) (Last accessed Dec. 2, 2019); California Energy Commission ("CEC"), Residential Water Heating Program, Facilitating the Market Transformation to Higher Efficiency Gas-Fired Water Heating (December 2012) (Available at: *http://www.energy.ca.gov/2013publications/CEC-500-2013-060/CEC-500-2013-060.pdf*) (Last accessed Dec. 2, 2019); NEEA, 2011 Water Heater Market Update (Jan. 2012) (Available at: *https://neea.org/img/uploads/2011WaterHeaterMarketUpdateA273DBB87CA3.pdf*) (Last accessed Dec. 2, 2019); ENERGY STAR, Water Heater Market Profile: Efficiency Sells (Sept 2010) (Available at: *https://www.energystar.gov/ia/partners/prod_development/new_specs/downloads/water_heaters/Water_Heater_Market_Profile_2010.pdf*) (Last accessed Dec. 2, 2019); ENERGY STAR, Water Heater Market Profile: New Technology, New Savings (Sept. 2009) (Available at: *https://www.energystar.gov/ia/partners/prod_development/new_specs/downloads/water_heaters/Water_Heater_Market_Profile_Sept2009.pdf*) (Last accessed Dec. 2, 2019); CEE, High-Efficiency Residential Gas Water Heating Initiative (March 2008); A.O. Smith, Water Heater Marketplace (2008) (Available at: *https://www.energystar.gov/sites/default/files/asset/document/AOSmith_General_Session.pdf*) (Last accessed Dec.2, 2019); NEEA, Residential Water Heater Market (July 2006) (Available at: *https://neea.org/img/uploads/AssessmentoftheResidentialWaterHeaterMarketingNWC6F59C4D2EEB.pdf*) (Last accessed Dec. 2, 2019); Lawrence Berkeley National Laboratory ("LBNL"), The LBNL Water Heater Retail Price Database (Oct. 2000) (Available at: *https://www.osti.gov/biblio/775102*) (Last accessed Dec. 2, 2019).

[10] Online sales includes sales through home improvement and hardware store websites (such as Home Depot, Lowe's, Ace Hardware, and Menards), as well as online-only websites (such as amazon.com). DOE does not have enough information at this point to compute a separate markup estimate the online sales distribution channel. DOE intends to assume that the retailer mark-up is similar to the online sales mark-up.

[11] In some cases, the retail outlet provides installation as part of a package. In others, the retail outlet links the customer to a contractor for installation. Self-installation is likely more common for electric than for gas water heaters due to the greater complexity of replacing a gas unit. This is consistent with data from ENERGY STAR's

where the manufacturer sells the consumer water heater directly to a commercial consumer through a national account or the commercial consumer purchases the consumer water heater directly through a wholesaler. These channels reflect those cases where the installation can be accomplished by site personnel.

In summary, DOE plans to characterize the replacement and new owner market distribution channels for consumer water heating systems as follows:

Manufacturer → Wholesaler → Contractor → Consumer

Manufacturer → Retail Store → Contractor → Consumer

Manufacturer → Retail Store → Consumer [Contractor-Installed]

Manufacturer → Retail Store → Consumer [Self-Installed]

Manufacturer → Wholesaler → Commercial Consumer[12]

Manufacturer → National Account → Commercial Consumer[13]

2010 Water Heater Market Profile study that show that consumers are more likely to install electric storage water heaters themselves compared to other categories of consumer water heaters.

[12] This represents consumer water heaters that are purchased by commercial consumers for use in a commercial applications. Unlike commercial consumers, residential consumers typically are unable to purchase directly from a wholesaler.

[13] This represents consumer water heaters that are purchased by commercial consumers for use in a commercial applications. Unlike commercial consumers, residential consumers typically are unable to purchase from manufacturers through a national account.

b. New Construction

The new construction distribution channel for consumer water heaters includes an additional link in the chain—the general contractor. In most new construction applications, the consumer water heater is part of the overall plumbing package installed by a plumbing contractor or, in the case of large building companies, by its own master plumber and crew. A plumbing contractor usually purchases the consumer water heater from a plumbing distributor, and in this case, DOE includes a contractor mark-up. In the case of mobile home new construction, the distribution channel includes a mobile home manufacturer and mobile home dealer. In addition, similar to the replacement and new owner distribution channel, DOE plans to consider distribution channels in which the manufacturer sells the consumer water heater directly to a commercial consumer through a national account or the commercial consumer purchases the consumer water heater directly through a wholesaler.

In the case of new construction, DOE plans to characterize the distribution channels as follows:

Manufacturer → Wholesaler → Contractor → General Contractor → Consumer

Manufacturer → Retailer → Contractor → General Contractor → Consumer

Manufacturer → Wholesaler → General contractor → Consumer

Manufacturer → Retailer → General contractor → Consumer

Manufacturer → Wholesaler → Consumer

Manufacturer → Retailer → Commercial Consumer[14]

Manufacturer → National Account → Commercial Consumer[15]

Manufacturer → Mobile Home Manufacturer → Mobile Home Dealer → Consumer

Issue F.1 DOE seeks input on whether the distribution channels described above are appropriate for each of the consumer water heaters product classes and are sufficient to characterize distributions in this market. In particular, DOE seeks input on the appropriate distribution channel for grid-enabled water heaters.

Issue F.2 DOE seeks input on the percentage of consumer water heaters being distributed through the different distribution channels and whether the share of products through each channel varies based on product capacity, water heater product class, or water heater technology. In particular, DOE seeks input about the percentage of consumer water heaters being distributed through online sales and whether the percentage is likely to increase in the future.

2. Mark-ups

To develop mark-ups for the parties involved in the distribution of the product, DOE plans to utilize several sources, including: (1) form 10-K reports[16] from the main consumer water

[14] This represents consumer water heaters that are purchased by commercial consumers for use in a commercial applications.
[15] This represents consumer water heaters that are purchased by commercial consumers for use in a commercial applications. Unlike commercial consumers, residential consumers typically are unable to purchase from manufacturers through a national account.

heater wholesalers[17] and retailers (for wholesalers and retailers); 3. the Heating, Air Conditioning & Refrigeration Distributors International ("HARDI") 2013 Profit Report[18] (for wholesalers); 3.U.S. Census 2017 Annual Retail Trade Survey data[19] (for retailers); and 3. Census Bureau 2012 Economic Census data[20] on the residential and commercial building construction industry (for general contractors, mechanical contractors, retailers, and mobile home manufacturers). DOE plans to use the 2005 Air Conditioning Contractors of America's ("ACCA") Financial Analysis on the Heating, Ventilation, Air-Conditioning, and Refrigeration ("HVACR") contracting industry[21] to disaggregate the mechanical contractor mark-ups into replacement and new construction markets. DOE also plans to use several sources for the derivation of the mobile home dealer mark-up.[22]

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[16] U.S. Securities and Exchange Commission, *SEC 10-K Reports* (Available at *https://www.sec.gov/*) (Last accessed Dec. 2, 2019).
[17] Clear Seas Research, *2017 Top List – Premier Distributors – Plumbing, Heating, Cooling* (Available at *https://clearseasresearch.com/product/2017-top-list-premier-distributors-plumbing-heating-cooling/*) (Last accessed Dec. 2, 2019).
[18] HARDI, *2013 HARDI Profit Report* (Available at: *http://hardinet.org/*) (Last accessed Dec. 2, 2019).
[19] U.S. Census Bureau, *2017 Annual Retail Trade Survey Data* (Available at *https://www.census.gov/programs-surveys/arts.html*) (Last accessed Dec. 2, 2019). Note the 2018 Annual Retail Trade Survey data are expected to be released in April 2020. Until that time, 2017 Annual Retail Trade Survey remains the most recent full data release.
[20] U.S. Census Bureau, *2012 Economic Census Data* (Available at: *https://www.census.gov/programs-surveys/economic-census.html*) (Last accessed Dec.2, 2019). Note that the 2017 Economic Census data are planned to be fully released by late 2020. Until that time, 2012 Economic Census remains the most recent full data release.
[21] ACCA, *Financial Analysis for the HVACR* Contracting Industry (2005) (Available at: *https://www.acca.org/store*) (Last accessed Dec. 2, 2019).
[22] Reference for Business Encyclopedia of Business, 2nd ed. SIC 6515 Operators of Residential Mobile Home Sites (Available at: *http://www.referenceforbusiness.com/industries/Finance-Insurance-Real-Estate/Operators-Residential-Mobile-Home-Sites.html*) (Last accessed Dec.2, 2019); Cook, P., State Board of Equalization, Staff Legislative Bill Analysis, Assembly Bill 1474 (2011) (Available at: *http://www.leginfo.ca.gov/pub/09-10/bill/asm/ab_1451-1500/ab_1474_cfa_20090515_114322_asm_comm.html*) (Last accessed Dec. 2, 2019); F. Walter, Comments on the Energy Conservation Program for Consumer Products: Standards for Furnaces & Boilers,

Issue F.3 DOE seeks recent data and recommendations regarding data sources to establish the markups for the parties involved with the distribution of the consumer water heating products.

G. Energy Use Analysis

As part of a typical rulemaking process, DOE conducts an energy use analysis to identify how products are used by consumers, and thereby determine the energy savings potential of energy efficiency improvements. The purpose of the energy use analysis is to determine the annual energy consumption of consumer water heaters at different efficiencies in representative U.S. single-family homes, manufactured housing, multi-family residences, and commercial buildings, and to assess the energy savings potential of increased consumer water heater efficiency. The energy use analysis estimates the range of energy use of consumer water heaters in the field (*i.e.*, as they are actually used by consumers). The energy use analysis provides the basis for other analyses DOE performs, particularly assessments of the energy savings and the savings in consumer operating costs that could result from adoption of amended or new standards. DOE will estimate the annual energy consumption of consumer water heaters at specified energy efficiency levels across a range of applications, house or building types, and climate zones. The annual energy consumption includes use of natural gas, liquefied petroleum gas ("LPG"), oil, or electricity for hot water production, as well as use of electricity for the auxiliary components.

DOE Docket Number EE-RM/STD-01-350, Comment No.13 (2001) Manufactured Housing Institute (Available at: *https://www.regulations.gov/#!documentDetail;D=EERE-2006-STD-0102-0042*) (Last accessed Dec. 2, 2019).

1. Building Sample

DOE intends to base the energy use analysis on key characteristics from the Energy Information Administration's ("EIA") 2015 Residential Energy Consumption Survey ("RECS")[23] for the subset of building types that use consumer water heating products covered by the standard. DOE also plans to look at the use of consumer water heaters in commercial applications, for which it plans to include characteristics from EIA's 2012 Commercial Building Energy Consumption Survey ("CBECS")[24] for a subset of building types that use consumer water heating products covered by this standard.

RECS and CBECS survey data include information on the physical characteristics of building units, water heating products used, size of the products in terms of rated volume, fuels used, energy consumption and expenditures, and other characteristics.[25] DOE intends to use available shipments data by water heater size to disaggregate the sample into the considered product classes.[26] DOE will also consult Building America's 2015 report, "Strategy Guideline:

[23] EIA, 2015 RECS (Available at: *http://www.eia.gov/consumption/residential/*) (Last accessed Dec. 2, 2019). Note the EIA plans to conduct the 2020 RECS sometime in 2020, and it usually takes a couple of years to fully release the data. Until that time, 2015 RECS remains the most recent full data release.

[24] EIA, 2012 CBECS (Available at: *http://www.eia.gov/consumption/commercial/*) (Last accessed Dec. 2, 2019). Note the 2018 CBECS data are expected to be released in late 2020. Until that time, 2012 CBECS remains the most recent full data release.

[25] Neither RECS nor CBECS provide data on whether the water heater used in the building is a consumer water heater covered in this rulemaking (*i.e.*, water heating could also be provided by a consumer boiler, commercial boiler, or commercial water heater). Therefore, DOE intends to develop a methodology for adjusting its building sample to reflect buildings that use a consumer water heater covered in this rulemaking based on ASHRAE and EPRI handbooks and other references on how consumer water heaters are typically used in residential and commercial applications.

[26] If shipments data are not available for a considered product class, DOE intends to use any other available data including number of available models.

Proper Water Heater Selection,"[27] as well as American Society of Heating, Refrigerating and Air-Conditioning Engineers ("ASHRAE")[28] and Electric Power Research Institute ("EPRI")[29] handbooks, which contain data on the typical categories and sizes (both input capacity and rated volume) of consumer water heaters used for different building types and applications, and can be used to compare to, supplement, and corroborate the RECS and CBECS data. In addition, DOE intends to review other data sets (*e.g.*, data from the End-Use Load and Consumer Assessment Program ("ELCAP"),[30] 2016 Residential Building Stock Assessment for the Northwest,[31] 2014 Commercial Building Stock Assessment for the Northwest,[32] 2015 Residential Statewide Baseline Study of New York State,[33] 2009 Residential Appliance Saturation Study ("RASS"),[34] and 2006 California Commercial End-Use Survey ("CEUS")[35]) to compare to RECS 2015 and CBECS 2012 data. Based on these data, DOE will develop a representative population of buildings for each consumer water heater product class. Calculating the hot water use for the sampled households requires assigning a specific water heater size (rated volume). DOE plans to

[27] Building America, DOE, Strategy Guideline: Proper Water Heater Selection (Available at: *https://www1.eere.energy.gov/buildings/publications/pdfs/building_america/strategy-guideline-water-heater-selection.pdf*) (Last accessed Dec. 2, 2019).

[28] ASHRAE, ASHRAE Handbook of HVAC Applications: Chapter 50 (Service Water Heating) (2011) pp. 50.1 to 50.32.

[29] EPRI, Commercial Water Heating Applications Handbook (1992) CU-6666.

[30] Bonneville Power Administration, ELCAP Data from 1986 to 1989 (2012) (Available at: *http://rtf.nwcouncil.org/ELCAP/*) (Last accessed Dec. 2, 2019).

[31] NEEA, Residential Building Stock Assessment (2016) (Available at: *https://neea.org/data/residential-building-stock-assessment*) (Last accessed Dec. 2, 2019).

[32] NEEA, Commercial Building Stock Assessment (2014) (Available at: *https://neea.org/data/commercial-building-stock-assessments*) (Last accessed Dec. 2, 2019).

[33] New York State Energy Research and Development Authority ("NYSERDA"), Residential Statewide Baseline Study of New York State (July 2015) (Available at: *https://www.nyserda.ny.gov/About/Publications/Building-Stock-and-Potential-Studies/Residential-Statewide-Baseline-Study-of-New-York-State*) (Last accessed Dec. 2, 2019).

[34] CEC, 2009 RASS (2009) (Available at: *https://ww2.energy.ca.gov/appliances/rass/previous_rass.html*) (Last accessed Dec. 2, 2019). Note the 2019 RASS data are expected to be completed in March 2020. Until that time, 2009 RASS remains the most recent full data release.

[35] CEC, 2006 CEUS (2006) (Available at: *http://www.energy.ca.gov/ceus/2006_enduse.html*) (Last accessed Dec. 2, 2019).

use the RECS sizing data together with the available shipments and models data to assign the consumer water heaters sizes for each sampled RECS household.

Issue G.1 DOE seeks shipments data and input on typical categories (in terms of product classes) and sizes (including fuel type, input capacity, and rated volume) of consumer water heaters used for different building types and applications.

Issue G.2 DOE seeks input and sources of data or recommendations to support sizing of consumer water heaters typical in consumer water heater applications.

Issue G.3 DOE requests comment on the fraction of installations and classes of consumer water heaters that are used in commercial applications.

2. Hot Water Use

To estimate the annual hot water use of each sampled unit, DOE intends to use the RECS 2015 and CBECS 2012 estimates of water heating annual energy consumption[36] together with the existing water heater's estimated efficiency and other water heater characteristics. DOE intends to assume that some households or buildings have multiple water heaters, with the hot water use split evenly between them. The efficiency of the existing water heater will be determined using the consumer water heater vintage (the year of installation of the product) provided by RECS and historical efficiency data for water heaters.

[36] EIA estimates the equipment's annual energy consumption from the household's utility bills using conditional demand analysis.

DOE plans to compare the results of its methodology to total hot water use from field data, models based on field data (such as the 2015 Florida Solar Energy Center study[37] and the model used in the April 2010 Final Rule (75 FR 20112)[38]), and any other model or data available in the literature. These total hot water use models typically account for the number and ages of the people who live in the household, the way they consume hot water, the presence of hot-water-using appliances, the tank size and thermostat set point of the consumer water heater, and the climate in which the residence is situated. DOE also plans to consider data regarding the total amount of water drawn per day for various draw patterns based on the field data collated by the Lawrence Berkeley National Laboratory ("LBNL") and other sources.[39]

For each analyzed consumer water heater and building type combination, DOE plans to determine the typical water heating usage profiles, water volumetric loads, and hot water usage temperatures using data from the ASHRAE Heating, Ventilation, and Air-Conditioning ("HVAC") Systems and Equipment Handbook, EPRI Handbook, and reports from National

[37] Danny Parker, Fairey, P, and Lutz, J., Estimating Daily Domestic Hot Water Use in North American Homes, Florida Solar Energy Center (June 2015) (Available at: *http://www.fsec.ucf.edu/en/publications/pdf/FSEC-PF-464-15.pdf)* (Last accessed Dec. 2, 2019).

[38] Lutz, J. D., X. Liu, J. E. McMahon, C. Dunham, L. J. Shown, and Q. T. McGrue, Modeling Patterns of Hot Water Use in Households (1996) LBNL (LBL-37805) (Available at: *https://ees.lbl.gov/sites/all/files/modeling_patterns_of_hot_water_use_in_households_lbl-37805_rev.pdf*) (Last accessed Dec. 2, 2019).

[39] The Water Research Foundation, Residential End Uses of Water, Version 2 (June 2019) (Available at: *https://www.waterrf.org/research/projects/residential-end-uses-water-version-2*) (Last accessed Dec.2, 2019); Kruis, N., B. Wilcox, J. Lutz, C. Barnaby, Development of Realistic Water Draw Profiles for California Residential Water Heating Energy Estimation (August 2017) (Available at: *http://www.ibpsa.org/proceedings/BS2017/BS2017_237.pdf*) (Last accessed Dec.2, 2019); Lutz, JD, Renaldi, Lekov A, Qin Y, and Melody M., "Hot Water Draw Patterns in Single Family Houses: Findings from Field Studies," LBNL Report number LBNL–4830E (May 2011) (Available at: *http://www.escholarship.org/uc/item/2k24v1kj*) (Last accessed Dec. 2, 2019); NREL, Tool for Generating Realistic Residential Hot Water Event Schedules (August 2010) (Available at: *https://www.ibpsa.us/sites/default/files/publications/SB10-PPT-TS06B-01-Hendron.pdf*) (Last accessed Dec. 2, 2019).

Renewable Energy Laboratory ("NREL")[40] and LBNL.[41] For residential applications, DOE plans to determine average set point temperature by using the 2006-2019 survey data from plumbing/hydronic heating contractor firms.[42] These data will capture the variability in water heating use due to factors such as building activity, schedule, occupancy, water supply temperature, tank losses, cycling losses, and distribution system piping losses. DOE intends to derive the inlet water temperature using an approach developed by NREL.[43] This approach accounts for seasonal variations in inlet water temperature as a function of annual average outdoor air temperature. The monthly average inlet water temperature varies directly with the average annual outdoor air temperature corrected by an offset term.

DOE also plans to consider market changes or future efficiency standards in technologies that reduce water heating loads in residential housing or commercial buildings using consumer water heaters, such as more-efficient clothes washers.

[40] NREL, DOE Commercial Reference Building Models of the National Building Stock (February 2011) (Available at: *https://www.nrel.gov/docs/fy11osti/46861.pdf*) (Last accessed Dec. 2, 2019).
[41] Huang, J., Akbari, H., Rainer, L, Ritschard, R., 481 Prototypical Commercial Buildings for 20 Urban Market Areas, LBL-29798 (April 1991) (Available at: *http://simulationresearch.lbl.gov/dirpubs/29798.pdf*) (Last accessed Dec. 2, 2019).
[42] Clear Seas Research, 2019 Mechanical Systems – Water Heater CLEAReport (Dec. 2019) (Available at: *https://clearseasresearch.com/product/2019-mechanical-systems-water-heater/*) (Last accessed Dec. 2, 2019).
[43] Burch, J. a. C. C., Towards Development of an Algorithm for Mains Water Temperature, NREL (Available at: *https://www.osti.gov/scitech/biblio/981988*) (Last accessed Dec. 2, 2019); Hendron, R., R. Anderson, C. Christensen, M. Eastment, and P. Reeves, Development of an Energy Savings Benchmark for All Residential End-Uses (August 2004) NREL, Report No. NREL/BK-610-28044 (Available at: *http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.577.9027&rep=rep1&type=pdf*) (Last accessed Dec. 2, 2019).

Issue G.4 DOE seeks field data and input on representative hot water usage, water heating usage load profile, and representative hot water usage temperatures for consumer water heaters used in various consumer and commercial water heater applications.

Issue G.5 DOE seeks input on the historical distribution of product efficiencies in the building population for different product classes.

Issue G.6 DOE seeks input on water use data by season to more accurately calculate the inlet water temperature.

3. Determination of Consumer Water Heating Energy Use

In the past, DOE calculated the field energy use of water heaters using a simplified energy equation, the consumer water heater analysis model ("WHAM"),[44] and modified WHAM equations developed for the April 2010 Final Rule. WHAM accounts for a range of operating conditions and energy efficiency characteristics of water heaters. To describe energy efficiency characteristics of water heaters, WHAM uses parameters that were also used in the previous consumer water heater test procedure. DOE intends to create a similar set of equations to determine field energy use based on the most recent consumer water heater test procedure, which determines UEF.

[44] Lutz, J., C. D. Whitehead, A. Lekov, D. Winiarski, and G. Rosenquist, WHAM: A Simplified Energy Consumption Equation for Water Heaters, in 1998 American Council for an Energy-Efficient Economy ("ACEEE") Summer Study on Energy Efficiency in Buildings (1998): Asilomar, CA. p. 1.171-1.183 (Available at: *https://www.osti.gov/biblio/20001984-wham-simplified-energy-consumption-equation-water-heaters*) (Last accessed Dec.2, 2019).

For gas-fired and oil-fired water heaters, DOE plans to estimate the auxiliary electricity use associated with water heater operation, such as that consumed by the electronic ignition, controls, power vent fan, standby mode and off mode, *etc*. For heat pump water heaters, DOE plans to take into account that the energy efficiency and consumption are dependent on ambient temperature when in heat pump mode and the amount of time the unit operates using the electric resistance mode. DOE also intends to estimate the impact of heat pump water heaters on the home's space heating, air conditioning, and dehumidifier operation.[45] DOE also plans to take into account the electricity use associated with condensate withdrawal, such as that consumed by the condensate pump or heat tape for condensing and heat pump water heater technologies. For grid-enabled water heaters, DOE plans to use common draw patterns and utility program structure (*i.e.*, turned off at a fixed schedule or turned off during peak periods only) to determine the electricity use and match it with the appropriate electricity tariff structure.

Issue G.7 DOE requests field or test energy use data or other relevant information that could assist in the development of an equation or set of equations based on the latest consumer water heater test procedure that can calculate field water heating energy use for each product class.

[45] Heat pump water heaters draw heat from the space in which they are located. Thus, when such a water heater is located in a conditioned space, its operation affects the load that the home's space heating and air conditioning equipment must meet. When the home is being heated, use of the heat pump water heater increases the heating load, and when the house is being cooled, its use decreases the cooling load.

Issue G.8 DOE requests comment on the methodology for determining energy use for each consumer water heater product class, including the impact of ambient conditions and draw patterns.

Issue G.9 DOE requests comment on the methodology for determining energy use of heat pump water heaters, including the impact of ambient conditions and draw patterns on efficiency, as well as taking into account the cooling effect and humidity withdrawal of heat pump water heaters installed in conditioned spaces.

Issue G.10 DOE requests comment on the methodology for determining energy use for grid-enabled water heaters.

Issue G.11 DOE requests comment on the fraction of installations and classes of consumer water heaters used for other applications such as space heating (in hydronic systems or fan-coils).

Issue G.12 DOE seeks input on the fraction of installations and types of buildings that use recirculation loops associated with consumer water heaters and the impact of recirculation loops on water heater performance.

H. Life-Cycle Cost and Payback Period Analysis

DOE plans to conduct LCC and PBP analyses to evaluate the economic impacts on individual consumers of potential energy conservation standards for consumer 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 intends to analyze the potential for variability by performing the LCC and PBP calculations on a representative sample of individual consumers. DOE plans to utilize the sample of buildings developed for the energy use analysis and the corresponding simulation results.[46] Within a given building, one or more consumer water heater units may serve the building's water heating needs, depending on the hot water requirements of the building. Therefore, DOE intends to express the LCC and PBP results for each of the individual consumer water heaters installed in the building. DOE plans to model uncertainty in many of the inputs to the LCC and PBP analysis using Monte Carlo simulation and probability distributions. As a result, the LCC and PBP results will be displayed as distributions of impacts compared to the no-new-standards case (*i.e.*, without amended standards) conditions.

Issue H.1 DOE requests comment on the overall methodology that it intends to use to conduct the LCC and PBP analysis for consumer water heaters.

Inputs to the LCC and PBP analysis are categorized as: (1) inputs for establishing the purchase expense, otherwise known as the total installed cost, and (2) inputs for calculating the operating costs. Each type of input is discussed in the paragraphs that follow.

[46] Specifically, DOE plans to utilize the household types defined in RECS 2015, as well as commercial building types in CBECS 2012 that use consumer water heaters.

1. Total Installed Cost

The primary inputs for establishing the total installed cost are the baseline consumer price, standard-level customer price increases, and installation costs. Baseline consumer prices and standard-level consumer price increases will be determined by applying markups to manufacturer selling price estimates and sales tax. For gas-fired water heaters, DOE intends to take into account location where ultra-low-NOx gas-fired water heaters would be required by the compliance date for any amended standards, such as the Bay Area Air Quality Management District ("AQMD") (Regulation 9, Rule 6),[47] Sacramento Metropolitan AQMD (Rule 414),[48] San Joaquin Valley Air Pollution Control District ("APCD") (Rule 4902),[49] Santa Barbara County APCD (Rule 352),[50] South Coast AQMD (Rule 1112),[51] Ventura County AQMD (Rule 74-11),[52] and Yolo-Solano AQMD (Rule 2.37).[53]

Issue H.2 DOE seeks input on locations requiring ultra-low-NOx gas-fired water heaters.

[47] Bay Area Air Quality Management District, Regulation 9: Inorganic Gaseous Pollutants; Rule 6: Nitrogen Oxides Emissions from Natural Gas-Fired Boilers and Water Heaters (Available at: *https://www.arb.ca.gov/drdb/ba/curhtml/r9-6.pdf*) (Last accessed Dec.2, 2019).

[48] Sacramento Metropolitan Air Quality Management District, Rule 414: Water Heaters, Boilers and Process Heaters Rated Less Than 1,000,000 BTU PER HOUR Adopted 08-01-96 (Amended 03-25-10) (Available at: *http://www.airquality.org/ProgramCoordination/Documents/rule414.pdf*) (Last accessed Dec.2, 2019).

[49] San Joaquin Valley Air Pollution Control District, Rule 4902: Residential Water Heaters (Adopted June 17, 1993; Amended March 19, 2009) (Available at: *http://valleyair.org/rules/currntrules/r4902.pdf*) (Last accessed Dec.2, 2019).

[50] Santa Barbara County Air Pollution Control District, Rule 352: Natural Gas-Fired Fan-Type Central Furnaces and Small Water Heaters (Adopted 9/16/1999, revised 10/20/2011) (Available at: *https://www.ourair.org/wp-content/uploads/rule352.pdf*) (Last accessed Dec.2, 2019).

[51] South Coast Air Quality Management District, Rule 1121: Control of Nitrogen Oxides from Residential Type, Natural Gas-Fired Water Heaters (Adopted Dec. 1, 1978; Amended Mar. 10, 1995; Amended Dec. 10, 1999; Amended Sept. 3, 2004) (Available at: *http://www.aqmd.gov/home/regulations/rules/support-documents/rule-1121*) (Last accessed Dec.2, 2019).

[52] Ventura County Air Quality Management District, Rule 74-11: Natural Gas-Fired Water Heaters (Available at: *http://www.vcapcd.org/pubs/Advisories/7411/Ru7411Revision2010.pdf*) (Last accessed Dec.2, 2019).

[53] Yolo-Solano Air Quality Management District, Rule 2.37: Natural Gas-Fired Water Heaters and Small Boilers (Adopted Nov 9, 1994; Revised April 8, 2009) (Available at: *https://www.arb.ca.gov/DRDB/YS/CURHTML/R2-37.pdf*) (Last accessed Dec.2, 2019).

The installation cost is added to the consumer price to arrive at a total installed cost. DOE intends to develop installation costs using the most recent RS Means data available.[54] DOE also intends to use regional labor costs to more accurately estimate installation costs by applying the appropriate regional labor cost from RS Means to each sampled household or building.

For water heaters in new homes, DOE plans to include basic installation cost, such as adding a gas line branch and/or electrical connection and water piping, in addition to putting the new water heater in place and additional set-up. For natural draft venting gas-fired water heaters in new construction, DOE plans to account for both commonly-vented water heaters (together with a central furnace) and isolated water heaters (separately vented). For replacement cases, DOE plans to include the installation cost associated with disconnecting and removing the old water heater, removal/disposal fees, permit fees, as well as the cost of putting the new water heater in place and additional set-up.

DOE also intends to account for additional labor costs associated with larger water heaters, replacing a larger drain pan, and potential space-constraint issues when the original water heater location is too small to accommodate the replacement water heater. DOE also intends to add any costs associated with updating or repairing existing flue venting including vent resizing and chimney relining. For efficiency levels that include electronic ignition, power vent, or condensing design, DOE intends to add the cost of installing an electrical outlet, a new venting system, and any additional cost for condensate disposal. For heat pump water heater

[54] RS Means, 2020 Mechanical Cost Data (Available at: *https://www.rsmeans.com/products/books/cost-books.aspx*) (Last accessed Dec.2, 2019).

installation, DOE intends to apply several additional costs, including one additional hour of labor for the extra time required to install this product, potential space-constraint issues, adding condensate withdrawal, and adding ductwork for supply and/or outlet air from the heat pump component (including adding louvered doors for water heaters installed in indoor closets).

Issue H.3 DOE seeks input on the approach and data sources it intends to use to develop installation costs, specifically, its intention to use the most recent RS Means Mechanical Cost Data.

Issue H.4 DOE seeks input on the fraction and categories of water heaters that encounter space-constraint issues (such as impact of height and width on installation space constraints or constraints in getting the consumer water heater through attic or closet doors).

Issue H.5 DOE seeks input on issues and costs associated with venting of flue gases of gas-fired storage and instantaneous water heaters, in particular regarding retrofit issues related to installing a new vent system for power vent and condensing water heaters, disconnecting the existing water heater from non-condensing furnace common venting system, and upgrading existing non-condensing venting (chimney relining or vent resizing). DOE also seeks input on how often and in what applications direct venting or sealed combustion are used or required.

Issue H.6 DOE seeks input on issues and costs associated with condensate disposal for condensing gas-fired storage and instantaneous water heaters, specifically how often and in what applications a condensate filter is installed or a condensate pump is installed.

Issue H.7 DOE seeks input on issues and costs associated with installing consumer water heaters in multi-family buildings and mobile homes.

Issue H.8 DOE seeks input on issues and costs associated with installing heat pump water heaters, including adjustment of electrical circuits, additional labor, space constraints, adding condensate withdrawal, and adding ductwork for supply and/or outlet air from the heat pump component.

Issue H.9 DOE seeks input on issues and costs associated with installing consumer water heaters with large input capacities, such as instantaneous natural gas water heaters, when replacing an existing smaller capacity natural gas storage water heater. DOE requests comment on how often a new larger gas pipe is required.

2. Operating Costs

The primary inputs for calculating the operating costs are energy consumption, product efficiency, energy prices, maintenance and repair costs, product lifetime, and discount rates. Both product lifetime and discount rates are used to calculate the present value of future operating costs.

The relevant energy consumption is the site energy use associated with providing water heating to the building. (The primary energy used to provide electricity for electric water heaters is accounted for in the NIA.) DOE intends to utilize the energy use calculation methodology described in section II.G of this document to determine water heater energy use.

DOE intends to determine recent gas, oil, and electricity prices based on geographically-available fuel cost data such as State level data, with consideration for the variation in energy costs paid by consumers living in different building types. DOE calculates energy expenses based on estimated marginal energy prices that customers are paying in different geographical areas of the country. DOE may consider data provided by EIA's Form EIA-861[55] to calculate residential and commercial electricity prices, EIA's Natural Gas Navigator[56] to calculate residential and commercial natural gas prices, and EIA's State Energy Data Systems ("SEDS")[57] to calculate liquefied petroleum gas (LPG) and fuel oil prices. Future energy prices will be projected using trends from the latest Annual Energy Outlook ("*AEO*").[58]

Issue H.10 DOE seeks comment on its planned approach and sources for developing gas, oil, and electricity prices.

Maintenance costs are expenses associated with ensuring continued operation of the covered product over time. DOE intends to develop maintenance costs using the most recent RS Means data available[59] and manufacturer product literature. DOE intends to assess whether maintenance costs vary with product efficiency and product category. In addition, DOE plans to consider the cases when the product is covered by service and/or maintenance agreements. More

[55] EIA, Survey form EIA-861 -- Annual Electric Power Industry Report (Available at: *https://www.eia.gov/electricity/*) (Last accessed Dec.2, 2019).
[56] EIA, Natural Gas Navigator (Available at: *http://www.eia.gov/dnav/ng/ng_pri_sum_dcu_nus_m.htm*) (Last accessed Dec.2, 2019).
[57] EIA, SEDS (Available at: *http://www.eia.gov/state/seds/*) (Last accessed Dec.2, 2019).
[58] EIA, AEO Full Version *(*Available at: *https://www.eia.gov/outlooks/aeo/*) (Last accessed Dec.2, 2019).
[59] RS Means, 2020 Facilities Maintenance & Repair Cost Data (Available at: *https://www.rsmeans.com/products/books/cost-books.aspx*) (Last accessed Dec.2, 2019).

specifically, DOE intends to account for the following: (1) maintenance cost associated with storage water heaters being drained and flushed annually to minimize deposition of sediment, maintain operating efficiency, and prolong product life; (2) any maintenance cost associated with the flammable vapor ignition resistant ("FVIR") component of gas-fired storage water heaters; (3) for a heat pump water heater, the cost of annual cleaning of the air filter and a preventive maintenance cost to check the evaporator and refrigeration system; (4) for gas-fired instantaneous water heaters, maintenance costs associated with the fouling of the heat exchanger from hard water, periodic sensor inspections, and filter changes; and (5) for oil-fired storage water heaters, the cost of annual maintenance contracts, which are available for this product category.

Issue H.11 DOE seeks input on the approach and data sources it intends to use to develop maintenance costs, specifically, its intention to use the most recent RS Means Facilities Maintenance & Repair Cost Data and to consider the cost of service and/or maintenance agreements.

Repair costs are expenses associated with repairing or replacing components of the covered product that have failed. DOE intends to develop maintenance costs using the most recent RS Means data available[60] and manufacturer literature. DOE intends to assess whether repair costs vary with product efficiency and product category. DOE intends to include repair cost for components that are more likely to fail during the consumer water heater's lifetime, such

[60] RS Means, 2020 Facilities Maintenance & Repair Cost Data (Available at: *https://www.rsmeans.com/products/books/cost-books.aspx*) (Last accessed Dec.2, 2019).

as pilot ignition, electronic ignition, and power vent fan for gas-fired water heaters; and electric resistance element, compressor, and the evaporator fan for electric water heaters. For oil-fired storage water heaters, DOE intends to calculate the cost of annual maintenance contracts, which typically include repair/replacement of failed components.

Issue H.12 DOE seeks comment as to whether water heater repair costs vary as a function of product efficiency. DOE also requests any data or information on developing repair costs.

Product lifetime is the age at which a unit is retired from service. DOE intends to conduct an analysis of water heater lifetimes using a combination of data on shipments, the consumer water heater stock, and RECS data on the age of existing water heaters in the sampled homes based on a methodology described in a journal article.[61] The data allow DOE to develop a Weibull probability distribution to characterize consumer water heater lifetime, which provides a range from minimum to maximum lifetime, as well as an average lifetime.[62]

Issue H.13 DOE seeks comment on its planned approach of using a Weibull probability distribution to characterize product lifetime. DOE also requests product lifetime data and information on whether product lifetime varies based on product characteristics, product application, or product efficiency.

[61] 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: https://*www.tandfonline.com/doi/abs/10.1080/10789669.2011.558166*) (Last accessed Dec.2, 2019).

[62] If the data are available, DOE also plans to take into account differences in consumer water heater lifetime based on usage and application of the consumer water heater.

In the calculation of LCC, DOE applies discount rates appropriate to households to estimate the present value of future operating costs. The discount rate used in the LCC analysis represents the rate from an individual consumer's perspective. DOE estimates a distribution of residential discount rates based on the opportunity cost of funds related to appliance energy cost savings and maintenance costs. DOE estimates commercial discount rates as the weighted average cost of capital ("WACC"), using the Capital Asset Pricing Model ("CAPM").

To establish residential discount rates for the LCC analysis, DOE intends to use the Federal Reserve Board's Survey of Consumer Finances[63] ("SCF") for 1995, 1998, 2001, 2004, 2007, 2010, 2013, and 2016 data, as well as other data sources,[64] to develop a distribution of discount rates by income group to represent the rates that may apply in the year in which potential amended standards would take effect. For commercial discount rates, DOE intends to

[63] The Federal Reserve Board, SCF (1995, 1998, 2001, 2004, 2007, 2010, 2013, and 2016) (Available at: *https://www.federalreserve.gov/econres/scfindex.htm*) (Last accessed Dec.2, 2019).

[64] Damodaran, A., Data Page: Historical Returns on Stocks, Bonds and Bills-United States (Available at: *http://pages.stern.nyu.edu/~adamodar/*) (Last accessed Dec.2, 2019); Moody's, Moody's Seasoned AAA Corporate Bond Yield [AAA], retrieved from FRED, Federal Reserve Bank of St. Louis (Available at: *https://fred.stlouisfed.org/series/AAA*) (Last accessed Dec.2, 2019); Wells Fargo, Wells Fargo Cost of Savings Index ("COSI") (Available at: *https://www.wellsfargo.com/mortgage/manage-account/cost-of-savings-index/*) (Last accessed Dec.2, 2019); National Bureau of Economic Research, Marginal Income Tax Rates by Income Type (Available at: *http://users.nber.org/~taxsim/marginal-tax-rates/*) (Last accessed Dec.2, 2019); U.S. Board of Governors of the Federal Reserve System, State and Local Bonds - Bond Buyer Go 20-Bond Municipal Bond Index (DISCONTINUED) [WSLB20], retrieved from FRED, Federal Reserve Bank of St. Louis (Available at: *https://fred.stlouisfed.org/series/WSLB20*) (Last accessed Dec.2, 2019); U.S. Board of Governors of the Federal Reserve System, 30-Year Treasury Constant Maturity Rate [DGS30], retrieved from FRED, Federal Reserve Bank of St. Louis (Available at: *https://fred.stlouisfed.org/series/DGS30*) (Last accessed Dec.2, 2019); Organisation for Economic Co-operation and Development ("OECD"), Short-term interest rates (indicator) (Available at *https://data.oecd.org/interest/short-term-interest-rates.htm*) (Last accessed Dec.2, 2019); U.S. Department of Labor–Bureau of Labor Statistics, Bureau of Labor Statistics Data, Consumer Price Index (2018) (Available at: *http://data.bls.gov*) (Last accessed Dec.2, 2019).

use Damodaran Online, which is a widely used source of information about company debt and equity financing for most types of firms, as the primary source of data.[65]

Issue H.14 DOE seeks comment on its planned discount rate methodology.

DOE measures LCC and PBP impacts of potential standard levels relative to a no-new-standards case that reflects the likely market in the absence of amended standards. DOE plans to develop market-share efficiency data (*i.e.*, the distribution of product shipments by efficiency) for the product classes DOE is considering, for the year in which compliance with any potential amended standards would be required. To estimate the market shares of different water heater energy efficiency levels in the no-new-standards case, DOE intends to use historical data provided by AHRI for the April 2010 Final Rule,[66] along with more recent data that may be provided by stakeholders. DOE also intends to use 2010-2018 ENERGY STAR shipments data.[67] Because these data may not cover all of the energy efficiency levels under consideration, DOE also intends to use data on the number of water heater models at different energy efficiency levels, as reported in DOE's compliance certification database,[68] the AHRI directory of certified

[65] Damodaran A., Data Page: Costs of Capital by Industry Sector (Available at: *http://pages.stern.nyu.edu/~adamodar/*) (Last accessed Dec.2, 2019).
[66] AHRI provided to DOE 2002-2006 shipments data by energy factor (EF) bins for gas-fired storage water heaters (40 gallons) and oil-fired storage water heaters (50 gallon). In addition, AHRI provided LBNL 2004-2007 shipments data by energy factor (EF) bins for gas-fired instantaneous water heaters.
[67] ENERGY STAR, 2010-2018 Unit Shipment Data (Available at: *https://www.energystar.gov/index.cfm?c=partners.unit_shipment_data*) (Last accessed Dec.2, 2019).
[68] DOE, Compliance Certification Database (Available at: *https://www.regulations.doe.gov/certification-data/CCMS-4-Water_Heaters.html#q=Product_Group_s%3A%22Water%20Heaters%22*) (Last accessed Dec.2, 2019).

product performance,[69] the California Energy Commission ("CEC") appliance efficiency database,[70] and the ENERGY STAR certified water heaters directory.[71]

Issue H.15 DOE requests shipments data for consumer water heaters, broken down by product class, that show current market shares by efficiency level. DOE also seeks input on similar historic data.

A table of the types of data requested for shipments in Issue H.15 can be found in Table II.7 and Table II.8. Table II.7 represents efficiency data from 2007-2015 based on EF metric based on the test procedure that was effective prior to December 31, 2015, while Table II.8 represents efficiency data from 2016-2018 based on the amended test procedure using the UEF metric. Interested parties are also encouraged to provide additional shipment data as may be relevant.

Table II.7 Summary Table of Shipments-Related Data Requests from 2007 to 2015 by EF Bins Using Test Procedure Prior to December 31, 2015 by Product Class and Representative Rated Volumes*

EF Bins	Historical Shipments (millions)								
	2007	2008	2009	2010	2011	2012	2013	2014	2015
Gas-fired Storage Water Heaters, 40 gal									
0.59-0.60									
0.61-0.63									
0.64-0.69									
0.70 and above									

[69] AHRI, Directory of Certified Product Performance for Residential Water Heaters (Available at: *https://www.ahridirectory.org/NewSearch?programId=24&searchTypeId=3*) (Last accessed Dec.2, 2019).
[70] CEC, Appliance Efficiency Database (Available at: *https://cacertappliances.energy.ca.gov/Pages/ApplianceSearch.aspx*) (Last accessed Dec.2, 2019).
[71] ENERGY STAR, ENERGY STAR Certified Water Heaters Directory (Available at: *https://www.energystar.gov/productfinder/product/certified-water-heaters/results*) (Last accessed Dec.2, 2019).

Oil-fired Storage Water Heaters, 32 gal									
0.53-0.61									
0.62-0.65									
0.66-0.67									
0.68 and above									
Electric Storage Water Heaters, 50 gal									
0.90									
0.91-0.93									
0.94-0.96									
0.97-2.49									
2.50-2.99									
3.00 and above									
Electric Storage Water Heaters, 80 gal									
0.86-0.96									
0.97-2.49									
2.50-2.99									
3.00 and above									
Gas-fired Instantaneous Water Heaters, all									
0.62-0.77									
0.78-0.80									
0.81-0.82									
0.83-0.86									
0.87-0.92									
0.93-0.94									
0.95 and above									
Grid-Enabled Water Heaters, 80 gal									
0.86-0.91									
0.92									
0.93-0.95									
0.96 and above									

* Any additional shipments by efficiency bins data for additional rated volumes, such as 50 or 30 gallons for gas-fired storage water heaters, 50 gallon oil-fired storage water heaters, 30, 40, or 67 gallons for electric storage water heaters, or 100 gallon for grid-enabled water heaters are welcome. In addition, any data for any other product classes are also welcome.

Table II.8 Summary Table of Shipments-Related Data Requests from 2016-2018 by Uniform Energy Factor (UEF) Bins Using Test Procedure After December 31, 2015 by Product Class and Representative Capacity*

UEF Bins	**Historical Shipments (millions)**		
	2016	**2017**	**2018**
Gas-fired Storage Water Heaters, 38 gal, Medium Draw Pattern			
0.58			
0.59-0.60			

0.61-0.63			
0.64-0.66			
0.67-0.69			
0.70 and above			
Oil-fired Storage Water Heaters, 30 gal, High Draw Pattern			
0.62-0.65			
0.66-0.67			
0.68 and above			
Electric Storage Water Heaters, 46 gal, Medium Draw Pattern			
0.92			
0.93-0.96			
0.97-2.49			
2.50-2.99			
3.00 and above			
Electric Storage Water Heaters, 80 gal, High Draw Pattern			
2.00-2.49			
2.50-3.00			
3.00 and above			
Gas-fired Instantaneous Water Heaters, all			
0.81			
0.82-0.86			
0.87-0.92			
0.93-0.94			
0.95 and above			
Grid-Enabled Water Heaters*, 80 gal, High Draw Pattern*			
0.90-0.91			
0.92			
0.93-0.95			
0.96 and above			

* Any additional shipments by efficiency bins data for additional rated volumes, such as 48 gallon (high draw) for gas-fired storage water heaters, 48 gallon (high draw) oil-fired storage water heaters, 27 gallon (low draw), 36 (medium draw), or 67 gallons (high draw) for electric storage water heaters, 100 gallon (high draw) for grid-enabled water heaters are welcome. In addition, any data for any other product classes are also welcome.

Issue H.16 DOE also requests information on expected future trends in efficiency for consumer water heaters product classes, including the relative market shares of condensing versus non-condensing products in the market for storage water heaters and instantaneous water

heaters, as well as the share of heat pump water heaters in the absence of amended efficiency standards.

DOE intends to consider the possibility for potential amended standards to impact the choice between categories of water heating products or product switching (including the potential for fuel switching), both for new construction and the replacement of existing products. Because home builders are sensitive to the cost of water heating products, standards that significantly increase the purchase price of one category of product relative to other options may induce some builders to switch to a different water heating product than they would have otherwise installed (*i.e.*, in the no-new-standards case). Such an amended standard level may also induce some home owners to replace their existing water heater at the end of its useful life with a different category of water heating product, or to repair the product instead of replacing, thereby delaying the replacement of the consumer water heater.

DOE plans to develop a consumer choice model to estimate the response of builders and homeowners to potential amended consumer water heater standards. DOE plans to consider three options available to each sample household: (1) replace with the same category of consumer water heater that meets a particular standard level, (2) replace with a consumer water heater using a different fuel or a different product category (*e.g.*, switching from a storage gas-fired unit to an instantaneous gas-fired unit; storage gas-fired unit to storage electric unit, storage electric unit to a storage gas-fired unit), or (3) repair the existing product, thereby delaying replacement. DOE plans to have the consumer choice model use the installed cost of each option, as estimated for each sample household or building, and the operating costs, taking into

account the water heating load for each household and the energy prices it will pay over the lifetime of the available product options. DOE intends to account for any additional costs to accommodate a new product or repair it. To determine which consumer choice option each sampled household or building is likely to select, DOE intends to use the estimated total installed cost and operating cost of each of the modeled choices together with decision criteria that take into account consumer willingness to pay for more-expensive but more-efficient products, as well as other factors such as income and purchase incentives.

Issue H.17 DOE seeks any data and comment on its planned consumer choice methodology approach.

Issue H.18 DOE seeks any data or comments on the consumer choice model in new construction, specifically identifying what the principal factors are driving the selection of different water heater categories in new construction. For example, how often are gas water heaters installed if a gas furnace is selected as the heating system in new construction?

I. Shipments Analysis

DOE uses shipment forecasts to calculate the national impacts of potential amended energy conservation standards on energy consumption, net present value ("NPV") of consumer benefits, and future manufacturer cash flows. DOE shipments projections are based on available historical data broken out by product class, capacity, and efficiency. Current sales estimates allow for a more accurate model that captures recent trends in the market. In the present case, DOE intends to develop a shipments model for consumer water heaters based on available

historical shipments data. DOE currently has historical shipments data by product class listed in Table II.9, from data sources as listed in Table II.10. In addition, DOE has limited historical data to disaggregate water heaters by capacity. Unless more recent data become available, DOE intends to use AHRI and U.S. Census shipments data to disaggregate gas-fired storage water heaters and electric storage water heaters above 55 gallons.[72]

Table II.9 Historical Shipments by Product Class

Product Class	**Historical Shipments (millions)**									
	2009	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**
Gas-fired Storage Water Heaters*	3.761	3.918	3.953	3.959	4.282	4.472	4.374	4.209	4.359	4.521
Electric Storage Water Heaters*	3.752	3.737	3.739	3.734	4.008	4.277	4.027	3.938	4.127	4.230
Oil-fired Storage Water Heaters	No Data									
Tabletop Water Heaters	No Data									
Instantaneous Gas-fired Water Heaters**	No Data	0.384	0.337	0.339	0.397	0.416	0.297	0.304	0.387	No Data
Instantaneous Electric Water Heaters	No Data									
Grid-Enabled Water Heaters	No Data									

* AHRI data for all storage water heaters that are marketed by the manufacturer for residential use. These data are aggregated and include grid-enabled and tabletop water heaters.
** Data from 2010 to 2017 are ENERGY STAR unit shipment data for whole home instantaneous water heaters meeting the ENERGY STAR criteria, which may not reflect the entire market. If no other data source is available, DOE intends to adjust these values so that they are more representative of the entire market.

[72] AHRI, Statistical Release: 1988–1995 data from the Gas Appliance Manufacturers Association ("GAMA") (1999); U.S. Department of Commerce-Bureau of the Census, Current Industrial Reports for Major Household Appliances (MA335F), 2003-2010 (Available at: *https://www.census.gov/data/tables/time-series/econ/cir/ma335f.html*) (Last accessed Dec.2, 2019).

Table II.10 Historical Shipments Data Sources Available by Product Classes

Product Class	Shipments Data Source
Gas-fired Storage Water Heaters	1954 to 2018 based on AHRI data[73] and Appliance Magazine report.[74]
Electric Storage Water Heaters	
Oil-fired Storage Water Heaters	1997 to 2007 data from Oil Heating Magazine.[75]
Tabletop Water Heaters	No data.
Instantaneous Gas-fired Water Heaters	2004 to 2007 shipments data provided by AHRI.[76] 2010 to 2017 shipments data from ENERGY STAR.[77]
Instantaneous Electric Water Heaters	No Data.
Grid-Enabled Water Heaters	No Data.

Issue I.1 DOE seeks up-to-date historical shipments data for consumer water heaters by product class, particularly for product classes other than gas-fired and electric storage water heaters.

The shipments model will consider three market segments: (1) new residential households or commercial buildings acquiring water heaters; (2) existing households or buildings replacing old water heaters; and (3) existing households or buildings acquiring new water heaters for the first time.[78]

[73] AHRI, Residential Automatic Storage Water Heaters Historical Data: 1996-2018 (Available at: *http://www.ahrinet.org/statistics.aspx*) (Last accessed Dec.2, 2019).
[74] Appliance Magazine, Appliance Historical Statistical Review: 1954-2012 (2014).
[75] Oil Heating Magazine, Multiple Years (1997-2007).
[76] Data submitted as part of the April 2010 Final Rule.
[77] ENERGY STAR, 2010-2017 Unit Shipment Data (Available at: *https://www.energystar.gov/index.cfm?c=partners.unit_shipment_data*) (Last accessed Dec.2, 2019).
[78] New owners primarily consist of households or buildings that during a major remodel add a consumer water heater, or households or buildings that switch from a non-consumer water heater (such as a boiler). For this analysis, new owners also include households or buildings that switch between different consumer water heater product classes.

DOE intends to utilize U.S. Census Bureau data to establish historical housing starts for residential households,[79,80] as well as National Energy Modeling System ("NEMS") data published in the latest *AEO* to establish historical new construction floor space for commercial buildings. DOE intends to use the latest *AEO* to project housing starts for residential households and new construction floor space for commercial buildings. Using these sources, as well as historical product saturation data from RECS and CBECS, DOE will estimate shipments to these market segments.

Issue I.2 DOE seeks input on the approach and data sources it intends to use in developing the shipments model and shipments projections for this analysis.

To estimate the impact on consumer water heater shipments from product switching and repair versus replacement decisions[81] that may be incentivized by potential standards, DOE plans to use the consumer choice model described in section II.G of this RFI. The options DOE plans to consider are: (1) replace with the same category of consumer water heater that meets a particular standard level, (2) replace with a consumer water heater using a different fuel or a different category product (*e.g.*, switching from a storage gas-fired unit to an instantaneous gas-fired unit; storage gas-fired unit to a storage electric unit, storage electric unit to a storage gas-fired unit), or (3) repair the existing product, thereby delaying the replacement. To determine

[79] U.S. Census Bureau, New Privately Owned Housing Units Started: Annual Data 1959-2018 (Available at: *http://www.census.gov/construction/nrc/historical_data/*) (Last accessed Dec.2, 2019).
[80] U.S. Census Bureau, Placements of New Manufactured Homes by Region and Size of Home: 1980 - 2018 (Available at: *https://www.census.gov/programs-surveys/mhs.html*) (Last accessed Dec.2, 2019).
[81] Consumers can choose to extend the useful life of their existing broken consumer water heater through additional repairs instead of replacing it.

whether a consumer would choose to switch products or repair rather than replacing their water heater, the shipments model will account for the combined effects of changes in purchase price and annual operating cost. Changes to the purchase price and operating costs due to amended energy conservation standards are the drivers for shipment estimates for the standards cases relative to the no-new-standards case.

Issue I.3 DOE seeks any data sources and input on the approach for determining potential impacts on product shipments related to consumers' decision on product switching and repair versus replacement.

J. National Impact Analysis

The purpose of the NIA is to estimate aggregate impacts of potential energy conservation standards at the national level. DOE's analysis includes the national energy savings ("NES") from potential standards and the NPV of the total consumer costs and savings.

To develop the NES, DOE calculates and examines the difference between the annual energy consumption for the no-new-standards case and the standards cases. DOE calculates the annual energy consumption using per-unit annual energy use data multiplied by projected shipments.

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 rate 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.

The NIA requires a projection of product energy efficiencies for the no-new-standards case and for each of the standards cases. For the no-new-standards case trend, DOE will consider whether historical data show any trend and whether any trend can be reasonably extrapolated beyond current efficiency levels.

Issue J.1 DOE requests comment on the anticipated future market share of higher-efficiency products, such as condensing gas-fired water heaters and heat pump water heaters, as compared to less-efficient products, such as non-condensing gas-fired water heaters and electric water heaters, respectively, for each product class.

For the various standards cases, to estimate the impact that amended energy conservation standards may have in the year compliance becomes required, DOE may use a “roll-up” scenario in which product efficiencies in the no-new-standards case that do not meet the new or amended standard level under consideration would "roll up" to meet that standard level, and shipments at efficiencies above the standard level under consideration would not be affected. After DOE establishes the efficiency distribution for the assumed compliance date of a standard, it may consider future projected efficiency growth using available trend data.

Issue J.2 DOE requests comment on use of a "roll-up" scenario for the standards cases.

When calculating energy consumption for water heaters at each considered efficiency level above the baseline, DOE plans to consider applying a rebound effect. A rebound effect occurs when a more-efficient product is used more intensively than its less-efficient predecessor, such that the expected energy savings from the efficiency improvement may not fully materialize. Accordingly, when a rebound effect is incorporated, calculated energy savings are lower than if no rebound effect were considered. For example, in the April 2010 Final Rule, DOE applied a rebound effect of 10 percent.

Issue J.3 DOE seeks information regarding whether there is a rebound effect associated with more-efficient consumer water heaters, as would be expected to impact a potential amended energy conservation standard for those products, and if so, what that effect would be. If data indicate that there is such an effect, DOE will account for the rebound effect in its calculation of NES.

K. Manufacturer Impact Analysis

The purpose of the manufacturer impact analysis ("MIA") is to estimate the impact of amended energy conservation standards on manufacturers of consumer water heaters. The MIA includes both quantitative and qualitative aspects. The quantitative part of the MIA primarily relies on the Government Regulatory Impact Model ("GRIM"), an industry cash-flow model adapted for each product in this analysis, with the key output of industry net present value ("INPV") to assess the financial impacts of a standard. The qualitative part of the MIA

addresses the potential impacts of energy conservation standards on manufacturing capacity and manufacturing employment as well as factors such as product characteristics, impacts on particular subgroups of firms, and important market and product trends.

As part of the MIA, DOE intends to analyze impacts of amended energy conservation standards on subgroups of manufacturers of covered products, including small business manufacturers. DOE uses the Small Business Administration's ("SBA") small business size standards to determine whether manufacturers qualify as small businesses, which are listed by the North American Industry Classification System ("NAICS").[82] Manufacturing of consumer water heaters is classified under NAICS 335220, "Major Household Appliance Manufacturing," and the SBA sets a threshold of 1,500 employees or less for a domestic entity to be considered as a small business. This employee threshold includes all employees in a business's parent company and any other subsidiaries.

One aspect of assessing manufacturer burden involves examining the cumulative impact of multiple DOE standards and the product-specific regulatory actions of other Federal agencies that affect the manufacturers of a covered product or equipment. While any one regulation may not impose a significant burden on manufacturers, the combined effects of several existing or impending regulations may have serious consequences for some manufacturers, groups of manufacturers, or an entire industry. Assessing the impact of a single regulation may overlook this cumulative regulatory burden. In addition to energy conservation standards, other

[82] Available at: *https://www.sba.gov/document/support--table-size-standards.*

regulations can significantly affect manufacturers' financial operations. Multiple regulations affecting the same manufacturer can strain profits and lead companies to abandon product lines or markets with lower expected future returns than competing products. For these reasons, DOE conducts an analysis of cumulative regulatory burden as part of its rulemakings pertaining to appliance efficiency.

Issue K.1 To the extent feasible, DOE seeks company names and contact information for domestic or foreign-based manufacturers that distribute consumer water heaters in commerce in the United States.

Issue K.2 DOE identified small businesses as a subgroup of manufacturers that could be disproportionally impacted by amended energy conservation standards. DOE requests the names and contact information of small business manufacturers (as defined by the SBA's size threshold) of consumer water heaters that distribute products in commerce in the United States. In addition, DOE requests comment on any other manufacturer subgroups that could be disproportionally impacted by amended energy conservation standards. DOE requests feedback on any potential approaches that could be considered to address impacts on manufacturers, including small businesses.

Issue K.3 DOE requests information regarding the cumulative regulatory burden impacts on manufacturers of consumer water heaters associated with: (1) other DOE standards applying to different products that these manufacturers may also make and (2) product-specific regulatory actions of other Federal agencies. DOE also requests comment on its methodology for

computing cumulative regulatory burden and whether there are any flexibilities it can consider that would reduce this burden while remaining consistent with the requirements of EPCA.

L. Other Energy Conservation Standards Topics

1. Market Failures

In the field of economics, a market failure is a situation in which the market outcome does not maximize societal welfare. Such an outcome would result in unrealized potential welfare. DOE welcomes comment on any aspect of market failures, especially those in the context of amended energy conservation standards for consumer water heaters.

2. Other

In addition to the issues identified earlier in this document, DOE welcomes comment on any other aspect of energy conservation standards for consumer water heaters not already addressed by the specific areas identified in this document.

III. Submission of Comments

DOE invites all interested parties to submit in writing by **[INSERT DATE 45 DAYS AFTER DATE OF PUBLICATION IN THE *FEDERAL REGISTER*]**, comments and information on matters addressed in this notice and on other matters relevant to DOE's consideration of amended energy conservations standards for consumer water heaters. After the close of the comment period, DOE will review the public comments received and may begin collecting data and conducting the analyses discussed in this RFI.

Submitting comments via http://www.regulations.gov. The *http://www.regulations.gov* webpage requires you to provide your name and contact information. Your contact information will be viewable to DOE Building Technologies staff only. Your contact information will not be publicly viewable except for your first and last names, organization name (if any), and submitter representative name (if any). If your comment is not processed properly because of technical difficulties, DOE will use this information to contact you. If DOE cannot read your comment due to technical difficulties and cannot contact you for clarification, DOE may not be able to consider your comment.

However, your contact information will be publicly viewable if you include it in the comment or in any documents attached to your comment. Any information that you do not want to be publicly viewable should not be included in your comment, nor in any document attached to your comment. Following such instructions, persons viewing comments will see only first and last names, organization names, correspondence containing comments, and any documents submitted with the comments.

Do not submit to *http://www.regulations.gov* information for which disclosure is restricted by statute, such as trade secrets and commercial or financial information (hereinafter referred to as Confidential Business Information ("CBI")). Comments submitted through *http://www.regulations.gov* cannot be claimed as CBI. Comments received through the website will waive any CBI claims for the information submitted. For information on submitting CBI, see the Confidential Business Information section.

DOE processes submissions made through *http://www.regulations.gov* before posting. Normally, comments will be posted within a few days of being submitted. However, if large volumes of comments are being processed simultaneously, your comment may not be viewable for up to several weeks. Please keep the comment tracking number that *http://www.regulations.gov* provides after you have successfully uploaded your comment.

Submitting comments via email, hand delivery/courier, or postal mail. Comments and documents submitted via email, hand delivery/courier, or postal mail also will be posted to *http://www.regulations.gov*. If you do not want your personal contact information to be publicly viewable, do not include it in your comment or any accompanying documents. Instead, provide your contact information in a cover letter. Include your first and last names, email address, telephone number, and optional mailing address. The cover letter will not be publicly viewable as long as it does not include any comments.

Include contact information each time you submit comments, data, documents, and other information to DOE. If you submit via postal mail or hand delivery/courier, please provide all items on a CD, if feasible. It is not necessary to submit printed copies. No telefacsimilies (faxes) will be accepted.

Comments, data, and other information submitted to DOE electronically should be provided in PDF (preferred), Microsoft Word or Excel, WordPerfect, or text (ASCII) file format. Provide documents that are not secured, written in English, and free of any defects or viruses.

Documents should not contain special characters or any form of encryption and, if possible, they should carry the electronic signature of the author.

Campaign form letters. Please submit campaign form letters by the originating organization in batches of between 50 to 500 form letters per PDF or as one form letter with a list of supporters' names compiled into one or more PDFs. This reduces comment processing and posting time.

Confidential Business Information. Pursuant to 10 CFR 1004.11, any person submitting information that he or she believes to be confidential and exempt by law from public disclosure should submit via email, postal mail, or hand delivery/courier two well-marked copies: one copy of the document marked "confidential" including all the information believed to be confidential, and one copy of the document marked "non-confidential" with the information believed to be confidential deleted. Submit these documents via email to *ConsumerWaterHeaters2017STD0019@ee.doe.gov* or on a CD, if feasible. DOE will make its own determination about the confidential status of the information and treat it according to its determination.

It is DOE's policy that all comments may be included in the public docket, without change and as received, including any personal information provided in the comments (except information deemed to be exempt from public disclosure).

DOE considers public participation to be a very important part of the process for developing energy conservation standards. DOE actively encourages the participation and interaction of the public during the comment period in each stage of this process. Interactions with and between members of the public provide a balanced discussion of the issues and assist

DOE in the process. Anyone who wishes to be added to the DOE mailing list to receive future notices and information about this process should contact Appliance and Equipment Standards Program staff at (202) 287-1445 or via e-mail at *ApplianceStandardsQuestions@ee.doe.gov*.

Signing Authority

This document of the Department of Energy was signed on February 25, 2020, by Alexander N. Fitzsimmons, Deputy Assistant Secretary for Energy Efficiency, 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 May 13, 2020.

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Treena V. Garrett
Federal Register Liaison Officer,
U.S. Department of Energy

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