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[6450-01-P]

DEPARTMENT OF ENERGY

10 CFR Part 430

[EERE-2017-BT-STD-0014]

RIN 1904-AF58

Energy Conservation Program: Energy Conservation Standards for Residential Clothes Washers

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

ACTION: Direct final rule.

SUMMARY: The Energy Policy and Conservation Act, as amended ("EPCA"), prescribes energy conservation standards for various consumer products and certain commercial and industrial equipment, including residential clothes washers ("RCWs"). In this direct final rule, the U.S. Department of Energy ("DOE") is adopting amended energy conservation standards for RCWs. DOE has determined that the amended energy conservation standards for these products would result in significant conservation of energy and are technologically feasible and economically justified.

DATES: The effective date of this rule is **[INSERT DATE 120 DAYS AFTER DATE OF PUBLICATION IN THE *FEDERAL REGISTER*]**. If adverse comments are received by **[INSERT DATE 110 DAYS AFTER DATE OF PUBLICATION IN THE FEDERAL REGISTER]** and DOE determines that such comments may provide a reasonable basis for withdrawal of the direct final rule under 42 U.S.C. 6295(o), a timely withdrawal of this rule will be published in the *Federal Register*. If no such adverse comments are received, compliance with the amended standards established for RCWs in this direct final rule is required on and after March 1, 2028. Comments regarding the likely competitive impact of the standards contained in this direct final rule should be sent to the Department of Justice contact listed in the **ADDRESSES** section on or before [**INSERT DATE 30 DAYS AFTER DATE OF PUBLICATION IN THE *FEDERAL REGISTER***].

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

The docket webpage can be found at *www.regulations.gov/docket/EERE-2017-BT-STD-0014*. The docket webpage contains instructions on how to access all documents, including public comments, in the docket.

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*.

The U.S. Department of Justice Antitrust Division invites input from market participants and other interested persons with views on the likely competitive impact of the standards contained in this direct final rule. Interested persons may contact the Antitrust Division at *energy.standards@usdoj.gov* on or before the date specified in the **DATES** section. Please indicate in the "Subject" line of your email the title and Docket Number of this direct final rule.

FOR FURTHER INFORMATION CONTACT:

Dr. Carl Shapiro, 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) 287-5649. Email: *ApplianceStandardsQuestions@ee.doe.gov*.

Ms. Amelia Whiting, U.S. Department of Energy, Office of the General Counsel, GC-33, 1000 Independence Avenue, SW., Washington, DC, 20585-0121. Telephone: (240) 586-2588. Email: *Amelia.Whiting@hq.doe.gov*.

SUPPLEMENTARY INFORMATION:

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I. Synopsis of the Direct Final Rule

The Energy Policy and Conservation Act, Public Law 94-163, as amended ("EPCA"),[1] authorizes DOE to regulate the energy efficiency of a number of consumer products and certain industrial equipment. (42 U.S.C. 6291–6317) Title III, Part B of EPCA[2] established the Energy Conservation Program for Consumer Products Other Than Automobiles. (42 U.S.C. 6291-6309) These products include consumer (residential)[3] clothes washers ("RCWs"), the subject of this direct final rule. (42 U.S.C. 6292(a)(7))

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

In light of the above and under the authority provided by 42 U.S.C. 6295(p)(4), DOE is issuing this direct final rule amending energy conservation standards for RCWs.

The adopted standard levels in this direct final rule were proposed in a letter submitted to DOE jointly by groups representing manufacturers, energy and

[1] All references to EPCA in this document refer to the statute as amended through the Energy Act of 2020, Public Law 116-260 (Dec. 27, 2020), which reflect the last statutory amendments that impact Parts A and A-1 of EPCA.
[2] For editorial reasons, upon codification in the U.S. Code, Part B was redesignated Part A.
[3] DOE uses the "residential" nomenclature and "RCW" abbreviation for consumer clothes washers in order to distinguish from the "CCW" abbreviation used for commercial clothes washers, which are also regulated equipment under EPCA.

environmental advocates, consumer groups, and a utility. This letter, titled "Energy Efficiency Agreement of 2023" (hereafter, the "Joint Agreement"[4]), recommends specific energy conservation standards for RCWs that, in the commenters' view, would satisfy the EPCA requirements in 42 U.S.C. 6295(o). DOE subsequently received letters of support for the Joint Agreement from States including New York, California, and Massachusetts[5] and utilities including San Diego Gas and Electric ("SDG&E") and Southern California Edison ("SCE")[6] advocating for the adoption of the recommended standards.

In accordance with the direct final rule provisions at 42 U.S.C. 6295(p)(4), DOE has determined that the recommendations contained in the Joint Agreement are compliant with 42 U.S.C. 6295(o). As required by 42 U.S.C. 6295(p)(4)(A)(i), DOE is also simultaneously publishing a notice of proposed rulemaking ("NOPR") that contains identical standards to those adopted in this direct final rule. Consistent with the statute, DOE is providing a 110-day public comment period on the direct final rule. (42 U.S.C. 6295(p)(4)(B)) If DOE determines that any comments received provide a reasonable basis for withdrawal of the direct final rule under 42 U.S.C. 6295(o) or any other applicable law, DOE will publish the reasons for withdrawal and continue the rulemaking under the NOPR. (42 U.S.C. 6295(p)(4)(C)) *See* section II.A of this document for more details on DOE's statutory authority.

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[4] This document is available in the docket at: www.regulations.gov/comment/EERE-2017-BT-STD-0014-0505.
[5] This document is available in the docket at: www.regulations.gov/comment/EERE-2017-BT-STD-0014-0506.
[6] This document is available in the docket at: www.regulations.gov/comment/EERE-2017-BT-STD-0014-0507.

The amended standards that DOE is adopting in this direct final rule are the efficiency levels recommended in the Joint Agreement (shown in Table I.1). The standards are expressed in terms of energy efficiency ratio ("EER"), measured in pounds per kilowatt-hour per cycle ("lb/kWh/cycle"), and water efficiency ratio ("WER"), measured in pounds per gallon per cycle ("lb/gal/cycle"), as determined in accordance with DOE's clothes washer test procedure codified at title 10 of the Code of Federal Regulations ("CFR") part 430, subpart B, appendix J ("appendix J"). The EER metric includes active mode, inactive mode, and off mode energy use. The amended standards recommended in the Joint Agreement are represented as trial standard level ("TSL") 2 in this document and described in section V.A of this document. The Joint Agreement's standards for RCWs apply to all products listed in Table I.1 manufactured in, or imported into, the United States starting on March 1, 2028.

Table I.1 Energy Conservation Standards for Residential Clothes Washers (Compliance Starting March 1, 2028)

Product Class	Minimum Energy Efficiency Ratio *(lb/kWh/cycle)*	Minimum Water Efficiency Ratio *(lb/gal/cycle)*
Automatic Clothes Washers		
Top-Loading Ultra-Compact (less than 1.6 ft^3 capacity)	3.79	0.29
Top-Loading Standard-Size (1.6 ft^3 or greater capacity) with an average cycle time of 30 minutes or greater	4.27	0.57
Front-Loading Compact (less than 3.0 ft^3 capacity)*	5.02	0.71
Front-Loading Standard-Size (3.0 ft^3 or greater capacity) with an average cycle time of 45 minutes or greater	5.52	0.77
Semi-Automatic Clothes Washers	2.12	0.27

* The standards in this table do not apply to front-loading clothes washers with a capacity greater than or equal to 1.6 ft^3 and less than 3.0 ft^3 with an average cycle time of less than 45 minutes.

A. Benefits and Costs to Consumers

Table I.2 summarizes DOE's evaluation of the economic impacts of the adopted standards on consumers of RCWs, as measured by the average life-cycle cost ("LCC") savings and the simple payback period ("PBP").[7] The average LCC savings are positive for all product classes, and the PBP is less than the average lifetime of RCWs, which is estimated to be 13.4 years (*see* section IV.F.6 of this document).

Table I.2 Impacts of Adopted Energy Conservation Standards on Consumers of Residential Clothes Washers

Product Class	Average LCC Savings 2022$	Simple Payback Period years
Automatic Clothes Washers		
Top-Loading Ultra-Compact (less than 1.6 ft^3 capacity) *	n.a.	n.a.
Top-Loading Standard-Size (1.6 ft^3 or greater capacity)	$111	6.2
Front-Loading Compact (less than 3.0 ft^3 capacity)	$9	9.3
Front-Loading Standard-Size (3.0 ft^3 or greater capacity)	$46	1.4
Semi-Automatic Clothes Washers	$284	0.5

*The entry "n.a." means not applicable because the adopted standard is at the baseline level.

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

B. Impact on Manufacturers[8]

The industry net present value ("INPV") is the sum of the discounted cash flows to the industry from the base year (2024) through the end of the analysis period, which is 30 years from the analyzed compliance date.[9] Using a real discount rate of 9.3 percent, DOE estimates that the INPV for manufacturers of RCWs in the case without amended

[7] The average LCC savings refer to consumers that are affected by a standard and are measured relative to the efficiency distribution in the no-new-standards case, which depicts the market in the compliance year in the absence of new or amended standards (*see* section IV.F.8 of this document). The simple PBP, which is designed to compare specific efficiency levels, is measured relative to the baseline product (*see* section IV.F.9 of this document).
[8] All monetary values in this document are expressed in 2022 dollars and, where appropriate, are discounted to 2024 unless explicitly stated otherwise.
[9] DOE's analysis period extends 30-years from the compliance year. The analysis period ranges from 2024–2056 for the no-new-standards case and all TSLs, except for TSL 2 (the Recommended TSL). The analysis period for the Recommended TSL ranges from 2024–2057 due to the 2028 compliance year.

standards is $1,707.9 million.[10] Under the adopted standards, which align with the efficiency levels recommended in the Joint Agreement (represented by TSL 2, hereafter, the "Recommended TSL") for RCWs, DOE estimates the change in INPV to range from –16.3 percent to –8.6 percent, which is –$278.3 million to –$146.9 million. In order to bring products into compliance with amended standards, it is estimated that industry will incur total conversion costs of $320.0 million.

DOE's analysis of the impacts of the adopted standards on manufacturers is described in sections IV.J and V.B.2 of this document.

C. National Benefits and Costs[11]

DOE's analyses indicate that the adopted energy conservation standards for RCWs would save a significant amount of energy and water. Relative to the case without amended standards, the lifetime energy and water savings for RCWs purchased in the 30-year period that begins in the anticipated year of compliance with the amended standards (2028–2057), amount to 0.67 quadrillion British thermal units ("Btu"), or quads of energy and 1.89 trillion gallons of water, respectively.[12] This represents a savings of 3.1

[10] The no-new-standards case INPV of $1,707.9 million reflects the sum of discounted free cash flows from 2024–2056 (from the reference year to 30 years after the 2027 compliance date) plus a discounted terminal value.
[11] All monetary values in this document are expressed in 2022 dollars and, where appropriate, are discounted to 2024 unless explicitly stated otherwise.
[12] The quantity refers to full-fuel-cycle ("FFC") energy savings. FFC energy savings includes the energy consumed in extracting, processing, and transporting primary fuels (*i.e.*, coal, natural gas, petroleum fuels), and, thus, presents a more complete picture of the impacts of energy efficiency standards. For more information on the FFC metric, *see* section IV.H.2 of this document.

percent relative to the energy use of these products in the case without amended standards (referred to as the "no-new-standards case").

The cumulative net present value ("NPV") of total consumer benefits of the standards for RCWs ranges from $3.28 billion (at a 7-percent discount rate) to $8.71 billion (at a 3-percent discount rate). This NPV expresses the estimated total value of future operating-cost savings minus the estimated increased product costs and installation costs for RCWs purchased during the period 2028–2057.

In addition, the adopted standards for RCWs are projected to yield significant environmental benefits. DOE estimates that the standards will result in cumulative emission reductions (over the same period as for energy savings) of 13.96 million metric tons ("Mt")[13] of carbon dioxide ("CO_2"), 3.65 thousand tons of sulfur dioxide ("SO_2"), 27.74 thousand tons of nitrogen oxides ("NO_X"), 124.57 thousand tons of methane ("CH_4"), 0.12 thousand tons of nitrous oxide ("N_2O"), and 0.02 tons of mercury ("Hg").[14] The estimated cumulative reduction in CO_2 emissions through 2030 amounts to 0.46 Mt, which is equivalent to the emissions resulting from the annual electricity use of more than 89 thousand homes.

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

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

DOE estimates the value of climate benefits from a reduction in greenhouse gases ("GHG") using four different estimates of the social cost of CO_2 ("SC-CO_2"), the social cost of methane ("SC-CH_4"), and the social cost of nitrous oxide ("SC-N_2O"). Together these represent the social cost of GHG ("SC-GHG"). DOE used interim SC-GHG values (in terms of benefit per ton of GHG avoided) developed by an Interagency Working Group on the Social Cost of Greenhouse Gases ("IWG").[15] The derivation of these values is discussed in section IV.L of this document. For presentational purposes, the climate benefits associated with the average SC-GHG at a 3-percent discount rate are estimated to be $0.84 billion. DOE does not have a single central SC-GHG point estimate and it emphasizes the importance and value of considering the benefits calculated using all four sets of SC-GHG estimates.

DOE estimated the monetary health benefits of SO_2 and NO_X emissions reductions, using benefit per ton estimates from the Environmental Protection Agency,[16] as discussed in section IV.L of this document. DOE estimated the present value of the health benefits would be $0.73 billion using a 7-percent discount rate, and $1.62 billion using a 3-percent discount rate.[17] DOE is currently only monetizing health benefits from changes in ambient fine particulate matter ("$PM_{2.5}$") concentrations from two precursors

[15] To monetize the benefits of reducing GHG emissions this analysis uses the interim estimates presented in the *Technical Support Document: Social Cost of Carbon, Methane, and Nitrous Oxide Interim Estimates Under Executive Order 13990* published in February 2021 by the IWG. ("February 2021 SC-GHG TSD"). Available at *www.whitehouse.gov/wp-content/uploads/2021/02/TechnicalSupportDocument_SocialCostofCarbonMethaneNitrousOxide.pdf.*
[16] U.S. EPA. Estimating the Benefit per Ton of Reducing Directly Emitted PM2.5, PM2.5 Precursors and Ozone Precursors from 21 Sectors. Available at *www.epa.gov/benmap/estimating-benefit-ton-reducing-pm25-precursors-21-sectors.*
[17] DOE estimates the economic value of these emissions reductions resulting from the considered TSLs for the purpose of complying with the requirements of Executive Order 12866.

(SO_2 and NO_X), and from changes in ambient ozone from one precursor (for NO_X), but will continue to assess the ability to monetize other effects such as health benefits from reductions in direct $PM_{2.5}$ emissions.

Table I.3 summarizes the monetized benefits and costs expected to result from the amended standards for RCWs. There are other important unquantified effects, including certain unquantified climate benefits, unquantified public health benefits from the reduction of toxic air pollutants and other emissions, unquantified energy security benefits, and distributional effects, among others.

Table I.3 Summary of Monetized Benefits and Costs of Adopted Energy Conservation Standards for Residential Clothes Washers

	Billion $2022
3% discount rate	
Consumer Operating Cost Savings	17.92
Climate Benefits*	0.84
Health Benefits**	1.62
Total Benefits†	20.38
Consumer Incremental Product Costs‡	9.20
Net Monetized Benefits	8.71
Change in Producer Cash Flow (INPV‡‡)	(0.28) - (0.15)
7% discount rate	
Consumer Operating Cost Savings	8.65
Climate Benefits* (3% discount rate)	0.84
Health Benefits**	0.73
Total Benefits†	10.22
Consumer Incremental Product Costs‡	5.37
Net Monetized Benefits	3.28
Change in Producer Cash Flow (INPV‡‡)	(0.28) - (0.15)

Note: This table presents the costs and benefits associated with RCWs shipped in 2028−2057. These results include consumer, climate, and health benefits that accrue after 2057 from the products shipped in 2028−2057.
* Climate benefits are calculated using four different estimates of the global SC-GHG (*see* section IV.L of this document). For presentational purposes of this table, the climate benefits associated with the average SC-GHG at a 3 percent discount rate are shown; however, DOE emphasizes the importance and value of considering the benefits

calculated using all four sets of SC-GHG estimates. To monetize the benefits of reducing GHG emissions this analysis uses the interim estimates presented in the *Technical Support Document: Social Cost of Carbon, Methane, and Nitrous Oxide Interim Estimates Under Executive Order 13990* published in February 2021 by the IWG.
** Health benefits are calculated using benefit-per-ton values for NO_X and SO_2. DOE is currently only monetizing (for SO_2 and NO_X) $PM_{2.5}$ precursor health benefits and (for NO_X) ozone precursor health benefits, but will continue to assess the ability to monetize other effects, such as health benefits from reductions in direct $PM_{2.5}$ emissions. *See* section IV.L of this document for more details.
† Total and net benefits include those consumer, climate, and health benefits that can be quantified and monetized. For presentation purposes, total and net benefits for both the 3-percent and 7-percent cases are presented using the average SC-GHG with 3-percent discount rate, but DOE does not have a single central SC-GHG point estimate. DOE emphasizes the importance and value of considering the benefits calculated using all four sets of SC-GHG estimates.
‡ Costs include incremental equipment costs as well as installation costs.
‡‡ Operating Cost Savings are calculated based on the life cycle costs analysis and national impact analysis as discussed in detail below. *See* sections IV.F and IV.H of this document. DOE's national impacts analysis includes all impacts (both costs and benefits) along the distribution chain beginning with the increased costs to the manufacturer to manufacture the product and ending with the increase in price experienced by the consumer. DOE also separately conducts a detailed analysis on the impacts on manufacturers (*i.e.*, manufacturer impact analysis, or "MIA"). *See* section IV.J of this document. In the detailed MIA, DOE models manufacturers' pricing decisions based on assumptions regarding investments, conversion costs, cash flow, and margins. The MIA produces a range of impacts, which is the rule's expected impact on the INPV. The change in INPV is the present value of all changes in industry cash flow, including changes in production costs, capital expenditures, and manufacturer profit margins. Change in INPV is calculated using the industry weighted average cost of capital value of 9.3 percent that is estimated in the MIA (*see* chapter 12 of the direct final rule technical support document ("TSD") for a complete description of the industry weighted average cost of capital). For RCWs, the change in INPV ranges from -$279 million to -$147 million. DOE accounts for that range of likely impacts in analyzing whether a TSL is economically justified. *See* section V.C of this document. DOE is presenting the range of impacts to the INPV under two manufacturer markup scenarios: the Preservation of Gross Margin scenario, which is the manufacturer markup scenario used in the calculation of Consumer Operating Cost Savings in this table, and the Preservation of Operating Profit scenario, where DOE assumed manufacturers would not be able to increase per-unit operating profit in proportion to increases in manufacturer production costs. DOE includes the range of estimated change in INPV in the previous table, drawing on the MIA explained further in section IV.J of this document to provide additional context for assessing the estimated impacts of this direct final rule to society, including potential changes in production and consumption, which is consistent with Office of Management and Budget ("OMB") Circular A-4 and Executive Order ("E.O.") 12866. If DOE were to include the change in INPV into the net benefit calculation for this direct final rule, the net benefits would range from $8.43 billion to $8.56 billion at 3-percent discount rate and would range from $3.00 billion to $3.13 billion at 7-percent discount rate. Parentheses () indicate negative values.

The benefits and costs of the adopted standards can also be expressed in terms of annualized values. The monetary values for the total annualized net benefits are (1) the reduced consumer operating costs, minus (2) the increase in product purchase prices and installation costs, plus (3) the value of climate and health benefits of emission reductions, all annualized.[18]

[18] To convert the time-series of costs and benefits into annualized values, DOE calculated a present value in 2024, the year used for discounting the NPV of total consumer costs and savings. For the benefits, DOE calculated a present value associated with each year's shipments in the year in which the shipments occur (*e.g.*, 2020 or 2030), and then discounted the present value from each year to 2024. Using the present value,

The national operating cost savings are domestic private U.S. consumer monetary savings that occur as a result of purchasing the covered products and are measured for the lifetime of RCWs shipped in 2028–2057. The benefits associated with reduced emissions achieved as a result of the adopted standards are also calculated based on the lifetime of RCWs shipped in 2028–2057. Total benefits for both the 3-percent and 7-percent cases are presented using the average GHG social costs with 3-percent discount rate. Estimates of total benefits values are presented for all four SC-GHG discount rates in section V.B.6 of this document.

Table I.4 presents the total estimated monetized benefits and costs associated with the adopted standard, expressed in terms of annualized values. The results under the primary estimate are as follows.

Using a 7-percent discount rate for consumer benefits and costs and health benefits from reduced NOX and SO2 emissions, and the 3-percent discount rate case for climate benefits from reduced GHG emissions, the estimated cost of the standards adopted in this rule is \$530.1 million per year in increased equipment costs, while the estimated annual benefits are \$853.9 million in reduced equipment operating costs, \$46.9 million in climate benefits, and \$71.9 million in health benefits. In this case, the net benefit would amount to \$442.5 million per year.

DOE then calculated the fixed annual payment over a 30-year period, starting in the compliance year, that yields the same present value.

Using a 3-percent discount rate for all benefits and costs, the estimated cost of the standards is $513.1 million per year in increased equipment costs, while the estimated annual benefits are $998.9 million in reduced operating costs, $46.9 million in climate benefits, and $90.3 million in health benefits. In this case, the net benefit would amount to $623.0 million per year.

Table I.4 Annualized Benefits and Costs of Adopted Standards for Residential Clothes Washers (2028−2057)

	Million 2022$/year		
	Primary Estimate	**Low-Net-Benefits Estimate**	**High-Net-Benefits Estimate**
3% discount rate			
Consumer Operating Cost Savings	998.9	957.2	1,020.9
Climate Benefits*	46.9	45.2	47.5
Health Benefits**	90.3	87.1	91.6
Total Benefits†	1,136.1	1,089.5	1,160.0
Consumer Incremental Product Costs‡	513.1	551.8	468.6
Net Benefits	623.0	537.7	691.4
Change in Producer Cash Flow (INPV‡‡)	(27) - (14)	(27) - (14)	(27) - (14)
7% discount rate			
Consumer Operating Cost Savings	853.9	821.2	871.7
Climate Benefits* (3% discount rate)	46.9	45.2	47.5
Health Benefits**	71.9	69.6	72.8
Total Benefits†	972.6	935.9	992.0
Consumer Incremental Product Costs‡	530.1	564.6	489.5
Net Benefits	442.5	371.3	502.5
Change in Producer Cash Flow (INPV‡‡)	(27) - (14)	(27) - (14)	(27) - (14)

Note: This table presents the costs and benefits associated with RCWs shipped in 2028−2057. These results include consumer, climate, and health benefits that accrue after 2057 from the products shipped in 2028−2057. The Primary, Low Net Benefits, and High Net Benefits Estimates utilize projections of energy prices from the *AEO2023* Reference case, Low Economic Growth case, and High Economic Growth case, respectively. In addition, incremental equipment costs reflect a medium decline rate in the Primary Estimate, a low decline rate in the Low Net Benefits Estimate, and a high decline rate in the High Net Benefits Estimate. The methods used to derive projected price trends are explained in sections IV.F.1 and IV.H.3 of this document. Note that the Benefits and Costs may not sum to the Net Benefits due to rounding.

* Climate benefits are calculated using four different estimates of the global SC-GHG (*see* section IV.L of this document). For presentational purposes of this table, the climate benefits associated with the average SC-GHG at a 3 percent discount rate are shown, but DOE does not have a single central SC-GHG point estimate, and it emphasizes the importance and value of considering the benefits calculated using all four sets of SC-GHG estimates. To monetize the benefits of reducing GHG emissions, this analysis uses the interim estimates presented in the *Technical Support*

Document: Social Cost of Carbon, Methane, and Nitrous Oxide Interim Estimates Under Executive Order 13990 published in February 2021 by the IWG.
** Health benefits are calculated using benefit-per-ton values for NO_X and SO_2. DOE is currently only monetizing (for SO_2 and NO_X) $PM_{2.5}$ precursor health benefits and (for NO_X) ozone precursor health benefits, but will continue to assess the ability to monetize other effects such as health benefits from reductions in direct $PM_{2.5}$ emissions. *See* section IV.L of this document for more details.
† Total benefits for both the 3-percent and 7-percent cases are presented using the average SC-GHG with 3-percent discount rate, but DOE does not have a single central SC-GHG point estimate.
‡ Costs include incremental equipment costs as well as installation costs.
‡‡ Operating Cost Savings are calculated based on the life cycle costs analysis and national impact analysis as discussed in detail below. *See* sections IV.F and IV.H of this document. DOE's national impacts analysis includes all impacts (both costs and benefits) along the distribution chain beginning with the increased costs to the manufacturer to manufacture the product and ending with the increase in price experienced by the consumer. DOE also separately conducts a detailed analysis on the impacts on manufacturers (MIA). *See* section IV.J of this document. In the detailed MIA, DOE models manufacturers' pricing decisions based on assumptions regarding investments, conversion costs, cash flow, and margins. The MIA produces a range of impacts, which is the rule's expected impact on the INPV. The change in INPV is the present value of all changes in industry cash flow, including changes in production costs, capital expenditures, and manufacturer profit margins. The annualized change in INPV is calculated using the industry weighted average cost of capital value of 9.3 percent that is estimated in the MIA (*see* chapter 12 of the direct final rule TSD for a complete description of the industry weighted average cost of capital). For RCWs, the annualized change in INPV ranges from -$27 million to -$14 million. DOE accounts for that range of likely impacts in analyzing whether a TSL is economically justified. *See* section V.C of this document. DOE is presenting the range of impacts to the INPV under two manufacturer markup scenarios: the Preservation of Gross Margin scenario, which is the manufacturer markup scenario used in the calculation of Consumer Operating Cost Savings in this table, and the Preservation of Operating Profit scenario, where DOE assumed manufacturers would not be able to increase per-unit operating profit in proportion to increases in manufacturer production costs. DOE includes the range of estimated annualized change in INPV in the above table, drawing on the MIA explained further in section IV.J of this document to provide additional context for assessing the estimated impacts of this direct final rule to society, including potential changes in production and consumption, which is consistent with OMB's Circular A-4 and E.O. 12866. If DOE were to include the annualized change in INPV into the annualized net benefit calculation for this direct final rule, the annualized net benefits, using the primary estimate, would range from $596 million to $609 million at 3-percent discount rate and would range from $415 million to $428 million at 7-percent discount rate. Parentheses () indicate negative values.

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

D. Conclusion

DOE has determined that the Joint Agreement was submitted jointly by interested persons that are fairly representative of relevant points of view, in accordance with 42 U.S.C. 6295(p)(4)(A). After considering the recommended standards and weighing the benefits and burdens, DOE has determined that the recommended standards are in accordance with 42 U.S.C. 6295(o), which contains the criteria for prescribing new or amended standards. Specifically, the Secretary of Energy ("Secretary") has determined that the adoption of the recommended standards would result in the significant conservation of energy and water and is the maximum improvement in energy efficiency that is technologically feasible and economically justified. In determining whether the recommended standards are economically justified, the Secretary has determined that the benefits of the recommended standards exceed the burdens. The Secretary has further concluded that the recommended standards, when considering the benefits of energy and water savings, positive NPV of consumer benefits, emission reductions, the estimated monetary value of the emissions reductions, and positive average LCC savings, would yield benefits that outweigh the negative impacts on some consumers and on manufacturers, including the conversion costs that could result in a reduction in INPV for manufacturers.

Using a 7-percent discount rate for consumer benefits and costs and NO_X and SO_2 reduction benefits, and a 3-percent discount rate case for GHG social costs, the estimated cost of the standards for RCWs is $495.4 million per year in increased product costs, while the estimated annual benefits are $798.0 million in reduced product operating costs, $45.5 million in climate benefits, and $67.2 million in health benefits. The net benefit amounts to $415.2 million per year. DOE notes that the net benefits are substantial even in the absence of the climate benefits,[19] and DOE would adopt the same standards in the absence of such benefits.

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

The significance of energy savings offered by a new or amended energy conservation standard cannot be determined without knowledge of the specific circumstances surrounding a given rulemaking.[20] For example, some covered products and equipment have most of their energy consumption occur during periods of peak energy demand. The impacts of these products on the energy infrastructure can be more pronounced than products with relatively constant demand. Accordingly, DOE evaluates the significance of energy savings on a case-by-case basis.

As previously mentioned, the standards are projected to result in estimated national energy savings of 0.67 quads FFC, the equivalent of the primary annual energy use of 4.5 million homes. In addition, they are projected to reduce cumulative CO_2 emissions by 13.96 Mt. Based on these findings, DOE has determined the energy savings from the standard levels adopted in this direct final rule are "significant" within the meaning of 42 U.S.C. 6295(o)(3)(B). A more detailed discussion of the basis for these conclusions is contained in the remainder of this document and the accompanying TSD.[21]

Under the authority provided by 42 U.S.C. 6295(p)(4), DOE is issuing this direct final rule amending the energy conservation standards for RCWs. Consistent with this authority, DOE is also simultaneously publishing elsewhere in this *Federal Register* a

[20] Procedures, Interpretations, and Policies for Consideration in New or Revised Energy Conservation Standards and Test Procedures for Consumer Products and Commercial/Industrial Equipment, 86 FR 70892, 70901 (Dec. 13, 2021).
[21] The TSD is available in the docket for this rulemaking at *www.regulations.gov/docket/EERE-2017-BT-STD-0014.*

NOPR proposing standards that are identical to those contained in this direct final rule. *See* 42 U.S.C. 6295(p)(4)(A)(i).

II. Introduction

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

A. Authority

EPCA authorizes DOE to regulate the energy efficiency of a number of consumer products and certain industrial equipment. Title III, Part B of EPCA established the Energy Conservation Program for Consumer Products Other Than Automobiles. These products include RCWs, the subject of this document. (42 U.S.C. 6292(a)(7)) EPCA prescribed energy conservation standards for these products (42 U.S.C. 6295(g)(2) and (g)(9)(A)), and directed DOE to conduct future rulemakings to determine whether to amend these standards. (42 U.S.C. 6295(g)(4) and (g)(9)(B)) EPCA further provides that, not later than 6 years after the issuance of any final rule establishing or amending a standard, DOE must publish either a notice of determination that standards for the product do not need to be amended, or a NOPR including new proposed energy conservation standards (proceeding to a final rule, as appropriate). (42 U.S.C. 6295(m)(1))

In establishing energy conservation standards with both energy and water use performance standards for RCWs manufactured after January 1, 2011, Congress also directed DOE to "determin[e] whether to amend" those standards. (42 U.S.C. 6295(g)(9)(B)) Congress's directive, in section 6295(g)(9)(B), to consider whether "to amend the standards in effect for RCWs" refers to "the standards" established in the immediately preceding paragraph, 6295(g)(9)(A). There, Congress established energy conservation standards with *both* energy and water use performance standards for RCWs. Indeed, the energy and water use performance standards for RCWs (both top-loading and front-loading) are each contained within a single subparagraph. *See id*. Everything in section 6295(g)(9) suggests that Congress intended both of those twin standards to be evaluated when it came time, "[n]ot later than December 13, 2011," to consider amending them. (*Id.* 6295(g)(9)(B)(i)) Accordingly, DOE understands its authority, under 6295(g)(9)(B), to include consideration of amended energy and water use performance standards for RCWs.

DOE similarly understands its authority under 42 U.S.C. 6295(m) to amend "standards" for covered products to include amending both the energy and water use performance standards for RCWs. Neither section 6295(g)(9)(B) nor section 6295(m) limit their application to "energy use standards." Rather, they direct DOE to consider amending "the standards," 42 U.S.C. 6295(g)(9)(B), or simply "standards," *id.* 6295(m)(1)(B), which may include both energy use standards and water use standards.

Finally, DOE is promulgating these standards as a direct final rule pursuant to section 42 U.S.C. 6295(p)(4). That section also extends broadly to any "energy or water conservation standard” without qualification. Thus, pursuant to section 6295(p)(4), DOE may, so long as the other relevant conditions are satisfied, promulgate a direct final rule that includes water use performance standards for a covered product like RCWs, where Congress has already established energy and water use performance standards.

DOE is aware that the definition of “energy conservation standard,” in section 6291(6), expressly references water use only for four products specifically named: showerheads, faucets, water closets, and urinals. *See id.* However, DOE does not read the language in 6291(6) as fully delineating the scope of DOE’s authority under EPCA. Rather, as is required of agencies in applying a statute, individual provisions, including section 6291(6) of EPCA, must be read in the context of the statute as a whole.

The energy conservation program was initially limited to addressing the energy use, meaning electricity and fossil fuels, of 13 covered products. (*See* sections 321 and 322 of the Energy and Policy Conservation Act, Pub. L. 94–163, 89 Stat 871 (December 22, 1975)). Since its inception, Congress has expanded the scope of the energy conservation program several times, including by adding covered products, prescribing energy conservation standards for various products, and by addressing water use for certain covered products. For example, in the Energy Policy Act of 1992, Congress amended the list of covered products in 42 U.S.C. 6292 to include showerheads, faucets, water closets and urinals and expanded DOE’s authority to regulate water use for these products. (*See* Sec. 123, Energy Policy Act of 1992, Pub. L. 102–486, 106 Stat 2776 (Oct. 24, 1992)). When it did so, Congress also made corresponding changes to the definition of “consumer product” (42 U.S.C. 6291(1)), the definition of “energy conservation standard" (42 U.S.C. 6291(6)), the section governing the promulgation of test procedures (42 U.S.C. 6293), the criteria for prescribing new or amended energy conservation standards (42 U.S.C. 6295(o)), and elsewhere in EPCA.

Later, Congress further expanded the scope of the energy conservation program several times. For instance, Congress added products and standards directly to 42 U.S.C. 6295, the section of EPCA that contains statutorily prescribed standards as well as DOE's standard-setting authorities. *See* 42 U.S.C. 6295(a) (stating that the "purposes of this section are to— (1) provide Federal energy conservation standards applicable to covered products; and (2) authorize the Secretary to prescribe amended or new energy conservation standards for each type (or class) of covered product.")). When Congress added these new standards and standard-setting authorities to 42 U.S.C. 6295 after the Energy Policy Act of 1992, it often did so without making any conforming changes to other provisions in EPCA, *e.g.*, sections 6291 or 6292. For example, in the Energy Policy Act of 2005, Congress prescribed standards by statute, or gave DOE the authority to set standards for, battery chargers, external power supplies, ceiling fans, ceiling fan light kits, beverage vending machines, illuminated exit signs, torchieres, low voltage dry-type distribution transformers, traffic signal modules and pedestrian modules, certain lamps, dehumidifiers, and commercial prerinse spray valves in 42 U.S.C. 6295 without updating the list of covered products in 42 U.S.C. 6292. (*See* Sec. 135, Energy Policy Act of 2005, 119 Stat 594 (Aug. 8, 2005)).

Congress also expanded the scope of the energy conservation program by directly adding water use performance standards for certain products to 42 U.S.C. 6295. For example, in the Energy Policy Act of 2005, Congress added a water use performance standard (but no energy use performance standard) for commercial prerinse spray valves ("CPSVs") and did so without updating the list of covered products in 42 U.S.C. 6292 to include CPSVs and without adding CPSVs to the list of enumerated products with water use performance standards in the "energy conservation standard" definition in 42 U.S.C. 6291(6). In the Energy Independence and Security Act of 2007 ("EISA 2007"), Congress amended 42 U.S.C. 6295 by prescribing standards for RCWs and dishwashers that included both energy and water use performance standards. (*See* Sec. 301, EISA 2007, Public Law 110–140, 121 Stat 1492 (Dec. 19, 2007)). Again, when it did so, Congress did not add these products to the list of enumerated products with water use performance standards in the definition of "energy conservation standard" in 42 U.S.C. 6291(6).

In considering how to treat these products and standards that Congress has directly added to 42 U.S.C. 6295 without making conforming changes to the rest of the statute, including the list of covered products in 42 U.S.C. 6292, and the water-use products in the definition of an "energy conservation standard," DOE construes the statute as a whole. When Congress added products and standards directly to 42 U.S.C. 6295 it must have meant those products to be covered products and those standards to be energy conservation standards, given that the purpose of 42 U.S.C. 6295 is to provide "energy conservation standards applicable to covered products" and to "authorize the Secretary to prescribe amended or new energy conservation standards for each type (or class) of covered product." Elsewhere in EPCA, the statute's references to covered products and energy conservation standards can only be read coherently as including the covered products and energy conservation standards Congress added directly to section

6295, even if Congress did not make conforming edits to 6291 or 6292. For example, manufacturers are prohibited from "distribut[ing] in commerce any new *covered product* which is not in conformity with an applicable *energy conservation standard*." (42 U.S.C. 6302(a)(5) (emphasis added)) It would defeat congressional intent to allow a manufacturer to distribute a product, *e.g.*, a CPSV or ceiling fan, that violates an applicable energy conservation standard that Congress prescribed simply because Congress added the product directly to 42 U.S.C. 6295 without also updating the list of covered products in 42 U.S.C. 6292(a). In addition, preemption in EPCA is based on "the effective date of an *energy conservation standard* established in or prescribed under section 6295 of this title for any *covered product*." (42 U.S.C. 6297(c)(emphasis added)) Nothing in EPCA suggests that standards Congress adopted in 6295 lack preemptive effect, merely because Congress did make conforming amendments to 6291, 6292, or 6293.

It would similarly defeat congressional intent for a manufacturer to be permitted to distribute a covered product, *e.g.*, a clothes washer or dishwasher, that violates a water use performance standard because Congress added the standard to 42 U.S.C. 6295 without also updating the definition of energy conservation standard in 42 U.S.C. 6291(6). By prescribing directly, in 6295(g)(9), energy conservation standards for RCWs that include both energy and water use performance standards, Congress intended that energy conservation standards for RCWs include both energy use and water use.

DOE recognizes that some might argue that Congress's specific reference in section 6291(6) to water standards for showerheads, faucets, water closets, and urinals could "create a negative implication" that energy conservations standards for other covered products may not include water use standards. *See Marx v. Gen. Revenue Corp.*, 568 U.S. 371, 381 (2013). "The force of any negative implication, however, depends on context." *Id.*; *see also NLRB v. SW Gen., Inc.*, 580 U.S. 288, 302 (2017) ("The *expressio unius* canon applies only when circumstances support a sensible inference that the term left out must have been meant to be excluded." (alterations and quotation marks omitted)). In this context, the textual and structural cues discussed above show that Congress did not intend to exclude from the definition of energy conservation standard the water use performance standards that it specifically prescribed, and directed DOE to amend, in section 6295. To conclude otherwise would negate the plain text of 6295(g)(9). Furthermore, to the extent the definition of energy conservation standards in section 6291(6), which was last amended in the Energy Policy Act of 1992, could be read as in conflict with the energy and water use performance standards prescribed by Congress in EISA 2007, any such conflict should be resolved in favor of the more recently enacted statute. *See United States v. Estate of Romani*, 523 U.S. 517, 530–31 (1998) ("[A] specific policy embodied in a later federal statute should control our construction of the priority statute, even though it had not been expressly amended."). Accordingly, based on a complete reading of the statute, DOE has determined that products and standards added directly to 42 U.S.C. 6295 are appropriately considered "covered products" and "energy conservation standards" for the purposes of applying the various provisions in EPCA.

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

Federal energy efficiency requirements for covered products established under EPCA generally supersede State laws and regulations concerning energy conservation testing, labeling, and standards. (42 U.S.C. 6297(a)–(c)) DOE may, however, grant waivers of Federal preemption in limited instances for particular State laws or regulations, in accordance with the procedures and other provisions set forth under EPCA. (See 42 U.S.C. 6297(d))

Subject to certain criteria and conditions, DOE is required to develop test procedures to measure the energy efficiency, energy use, or estimated annual operating cost of each covered product. (42 U.S.C. 6295(r)) Manufacturers of covered products must use the prescribed DOE test procedure as the basis for certifying to DOE that their products comply with the applicable energy conservation standards adopted under EPCA and when making representations to the public regarding the energy use or efficiency of those products. (42 U.S.C. 6293(c) and 6295(s)) Similarly, DOE must use these test procedures to determine whether the products comply with standards adopted pursuant to EPCA. (42 U.S.C. 6295(s)) The DOE test procedures for RCWs appear at 10 CFR part 430, subpart B, appendix J (“appendix J”) and appendix J2 (“appendix J2”).

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

Moreover, DOE may not prescribe a standard if DOE determines by rule that the standard is not technologically feasible or economically justified. (42 U.S.C. 6295(o)(3)(B)) In deciding whether a proposed standard is economically justified, DOE must determine whether the benefits of the standard exceed its burdens. (42 U.S.C. 6295(o)(2)(B)(i)) DOE must make this determination after receiving comments on the proposed standard, and by considering, to the greatest extent practicable, the following seven statutory factors:

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

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

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

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

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

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

(7) Other factors the Secretary considers relevant.

(42 U.S.C. 6295(o)(2)(B)(i)(I)–(VII))

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

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

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

Additionally, pursuant to the amendments contained in the EISA 2007, Public Law 110-140, final rules for new or amended energy conservation standards promulgated after July 1, 2010, are required to address standby mode and off mode energy use. (42 U.S.C. 6295(gg)(3)) Specifically, when DOE adopts a standard for a covered product after that date, it must, if justified by the criteria for adoption of standards under EPCA (42 U.S.C. 6295(o)), incorporate standby mode and off mode energy use into a single standard, or, if that is not feasible, adopt a separate standard for such energy use for that product. (42 U.S.C. 6295(gg)(3)(A)–(B)) DOE's current test procedures for RCWs address standby mode and off mode energy use, as do the amended standards adopted in this direct final rule.

Finally, EISA 2007 amended EPCA, in relevant part, to grant DOE authority to issue a final rule (*i.e.*, a "direct final rule") establishing an energy conservation standard upon receipt of a statement submitted jointly by interested persons that are fairly representative of relevant points of view (including representatives of manufacturers of covered products, States, and efficiency advocates), as determined by the Secretary, that contains recommendations with respect to an energy or water conservation standard. (42 U.S.C. 6295(p)(4)) Pursuant to 42 U.S.C. 6295(p)(4), the Secretary must also determine whether a jointly-submitted recommendation for an energy or water conservation standard satisfies 42 U.S.C. 6295(o) or 42 U.S.C. 6313(a)(6)(B), as applicable.

The direct final rule must be published simultaneously with a NOPR that proposes an energy or water conservation standard that is identical to the standard established in the direct final rule, and DOE must provide a public comment period of at least 110 days on this proposal. (42 U.S.C. 6295(p)(4)(A)–(B)) While DOE typically provides a comment period of 60 days on proposed standards, for a NOPR accompanying a direct final rule, DOE provides a comment period of the same length as the comment period on the direct final rule—*i.e.*, 110 days. Based on the comments received during this period, the direct final rule will either become effective, or DOE will withdraw it not later than 120 days after its issuance if: (1) one or more adverse comments is received, and (2) DOE determines that those comments, when viewed in light of the rulemaking record related to the direct final rule, may provide a reasonable basis for withdrawal of the direct final rule under 42 U.S.C. 6295(o). (42 U.S.C. 6295(p)(4)(C)) Receipt of an alternative joint recommendation may also trigger a DOE withdrawal of the direct final rule in the same manner. (*Id*.)

DOE has previously explained its interpretation of its direct final rule authority. In a final rule amending the Department's "Procedures, Interpretations and Policies for Consideration of New or Revised Energy Conservation Standards for Consumer Products" at 10 CFR part 430, subpart C, appendix A ("Process Rule" or "appendix A"), DOE noted that it may issue standards recommended by interested persons that are fairly representative of relative points of view as a direct final rule when the recommended standards are in accordance with 42 U.S.C. 6295(o) or 42 U.S.C. 6313(a)(6)(B), as applicable. 86 FR 70892, 70912 (Dec. 13, 2021). But the direct final rule provision in EPCA does not impose additional requirements applicable to other standards rulemakings, which is consistent with the unique circumstances of rules issued through consensus agreements under DOE's direct final rule authority. *Id.* DOE's discretion remains bounded by its statutory mandate to adopt a standard that results in the maximum improvement in energy efficiency that is technologically feasible and economically justified—a requirement found in 42 U.S.C. 6295(o). *Id*. As such, DOE's review and analysis of the Joint Agreement is limited to whether the recommended standards satisfy the criteria in 42 U.S.C. 6295(o).

B. Background

1. Current Standards

In a direct final rule published on May 31, 2012 ("May 2012 Direct Final Rule"), DOE prescribed the current energy conservation standards for RCWs manufactured on or after January 1, 2018. 77 FR 32308.[22] These standards are set forth in DOE's regulations at 10 CFR 430.32(g)(4). These standards are consistent with a prior joint proposal submitted to DOE by interested parties representing manufacturers, energy and environmental advocates, and consumer groups.[23] The current standards are defined in terms of a minimum allowable integrated modified energy factor ("IMEF"), measured in cubic feet per kilowatt-hour per cycle ("ft^3/kWh/cycle"), and maximum allowable integrated water factor ("IWF"), measured in gallons per cycle per cubic foot ("gal/cycle/ft^3"), as measured according to appendix J2.

Table II.1 Federal Energy Efficiency Standards for Residential Clothes Washers

Product Class	**Minimum Integrated Modified Energy Factor** *(ft^3/kWh/cycle)*	**Maximum Integrated Water Factor** *(gal/cycle/ft^3)*
Top-Loading, Compact (less than 1.6 ft^3 capacity)	1.15	12.0
Top-Loading, Standard (1.6 ft^3 or greater capacity)	1.57	6.5
Front-Loading, Compact (less than 1.6 ft^3 capacity)	1.13	8.3
Front-Loading, Standard (1.6 ft^3 or greater capacity)	1.84	4.7

[22] DOE published a confirmation of effective date and compliance date for the direct final rule on October 1, 2012. 77 FR 59719.
[23] Available at www.regulations.gov/document/EERE-2008-BT-STD-0019-0032.

For top-loading semi-automatic clothes washers, a design standard currently applies, which requires such products to have an unheated rinse water option. 10 CFR 430.32(g)(1).

2. Current Test Procedure

As discussed, DOE's current energy conservation standards for RCWs are expressed in terms of IMEF and IWF as measured using appendix J2. (*See* 10 CFR 430.32(g)(4).)

In a final rule published on June 1, 2022 ("June 2022 TP Final Rule") DOE finalized a new test procedure at appendix J, which defines new energy efficiency metrics: an energy efficiency ratio (*i.e.*, EER) and a water efficiency ratio (*i.e.*, WER). 87 FR 33316, 33319. EER is defined as the quotient of the weighted-average load size divided by the total clothes washer energy consumption per cycle, with such energy consumption expressed as the sum of (1) the machine electrical energy consumption, (2) the hot water energy consumption, (3) the energy required for removal of the remaining moisture in the wash load, and (4) the combined low-power mode energy consumption. 10 CFR part 430 subpart B, appendix J section 1. WER is defined as the quotient of the weighted-average load size divided by the total weighted per-cycle water consumption for all wash cycles in gallons. *Id.* For both EER and WER, a higher value indicates more efficient performance. The standards enacted by this direct final rule are expressed in terms of the EER and WER metrics as measured according to the newly established test procedure contained in appendix J.

3. The Joint Agreement

On September 25, 2023, DOE received a joint statement (*i.e.*, the Joint Agreement) recommending standards for RCWs, that was submitted by groups representing manufacturers, energy and environmental advocates, consumer groups, and a utility.[24] In addition to the recommended standards for RCWs, the Joint Agreement also included separate recommendations for several other covered products.[25] And, while acknowledging that DOE may implement these recommendations in separate rulemakings, the Joint Agreement also stated that the recommendations were recommended as a complete package and each recommendation is contingent upon the other parts being implemented. DOE understands this to mean that the Joint Agreement is contingent upon DOE initiating rulemaking processes to adopt all of the recommended standards in the agreement. That is distinguished from an agreement where issuance of an amended energy conservation standard for a covered product is contingent on issuance of amended energy conservation standards for the other covered products. If the Joint Agreement were so construed, it would conflict with the anti-backsliding provision in 42 U.S.C. 6295(o)(1), because it would imply the possibility that, if DOE were unable to

[24] The signatories to the Joint Agreement include AHAM, American Council for an Energy-Efficient Economy, Alliance for Water Efficiency, Appliance Standards Awareness Project, Consumer Federation of America, Consumer Reports, Earthjustice, National Consumer Law Center, Natural Resources Defense Council, Northwest Energy Efficiency Alliance, and Pacific Gas and Electric Company. Members of AHAM's Major Appliance Division that make the affected products include: Alliance Laundry Systems, LLC; Asko Appliances AB; Beko US Inc.; Brown Stove Works, Inc.; BSH Home Appliances Corporation; Danby Products, Ltd.; Electrolux Home Products, Inc.; Elicamex S.A. de C.V.; Faber; Fotile America; GE Appliances, a Haier Company; L'Atelier Paris Haute Design LLG; LG Electronics; Liebherr USA, Co.; Midea America Corp.; Miele, Inc.; Panasonic Appliances Refrigeration Systems (PAPRSA) Corporation of America; Perlick Corporation; Samsung Electronics America Inc.; Sharp Electronics Corporation; Smeg S.p.A; Sub-Zero Group, Inc.; The Middleby Corporation; U-Line Corporation; Viking Range, LLC; and Whirlpool Corporation.

[25] The Joint Agreement contained recommendations for 6 covered products: refrigerators, refrigerator-freezers, and freezers; residential clothes washers; consumer clothes dryers; dishwashers; consumer conventional cooking products; and miscellaneous refrigeration products.

issue an amended standard for a certain product, it would have to withdraw a previously issued standard for one of the other products. The anti-backsliding provision, however, prevents DOE from withdrawing or amending an energy conservation standard to be less stringent. As a result, DOE will be proceeding with individual rulemakings that will evaluate each of the recommended standards separately under the applicable statutory criteria.

A court decision issued after DOE received the Joint Agreement is also relevant to this rule. On March 17, 2022, various States filed a petition seeking review of a final rule revoking two final rules that established product classes for residential dishwashers with a cycle time for the normal cycle of 60 minutes or less, top-loading RCWs and certain classes of consumer clothes dryers with a cycle time of less than 30 minutes, and front-loading RCWs with a cycle time of less than 45 minutes (collectively, "short cycle product classes"). The petitioners argued that the final rule revoking the short cycle product classes violated EPCA and was arbitrary and capricious. On January 8, 2024, the United States Court of Appeals for the Fifth Circuit granted the petition for review and remanded the matter to DOE for further proceedings consistent with the Fifth Circuit's opinion. *See Louisiana v. United States Department of Energy*, 90 F.4th 461 (5th Cir. 2024).

On February 14, 2024, following the Fifth Circuit's decision in *Louisiana v. United States Department of Energy,* DOE received a second joint statement from this same group of stakeholders in which the signatories reaffirmed the Joint Agreement, stating that the recommended standards represent the maximum levels of efficiency that are technologically feasible and economically justified.[26] In the letter, the signatories clarified that "short-cycle" product classes for RCWs, consumer clothes dryers, and dishwashers did not exist at the time that the signatories submitted their recommendations and it is their understanding that these classes also do not exist at the current time. Accordingly, the parties clarified that the Joint Agreement did not address short-cycle product classes. The signatories also stated that they did not anticipate that the recommended energy conservation standards in the Joint Agreement will negatively affect features or performance, including cycle time, for RCWs.

The Joint Agreement recommends amended standard levels for RCWs as presented in Table II.2. (Joint Agreement, No. 505 at p. 9) Details of the Joint Agreement recommendations for other products are provided in the Joint Agreement posted in the docket.[27]

[26] This document is available in the docket at: www.regulations.gov/comment/EERE-2017-BT-STD-0014-0509.
[27] The Joint Agreement is available in the docket at www.regulations.gov/comment/EERE-2017-BT-STD-0014-0505.

Table II.2 Recommended Amended Energy Conservation Standards for Residential Clothes Washers

Product Class	Minimum Energy Efficiency Ratio *(lb/kWh/cycle)*	Minimum Water Efficiency Ratio *(lb/gal/cycle)*	Compliance Date
Top-Loading, Ultra-Compact (less than 1.6 ft^3 capacity)	3.79	0.29	March 1, 2028
Top-Loading, Standard-Size (1.6 ft^3 or greater capacity)	4.27	0.57	
Front-Loading, Compact (less than 1.6 ft^3 capacity)	5.02	0.71	
Front-Loading, Standard-Size (1.6 ft^3 or greater capacity)	5.52	0.77	
Semi-Automatic Clothes Washers	2.12	0.27	

When the Joint Agreement was submitted, DOE was conducting a rulemaking to consider amending the standards for RCWs. As part of that process, DOE published a NOPR and announced a public meeting on March 3, 2023, ("March 2023 NOPR") seeking comment on its proposed amended standards to inform its decision consistent with its obligations under EPCA and the Administrative Procedure Act ("APA"). 88 FR 13520. The March 2023 NOPR proposed amended standards defined in terms of the EER and WER metrics as measured according to appendix J. *Id*. at 88 FR 13522. The March 2023 NOPR also proposed to re-establish a product class, and establish new performance standards, for semi-automatic clothes washers. *Id*. at 88 FR 13541.[28] The March 2023 NOPR TSD is available at: *www.regulations.gov/document/EERE-2017-BT-STD-0014-0058*.

[28] Top-loading semi-automatic clothes washers were subject to a design standard requiring an unheated rinse water option, as established by section 5(g) of the National Appliance Energy Conservation Act of 1987, Public Law 100-12.

Although DOE is adopting the Joint Agreement as a direct final rule and no longer proceeding with its own rulemaking, DOE did consider relevant comments, data, and information obtained during that rulemaking process in determining whether the recommended standards from the Joint Agreement are in accordance with 42 U.S.C. 6295(o). Any discussion of comments, data, or information in this direct final rule that were obtained during DOE's prior rulemaking will include a parenthetical reference that provides the location of the item in the public record.[29]

III. General Discussion

DOE is issuing this direct final rule after determining that the recommended standards submitted in the Joint Agreement meet the requirements in 42 U.S.C. 6295(p)(4). More specifically, DOE has determined that the recommended standards were submitted by interested persons that are fairly representative of relevant points of view and the recommended standards satisfy the criteria in 42 U.S.C. 6295(o).

On March 17, 2022, various States filed a petition seeking review of a final rule revoking two final rules that established product classes for residential dishwashers with a cycle time for the normal cycle of 60 minutes or less, top-loading RCWs and certain classes of consumer clothes dryers with a cycle time of less than 30 minutes, and front-loading RCWs with a cycle time of less than 45 minutes (collectively, "short cycle

[29] The parenthetical reference provides a reference for information located in the docket of DOE's rulemaking to develop energy conservation standards for residential clothes washers. (Docket No. EERE-2017-BT-STD-0014, which is maintained at *www.regulations.gov*). The references are arranged as follows: (commenter name, comment docket ID number at page number of that document).

product classes"). The petitioners argued that the final rule revoking the short cycle product classes violated EPCA and was arbitrary and capricious. On January 8, 2024, the United States Court of Appeals for the Fifth Circuit granted the petition for review and remanded the matter to DOE for further proceedings consistent with the Fifth Circuit's opinion. *See Louisiana v. United States Department of Energy*, 90 F.4th 461 (5th Cir. 2024).

Following the Fifth Circuit's decision, the signatories to the Joint Agreement submitted a second letter to DOE, which stated that Joint Recommendation did not "address" "short-cycle product classes."[30] That is because, as the letter explained, such product classes "did not exist" at the time of the Joint Agreement.

In a recently issued request for information ("RFI"),[31] DOE is commencing a rulemaking process on remand from the Fifth Circuit (the "Remand Proceeding") by soliciting further information, relevant to the issues identified by the Fifth Circuit, regarding any short cycle product classes. In that Remand Proceeding, DOE will conduct the analysis required by 42 U.S.C. 6295(q)(1)(B) to determine whether any short-cycle products have a "capacity or other performance-related feature [that] . . . justifies a higher or lower standard from that which applies (or will apply) to other products. ....."

The current standards applicable to any products within the scope of that proceeding remain unchanged by this rule. *See* 10 CFR 430.32(g). Consistent with the

[30] This document is available in the docket at: www.regulations.gov/comment/EERE-2017-BT-STD-0014-0509.
[31] See www1.eere.energy.gov/buildings/appliance_standards/standards.aspx?productid=68.

Joint Parties' letter, short-cycle products are not subject to the amended standards adopted by this DFR. If the short-cycle products that DOE will consider in the Remand Proceeding were subject to these standards, that would have the practical effect of limiting the options available in the Remand Proceeding. That is because EPCA's anti-backsliding provision precludes DOE from prescribing any amended standard "which increases the maximum allowable energy use" of a covered product. 42 U.S.C. 6295(o)(1). Accordingly, were the products at issue in the Remand Proceeding also subject to the amended standards adopted here, the Department could only reaffirm the standards adopted in this direct final rule or adopt more stringent standards.

The Joint Agreement specifies the product classes for RCWs: semi-automatic; top-loading, ultra-compact; top-loading, standard-size; front-loading, compact; and front-loading, standard-size. Although these product classes were not further divided by cycle time, DOE understands them to exclude top-loading standard-size RCWs with an average cycle time of less than 30 minutes, and front-loading standard-size RCWs with an average cycle time of less than 45 minutes. As noted above, any such "short-cycle" RCWs will be considered in the Remand Proceeding; the current standards applicable to such "short-cycle" RCWs are unchanged by this rule.

Under the direct final rule authority at 42 U.S.C. 6295(p)(4), DOE evaluates whether recommended standards are in accordance with criteria contained in 42 U.S.C. 6295(o). DOE does not have the authority to revise recommended standards submitted under the direct final rule provision in EPCA. Therefore, DOE did not analyze any additional product classes beyond those product classes included in the Joint Agreement.

That is, DOE has not separately considered or established amended standards applicable to any short-cycle product classes. In the event that DOE establishes short-cycle product classes, pursuant to the rulemaking on remand from the Fifth Circuit, DOE will necessarily consider what amended standards ought to apply to any such product classes and will do so in conformance with EPCA.

DOE notes that the data and analysis used to support this direct final rule includes information for standard-size, top-loading and front-loading clothes washers that is not distinguished by cycle time and is representative of all clothes washers currently on the market today. To the extent that any short cycle products were included in this data and analysis, DOE believes the amount of such data is negligible.

A. Scope of Coverage

Before discussing how the Joint Agreement meets the requirements for issuing a direct final rule, it is important to clarify the scope of coverage for the recommended standards. EPCA does not define the term "clothes washer." (*See* 42 U.S.C. 6291) DOE has defined a "clothes washer" as a consumer product designed to clean clothes, utilizing a water solution of soap and/or detergent and mechanical agitation or other movement, and must be one of the following classes: automatic clothes washers, semi-automatic clothes washers, and other clothes washers. 10 CFR 430.2. This direct final rule covers those consumer products that meet the definition of "clothes washer," as codified at 10 CFR 430.2.

An "automatic clothes washer" is a class of clothes washer that has a control system which is capable of scheduling a preselected combination of operations, such as regulation of water temperature, regulation of the water fill level, and performance of wash, rinse, drain, and spin functions without the need for user intervention subsequent to the initiation of machine operation. Some models may require user intervention to initiate these different segments of the cycle after the machine has begun operation, but they do not require the user to intervene to regulate the water temperature by adjusting the external water faucet valves. *Id*.

A "semi-automatic clothes washer" is a class of clothes washer that is the same as an automatic clothes washer except that user intervention is required to regulate the water temperature by adjusting the external water faucet valves. *Id*. "Other clothes washer" means a class of clothes washer that is not an automatic or semi-automatic clothes washer. *Id*.

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

B. Fairly Representative of Relevant Points of View

Under the direct final rule provision in EPCA, recommended energy conservation standards must be submitted by interested persons that are fairly representative of relevant points of view (including representatives of manufacturers of covered products, States, and efficiency advocates) as determined by DOE. (42 U.S.C. 6295(p)(4)(A)) With respect to this requirement, DOE notes that the Joint Agreement included a trade association, the Association of Home Appliance Manufacturers ("AHAM"), which represents 12 manufacturers of RCWs.[32] The Joint Agreement also included environmental and energy-efficiency advocacy organizations, consumer advocacy organizations, and a gas and electric utility company. Additionally, DOE received a letter in support of the Joint Agreement from the States of New York, California, and Massachusetts (*See* comment No. 506). DOE also received a letter in support of the Joint Agreement from the gas and electric utility, SDG&E, and the electric utility, SCE (*See* comment No. 507). As a result, DOE has determined that the Joint Agreement was submitted by interested persons who are fairly representative of relevant points of view.

C. Technological Feasibility

1. General

In each energy conservation standards rulemaking, DOE conducts a screening analysis based on information gathered on all current technology options and prototype designs that could improve the efficiency of the products or equipment that are the subject of the rulemaking. As the first step in such an analysis, DOE develops a list of technology options for consideration in consultation with manufacturers, design engineers, and other interested parties. DOE then determines which of those means for improving efficiency are technologically feasible. DOE considers technologies

[32] These companies include: Alliance Laundry Systems, LLC; Asko Appliances AB; Beko US Inc.; BSH Home Appliances Corporation; Danby Products, Ltd.; Electrolux Home Products, Inc.; GE Appliances, a Haier Company; LG Electronics; Midea America Corp.; Miele, Inc.; Samsung Electronics America Inc.; and Whirlpool Corporation.

incorporated in commercially available products or in working prototypes to be technologically feasible. Sections 6(b)(3)(i) and 7(b)(1) of the Process Rule.

After DOE has determined that particular technology options are technologically feasible, it further evaluates each technology option in light of the following additional screening criteria: (1) practicability to manufacture, install, and service; (2) adverse impacts on product utility or availability; (3) adverse impacts on health or safety and (4) unique-pathway proprietary technologies. Section 7(b)(2)-(5) of the Process Rule. Section IV.B of this document discusses the results of the screening analysis for RCWs, particularly the designs DOE considered, those it screened out, and those that are the basis for the standards considered in this rulemaking. For further details on the screening analysis for this rulemaking, see chapter 4 of the direct final rule TSD.

2. Maximum Technologically Feasible Levels

When DOE proposes to adopt a new or amended standard for a type or class of covered product, it must determine the maximum improvement in energy efficiency or maximum reduction in energy use that is technologically feasible for such product. (42 U.S.C. 6295(o)(2)(A)) Accordingly, in the engineering analysis, DOE determined the maximum technologically feasible ("max-tech") improvements in energy efficiency for RCWs, using the design parameters for the most efficient products available on the market or in working prototypes. The max-tech levels that DOE determined for this rulemaking are described in section IV.C of this document and in chapter 5 of the direct final rule TSD.

D. Energy Savings

1. Determination of Savings

For each TSL, DOE projected energy savings from application of the TSL to RCWs purchased in the 30-year period that begins in the year of compliance with the amended standards (2027–2056 for all TSLs except the Recommended TSL, *i.e.*, TSL 2, and 2028–2057 for TSL 2).[33] The savings are measured over the entire lifetime of products purchased in the 30-year analysis period. DOE quantified the energy savings attributable to each TSL as the difference in energy consumption between each standards case and the no-new-standards case. The no-new-standards case represents a projection of energy consumption that reflects how the market for a product would likely evolve in the absence of amended energy conservation standards.

DOE used its national impact analysis ("NIA") spreadsheet models to estimate national energy savings ("NES") and national water savings ("NWS") from potential amended standards for RCWs. The NIA spreadsheet model (described in section IV.H of this document) calculates energy savings in terms of site energy, which is the energy directly consumed by products at the locations where they are used. For electricity, DOE reports national energy savings in terms of primary energy savings, which is the savings in the energy that is used to generate and transmit the site electricity. For natural gas, the primary energy savings are considered to be equal to the site energy savings. DOE also calculates NES in terms of FFC energy savings. The FFC metric includes the energy consumed in extracting, processing, and transporting primary fuels (*i.e.*, coal, natural gas,

[33] DOE also presents a sensitivity analysis that considers impacts for products shipped in a 9-year period.

petroleum fuels), and thus presents a more complete picture of the impacts of energy conservation standards.[34] DOE's approach is based on the calculation of an FFC multiplier for each of the energy types used by covered products or equipment. For more information on FFC energy savings, see section IV.H.2 of this document.

2. Significance of Savings

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

The significance of energy savings offered by a new or amended energy conservation standard cannot be determined without knowledge of the specific circumstances surrounding a given rulemaking.[35] For example, some covered products and equipment have most of their energy consumption occur during periods of peak energy demand. The impacts of these products on the energy infrastructure can be more pronounced than products with relatively constant demand.

Accordingly, DOE evaluates the significance of energy savings on a case-by-case basis, taking into account the significance of cumulative FFC national energy savings, the

[34] The FFC metric is discussed in DOE's statement of policy and notice of policy amendment. 76 FR 51282 (Aug. 18, 2011); as amended at 77 FR 49701 (Aug. 17, 2012).
[35] Procedures, Interpretations, and Policies for Consideration in New or Revised Energy Conservation Standards and Test Procedures for Consumer Products and Commercial/Industrial Equipment, 86 FR 70892, 70901 (Dec. 13, 2021).

cumulative FFC emissions reductions, and the need to confront the global climate crisis, among other factors.

As stated, the standard levels adopted in this direct final rule are projected to result in national energy savings of 0.67 quads, the equivalent of the primary annual energy use of 4.5 million homes. Based on the amount of FFC savings, the corresponding reduction in emissions, and the need to confront the global climate crisis, DOE has determined the energy savings from the standard levels adopted in this direct final rule are “significant” within the meaning of 42 U.S.C. 6295(o)(3)(B).

E. Economic Justification

1. Specific Criteria

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

a. Economic Impact on Manufacturers and Consumers

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

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

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

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

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

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

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

c. Energy Savings

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

d. Lessening of Utility or Performance of Products

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

e. Impact of Any Lessening of Competition

EPCA directs DOE to consider the impact of any lessening of competition, as determined in writing by the Attorney General, that is likely to result from a standard. (42 U.S.C. 6295(o)(2)(B)(i)(V)) It also directs the Attorney General to determine the impact, if any, of any lessening of competition likely to result from a standard and to transmit such determination to the Secretary within 60 days of the publication of a proposed rule, together with an analysis of the nature and extent of the impact. (42 U.S.C. 6295(o)(2)(B)(ii)) DOE will transmit a copy of this direct final rule to the Attorney General with a request that the Department of Justice ("DOJ") provide its determination on this issue. DOE will consider DOJ's comments on the rule in determining whether to withdraw the direct final rule. DOE will also publish and respond to the DOJ's comments in the *Federal Register* in a separate notice.

f. Need for National Energy Conservation

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

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

g. Other Factors

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

2. Rebuttable Presumption

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

IV. Methodology and Discussion of Related Comments

This section addresses the analyses DOE has performed for this rulemaking with regard to RCWs. Separate subsections address each component of DOE's analyses, including relevant comments DOE received during its separate rulemaking to amend the energy conservation standards for RCWs prior to receiving the Joint Agreement.

DOE used several analytical tools to estimate the impact of the standards considered in this document. The first tool is a spreadsheet that calculates the LCC savings and PBP of potential amended or new energy conservation standards. The national impacts analysis uses a second spreadsheet set that provides shipments projections and calculates national energy savings and net present value of total consumer costs and savings expected to result from potential energy conservation standards. DOE uses the third spreadsheet tool, the Government Regulatory Impact Model ("GRIM"), to assess manufacturer impacts of potential standards. These three spreadsheet tools are available on the DOE website for this rulemaking: *www.regulations.gov/docket/EERE-2017-BT-STD-0014*. Additionally, DOE used output from the latest version of the U.S. Energy Information Administration ("EIA") *Annual Energy Outlook* ("*AEO*") for the emissions and utility impact analyses.

A. Market and Technology Assessment

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

1. Product Classes

The Joint Agreement specifies the five product classes for RCWs. (Joint Agreement, No. 505 at p. 9). In this direct final rule, DOE is adopting the product classes from the Joint Agreement, as listed in Table IV.1.

Table IV.1 Joint Agreement Residential Clothes Washer Product Classes

Product Class
Automatic Clothes Washers
Top-Loading Ultra-Compact (less than 1.6 ft^3 capacity)
Top-Loading Standard-Size (1.6 ft^3 or greater capacity)
Front-Loading Compact (less than 3.0 ft^3 capacity)
Front-Loading Standard-Size (3.0 ft^3 or greater capacity)
Semi-Automatic Clothes Washers

DOE further notes that product classes established through EPCA's direct final rule authority are not subject to the criteria specified at 42 U.S.C. 6295(q)(1) for establishing product classes. Nevertheless, in accordance with 42 U.S.C. 6295(o)(4)—which is applicable to direct final rules—DOE has concluded that the standards adopted in this direct final rule will not result in the unavailability in any covered product type (or class) of performance characteristics, features, sizes, capacities, and volumes that are substantially the same as those generally available in the United States currently.[36] DOE's findings in this regard are discussed in detail in section V.B.4 of this document.

2. Technology Options

In this direct final rule, DOE considered the technology options listed in Table IV.2, consistent with the table of technology options presented in the March 2023 NOPR. See 88 FR 13520, 13541. DOE notes that it did not receive any comments regarding the technology options analyzed in the March 2023 NOPR.

In general, technology options for RCWs may reduce energy use alone, water use alone, or both energy and water use together. Because the energy used to heat any hot water consumed by the RCW is included as part of the EER metric, technologies that decrease hot water use also inherently decrease energy use. In Table IV.2, the technology options that reduce energy use alone are those indicated as methods for decreasing machine energy, drying energy, and standby energy. One technology option—spray rinse—reduces water use alone, listed among the methods for decreasing water use.[37] The technology options that reduce both energy and water use together are the remaining

[36] EPCA specifies that DOE may not prescribe an amended or new standard 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))

[37] Since nearly all RCWs use only cold water in the rinse portion of the cycle (*i.e.*, generally no hot water is used in the rinse portion of the cycle), spray rinse reduces water use without any corresponding reduction in energy use.

three options among the methods for decreasing water use, as well as those indicated as methods for reducing water heating energy.

Chapter 3 of the TSD for this direct final rule includes a detailed list and descriptions of all technology options identified for RCWs, including a discussion of how each technology option reduces energy use only, water use only, or both energy and water use together.

Table IV.2 Technology Options for Residential Clothes Washers

Methods for Decreasing Water Use*
Adaptive water fill controls
Hardware features enabling lower water levels
Spray rinse
Polymer bead cleaning
Methods for Decreasing Machine Energy
More efficient motor
Direct drive motor
Methods for Decreasing Water Heating Energy
Wash temperature decrease
Ozonated laundering
Methods for Decreasing Drying Energy
Hardware features enabling spin speed increase
Spin time increase
Methods for Decreasing Standby Energy
Lower standby power components
Methods for Increasing Overall Efficiency
Capacity increase

*Most of the methods for decreasing water use are also methods for decreasing water heating energy, since less hot water is used.

B. Screening Analysis

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

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

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

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

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

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

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

In sum, if DOE determines that a technology, or a combination of technologies, fails to meet one or more of the listed five criteria, it will be excluded from further consideration in the engineering analysis.

The subsequent sections of this document discuss DOE's evaluation of each technology option against the screening analysis criteria and whether DOE determined that a technology option should be excluded ("screened out") based on the screening criteria. The results of the screening analysis are discussed in greater detail in chapter 4 of the TSD for this direct final rule.

1. Screened-Out Technologies

DOE partially screened out capacity increase as a technology option. Specifically, DOE screened out any capacity increase that would require a corresponding increase in cabinet width larger than 27 inches, on the basis of the practicability to install and service RCWs with cabinet widths larger than 27 inches. DOE recognizes that products with a width greater than 27 inches may not be able to fit through many standards-size interior doorways.

DOE also screened out ozonated laundering and polymer bead cleaning on the basis of their practicability to install, manufacture, and service. Polymer bead cleaning is also a unique-pathway proprietary technology. DOE also screened out electrolytic disassociation of water on the basis that this technology could have impacts on product utility or availability. Chapter 3 of the TSD for this direct final rule includes a detailed description of each of these technology options.

DOE notes that the results of the screening analysis conducted for this direct final rule align with the screening analysis DOE conducted for the March 2023 NOPR. See 88 FR 13520, 13542–13453. In the March 2023 NOPR, DOE sought comment on whether any additional technology options should be screened out on the basis of any of the screening criteria. *Id*. at 88 FR 13543. In conducting the screening analysis for this direct final rule, DOE considered comments it had received in response to the March 2023 NOPR.

Fisher *et al*.[38] commented that the proposed standards are not technologically feasible because they would require manufacturers to overhaul many design features that have the potential to impact performance.[39] (Fisher *et al*., No. 463 at pp. 2–3)

In response to Fisher *et al*.'s comment regarding technological feasibility due to potential impacts on certain aspects of clothes washer performance, DOE has concluded that the standards adopted in this direct final rule are technologically feasible as the technologies used to achieve the adopted standards are widely incorporated in commercial products already. Sections 6(b)(3)(i) and 7(b)(1) of the Process Rule. Furthermore, DOE has determined through analysis of test data that the standards adopted in this direct final rule will not lessen the utility or performance of the RCWs

[38] "Fisher *et al.*" refers to a joint comment from Travis Fisher, Rachael Wilfong, and Kevin Dayaratna. Although these individual commenters are associated with The Heritage Foundation, the comment states that the views expressed in it should not be construed as representing any official position of The Heritage Foundation. (Fisher *et al.*, No. 463 at p. 1)

[39] DOE did not include Fisher *et al*.'s comments about spin-time increase and wash temperature decrease in top-loading standard-size RCWs at the proposed standard level because the adopted standard level in this direct final rule is different than what was proposed in the March 2023 NOPR.

under consideration in this rulemaking, as discussed further in section V.B.4 of this document.

NEEA *et al.*[40] supported the inclusion in the analysis of larger wash baskets for top-loading models at higher efficiency levels, assuming common sense limitations to ensure similar installation locations. (NEEA *et al.*, No. 455 at p. 5)

Appliance Standards Awareness Project ("ASAP"), American Council for an Energy-Efficient Economy ("ACEEE"), and the New York State Energy Research and Development Authority ("NYSERDA") commented that, contrary to concerns raised at DOE's public meeting, manufacturers have increased top-loading RCW capacity from 3.8 ft^3 to 5.3 ft^3 without a meaningful increase in cabinet dimensions, which supports DOE screening out from the analysis any capacity increase that would increase cabinet widths. (ASAP, ACEEE, and NYSERDA, No. 458 at p. 4)

Samsung Electronics America, Inc. ("Samsung") commented that the necessary technological advancements and solutions identified by DOE are readily available and accessible, which aligned with DOE's assessment of the technological feasibility of the standards proposed in the March 2023 NOPR. (Samsung, No. 461 at p. 4)

[40] "NEEA *et al.*" refers to a joint comment from Northwest Energy Efficiency Alliance, Commonwealth Edison Company, and Natural Resources Defense Council.

Strauch commented that direct-drive or brushless permanent magnet ("BPM") motors will increase RCW cost and decrease reliability. (Strauch, No. 430 at p. 2)

DOE notes that the incremental cost of higher-efficiency design options is considered as part of the engineering analysis, from which DOE derives its cost efficiency "curves." DOE's analysis specifically accounts for the increased cost of implementing direct drive and BPM motors to improve efficiency. (*See* section IV.C.4 of this document and chapter 5 of the direct final rule TSD). In response to Strauch's comment asserting that direct drive and BPM motors will decrease reliability, DOE does not have any data on the comparative reliability of RCWs that use various motor technologies. However, as discussed further in section IV.F.5 of this document, DOE's analysis does incorporate an assumption of increased repair costs for higher efficiency RCWs. DOE additionally notes that multiple RCW manufacturers offer warranties specifically for the direct drive motor component of the clothes washer ranging from 10-year[41] or 20-year[42] warranties to lifetime[43] warranties—indicative of manufacturers' expectation of the relatively high reliability of these components.

Whirlpool Corporation ("Whirlpool") commented that DOE's proposal may create consumer accessibility issues for shorter-than-average consumers and consumers with disabilities or limited mobility, as they may struggle to reach the bottom of larger-capacity RCWs, which manufacturers will have to deepen to satisfy the standards

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[41]See, for example, www.maytag.com/services/limited-10-year-warranty.html.
[42]See, for example, www.samsung.com/latin_en/microsite/20-years-warranty/.
[43]See, for example, www.kenmore.com/warranty-information/#washers.

proposed in the March 2023 NOPR, because the width of cabinets cannot be increased beyond standard doorway clearance. (Whirlpool, No. 462 at p. 9) Whirlpool commented that people of average and below-average height may not be able to access the bottom of deeper-basket top-loading RCWs without bringing their feet off the ground, which could create a fall hazard and possible soft-tissue compression of the chest and abdominal area. (*Id.* at p. 10) Whirlpool commented that some people could be forced to shift to a front-loading configuration, further increasing the ownership cost and eliminating any potential operating cost savings for many consumers. (*Id*.) Whirlpool asserted that larger-capacity top-loading RCWs would be ineligible for compliance with the Americans with Disabilities Act, due to strict requirements for height and depth of units. (*Id*.) Whirlpool also commented that there is a loss of utility as some consumers do not want or need to use larger load sizes as well as installation problems related to smaller doorways and basements. (Whirlpool, Public Transcript, No. 91 at pp. 82–83)

Mannino[44], in referencing Whirlpool's comment during the public webinar that people have a hard time reaching the bottom of larger tubs,[45] added that many customers have a step stool next to their RCWs that they must stand on to get waist-high so they can bend over far enough to take their clothes out. (Mannino, Public Webinar Transcript, No. 91 at p. 84)

[44] "Mannino" refers to comments made by Michael Mannino representing Appliance Service Systems during the public webinar held March 28, 2023.
[45] (Whirlpool, Public Webinar Transcript, No. 91 at pp. 8283)

DOE notes that, as discussed in section V.B.4.b of this document, for this direct final rule DOE has re-evaluated its assumption from the March 2023 NOPR that capacity increase would be required to meet the standards proposed in the March 2023 NOPR for top-loading standard-size RCWs. For this direct final rule, DOE has conducted additional analysis that indicates that the amended standards can be met by all capacities currently available on the market without the need to implement the design option of increasing capacity. Therefore, manufacturers will continue to be able to offer the same range of capacities as are currently available on the market. In chapter 5 of the direct final rule TSD, DOE provides example design pathways that manufacturers could use to achieve higher efficiency without increasing capacity as a design option, such that DOE does not expect it will raise accessibility concerns.

Whirlpool further commented that DOE must work closely with the Consumer Product Safety Commission ("CPSC") to understand their work and ensure that RCWs can safely withstand high spin speeds under spontaneous unbalanced load conditions, given that the standards proposed in the March 2023 NOPR would effectively mandate higher spin speeds. (*Id.* at p. 13) AHAM noted that although higher spin speeds are an available option to increase efficiency, UL formed a working group to address recalls that happened with vertical axis clothes washers and instantaneous out-of-balance events that happened in the field. AHAM commented that DOE must coordinate with the CPSC as it considers certain technology options because manufacturers will need to dedicate resources to ensure that increased spin speeds do not decrease product safety. (AHAM, No. 464 at p. 17)

Representatives Latta *et al*.[46] commented that increased spin speeds to meet amended standards could increase the potential for load imbalance issues. (Representatives Latta *et al*., No. 456 at pp. 2–3)

DOE only considered spin increase as a design option insofar as it is already demonstrated in RCWs available on the market. The prevalence of high-speed spin features currently available on the market is indicative that RCWs can be designed to safely withstand such spin speeds. DOE notes that models at the Recommended TSL would also require faster spin speeds compared to the baseline, and the Recommended TSL is supported by the Joint Commenters, which includes manufacturers with commercially available products that meet or exceed these levels being safely used today by consumers. As previously discussed, on February 14, 2024, DOE received a second joint statement from the same group of stakeholders that submitted the Joint Agreement (of which Whirlpool is a member) in which the signatories reaffirmed the standards recommended in the Joint Agreement.[47] In particular, the letter states that the joint stakeholders do not anticipate the recommended standards will negatively affect features or performance.

AHAM commented that high-frequency components (*e.g.*, variable-speed motors) in higher-efficiency RCWs contribute to RCWs losing power due to so-called "nuisance tripping" of the electrical outlet. (AHAM, No. 464 at pp. 17–22) Specifically, AHAM

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[46] "Representatives Latta *et al.*" refers to a joint comment from the following members of the U.S. House of Representatives: Robert E. Latta (OH), H. Morgan Griffith (VA), Russ Fulcher (ID), Rick W. Allen (GA), and Greg Pence (IN).

[47] This document is available in the docket at: www.regulations.gov/comment/EERE-2017-BT-STD-0014-0509.

explained that arc-fault circuit-interrupters ("AFCIs") are devices required by the National Electrical Code and local building codes that trip and disable appliances when they detect certain electrical signals, including conducted emissions. (*Id*. at p. 17) AHAM commented that many AFCI manufacturers implement more stringent tripping thresholds than those recommended by the Federal Communications Commission or the National Electrical Manufacturers Association, and that the variability in AFCI tripping thresholds among AFCI manufacturers creates a major challenge for home appliance manufacturers in making products more efficient, noting that AFCI manufacturers are not required to publicize changes to the tripping thresholds or update the relevant industry standard with this information. (*Id*. at pp. 17–18) AHAM commented that DOE must not endanger manufacturers' ability to address this issue by pushing RCWs towards use of components that generate higher frequency conducted emissions, such as variable-speed motors. (*Id*. at p. 19) AHAM requested that DOE consider how updated standards will impact manufacturers' ability to meet the specifications required to prevent AFCI nuisance tripping, quantify this impact, and adjust its analysis accordingly. (*Id*.)

AHAM further commented on similar issues regarding ground-fault circuit interrupters ("GFCIs"), which are also devices required by the National Electrical Code that trip and disable appliances when they detect a ground-fault. (*Id*. at p. 20) AHAM commented that while appliance manufacturers can add filters to help avoid nuisance tripping, doing so increases energy consumption and does not solve the root cause, which AHAM states is highly variable GFCI tripping thresholds at high frequencies. (*Id*.)

AHAM noted that the latest Underwriters Laboratory ("UL") standard for GFCIs[48] does not define the electrical amperage tripping threshold for frequencies other than 60 Hertz. (*Id*. at p. 21) AHAM commented that UL has conducted a study that verified that components operating at high frequencies contribute to nuisance tripping, even when no electrical hazard exists. (*Id*. at p. 20) The UL study referenced by AHAM explored the root causes of reported interoperability incidents (*i.e.*, nuisance tripping) between certain GFCIs and home appliances, including RCWs. (*Id*. at pp. 59–68) The UL study referenced by AHAM noted that its results were used in a proposal to add a GFCI interoperability test to the UL standard for appliances that are plugged into GFCIs,[49] and that the results from the study are anticipated to facilitate the development of new performance requirements for UL 943 for frequencies other than 60 Hertz. (*Id*.)

AHAM requested that DOE use its expertise and resources to properly investigate what it characterizes as the technological incompatibility between high-frequency components and AFCIs/GFCIs and suggested that DOE adjust its analysis and quantify the impact from nuisance tripping. (*Id*. at p. 22)

In response to AHAM's concern regarding high-frequency components' impact on nuisance tripping, DOE emphasizes that it only considered design options that are already demonstrated in RCWs available on the market. DOE is aware of the potential for "nuisance tripping" of GFCI circuit protectors by high-frequency components such as variable-speed motors. However, DOE understands that nuisance tripping can generally

[48] UL 943 is the standard for Ground-Fault Circuit-Interrupters.
[49] UL 101 is the standard for Leakage Current for Utilization Equipment.

be mitigated through the use of best practices for reducing leakage current, such as minimizing electrical cable lengths and ensuring that filtered and unfiltered cables are separated to whatever extent possible to reduce leakage current. Additionally, optimizing the variable-frequency controller power filter to reduce total leakage current to levels below the GFCI detection limits can further prevent GFCI tripping. To the extent that the use of additional electronic components is needed in conjunction with the use of design options with high-frequency components (such as variable-speed motors), and to the extent that such additional electronic components are provided in RCWs currently on the market that make use of such design options, DOE's teardown analysis captures any additional cost associated with such components.

DOE notes that despite any potential for nuisance tripping, a wide range of appliances on the market today, including clothes washers, implement variable-frequency drives in their designs. The inclusion of these variable-frequency drive designs in units on the market suggests that they do not have a significant impact on the consumer utility of these products. DOE notes that variable-speed motors have been used in RCWs for over a decade[50] and observes the widespread usage of variable-speed motors in RCWs currently on the market, as discussed further in chapter 5 of the direct final rule TSD. DOE is not aware of widespread issues with the currently available products that would warrant exclusion from consideration. Further, as indicated by the Joint Agreement of which AHAM was a signatory, products at the standard level being adopted in this direct final

[50] *See*, for example, discussion of variable-speed motors in chapter 5 of the TSD accompanying the energy conservation standards May 2012 Direct Final Rule. Available at *www.regulations.gov/document/EERE-2008-BT-STD-0019-0047*.

rule are widely available, have significant market share—as the adopted standard represents the ENERGY STAR level—and manufacturers have not indicated consumer dissatisfaction with the clothes washers commercially available today.

2. Remaining Technologies

Through a review of each technology, DOE concludes that all of the other identified technologies listed in Table IV.3 meet all screening criteria to be examined further as design options in DOE's direct final rule analysis. In summary, DOE did not screen out the following technology options:

Table IV.3 Retained Design Options for Residential Clothes Washers

Methods for Decreasing Water Use*
Adaptive water fill controls
Hardware features enabling lower water levels
Spray rinse
Methods for Decreasing Machine Energy
More efficient motor
Direct drive motor
Methods for Decreasing Water Heating Energy
Wash temperature decrease
Methods for Decreasing Drying Energy
Hardware features enabling spin speed increase
Spin time increase
Methods for Decreasing Standby Energy
Lower standby power components
Methods for Increasing Overall Efficiency
Capacity increase (without requiring a cabinet width increase)

*Most of the methods for decreasing water use are also methods for decreasing water heating energy, since less hot water is used.

As discussed, technology options for RCWs may reduce energy use alone, water use alone, or both energy and water use together. The technology options that reduce energy use alone are those indicated as methods for decreasing machine energy, drying energy, and standby energy. Spray rinse, indicated as one of the methods for reducing water use, reduces water use alone. The technology options that reduce both energy and water use together are the remaining two options among the methods for decreasing water use, as well as those indicated as methods for reducing water heating energy.

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

C. Engineering Analysis

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

1. Metric Translations

As discussed in section II.B.2 of this document, the June 2022 TP Final Rule established a new test procedure, appendix J, which established new EER and WER efficiency metrics. 87 FR 33316. Appendix J also incorporates a number of revisions that affect the per-cycle energy and water use in comparison to results obtained under the current appendix J2 test procedure. See 10 CFR part 430 subpart B appendix J. In the March 2023 NOPR, DOE identified efficiency levels initially in terms of the existing IMEF and IWF metrics and used a translation equation to convert the identified IMEF and IWF levels into corresponding EER and WER levels as the basis for the proposed amended standards. 88 FR 13520, 13545. The translation equation was based on testing performed by DOE on a representative sample of RCW models. *Id*. at 88 FR 13555–13559.

In this direct final rule, DOE used the same translation equations presented in the March 2023 NOPR to translate efficiency levels from the appendix J2 metrics (*i.e.*, IMEF and IWF) into the appendix J metrics (*i.e.*, EER and WER).

2. Efficiency Analysis

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

For this direct final rule, DOE used an efficiency-level approach, supplemented with the design-option approach for certain “gap fill” efficiency levels. The efficiency-level approach is appropriate for RCWs given the availability of certification data to determine the market distribution of existing products and to identify efficiency level “clusters” that already exist on the market.

In conducting the efficiency analysis for the automatic clothes washer product classes, DOE first identified efficiency levels in terms of the current IMEF and IWF metrics defined in appendix J2 that are the most familiar to interested parties. DOE also initially determined the cost-efficiency relationships based on these metrics. Following that, DOE translated each efficiency level into its corresponding EER and WER values using the translation equations developed for each product class, as discussed previously in section IV.C.1 of this document.

For the semi-automatic product class, for which reliable certification data is unavailable, DOE tested a representative sample of units to appendix J and used that set of data points to determine the baseline and higher efficiency levels, as described further in section IV.C.2.c of this document.

The efficiency levels that DOE considered in the engineering analysis are attainable using technologies currently available on the market in RCWs. DOE used the results of the testing and teardown analyses to determine a representative set of technologies and design strategies that manufacturers use to achieve each higher efficiency level. This information provides interested parties with additional transparency of assumptions and results, and the ability to perform independent analyses for verification. Chapter 5 of the direct final rule TSD describes the methodology and results of the analysis used to derive the cost-efficiency relationships.

a. Baseline Efficiency Levels

For each product class, DOE generally selects a baseline model as a reference point for each class, and measures changes resulting from potential energy conservation standards against the baseline. The baseline model in each product class represents the characteristics of a product typical of that class (*e.g.*, capacity, physical size). Generally, a baseline model is one that just meets current energy conservation standards, or, if no standards are in place, the baseline is typically the most common or least efficient unit on the market.

In defining the baseline efficiency levels for this direct final rule, DOE considered comments it had received in response to the baseline efficiency levels proposed in the March 2023 NOPR.

In the March 2023 NOPR, DOE analyzed the baseline efficiency levels shown in Table IV.4 for each automatic product class. 88 FR 13520, 13546. The semi-automatic product class is discussed separately in section IV.C.2.c of this document.

Table IV.4 Baseline Efficiency Levels Analyzed in the March 2023 NOPR

Product Class	Description	Minimum IMEF *(ft^3/kWh/cycle)*	Maximum IWF *(gal/cycle/ft^3)*	Minimum EER *(lb/kWh/cycle)*	Minimum WER *(lb/gal/cycle)*
Top-Loading Ultra-Compact (<1.6 ft^3)	Current DOE standard	1.15	12.0	3.79	0.29
Top-Loading Standard-Size (≥1.6 ft^3)	Current DOE standard	1.57	6.5	3.50	0.38
Front-Loading Compact (<3.0 ft^3)	Current DOE standard for front-loading standard-size (≥1.6 ft^3) *	1.84	4.7	4.41	0.53
Front-Loading Standard-Size (≥3.0 ft^3)	ENERGY STAR v. 7.0 **	2.38	3.7	5.02	0.64

* Although the current DOE standard for front-loading compact (<1.6 ft^3) is 1.13 IMEF/8.3 IWF, no front-loading units are currently on the market with a capacity <1.6 ft^3. The baseline efficiency level proposed in the March 2023 NOPR reflected the currently applicable standard for front-loading RCWs with capacities between 1.6 and 3.0 ft^3.
** Although the current DOE standard for front-loading standard-size (≥1.6 ft^3) is 1.84 IMEF/4.7 IWF, at the time of analysis, the least efficient front-loading standard-size RCW available on the market had an efficiency rating of 2.38 IMEF/3.7 IWF. DOE noted in the March 2023 NOPR that although DOE's Compliance Certification Database ("CCD") includes front-loading standard-size RCWs that are rated at the current standard level of 1.84 IMEF, it had determined through testing that these units perform significantly above their rated value at the current standard level. 88 FR 13520, 13545.

In the March 2023 NOPR, DOE discussed an alternate approach it was considering for defining the baseline levels. *Id*. at 88 FR 13561. The baseline efficiency levels defined in the March 2023 NOPR represented an IMEF-to-EER translation based on "consistent spin" performance[51] across all the cycle settings required for testing. DOE observed through testing, however, that some units on the market are designed such that only the cycle setting required for measuring the remaining moisture content ("RMC") under appendix J2 (*i.e.*, the Cold/Cold cycle with maximum load size) is optimized[52] to achieve a favorable RMC value; on such units, the spin portion of the cycle is significantly faster or longer on the Cold/Cold setting with a maximum load size than for the other temperature settings or load sizes that are tested as part of the energy test. *Id.* at 88 FR 13556. As discussed in the March 2023 NOPR, comments submitted by a manufacturer suggested that, were DOE to amend standards based on appendix J, manufacturers that currently use "Cold/Cold optimized spin" would likely increase the spin speeds or spin durations across all temperature settings to match the spin behavior of the Cold/Cold temperature setting; *i.e.*, such units would be redesigned to exhibit "consistent spin" performance to provide the lowest possible (*i.e.,* best possible) RMC measurement under appendix J. *Id.* at 88 FR 13557. Under the alternate approach to defining the baseline efficiency levels discussed in the March 2023 NOPR, DOE would define the baseline efficiency levels based on a translation between appendix J2 and

[51] In the March 2023 NOPR, DOE discussed its observation of various approaches used by manufacturers for the final spin portion of the wash cycle across all the cycle setting required for testing. 88 FR 13520, 13561. DOE used the term "consistent spin" to refer to units in which the characteristics of the spin cycle (*e.g.*, spin speed, spin time) are consistent across temperature selections. *Id*. at 88 FR 13556. On such units, RMC values measured on Warm/Cold, Hot/Cold, and Extra Hot/Cold cycles are substantially similar to the RMC value measured on the Cold/Cold cycle. *Id.*

[52] DOE used the term "Cold/Cold optimized spin" in the March 2023 NOPR to refer to units in which the spin cycle is optimized on the Cold/Cold setting with maximum load size. *Id.*

appendix J metrics without consideration of any changes to spin implementations as a result of adopting the new appendix J test procedure. *Id.* at 88 FR 13561. DOE referred to this in the March 2023 NOPR as the "unadjusted" baseline approach. *Id.* Using this approach, the baseline level presented in the March 2023 NOPR would instead be considered efficiency level ("EL") 1.

DOE sought comment on the baseline efficiency levels analyzed in the March 2023 NOPR for each product class. *Id*. at 88 FR 13546. DOE also sought comment on whether it should consider defining an "unadjusted" baseline efficiency level based on a translation between appendix J2 and appendix J metrics without consideration of any changes to spin implementations as a result of adopting the appendix J test procedure. *Id.* at 88 FR 13561.

AHAM agreed with DOE's proposal to establish the baseline at the current DOE standard for top-loading standard-size RCWs and at the current standard for front-loading standard-size RCWs for the front-loading compact product class. (AHAM, No. 464 at pp. 16–17)

AHAM opposed DOE's proposal to establish the baseline for front-loading standard-size RCWs at the ENERGY STAR v. 7.0 level and instead recommended establishing the baseline at the current DOE standard. (*Id*. at p. 17) AHAM commented that even if DOE tested some products that meet higher levels of efficiency than their rated values, that may not universally be the case; and that even if it is, the DOE standard does continue to represent the baseline, as those products are designed in order to ensure they meet the current energy conservation standard. (*Id*.) AHAM further commented that DOE's approach does not match the intent of establishing the baseline, which is to identify the least-efficient product and set the baseline at that level. (*Id*.) As such, AHAM recommended that DOE establish the baseline at the current DOE standard for front-loading standard-size products. (*Id.*)

In response to AHAM's comment regarding the definition of the baseline level for front-loading standard-size RCWs, DOE is adopting AHAM's recommended approach for this direct final rule and defining the baseline level for the front-loading standard-size product class as the current DOE standard (corresponding to 1.84 IMEF / 5.7 IWF).[53]

The CA IOUs[54] recommended that DOE use an "unadjusted" baseline efficiency level as presented in appendix 5A of the March 2023 NOPR TSD and update the market share distributions by including a "consistent spin" implementation technology option reflecting the existing market. (CA IOUs, No. 460 at pp. 3–4) The CA IOUs stated that they acknowledge the challenges of transitioning to the new test procedure's energy and water metrics, but maintain that assuming all units will adopt the "consistent spin" implementation method and that incorporating this assumption as the baseline for each product class does not represent real-world usage. (*Id*.) The CA IOUs recommended DOE use the least efficient tested EER in its test sample to define the baseline efficiency level and that DOE may apply consistent spin implementation and the associated cost and

[53] In this direct final rule ("DFR"), DOE labels the EL corresponding to the current DOE standard as "DFR Baseline" and the EL corresponding to ENERGY STAR v. 7.0 as "NOPR Baseline."
[54] The "CA IOUs" includes Pacific Gas and Electric Company, SDG&E, and SCE; collectively, the California Investor-Owned Utilities.

energy savings as a technology improvement at EL 1. (*Id*. at p. 4) The CA IOUs noted that this method would respect DOE's expectation that manufacturers adopt a consistent spin profile in response to appendix J. (*Id*.) The CA IOUs commented that this approach should also result in updates to the efficiency distribution for all product classes where DOE found units with a non-consistent spin implementation. (*Id*.) The CA IOUs stated the same market distribution calculations and adjustments should be implemented for top-loading standard-size, front-loading compact, and semi-automatic product classes since all were found to have products with non-consistent spin implementation in DOE's testing. (*Id*.) The CA IOUs further stated that these adjustments to DOE's analysis will accurately represent energy savings from this rulemaking by properly characterizing existing products and their variety of spin implementations. (*Id*. at pp. 4–5) The CA IOUs requested that, should DOE decline to adopt the proposed methodology, DOE clarify its position on the inclusion of the costs associated with the spin improvements. (*Id*. at p. 5) The CA IOUs requested that DOE ensure uniformity in its treatment of consistent spin profiles to account for both or none of the savings and costs. (*Id*.)

In response to the CA IOUs' recommendation to use the "unadjusted" baseline approach to define the baseline efficiency levels, DOE has further evaluated this approach and determined that DOE would not be able to reliably extrapolate its test results to the entire market to determine how market shares would need to be apportioned between an "unadjusted" baseline level and the baseline level defined in the March 2023 NOPR using the translation equations. More specifically, although DOE identified units in its test sample with "Cold/Cold optimized" spin characteristic, DOE was not able to determine a consistent pattern of implementation of this characteristic—either among manufacturers or product platforms—that could be used to extrapolate to the entire RCW market. For example, DOE's test results indicated that some individual manufacturers use different spin characteristics across their RCW model offerings (*e.g.*, using "consistent spin" on some models, while using "Cold/Cold optimized spin" on other model), and in some cases across different individual models within the same product family (*e.g.*, among front-loading standard-size models designed and built on the same underlying product platform). DOE recognizes that by not explicitly accounting for changes to spin implementation at the baseline level for some portion of the market, any incremental energy savings attributable to the change in test procedure to appendix J are not accounted for in DOE's assessment of the total energy savings resulting from the amended standards enacted by this direct final rule. Regarding DOE's accounting of any costs associated with such changes in spin implementation, DOE is not assigning any additional manufacturing cost to the baseline level with respect to this issue. The design changes incorporated into DOE's cost-efficiency curves at the amended standard level already include any necessary structural improvements that would potentially be required to convert a product from using a "Cold/Cold optimized" spin implementation to a "consistent spin" implementation (*e.g.*, more robust bearings or suspension to accommodate increased spin speeds).

b. Higher Efficiency Levels

To establish higher efficiency levels for the analysis, DOE reviewed data in DOE's CCD to evaluate the range of efficiencies for RCWs currently available on the market.[55]

As part of DOE's analysis, the maximum available efficiency level is the highest efficiency unit currently available on the market. DOE also defines a "max-tech" efficiency level to represent the maximum possible efficiency for a given product in each product class. (42 U.S.C. 6295(p)(1)) DOE typically determines max-tech levels based on technologies that are either commercially available or have been demonstrated as working prototypes. If the max-tech design meets DOE's screening criteria, DOE considers the design in further analysis.

In defining the higher efficiency levels for this direct final rule, DOE considered comments it had received in response to the higher efficiency levels proposed in the March 2023 NOPR.

In the March 2023 NOPR, DOE tentatively determined that the max-tech efficiency level for each RCW product class corresponds to the maximum available level for each product class. 88 FR 13520, 13546. In other words, DOE did not define or analyze any efficiency levels higher than those currently available on the market. *Id*.

[55] DOE's Compliance Certification Database is available at *www.regulations.doe.gov/certification-data*. Analysis conducted May 2023.

As noted, EPCA requires that any new or amended energy conservation standard be designed to achieve the maximum improvement in energy efficiency that is technologically feasible. (42 U.S.C. 6295(o)(2)(A)) For RCWs, a determination of technological feasibility must encompass not only an achievable reduction in energy and/or water consumption, but also the ability of the product to perform its intended function (*i.e.*, wash clothing) at reduced energy or water levels.[56] Attributes that are relevant to consumers encompass multiple aspects of RCW operation such as stain removal, solid particle removal, rinsing effectiveness, fabric gentleness, cycle time, noise, vibration, and others. Each of these attributes may be affected by energy and water efficiency levels, and achieving better performance in one attribute may require a tradeoff with one or more other attributes. DOE does not have the means to be able to determine whether a product that uses less water or energy than the maximum efficiency level available on the market would represent a viable (*i.e.*, technologically feasible) product that would satisfy consumer expectations regarding all the other aspects of RCW performance that are not measured by the DOE test procedure. As far as DOE is aware, the complexity of the interdependence among all these attributes precludes being able to use a computer model or other similar means to predict changes in these product attributes as a result of reduced energy and water levels. Rather, as far as DOE is aware, such determinations are made in an iterative fashion through extensive product testing as part of manufacturers' design processes.

[56] As an extreme example, DOE could consider a hypothetical RCW that reduces its water consumption to near-zero, but such a product would not be viable for washing clothing, given current technology.

DOE sought comment on the higher efficiency levels analyzed in the March 2023 NOPR for each product class. *Id*. at 88 FR 13549.

DOE did not receive any comments regarding the higher efficiency levels analyzed in the March 2023 NOPR.

At each higher efficiency level, both energy use and water use decrease through the implementation of combinations of design options that individually either reduce energy use alone, reduce water use alone, or reduce both energy and water use together, as discussed previously in section IV.A.2 of this document. Chapter 5 of the direct final rule TSD provides a detailed discussion of the specific design changes that DOE believes manufacturers would typically use to meet each higher efficiency level considered in this engineering analysis, including a discussion of whether such design changes would reduce energy use only, water use only, or reduce both energy and water use together.

In this direct final rule, DOE analyzed the higher efficiency levels shown in Table IV.5 through Table IV.8, consistent with the levels analyzed in the March 2023 NOPR.

Table IV.5 Top-Loading Ultra-Compact (<1.6 ft^3) Efficiency Levels

EL	**Efficiency Level Description**	**IMEF** *(ft^3/kWh/cycle)*	**IWF** *(gal/cycle/ft^3)*	**EER** *(lb/kWh/cycle)*	**WER** *(lb/gal/cycle)*
Baseline	Current DOE standard	1.15	12.0	3.79	0.29

Table IV.6 Top-Loading Standard-Size (≥1.6 ft³) Efficiency Levels

EL	Efficiency Level Description	IMEF *(ft³/kWh/cycle)*	IWF *(gal/cycle/ft³)*	EER *(lb/kWh/cycle)*	WER *(lb/gal/cycle)*
Baseline	Current DOE standard	1.57	6.5	3.50	0.38
1	Gap fill	1.82	5.4	3.89	0.47
2	ENERGY STAR v. 8.1	2.06	4.3	4.27	0.57
3	2015–2017 CEE Tier 1	2.38	3.7	4.78	0.63
4	Maximum available (2016/2017 ENERGY STAR Most Efficient)	2.76	3.2	5.37	0.67

Table IV.7 Front-Loading Compact (<3.0 ft³) Efficiency Levels

EL	Efficiency Level Description	IMEF *(ft³/kWh/cycle)*	IWF *(gal/cycle/ft³)*	EER *(lb/kWh/cycle)*	WER *(lb/gal/cycle)*
Baseline	Current DOE standard for front-loading standard-size (≥1.6 ft³)	1.84	4.7	4.41	0.53
1	ENERGY STAR v. 8.1 level for units ≤2.5 ft³	2.07	4.2	4.80	0.62
2	2023 ENERGY STAR Most Efficient for units ≤2.5 ft³	2.20	3.7	5.02	0.71
3	Gap fill	2.50	3.5	5.53	0.75
4	Maximum available (ENERGY STAR v. 8.1 level for units >2.5 ft³)	2.76	3.2	5.97	0.80

Table IV.8 Front-Loading Standard-Size (≥3.0 ft³) Efficiency Levels

EL	Efficiency Level Description	IMEF *(ft³/kWh/cycle)*	IWF *(gal/cycle/ft³)*	EER *(lb/kWh/cycle)*	WER *(lb/gal/cycle)*
DFR Baseline	Current DOE standard	1.84	4.7	4.31	0.38
NOPR Baseline	ENERGY STAR v. 7.0	2.38	3.7	5.02	0.64
1	Gap fill	2.60	3.5	5.31	0.69
2	ENERGY STAR v. 8.1	2.76	3.2	5.52	0.77
3	2023 ENERGY STAR Most Efficient	2.92	3.2	5.73	0.77
4	Maximum available	3.10	2.9	5.97	0.85

c. Semi-Automatic

As discussed in section IV.A.1 of this document, this direct final rule re-establishes a separate product class for semi-automatic clothes washers and establishes performance-based standards for semi-automatic clothes washers. In considering the definition of efficiency levels for semi-automatic clothes washers for this direct final rule, DOE used the same methodology it had proposed in the March 2023 NOPR.

As discussed in the March 2023 NOPR, given the lack of specificity in appendix J2 regarding the testing of semi-automatic clothes washers, and the significant differences in testing between appendix J2 versus appendix J for semi-automatic clothes washers, DOE tentatively determined that it could not develop an accurate correlation between appendix J2 metrics (*i.e.*, IMEF and IWF) and appendix J metrics (*i.e.*, EER and WER) for semi-automatic clothes washers. *Id.* at 88 FR 13549. Therefore, DOE proposed to define efficiency levels in terms of EER and WER directly rather than first defining efficiency levels in terms of IMEF and IWF and then developing translation equations to translate those levels to EER and WER. *Id.* As discussed in the March 2023 NOPR, DOE determined efficiency levels for the semi-automatic clothes washer product class by testing a representative sample of models on the market and observing the range of EER and WER results. *Id.* DOE sought comment on the efficiency levels analyzed in the March 2023 NOPR for semi-automatic RCWs. *Id.*

DOE did not receive any comments regarding the efficiency levels analyzed in the March 2023 NOPR for semi-automatic RCWs. In this direct final rule, DOE used the efficiency levels defined in the March 2023 NOPR for semi-automatic RCWs.

Table IV.9 shows the efficiency levels for the semi-automatic product class. See chapter 5 of the direct final rule TSD for more details.

Table IV.9 Semi-Automatic Efficiency Levels

EL	Efficiency Level Description	EER *(lb/kWh/cycle)*	WER *(lb/gal/cycle)*
Baseline	Minimum available	1.60	0.17
1	Gap fill	2.12	0.27
2	Maximum available	2.51	0.36

3. Cost Analysis

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

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

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

- *Price surveys*: If neither a physical nor catalog teardown is feasible (for example, for tightly integrated products such as fluorescent lamps, which are infeasible to disassemble and for which parts diagrams are unavailable) or cost-prohibitive and otherwise impractical (e.g., large commercial boilers),

> DOE conducts price surveys using publicly available pricing data published on major online retailer websites and/or by soliciting prices from distributors and other commercial channels.

In the present case, DOE conducted the analysis using the physical teardown approach. For each product class, DOE tore down a representative sample of models spanning the entire range of efficiency levels, as well as multiple manufacturers within each product class. DOE aggregated the results so that the cost-efficiency relationship developed for each product class reflects DOE's assessment of a market-representative "path" to achieve each higher efficiency level. The resulting bill of materials provides the basis for the manufacturer production cost ("MPC") estimates.

To account for manufacturers' profit margin, DOE applies a multiplier (the manufacturer markup) to the MPC. The resulting manufacturer selling price ("MSP") is the price at which the manufacturer distributes a unit into commerce. DOE developed an average manufacturer markup by examining the annual Securities and Exchange Commission ("SEC") 10-K reports filed by publicly-traded manufacturers primarily engaged in appliance manufacturing and whose combined product range includes RCWs.[57] *See* chapter 12 of the TSD for this direct final rule for additional detail on the manufacturer markup.

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[57] U.S. Securities and Exchange Commission, Electronic Data Gathering, Analysis, and Retrieval (EDGAR) system. Available at *www.sec.gov/edgar/search/* (last accessed June 30, 2023).

4. Cost-Efficiency Results

In developing the baseline and incremental MPCs for each defined product class for this direct final rule, DOE considered comments it had received in response to the cost-efficiency results presented in the March 2023 NOPR.

As discussed in the March 2023 NOPR, in support of this rulemaking, DOE conducted teardowns on 47 RCW models, which covered the entire range of efficiency levels within each analyzed product class. *See* chapter 5 of the March 2023 NOPR TSD.

DOE sought comment in the March 2023 NOPR on the baseline and incremental MPCs developed for each product class. *Id*. at 88 FR 13553.

ASAP, ACEEE, and NYSERDA commented that they believe DOE is likely overestimating incremental cost increases, especially for top-loading standard-size RCWs. (ASAP, ACEEE, ASAP, and NYSERDA, No. 458 at p. 2) ASAP, ACEEE, and NYSERDA stated that while DOE assumes in the engineering analysis that baseline top-loading RCWs have enameled baskets and that units meeting the standards proposed in the March 2023 NOPR would have stainless steel baskets, NEEA market research found that almost two-thirds of baseline top-loading standard-size RCW sales already include stainless steel baskets, including half of the least-expensive baseline models. (*Id*.) ASAP, ACEEE, and NYSERDA further commented that DOE has historically overestimated cost increases from energy efficiency standards, and they noted that a 2022 Spurlock &

Fujita study[58] concluded that baseline RCW prices stayed flat while efficiency increased by 30 percent, demonstrating that efficiency standards for RCWs benefit all consumers and that low-income consumers were not priced out of the market. (*Id*. at pp. 2–3) ASAP, ACEEE, and NYSERDA commented that historical trends suggest that any incremental increases in first cost experienced by customers will likely be smaller than those estimated by DOE. (*Id*. at p. 3)

In response to the comment from ASAP, ACEEE, and NYSERDA regarding the prevalence of stainless steel wash baskets at the baseline level, in this direct final rule, DOE has updated its approach to calculating the baseline MPC for top-loading standard-size RCWs to reflect a market-weighted average of the use of stainless steel wash baskets versus enameled steel at the baseline level. DOE used information derived through confidential manufacturer interviews to determine the market weightings of each basket type. DOE has determined that using a market-weighted average provides a more accurate representation of the industry-average MPC at the baseline level for the top-loading standard-size product class.

In response to the comment from ASAP, ACEEE, and NYSERDA that DOE has historically overestimated cost increases from amended standards, DOE notes that the MPCs developed as part of the engineering analysis reflect observations of technologies as they are implemented on the market at the time of the analysis. As discussed further in chapter 5 of the direct final rule TSD, DOE takes into account that certain component-

[58] C. A. Spurlock & K. S. Fujita, "Equity implications of market structure and appliance energy efficiency regulation," Energy Policy, 2022, Vol. 165, 112943.

level costs would generally be lower on a per-unit basis due to higher production volumes that would result if DOE were to establish standards at a particular higher efficiency level.[59] To the extent that the actual cost of an improved baseline product brought to market in compliance with amended standards is less than the cost predicted by DOE in a prior rulemaking analysis, DOE notes that product cost reductions may not necessarily be related to efficiency redesigns even if implemented at the same time as efficiency-related design changes. For example, throughout the home appliance industry, DOE has observed a trend of greater use of plastic components to replace components that were previously made of metal or other more expensive materials. Manufacturers may also implement product redesigns that require fewer parts, therefore resulting in shorter assembly times and lower manual labor costs. DOE further notes that manufacturers may choose to implement such non-efficiency design changes at the same time as efficiency-related design changes in order to minimize the number of product redesigns. DOE often does not have insights into future non-efficiency related design changes being considered by manufacturers. Furthermore, trends that may have occurred in the past that resulted in cost reductions (*e.g.*, increased used of plastic components) would be expected to reach a "saturation point" and would therefore not be expected to continue indefinitely into the future. For these reasons, it would be inappropriately speculative, and therefore unjustifiable, for DOE to assume that non-efficiency related product cost reductions realized in the past would continue to be realized in the future in conjunction with future product redesigns prompted by amended efficiency standards.

[59] In general, higher product volumes result in lower per-unit costs for each part.

AHAM commented that the changes to load sizes in new appendix J will increase the inherent RMC in the loads, while the standards proposed in the March 2023 NOPR require RMC to be extremely low at the end of the cycle. (AHAM, No. 464 at p. 2) AHAM stated that in order to meet the standards proposed in the March 2023 NOPR using the updated test procedure, manufacturers will need to increase spin speed and high spin speed plateau times. (*Id.*) AHAM further commented that the changes to spin speed and time would drive motor, structure, and possible other design changes (such as larger counterweights in front-loading RCWs). (*Id*.) AHAM further commented that the changes to tested temperature settings in new appendix J will force cycle redesigns such as lowering the warmest warm temperature and other changes that add significant cost to maintain current levels of performance. (*Id*.)

In response to AHAM's comment regarding the impacts of the new test procedure on tested values, DOE notes that the translation equations developed to translate IMEF efficiency levels into EER efficiency levels inherently account for all the changes between the two test procedures, including the change in load size and the tested temperature settings.[60] The application of these translation equations is such that the translated EER level corresponding to a given IMEF level represents the same level of stringency as the IMEF level, even though the underlying RMC value may be different and/or the tested temperature selections may be weighted differently. As such, DOE has determined that the estimated costs associated with achieving higher efficiency levels in

[60] As discussed in section IV.C.1 of this document, these translation equations were developed by testing a representative sample of RCWs to both the appendix J test procedure and the appendix J2 test procedure, and correlating the results.

terms of IMEF and IWF are representative of the costs associated with achieving the corresponding EER and WER levels as determined through application of the translation equations.

Finally, for this direct final rule, DOE updated the underlying raw material prices used in its cost model to reflect current raw material prices, which resulted in slight changes to the MPC values in comparison to the values used in the March 2023 NOPR. Table IV.10 presents the baseline MPCs for each product class as determined for this direct final rule. Table IV.11 through Table IV.14 provide the incremental MPCs for each higher efficiency level for each product class as determined for this direct final rule. As discussed, no automatic top-loading compact RCWs are available on the market that exceed the baseline level. Accordingly, DOE did not consider any higher efficiency levels for this product class.

Table IV.10 Baseline Manufacturer Production Costs (2022$)

Product Class	Manufacturer Production Cost
Top-Loading Ultra-Compact (less than 1.6 ft^3 capacity)	$340.99
Top-Loading Standard-Size (1.6 ft^3 or greater capacity)	$263.56
Front-Loading Compact (less than 3.0 ft^3 capacity)	$307.19
Front-Loading Standard-Size (3.0 ft^3 or greater capacity)	$438.11
Semi-Automatic	$177.77

Table IV.11 Incremental Manufacturer Production Costs for Top-Loading Standard-Size (≥1.6 ft^3) Product Class (2022$)

EL	IMEF	IWF	EER	WER	Incremental Cost
Baseline	1.57	6.5	3.50	0.38	-
1	1.82	5.4	3.89	0.47	$49.55
2	2.06	4.3	4.27	0.57	$91.83
3	2.38	3.7	4.78	0.63	$99.90
4	2.76	3.2	5.37	0.67	$103.41

Table IV.12 Incremental Manufacturer Production Costs for Front-Loading Compact (<3.0 ft^3) Product Class (2022$)

EL	IMEF	IWF	EER	WER	Incremental Cost
Baseline	1.84	4.7	4.41	0.53	-
1	2.07	4.2	4.80	0.62	$33.27
2	2.20	3.7	5.02	0.71	$57.03
3	2.50	3.5	5.53	0.75	$79.67
4	2.76	3.2	5.97	0.80	$81.29

Table IV.13 Incremental Manufacturer Production Costs for Front-Loading Standard-Size (≥3.0 ft^3) Product Class (2022$)

EL	IMEF	IWF	EER	WER	Incremental Cost
DFR Baseline	1.84	4.7	4.31	0.38	-
NOPR Baseline	2.38	3.7	5.02	0.64	$0.00
1	2.60	3.5	5.31	0.69	$24.33
2	2.76	3.2	5.52	0.77	$42.03
3	2.92	3.2	5.73	0.77	$48.86
4	3.10	2.9	5.97	0.85	$58.27

Table IV.14 Incremental Manufacturer Production Costs for Semi-Automatic Product Class (2022$)

EL	EER	WER	Incremental Cost
Baseline	1.60	0.17	-
1	2.12	0.27	$8.35
2	2.51	0.36	$13.58

D. Markups Analysis

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

For RCWs, the main parties in the post-manufacturer distribution chain are retailers/distributors and consumers.

DOE developed baseline and incremental markups for each actor in the distribution chain. Baseline markups are applied to the price of products with baseline efficiency, while incremental markups are applied to the difference in price between baseline and higher-efficiency models (the incremental cost increase). The incremental markup is typically less than the baseline markup and is designed to maintain similar per-unit operating profit before and after new or amended standards.[61]

For the March 2023 NOPR, DOE relied on economic data from the U.S. Census Bureau to estimate average baseline and incremental markups.[62]

For this direct final rule, DOE considered comments it had received regarding the markups analysis conducted for the March 2023 NOPR. The approach for determining markups in this direct final rule was the same approach DOE had used for the March 2023 NOPR analysis.

In response to the March 2023 NOPR, AHAM commented that it, along with AHRI and other stakeholders, disputes DOE's distinction between markups from manufacturers to end customers for the base case and those for costs added to meet

[61] Because the projected price of standards-compliant products is typically higher than the price of baseline products, using the same markup for the incremental cost and the baseline cost would result in higher per-unit operating profit. While such an outcome is possible, DOE maintains that in markets that are reasonably competitive it is unlikely that standards would lead to a sustainable increase in profitability in the long run.
[62] US Census Bureau, *Annual Wholesale Trade Survey.* 2017. Available at *www.census.gov/awts* (last accessed May 2, 2023).

proposed standards. (AHAM, No. 464 at p. 34) AHAM presented data, including quotes from retailers, which AHAM believes contradicts DOE's process and theory, arguing that it lacks empirical evidence and relies on discredited theories. (*Id*.) AHAM commented that DOE's theory is inconsistent with the data DOE presents, as the price of RCWs has decreased over time while retailer gross margins have remained constant. (*Id*.) AHAM asserted that DOE cannot disregard data that contradicts its analysis and must take these comments into account to avoid arbitrary and capricious rulemaking. (*Id*. at p. 35)

DOE's incremental markup approach assumes that an increase in operating profits, which is implied by keeping a fixed markup when the product price goes up, is unlikely to be viable over time in a reasonably competitive market like household appliance retailers. The Herfindahl-Hirschman Index ("HHI") reported by the 2017 Economic Census indicates that the household appliance stores sector (NAICS 443141) is a competitive marketplace.[63] DOE recognizes that actors in the distribution chains are likely to seek to maintain the same markup on appliances in response to changes in manufacturer selling prices after an amendment to energy conservation standards. However, DOE believes that retail pricing is likely to adjust over time as those actors are forced to readjust their markups to reach a medium-term equilibrium in which per-unit profit is relatively unchanged before and after standards are implemented.

DOE acknowledges that markup practices in response to amended standards are complex and varying with business conditions. However, DOE's analysis necessarily

[63] 2017 Economic Census, Selected sectors: Concentration of largest firms for the U.S. Available at *www.census.gov/data/tables/2017/econ/economic-census/naics-sector-44-45.html*.

only considers changes in appliance offerings that occur in response to amended standards and isolates the effect of amended standards from other factors. Obtaining data on markup practices in the situation described above is very challenging. Hence, DOE continues to maintain that its assumption that standards do not facilitate a sustainable increase in profitability is reasonable.

Chapter 6 of the direct final rule TSD provides details on DOE's development of markups for RCWs.

E. Energy and Water Use Analysis

The purpose of the energy and water use analysis is to determine the annual energy and water consumption of RCWs at different efficiencies in representative U.S. single-family homes, multi-family residences, and mobile homes, and to assess the energy savings potential of increased RCW efficiency. The energy and water use analysis estimates the range of energy and water use of RCWs in the field (*i.e.*, as they are actually used by consumers). The energy and water use analysis provides the basis for other analyses DOE performed, particularly assessments of the energy and water savings and the savings in consumer operating costs that could result from adoption of amended or new standards.

To establish a reasonable range of energy and water consumption in the field for RCWs, DOE primarily used data from 2020 Residential Energy Conservation Survey

(“RECS”).[64] RECS is a national sample survey of housing units that collects statistical information on the consumption of and expenditures for energy in housing units along with data on energy-related characteristics of the housing units and occupants. The 2020 RECS collected data on 18,496 housing units and was constructed by EIA to be a national representation of the household population in the United States. DOE’s assumptions for establishing an RCW sample included the following considerations:

- The household had a clothes washer.
- Clothes washer use was greater than zero.

DOE divided the sample of households into five sub-samples to characterize the product classes being analyzed: top-loading ultra-compact RCWs; automatic, top-loading standard-size RCWs; automatic, front-loading compact RCWs; automatic, front-loading standard-size RCWs; and semi-automatic RCWs. For ultra-compact, compact, and semi-automatic clothes washers, DOE developed a sub-sample consisting of households from multi-family buildings, manufactured homes, and single-family homes with less than 1,000 square feet and no garage or basement, since DOE reasoned that such products are most likely to be found in these housing types.

The energy and water use analysis requires DOE to establish a range of total annual usage or annual number of cycles in order to estimate annual energy and water consumption by a clothes washer unit. DOE unutilized data from the 2020 RECS, which

[64] U.S. Department of Energy - Energy Information Administration, Residential Energy Consumption Survey: 2020 Public Use Data Files, 2020. Available at *www.eia.gov/consumption/residential/data/2020/* (last accessed June 28, 2023).

provided information on the number of laundry loads washed (clothes washer cycles) per week for sample households. The average annual energy and water consumption were then calculated, reflecting an average annual weighted usage of 210 cycles per year (206 cycles for top-loading RCWs and 217 cycles for front-loading RCWs).

For each sample household, DOE estimated the field-based annual energy and water use of the clothes washer by multiplying the annual number of clothes washer cycles for each household by the per-cycle energy and water use values established by the engineering analysis (using the DOE test procedure) for each considered efficiency level. Per-cycle clothes washer energy use is calculated in the test procedure as the sum of per-cycle machine energy use associated with the clothes washer (including the energy used to heat water and remove moisture from clothing),[65] and combined low-power-mode energy use.

For this direct final rule, DOE considered comments it had received regarding the energy and water use analysis conducted for the March 2023 NOPR. The approach used for this direct final rule is largely the same as the approach DOE had used for the March 2023 NOPR analysis.

In response to the March 2023 NOPR, Whirlpool commented that DOE appears to double-count the savings for drying energy between the RCW standard analysis and the consumer clothes dryer standard analysis. (Whirlpool, No. 462 at p. 14) Whirlpool

[65] The per-cycle energy consumption associated with a given clothes washer has three components: energy used for heating water, operating the machine, and drying the clothes.

noted that DOE's RCW analysis assumed an RMC of 37 percent and 33 percent were needed to meet the standard levels proposed in the March 2023 NOPR (for top-loading and front-loading, respectively), whereas the clothes dryer test procedure at 10 CFR part 430, subpart B, appendix D2 ("appendix D2") assumes an initial moisture content of 57.5 percent. (*Id.*) Whirlpool commented that this effectively accounts for a significantly higher moisture content of the clothes going into the clothes dryer than would be allowed for coming out of the clothes washer under the standards for RCWs proposed in the March 2023 NOPR. (*Id.*) Whirlpool suggested that DOE choose which appliance (clothes washers or clothes dryers) should include the reduction of RMC in its analysis, and that the analysis for the other standard should not also account for it. (*Id.*) Whirlpool commented that the current approach may hurt consumers who may not get the full savings they are expecting and significantly impact the economic analysis, selection of efficiency levels, and whether the level is economically justified. (*Id.*)

AHAM commented that DOE is overestimating the expected energy savings between clothes washers and clothes dryers by assuming an RMC at the proposed standard of 37 percent for top-loading standard-size RCWs and of 33 percent for front-loading standard-size RCWs, which is lower than the initial moisture content of 57.5 percent in the clothes dryers test procedure. (AHAM, No. 464 at p. 23) AHAM commented that DOE is therefore assuming that the drying cycle requires more energy than is needed. (*Id.*) AHAM commented that these assumptions overestimate the savings that many consumers will experience when purchasing a laundry pair and that DOE should better estimate the savings by considering the pair purchase rate and usage of older clothes washers with possibly higher RMC values after the standard goes into effect. (*Id.*)

To the greatest extent possible, DOE avoids double-counting between the RCW standards analysis and the consumer clothes dryer standards analysis, as explained by the following. Amended RCW standards result in less total moisture needing to be removed from the clothing in a clothes dryer, whereas amended consumer clothes dryer standards result in a less energy-intensive process for removing that moisture. As such, the drying energy savings associated with amended RCW standards represent savings experienced through shorter drying times (due to the clothing being “less wet” after the completion of the wash cycle due to faster spin speeds), whereas the drying energy savings associated with amended consumer clothes dryer standards represents savings attributable to improvements to the inherent efficiency of the drying process itself. Pertaining to this RCW standards analysis, the clothes dryer energy savings associated with reduced RMC values—essentially resulting in shorter drying cycles—would be experienced by consumers regardless of whether a consumer purchases a new clothes dryer alongside a new RCW or continues to use their existing clothes dryer.

For RCWs, the embedded assumptions and usage factors defined in the test procedure for calculating drying energy are intended to reflect the characteristics of the current installed stock of consumer clothes dryers on a nationally representative basis. Similarly, for clothes dryers, the assumed initial moisture content value defined in the clothes dryer test procedure is intended to reflect the characteristics of the current installed stock of RCWs on a nationally representative basis. DOE regularly reevaluates these assumptions and usage factors as part of its test procedure rulemakings—and adjusts each value when warranted—to ensure that each respective test procedure produces test results that are nationally representative as the markets for these products evolve over time, in part due to amended energy conservation standards.

Alliance for Water Efficiency ("AWE") recommended that DOE evaluate energy embedded in the water that will be saved as a result of the proposed standard. (AWE, No. 444 at p. 4) AWE stated that it has developed a tool for evaluating the water savings, costs, and benefits of urban water conservation programs and for projecting future demands that provides a range of estimates for embedded water and wastewater energy. (*Id*.) AWE recommended that DOE use the estimates from AWE's conservation tracking tool for calculating the energy embedded in the water and noted that DOE could also adjust this based on the assumptions it is currently using for private wells. (*Id*.)

DOE has previously determined that EPCA does not direct DOE to consider the energy used for water treatment and delivery. In the May 2012 Direct Final Rule, DOE noted that EPCA directs DOE to consider "the total projected amount of energy, or as applicable, water, savings likely to result directly from the imposition of the standard." 77 FR 32308, 32346 (quoting 42 U.S.C. 6295(o)(2)(B)(i)(III)). In the May 2012 Direct Final Rule, DOE interpreted "directly from the imposition of the standard" to include energy used in the generation, transmission, and distribution of fuels used by appliances. Unlike the energy used for water treatment and delivery, both DOE's current accounting of primary energy savings and the full-fuel-cycle measure are directly linked to the energy used by appliances. *Id.*

ASAP, ACEEE, and NYSERDA noted that data found in the 2016 Residential End Uses of Water ("REUW") report suggest that DOE may be significantly underestimating the average number of RCW loads per year. (ASAP, ACEEE, and NYSERDA, No. 458 at p. 3)

AWE recommended that DOE use actual data from 2016 REUW or other actual end-use data for its assumptions about RCW loads per year. (AWE, No. 444 at p. 3) AWE stated that there are often large gaps between consumer survey responses and actual behavior when it comes to fixture and appliance uses, and therefore data from reports like 2016 REUW or other sources, such as smart metering companies, could be more reliable than the 2015 RECS. (*Id.*) AWE recommended that DOE consider using actual customer end use beyond the EIA's survey data and, in the absence of data from additional sources, DOE should use 285 loads per year based on actual data from 2016 REUW, instead of 234 load per year. (*Id.*)

DOE has reviewed the 2016 REUW report, published by the Water Research Foundation, which analyzed RCW end-use data from detailed log data from 737 households. However, DOE noticed a significant disparity between the annual clothes washer usage reported in this report compared to the latest data from the 2020 RECS. Specifically, as noted by AWE, the 2016 REUW shows an average of 285 loads per year compared to an average of 210 cycles per year determined based on the 2020 RECS. DOE acknowledges that RECS is based on household reported frequency of average clothes washer usage per week rather than on contemporaneous logs taken by households, which could be more reliable on an individual basis. However, unlike the

2016 REUW[66] or any other field metered consumer end-use data that DOE is aware of, the 2020 RECS consists of a nationally representative sample of housing units including more than 10,000 households that report RCW usage.

Although stakeholders suggested that the cycles per year determined based on RECS may be underestimated, the 2020 RECS is the most comprehensive and most current data source available on this topic, and, as such, DOE is adopting the lower usage reported in the latest RECS. This approach results in a conservative estimate for energy and water savings.

Representatives Latta *et al*. commented that DOE's energy savings analysis assumes consumers will wash full loads because they have larger RCWs, and asserted that DOE offers little evidence to suggest consumers will modify their behavior by washing larger loads to achieve the full efficiency benefits of owning large-capacity clothes washers. (Representatives Latta *et al*., No. 456 at p. 2)

Whirlpool commented that the assumption made by DOE that larger RCWs lead to energy savings is incorrect. (Whirlpool, No. 462 at pp. 8–9) Whirlpool asserted that many consumers do laundry based on the size of their laundry basket or on a regular schedule, disregarding the RCW's available capacity; despite load sensing technology, larger RCWs may be less efficient for the same load size compared to smaller ones; some

[66] The 2016 REUW only covered the following states: Colorado, Arizona, Georgia, Texas, Washington, and Florida.

consumers may not fill the wash basket completely, compromising the benefits of larger capacity RCWs for better cleaning. (*Id*.)

ASAP, ACEEE, and NYSERDA noted that DOE's per-cycle energy and water use analysis is based on the test procedure, which assumes that load sizes are larger for larger machines. (ASAP, ACEEE, and NYSERDA, No. 458 at p. 3) ASAP, ACEEE, and NYSERDA stated that by assuming that tub capacity would increase from 4.0 to 4.7 ft^3 in response to the standards for top-loading standard-size RCWs proposed in the March 2023 NOPR, DOE's energy and water use analysis thereby assumes that consumers wash 15 percent more clothing annually under the proposed standard. (*Id.*) ASAP, ACEEE, and NYSERDA asserted that this assumption that tub capacity would increase and lead to more clothing washed annually seems unlikely and has the effect of reducing overall energy, water, and cost savings in the downstream analysis. (*Id.*)

The energy and water use values associated with each efficiency level in the energy use analysis are derived from testing conducted according to the new appendix J test procedure, as described by ASAP, ACEEE, and NYSERDA. Indeed, for the top-loading standard-size efficiency levels for which DOE has modeled as increase in tub size as a design option path, the associated energy and water use estimates are based on the assumed use of larger load sizes—as defined by the test procedure—while assuming the same number of annual cycles (*i.e.*, 206 cycles for top-loading RCWs) at each efficiency level. 87 FR 33316, 33330–33334 DOE acknowledges that this analytical framework reflects more clothing being washed annually in units with larger tub capacities. Under this methodology, maintaining the same volume of annual clothing washed at the efficiency levels where capacity increases could be modeled by either reducing the number of annual cycles, or assuming the same load size is used in the larger-capacity units as for the smaller-capacity units, or some combination of both. DOE notes that data from historical RECS indicates that the average use of each RCW has steadily declined from 292 cycles in 2005, 282 cycles in 2009, 235 cycles in 2015, to 210 cycles in the 2020 RECS. This decline in usage trend aligns with a significant increase in washing machine capacity, which grew from shipments-weighted 2.52 ft^3 to 4.25 ft^3 between 1991 and 2020, according to data submitted by AHAM. The data indicate that on average the volume of clothing washed by U.S. households has remained constant over the past 15 years and consumers generally are capitalizing on the larger capacity of RCWs to conduct fewer, but fuller loads.[67] Additionally, the 2020 RECS estimate of 210 cycles per year reflects the range of RCW capacities within the stock, as well as the range of load sizes consumers use for their laundry. As the RECS data does not include information about household washing machine capacities and load sizes, utilizing a single weighted average annual usage across efficiency levels leads to conservative estimates for energy and water savings when compared to using higher annual usage cycles for the baseline and lower annual usage cycles for higher efficiency levels. DOE assumes that household washing volumes remain constant, leading to fewer laundry cycles with the use of a larger RCW.

[67] In this direct final rule, DOE has not studied whether there is any correlation between the declining annual usage of clothes washers and other potential factors, such as changes in detergent formulations, changes in types of clothing, or changes in household dynamics.

Chapter 7 of the direct final rule TSD provides details on DOE's energy use analysis for RCWs.

F. Life-Cycle Cost and Payback Period Analysis

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

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

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

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

For each considered efficiency level in each product class, DOE calculated the LCC and PBP for a nationally representative set of residential housing units. As stated previously, DOE developed household samples from the 2020 RECS. For each sample household, DOE determined the energy and water consumption for the RCWs and the appropriate energy and water prices. By developing a representative sample of households, the analysis captured the variability in energy and water consumption and energy and water prices associated with the use of RCWs.

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

The computer model DOE uses to calculate the LCC relies on a Monte Carlo simulation to incorporate uncertainty and variability into the analysis. The Monte Carlo simulations randomly sample input values from the probability distributions and RCW user samples. For this rulemaking, the Monte Carlo approach is implemented in MS Excel together with the Crystal Ball™ add-on.[68] The model calculated the LCC for products at each efficiency level for 10,000 housing units per simulation run. The analytical results include a distribution of 10,000 data points showing the range of LCC savings for a given efficiency level relative to the no-new-standards case efficiency distribution. In performing an iteration of the Monte Carlo simulation for a given consumer, product efficiency is chosen based on its probability. If the chosen product efficiency is greater than or equal to the efficiency of the standard level under consideration, the LCC calculation reveals that a consumer is not impacted by the standard level. By accounting for consumers who already purchase more-efficient products, DOE avoids overstating the potential benefits from increasing product efficiency.

DOE calculated the LCC and PBP for consumers of RCWs as if each were to purchase a new product in the first year of required compliance with amended standards. Amended standards apply to RCWs manufactured 3 years after the date on which any amended standard is published. (42 U.S.C. 6295(m)(4)(A)(i)) Therefore, DOE used 2027 as the first year of compliance with any considered TSLs for RCWs, except for the Recommended TSL. For the Recommended TSL, DOE used 2028 as the first year of compliance.

[68] Crystal Ball™ is commercially available software tool to facilitate the creation of these types of models by generating probability distributions and summarizing results within Excel, available at *www.oracle.com/technetwork/middleware/crystalball/overview/index.html* (last accessed July 6, 2023).

Table IV.15 summarizes the approach and data DOE used to derive inputs to the LCC and PBP calculations. The subsections that follow provide further discussion. Details of the spreadsheet model, and of all the inputs to the LCC and PBP analyses, are contained in chapter 8 of the direct final rule TSD and its appendices.

Table IV.15 Summary of Inputs and Methods for the LCC and PBP Analysis*

Inputs	Source/Method
Product Cost	Derived by multiplying MPCs by manufacturer and retailer markups and sales tax, as appropriate. Used historical data to derive a price scaling index to project product costs.
Installation Costs	Baseline installation cost determined with data from RS Means Residential Cost Data 2022. Assumed no change with efficiency level.
Annual Energy and Water Use	Per cycle energy and water use multiplied by the cycles per year. Average number of cycles based on field data. Variability: Based on the 2020 RECS.
Energy and Water Prices	Electricity: Based on EIA's Form 861 data for 2022. Variability: Regional energy prices determined for 9 Census Divisions. Water: Based on 2020 AWWA/Raftelis Survey Variability: Regional water prices determined for 4 Census Regions.
Energy and Water Price Trends	Based on *AEO2023* price projections. Water: Forecasted using BLS historic water price index information.
Repair and Maintenance Costs	Repair costs vary by product class and vary between ENERGY STAR and non-ENERGY STAR RCWs.
Product Lifetime	Average: 13.4 years
Discount Rates	Approach involves identifying all possible debt or asset classes that might be used to purchase the considered appliances, or might be affected indirectly. Primary data source was the Federal Reserve Board's Survey of Consumer Finances.
Compliance Date	TSL 1, TSL 3, and TSL 4: 2027 TSL 2 (Recommended TSL): 2028

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

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

In the March 2023 NOPR, DOE performed a random assignment of efficiency levels to consumers in its Monte Carlo sample. 88 FR 13520, 13564. While DOE acknowledges that economic factors may play a role when consumers decide on what type of RCW to install, assignment of RCW product efficiency for a given installation, based solely on economic measures such as life-cycle cost or simple payback period, most likely would not fully and accurately reflect actual real-world installations. There are a number of market failures discussed in the economics literature that illustrate how purchasing decisions with respect to energy efficiency are unlikely to be perfectly correlated with energy use, as described below. DOE maintains that the method of assignment, which is in part random, is a reasonable approach, because it simulates behavior in the RCW product market, where market failures result in purchasing decisions not being perfectly aligned with economic interests, and is more realistic than relying only on apparent cost-effectiveness criteria derived from the limited information in RECS. DOE further emphasizes that its approach does not assume that all purchasers of RCW products make economically irrational decisions (*i.e.*, the lack of a correlation is not the same as a negative correlation). By using this approach, DOE acknowledges the uncertainty inherent in the data and minimizes any bias in the analysis by using random assignment, as opposed to assuming certain market conditions that are unsupported given the available evidence.

The following discussion provides more detail about the various market failures that affect RCW product purchases. First, consumers are motivated by more than simple financial trade-offs. There are consumers who are willing to pay a premium for more energy-efficient products because they are environmentally conscious.[69] There are also several behavioral factors that can influence the purchasing decisions of complicated multi-attribute products, such as RCW products. For example, consumers (or decision makers in an organization) are highly influenced by choice architecture, defined as the framing of the decision, the surrounding circumstances of the purchase, the alternatives available, and how they are presented for any given choice scenario.[70] The same consumer or decision maker may make different choices depending on the characteristics of the decision context (*e.g.*, the timing of the purchase, competing demands for funds), which have nothing to do with the characteristics of the alternatives themselves or their prices. Consumers or decision makers also face a variety of other behavioral phenomena including loss aversion, sensitivity to information salience, and other forms of bounded rationality.[71] Thaler, who won the Nobel Prize in Economics in 2017 for his contributions to behavioral economics, and Sunstein point out that these behavioral factors are strongest when the decisions are complex and infrequent, when feedback on the decision is muted and slow, and when there is a high degree of information asymmetry.[72] These characteristics describe almost all purchasing situations of appliances and equipment, including RCWs. The installation of a new or replacement RCW product is done very

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[69] Ward, D.O., Clark, C.D., Jensen, K.L., Yen, S.T., & Russell, C.S. (2011): "Factors influencing willingness-to pay for the ENERGY STAR® label," *Energy Policy, 39* (3), 1450-1458 (Available at: *www.sciencedirect.com/science/article/abs/pii/S0301421510009171*) (Last accessed August 1, 2023).
[70] Thaler, R.H., Sunstein, C.R., and Balz, J.P. (2014). "Choice Architecture" in *The Behavioral Foundations of Public Policy,* Eldar Shafir (ed).
[71] Thaler, R.H., and Bernartzi, S. (2004). "Save More Tomorrow: Using Behavioral Economics in Increase Employee Savings," *Journal of Political Economy* 112(1), S164-S187. *See also* Klemick, H., *et al.* (2015) "Heavy-Duty Trucking and the Energy Efficiency Paradox: Evidence from Focus Groups and Interviews," *Transportation Research Part A: Policy & Practice,* 77, 154-166 (providing evidence that loss aversion and other market failures can affect otherwise profit-maximizing firms).
[72] Thaler, R.H., and Sunstein, C.R. (2008). Nudge: Improving Decisions on Health, Wealth, and Happiness. New Haven, CT: Yale University Press.

infrequently, as evidenced by the mean lifetime of 13.4 years. Further, if the purchaser of the RCW is not the entity paying the energy costs (*e.g.*, a building owner and tenant), there may be little to no feedback on the purchase. Additionally, there are systematic market failures that are likely to contribute further complexity to how products are chosen by consumers, as explained in the following paragraphs. The first of these market failures—the split-incentive or principal-agent problem—is likely to significantly affect RCWs. The principal-agent problem is a market failure that results when the consumer that purchases the equipment does not internalize all of the costs associated with operating the equipment. Instead, the user of the product, who has no control over the purchase decision, pays the operating costs. There is a high likelihood of split-incentive problems in the case of rental properties where the landlord makes the choice of what RCW product to install, whereas the renter is responsible for paying water and energy bills.

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

Additionally, Davis and Metcalf[73] conducted an experiment demonstrating that, even when consumers are presented with energy consumption information, the nature of the information available to consumers (*e.g.*, from EnergyGuide labels) results in an inefficient allocation of energy efficiency across households with different usage levels. Their findings indicate that households are likely to make decisions regarding the efficiency of the air conditioning equipment of their homes that do not result in the highest net present value for their specific usage pattern (*i.e.*, their decision is based on imperfect information and, therefore, is not necessarily optimal). Also, most consumers did not properly understand the labels (specifically whether energy consumption and cost estimates were national averages or specific to their State). As such, consumers did not make the most informed decisions.

In part because of the way information is presented, and in part because of the way consumers process information, there is also a market failure consisting of a systematic bias in the perception of equipment energy usage, which can affect consumer choices. Attari *et al.*[74] show that consumers tend to underestimate the energy use of large energy-intensive appliances (such as air conditioners, dishwashers, and consumer clothes dryers), but overestimate the energy use of small appliances (such as light bulbs).

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[73] Davis, L.W., and G.E. Metcalf (2016): "Does better information lead to better choices? Evidence from energy-efficiency labels," *Journal of the Association of Environmental and Resource Economists,* 3(3), 589-625 (Available at: *www.journals.uchicago.edu/doi/full/10.1086/686252*) (Last accessed August 1, 2023).

[74] Attari, S.Z., M.L. DeKay, C.I. Davidson, and W. Bruine de Bruin (2010): "Public perceptions of energy consumption and savings." *Proceedings of the National Academy of Sciences* 107(37), 16054-16059 (Available at: *www.pnas.org/content/107/37/16054*) (Last accessed August 1, 2023).

Therefore, it is possible that consumers systematically underestimate the energy use associated with RCWs, resulting in less cost-effective purchases.

These market failures affect a sizeable share of the consumer population. A study by Houde[75] indicates that there is a significant subset of consumers that appear to purchase appliances without taking into account their energy efficiency and operating costs at all.

The existence of market failures in the residential sector is well supported by the economics literature and by a number of case studies. If DOE developed an efficiency distribution that assigned RCW product efficiency in the no-new-standards case solely according to energy use or economic considerations such as life-cycle cost or payback period, the resulting distribution of efficiencies within the consumer sample would not reflect any of the market failures or behavioral factors above. Thus, DOE concludes such a distribution would not be representative of the RCW product market. Further, even if a specific household is not subject to the market failures above, the purchasing decision of RCW product efficiency can be highly complex and influenced by a number of factors (*e.g.*, aesthetics) not captured by the building characteristics available in the RECS sample. These factors can lead to households or building owners choosing an RCW product efficiency that deviates from the efficiency predicted using only energy use or economic considerations such as life-cycle cost or payback period.

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[75] Houde, S. (2018): "How Consumers Respond to Environmental Certification and the Value of Energy Information," *The RAND Journal of Economics,* 49 (2), 453-477 (Available at: *onlinelibrary.wiley.com/doi/full/10.1111/1756-2171.12231*) (Last accessed August 1, 2023).

There is a complex set of behavioral factors, with sometimes opposing effects, affecting the RCW product market. It is impractical to model every consumer decision incorporating all of these effects at this extreme level of granularity given the limited available data. Given these myriad factors, DOE estimates the resulting distribution of such a model, if it were possible, would be very scattered with high variability. It is for this reason DOE utilizes a random distribution (after accounting for efficiency market share constraints) to approximate these effects. The methodology is not an assertion of economic irrationality, but instead, it is a methodological approximation of complex consumer behavior. The analysis is neither biased toward high or low energy savings. The methodology does not preferentially assign lower-efficiency RCW products to households in the no-new-standards case where savings from the rule would be greatest, nor does it preferentially assign lower-efficiency RCW products to households in the no-new-standards case where savings from the rule would be smallest. Some consumers were assigned the RCW products that they would have chosen if they had engaged in perfect economic considerations when purchasing the products. Others were assigned less-efficient RCW products even where a more-efficient product would eventually result in life-cycle savings, simulating scenarios where, for example, various market failures prevent consumers from realizing those savings. Still others were assigned RCW products that were *more* efficient than one would expect simply from life-cycle costs analysis, reflecting, say, “green” behavior, whereby consumers ascribe independent value to minimizing harm to the environment.

For this direct final rule, DOE considered comments it had received regarding the LCC analysis conducted for the March 2023 NOPR. The LCC approach used for this direct final rule is largely the same as the approach DOE had used for the March 2023 NOPR analysis.

In response to the March 2023 NOPR, AHAM commented that DOE's reliance on the RECS database in its analysis is introducing outlier values into its LCC analysis. (AHAM, No. 464 at p. 36) AHAM commented that the documentation of the 2015 RECS reveals uncertainties, errors, and approximations within its data, making it difficult to determine the accuracy of consumption projections for individual housing units. (*Id*. at p. 37) AHAM therefore cautioned DOE against relying on potentially inaccurate outlier values, noting that this concern is highlighted by the significant difference between the mean and median LCC savings at any standard level, where these measures should ideally be closely aligned. (*Id*.) AHAM urged DOE to use median values instead of mean values to mitigate these data issues. (*Id*.)

As described in section IV.E of this document., DOE's energy and water use analysis for this direct final rule is derived based on 2020 RECS, which provides household's clothes washer loads information ranging from 1 cycle to 30 cycles per week. The field-based annual energy and water use for each household then feed into the LCC analysis. DOE notes that there is no indication that any of households in the RECS sample represent non-valid data that should be excluded as an outlier. Excluding minimum and maximum values from the field-based usage statistics would result in a less accurate representation of the actual energy and water consumption patterns exhibited by households participating in the survey. However, as a standardized approach, DOE presents all statistical results of LCC savings in chapter 8 of its TSD (*i.e.*, box plots). This approach allows stakeholders to observe the full range of LCC savings and understand the distribution of results, enabling a more informed evaluation of the potential impacts of proposed standards. In addition, DOE's decision on amended standards is not solely determined by (mean) LCC savings. While LCC savings play a role, they may be considered alongside other critical factors, including the percentage of negatively impacted consumers, the simple payback period, and the overall impact on manufacturers.

AHAM commented that DOE should focus on conducting a purchase decision analysis instead of relying on outcomes and long-term cost analyses. (AHAM, No. 464 at p. 33) AHAM commented that the basis for regulation lies in identifying consumer and systemic market failures, where consumer failure refers to making "incorrect" decisions due to a lack of information. (*Id*.) AHAM suggested that modeling efforts should prioritize identifying rational decisions, as it is unreasonable to predict actual outcomes given the numerous unpredictable factors that can influence them. (*Id*.) AHAM commented on the importance of considering the actual conditions and expectations of purchasers in DOE's LCC model, separate from the broader economic impact analysis. (*Id*. at p. 34) AHAM suggested that the LCC model should assess the extent of market failure by comparing the actual rate of energy-efficient product purchases with the rate that rational consumers would choose. (*Id*.)

In response to the March 2023 NOPR, an anonymous commenter stated that the proposed rule change makes questionable assumptions about consumer behavior, particularly the expectation that consumers will buy their RCWs within the first year, which might skew the cost-benefit analysis. (Anonymous, No. 391 at p. 1)

First, DOE notes that the LCC analysis currently relies on market data on the distribution of efficiency of products to assign products with varying efficiency performance to each household when compliance with the standard becomes required. This approach is intended to simulate the range of individual outcomes likely to result from the hypothetical setting of a revised energy conservation standard at various levels of efficiency when the data needed to develop a product-specific consumer choice model are currently unavailable. DOE does not negate the consumer decision theory established in the broad behavioral economic field; rather, this is a methodological decision made by DOE after considering the existence of various systematic market failures (*e.g.*, information asymmetries, bounded rationality, principal-agent relationship, *etc*.) and their implication in rational versus actual purchase behavior. The outcome of the LCC is not considered in isolation, but in the context of the broader set of analyses, including the NIA. Additionally, DOE's shipment analysis takes into account consumers' sensitivity to higher purchase prices under a considered TSL. DOE assumes that when market impacts occur, some consumers would prefer to repair or purchase a used unit rather than buy a new clothes washer when amended standards take effect. This approach ensures that the national cost-benefit results are neither skewed nor biased. See chapter 9 of the direct final rule TSD for details.

1. Product Cost

To calculate consumer product costs, DOE multiplied the MPCs developed in the engineering analysis by the markups described previously (along with sales taxes). DOE used different markups for baseline products and higher-efficiency products, because DOE applies an incremental markup to the increase in MSP associated with higher-efficiency products.

Economic literature and historical data suggest that the real costs of many products may trend downward over time according to "learning" or "experience" curves. Experience curve analysis implicitly includes factors such as efficiencies in labor, capital investment, automation, materials prices, distribution, and economies of scale at an industry-wide level.[76] To derive the learning rate parameter for RCWs, DOE obtained historical Producer Price Index ("PPI") data for "household laundry equipment" between 1948 and 2016 and "major household appliance: primary products" between 2016 and 2022 from the Bureau of Labor Statistics' ("BLS") to form a time series price index representing household laundry equipment from 1948 to 2022.[77] These two PPI series are the most current and disaggregated price index that includes RCWs, and DOE assumes that the price trend estimated from the household laundry equipment PPI is representative of that for RCWs. Inflation-adjusted price indices were calculated by dividing the PPI series by the gross domestic product index from Bureau of Economic Analysis for the

[76] Taylor, M. and Fujita, K.S. Accounting for Technological Change in Regulatory Impact Analyses: *The Learning Curve Technique*. LBNL-6195E. Lawrence Berkeley National Laboratory, Berkeley, CA. April 2013. Available at *escholarship.org/uc/item/3c8709p4#page-1*.
[77] "Household laundry equipment" PPI (PCU3352203352204) is available through May 2016, and "major household appliance: primary products" PPI (PCU335220335220P) is available from May 2016 to present. *See* more information at *www.bls.gov/ppi/* (last accessed June 13, 2023).

same years. The estimated learning rate (defined as the fractional reduction in price expected from each doubling of cumulative production) is 17.2 percent. *See* chapter 8 of the direct final rule TSD for further details on this topic.

For this direct final rule, DOE considered comments it had received regarding the methodology for calculating consumer product costs that was presented in the March 2023 NOPR. The approach used for this direct final rule is largely the same as the approach DOE had used for the March 2023 NOPR analysis.

In response to the March 2023 NOPR, AHAM commented that DOE's application of a "learning or experience curve" to reduce expected extra manufacturing costs required to meet proposed standard levels lacks a solid theoretical foundation. (AHAM, No. 464 at p. 35) AHAM commented that the approach, based solely on empirical relationships, demands clear alignment with the actual products under consideration, with a necessity to adjust equations when data changes shape. (*Id*. at pp. 35–36) AHAM commented that DOE's justification that continued use of learning rates is justified by past price declines is DOE confusing past correlation with future causation and questions the basis for forward projection. (*Id*. at p. 36) AHAM further opposed the proposed continuous function form of future trends, particularly given signs of data "flattening" in DOE's learning curve equation and that all recent data is above the line drawn by the equation. AHAM commented that such "learning" should not be projected beyond labor and materials costs, given it does not logically apply to overheads, sales, marketing, general and administrative costs, or depreciation and financing costs. (*Id*. at p. 36)

DOE notes that there is considerable empirical evidence of consistent price declines for appliances in the past few decades. Several studies examined refrigerator retail prices during different periods of time and showed that prices had been steadily falling while efficiency had been increasing, for example Dale, *et al*. (2009)[78] and Taylor, *et al*. (2015).[79] Given the limited data availability on historical manufacturing costs broken out by different components, DOE utilized the Producer Price Index ("PPI") published by the BLS as a proxy for manufacturing costs to represent the analyzed product as a whole. Thus, DOE applied the price learning to the entire costs and did not consider the applicability of learning on individual cost components. While products may experience varying degrees of price learning during different product stages, DOE modeled the average learning rate based on the full historical PPI series to capture the overall price evolution in relation to the cumulative shipments. DOE also conducted sensitivity analyses that are based on a particular segment of the PPI data for household laundry products manufacturing to investigate the impact of alternative product price projections in the LCC (constant price) and NIA (high price learning and constant price) of this direct final rule. For details of the sensitivity results, see appendix 8F and appendix 10C of the direct final rule TSD.

Representatives Latta *et al*. expressed concern at the consumer cost impact of the proposed standards, noting that top-loading standard-size RCWs currently on the market

[78] Dale, L., C. Antinori, M. McNeil, James E. McMahon, and K. S. Fujita. Retrospective evaluation of appliance price trends. Energy Policy. 2009. 37 (2) pp. 597-605. *doi.org/10.1016/j.enpol.2008.09.087*.
[79] Taylor, M., C. A. Spurlock, and H.-C. Yang. Confronting Regulatory Cost and Quality Expectations. An Exploration of Technical Change in Minimum Efficiency Performance Standards. 2015. Lawrence Berkeley National Lab. (LBNL), Berkeley, CA (United States). Report No. LBNL-1000576. Available at *www.osti.gov/biblio/1235570/* (last accessed June 30, 2023).

meeting the standard proposed in the March 2023 NOPR have a manufacturer's suggested retail price ("MSRP") of over $1,000, a price that Representatives Latta *et al*. characterized as out of reach for many consumers and that is over $400 higher than the MSRP of entry-level models. (Representatives Latta *et al*., No. 456 at p. 2)

DOE notes that in most cases—and in particular for top-loading standard-size RCWs—the MSRP of an existing model at a certain higher efficiency level does not reflect the consumer purchase price that would be expected if DOE were to enact an amended standard at that higher efficiency level, for two main reasons. First, current models at higher efficiency levels are produced at significantly lower shipment volumes than baseline models, which generally results in higher per-unit costs for each component part for the higher efficiency models. Second, higher efficiency models are often "bundled" with non-efficiency related features that add additional cost to the product and contribute to the overall higher MSRP. Because of these drawbacks to using MSRP as the basis for evaluating the economic justification of a higher standard, DOE instead uses a reverse-engineering approach—combined with a detailed analysis of markups—to estimate the impact on consumer purchase price that would be expected as a result of an amended standard. As discussed in sections IV.C.3 and IV.D of this document, DOE evaluates the cost impact to consumers by developing incremental MPC costs and multiplying the MPCs by various markups to develop the consumer purchase price. This approach allows DOE to account for any economies of scale that would result from producing more efficient RCWs at larger shipment volumes and to isolate the cost of any non-efficiency-related features that are often bundled with higher-efficiency RCWs on the market today.

2. Installation Cost

Installation cost includes labor, overhead, and any miscellaneous materials and parts needed to install the product. DOE used data from 2022 *RS Means Residential Cost Data* to estimate the baseline installation cost for RCWs.[80] DOE found no evidence that installation costs would be impacted with increased efficiency levels.

3. Annual Energy and Water Consumption

For each sampled household, DOE determined the energy and water consumption for an RCW at different efficiency levels using the approach described previously in section IV.E of this document.

4. Energy and Water Prices

a. Energy Prices

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

[80] RS Means Company Inc., RS Means Residential Cost Data (2022). Available at *https://rsmeans.com/*.

DOE derived electricity prices in 2022 using data from EEI Typical Bills and Average Rates reports for summer and winter 2022.[81] Based upon comprehensive, industry-wide surveys, this semi-annual report presents typical monthly electric bills and average kilowatt-hour costs to the customer as charged by investor-owned utilities. For the residential sector, DOE calculated electricity prices using the methodology described in Coughlin and Beraki (2018).[82]

DOE's methodology allows electricity prices to vary by sector, region and season. In the analysis, variability in electricity prices is chosen to be consistent with the way the consumer economic and energy use characteristics are defined in the LCC analysis.

DOE obtained data for calculating regional prices of natural gas from the EIA publication, *Natural Gas Navigator*.[83] This publication presents monthly volumes of natural gas deliveries and average prices by State for residential, commercial, and industrial customers. DOE used the complete annual data for 2022 to calculate an average annual price for each census division. Residential natural gas prices were adjusted by applying seasonal marginal price factors to reflect a change in a consumer's bill associated with a change in energy consumed.

[81] Edison Electric Institute. Typical Bills and Average Rates Report. Winter 2022, Summer 2022. Available at *www.eei.org/resourcesandmedia/products/Pages/Products.aspx*.
[82] Coughlin, K. and B. Beraki.2018. Residential Electricity Prices: A Review of Data Sources and Estimation Methods. Lawrence Berkeley National Lab. Berkeley, CA. Report No. LBNL-2001169. Available at *ees.lbl.gov/publications/residential-electricity-prices-review*.
[83] U.S. Department of Energy–Energy Information Administration. *Natural Gas Navigator* 2022. Available at *www.eia.gov/naturalgas/data.php*.

DOE assigned average prices to each household in the LCC sample based on its location and its baseline electricity and gas consumption. For sampled households who were assigned a product efficiency greater than or equal to the considered level for a standard in the no-new-standards case, DOE assigned marginal prices to each household based on its location and the decremented electricity and gas consumption. In the LCC sample, households could be assigned to one of nine census divisions. *See* chapter 8 of the direct final rule TSD for details.

To estimate energy prices in future years, DOE multiplied the 2022 energy prices by the projection of annual average price changes for each of the nine census divisions from the Reference case in *AEO2023*, which has an end year of 2050.[84] To estimate price trends after 2050, the 2046–2050 average was used for all years.

b. Water and Wastewater Prices

DOE obtained residential water and wastewater price data from the Water and Wastewater Rate Survey conducted by Raftelis Financial Consultants and the American Water Works Association.[85] The survey covers approximately 194 water utilities and 140 wastewater utilities analyzing each industry (water and wastewater) separately. For each water or wastewater utility, DOE calculated the average-price-per-unit volume by dividing the total volumetric cost by the volume delivered. DOE also calculated the

[84] EIA. Annual Energy Outlook 2023. Available at *www.eia.gov/outlooks/aeo/* (last accessed June 20, 2023).
[85] Raftelis Financial Consultants, Inc. 2020 RFC/AWWA Water and Wastewater Rate Survey. 2021. Charlotte, NC, Kansas City, MO, and Pasadena, CA.

marginal price by dividing the incremental cost by the increased volume charged at each consumption level.

The samples that DOE obtained of the water and wastewater utilities is too small to calculate regional prices for all U.S. Census divisions. Therefore, DOE calculated regional costs for water and wastewater service at the Census region level (Northeast, South, Midwest, and West) by weighting each State in a region by its population.

For this direct final rule analysis, DOE has updated its methodology for developing water prices for consumers who rely on a private well water system, instead of the public supply system in consideration of stakeholder comments received in response to the March 2023 NOPR DOE primarily considered well maintenance costs and pump operating costs when developing the average water price. Conversely, DOE only considered pump operating costs when developing the marginal price for well users. As a result, the estimated average and marginal water prices for well users are $1.24 and $0.39 per thousand gallons, respectively. For septic tank users, DOE considered only the septic tank maintenance cost when determining the average price and excluded the marginal cost component, as any marginal costs are likely to be negligible. DOE is unable to develop Census-region-level well water and septic tank prices due to the limitation of available data. As a result, the same values were used for each Census region.

To determine the current percentage of the U.S. population served by private wells and septic tanks, DOE used historical American Housing Survey（"AHS") data from 1990 to 2021 to develop a projection for 2027, the effective year of potential new standards for RCWs except for the Recommended TSL.[86] The effective year of the Recommended TSL is 2028.

DOE then conducted random simulations[87] to determine the sample of households in rural areas served by private wells and septic tanks. Based on the estimated sample, well water prices and septic tank prices were assigned to sampled households accordingly. Furthermore, DOE estimated the septic tank user population and assigned corresponding septic tank prices to households relying on public water systems.

To estimate the future trend for public water and wastewater prices, DOE used data on the historic trend in the national water price index (U.S. city average) from 1988 through 2022 provided by the Labor Department's BLS.[88] DOE extrapolated the future trends based on the linear growth from 1988 to 2022. DOE used the extrapolated trend to forecast prices through 2050. To estimate the price trend after 2050, DOE used a constant value derived from the average values from 2046 through 2050.

To estimate the future trend for well water and septic tank prices, DOE used data on the historic trend in the overall national consumer price index from 1988 through 2022

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[86] The U.S. Census Bureau. The American Housing Survey. Years 1970-2021. Available at *www.census.gov/programs-surveys/ahs.html* (last accessed June 12, 2023).
[87] DOE utilized random simulations to more accurately assess the distribution of households in rural areas using private wells and septic tanks. These simulations were designed to randomly assign users of well water and septic tanks, based on the estimated percentage of the well water and septic tank user population in each census region, thereby incorporating uncertainties and variabilities.
[88] U.S. Department of Labor-Bureau of Labor Statistics, Consumer Price Indexes, Item: Water and sewerage maintenance, Series Id: CUSR0000SEHG01, U.S. city average, 2022. Washington, DC. Available at *www.bls.gov/cpi/home.htm#data*.

provided by the Labor Department's BLS.[89] DOE extrapolated the future trends based on the linear growth from 1988 to 2022. DOE used the extrapolated trend to forecast prices through 2050. To estimate the price trend after 2050, DOE used a constant value derived from the average values from 2046 through 2050.

In response to the March 2023 NOPR, AHAM commented that it previously suggested that DOE should consider the actual water costs for households on well systems, acknowledge that there are no incremental costs for consumers using septic systems, and treat these consumers as a separate subgroup instead of averaging them into composite water and sewer costs. AHAM noted that while DOE implemented AHAM's recommendation on sewer costs, it disregarded the other two suggestions without explanation. (AHAM, No. 464 at pp. 37–38)

As discussed, DOE agrees with AHAM that consumers using septic systems have near-zero marginal costs for wastewater and has updated the analysis accordingly. As discussed in section IV.I.3 of this document, DOE has also included an analysis of well-water users in the consumer subgroup analysis.

AHAM commented that it opposed DOE's use of "economic value of water" in the LCC model. According to AHAM, private well users pay the actual marginal cost of water, primarily the electricity for pumping, not an "economic value". AHAM noted that while there are embedded costs for drilling a well, these costs are sunk and the marginal

[89] U.S. Department of Labor-Bureau of Labor Statistics, Consumer Price Indexes, All Items, Series Id: CUUR0000SA0, U.S. city average, 2022. Washington, DC. Available at *www.bls.gov/cpi/home.htm#data*.

cost is electricity. AHAM suggested that if DOE insists on the "economic value", DOE should define it, demonstrate how well-water use reduces water availability, and quantify the actual "economic value" of lost well water. (AHAM, No. 464, at p. 38) AHAM further stated that even if there is an "economic value", it should be considered in the NIA, not the LCC. (*Id*. at p. 39)

DOE agrees with AHAM that "economic value of water" is not the actual price that well users would pay. Hence, for this direct final rule, DOE has adjusted its methodology regarding water price for well users and septic tank price. To derive well water price, DOE conducted a comprehensive literature review and took into consideration the inputs provided by AHAM. As a result, DOE estimated the average water price for well users to be $1.24 per thousand gallons, with a marginal price of $0.39 per thousand gallons representing the electricity cost for pumping as suggested by AHAM. Regarding septic tank price, DOE estimated the average cost to be $1.30 per thousand gallons and excluded the marginal cost component, as it may be negligible or close to $0 per thousand gallons. For details of the well water and septic tank prices, see chapter 8 of the direct final rule TSD. In addition, in the LCC, DOE has explicitly assigned well water and septic users randomly to the rural population based on estimated population and given them well and/or septic specific prices; DOE is no longer using composite water and sewer costs applied to the entire sample. As such, well and/or septic users are now fully accounted for in the LCC sample.

AWE commented that it is unclear why DOE referred to the water and sewerage maintenance item from the CPI to determine future price trends for water and sewage.

AWE stated that DOE’s methodology for price trends regarding RCWs deviates from the methodology DOE proposed regarding dishwashers. AWE recommended that DOE use the AWWA/Raftelis Water and Wastewater Rate Survey for both dishwashers and RCWs because the AWWA/Raftelis survey is more accurate and representative of price trend data between 1998 and 2020. (AWE, No. 444 at pp. 2–3)

AWWA/Raftelis provides water and wastewater rates survey data every two years for U.S. water and wastewater utilities. For each of the AWWA/Raftelis surveys, utilities in the sample respond voluntarily to the survey questions, with a limited number of overlapping utilities in each survey year. For this reason, it is possible that the annual change in rates may be affected by which utilities respond to the survey. In addition, the rate data are reported in usage tiers set by each utility and not on actual household water consumption.

The BLS Water and Sewer CPI sample represents 600 to 700 quotes for water or sewer service, and the sample is consistent for four years, which reduces the possible year over year bias as compared to AWWA/Raftelis. Additionally, the Water and Sewer CPI was estimated based on consumer water bills that were related to household water consumption. Therefore, DOE concludes that the BLS’ CPI water and sewer data better reflect the nationally representative price trends. DOE therefore used the CPI for water and sewer for its public utilities’ water and wastewater price trend forecast for this direct final rule.

DOE used a similar methodology to develop future water and wastewater prices in its dishwasher standard rulemaking as it used in the March 2023 NOPR analysis. The only difference between the two standards rulemaking analyses is that for RCWs, DOE used a constant value derived from the average values from 2046 through 2050 to estimate the price trend after 2050, whereas in the dishwashers NOPR, published May 19, 2023 (88 FR 32514), DOE used the 2050 value for the price trend after 2050.[90] As described previously, for this direct final rule, DOE has used the same approach as the March 2023 NOPR for water and wastewater (including well water and septic tank) price trends after 2050.

5. Maintenance and Repair Costs

Repair costs are associated with repairing or replacing product components that have failed in an appliance; maintenance costs are associated with maintaining the operation of the product. Typically, small incremental increases in product efficiency entail no, or only minor, changes in repair and maintenance costs compared to baseline efficiency products.

For RCWs, DOE determined the repair cost associated with loading type and clothes washer capacity commonly found on an appliance repair web site.[91] DOE estimated the average repair cost for an RCW is about $241, ranging from $123 to $294 over the product lifetime and then converted to annual cost. For maintenance cost, DOE

[90] Additional details regarding the dishwasher analysis are provided in the NOPR TSD, available at *www.regulations.gov/document/EERE-2019-BT-STD-0039-0032*.

[91] Fixr, How Much Does It Cost to Repair a Washing Machine? Available at www.fixr.com/costs/washing-machine-repair#washing-machine-repair-cost-by-type-of-repair.

conducted a literature review of maintenance cost available from a variety of sources, including online resources. DOE estimated the annual maintenance cost for an RCW is approximately $27, including costs of clothes washer cleaners and of running clothes washer cleaning cycles.

Typically, small incremental increases in product efficiency produce no, or only minor, changes in repair and maintenance costs compared to baseline efficiency products. For this direct final rule analysis, DOE estimated that for repair costs, there is a cost difference between an ENERGY STAR and non-ENERGY STAR RCW of approximately $47 for a front-loading RCW and $34 for a top-loading RCW, based on information aggregated from manufacturer interviews. For maintenance costs, DOE assumed that there is no change with efficiency level for RCWs.[92]

For this direct final rule, DOE considered comments it had received regarding its determination of maintenance and repair costs in the March 2023 NOPR. The approach used for this direct final rule is largely the same as the approach DOE had used for the March 2023 NOPR analysis.

In response to the March 2023 NOPR, Representatives Latta *et al*. commented that additional product complexity to meet amended standard levels could drive higher repair costs. (Representatives Latta *et al*., No. 456 at pp. 2–3)

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[92] Based on literature reviews, DOE found that manufacturers recommend monthly self-cleaning for RCWs, regardless of the clothes washer's loading type and efficiency level.

As discussed in the March 2023 NOPR, DOE implemented higher repair costs for ENERGY STAR qualified and above ENERGY STAR qualified RCWs compared to the baseline models based on information obtained through manufacturer interviews. These same inputs have been used in the current direct final rule analysis. DOE estimated the cost difference between an ENERGY STAR and non-ENERGY STAR RCW of approximately $34 for a top-loading and $47 for a front-loading RCW. See section 8.3.5 of chapter 8 of the direct final rule TSD for details.

The National Multifamily Housing Council ("NMHC") and National Apartment Association ("NAA") recommended that DOE reevaluate the costs and ongoing operations and maintenance impacts of longer cycle times, multiple wash cycles, and increased stress on the equipment. (NMHC and NAA, No. 451 at pp. 3–4)

CEI[93] commented that expensive repairs, including ones within the first 3 years of purchase, are no longer uncommon, and that consumers will often not undertake repairs that cost half or more of the price of a new machine. CEI noted that these problems are likely to be exacerbated by the standards proposed in the March 2023 NOPR. (CEI, No. 454 at p. 3)

CEI asserted that repair costs would likely increase, leading consumers to refrain from repairs under the proposed rule if they cost half or more of the price of a new machine. However, CEI did not provide additional supporting data for DOE to consider

[93] "CEI" includes the comments of the Competitive Enterprise Institute and Michael Mannino.

to suggest that the repair price would be higher than what was used in the March 2023 NOPR and for this direct final rule analysis. As described in section IV.F.5 of this document, DOE has estimated a slight increase in retirement for RCWs before reaching 4 years of age using the latest 2020 RECS and AHS data.

As stated in section V.B.4 of this document, at TSL 2—the standards level adopted in this direct final rule—DOE's data demonstrates no negative impact on consumer utility, including cycle time. For further discussion of performance as it relates to amended standards, see section V.B.4.a of this document.

6. Product Lifetime

Product lifetime is the age at which an appliance is retired from service. To determine estimates for RCW lifetime, DOE conducted an analysis of standard-capacity RCW lifetime in the field based on a combination of shipments data and data on the ages of the clothes washer products reported in the household stock from RECS conducted in 2001, 2005, 2009, 2015, and 2020.[94]

The data allowed DOE to estimate a survival function, which provided an average appliance lifetime of approximately 14 years. From the 2015 RECS to the 2020 RECS, there was a 3.6 percent increase in the number of RCWs under 5 years of age, and an additional 0.7 percent of RCWs lasting beyond 15 years. Therefore, for this direct final rule, DOE has slightly updated its estimated average lifetime for RCWs to 13.4 years,

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

with a distribution that includes 1.4 percent more RCWs retiring before reaching 4 years and 2.9 percent more RCWs remaining after 15 years and up to 30 years, compared to the Weibull lifetime probability distribution used in the March 2023 NOPR.

For this direct final rule, DOE considered comments it had received regarding its estimation of product lifetime in the March 2023 NOPR. The approach used for this direct final rule is largely the same as the approach DOE had used for the March 2023 NOPR analysis.

In response to the March 2023 NOPR, NEEA *et al.* commented in support of using a 13.7-year product lifetime. (NEEA *et al.*, No. 455 at p. 5)

The AGs of TN *et al*.[95] commented that DOE's lack of consideration of the reduced lifetime and associated costs of a more complex product is not appropriate. Additionally, the AGs of TN *et al.* argued that a major component of the product's lifetime energy use is the energy consumed in manufacturing the product and that decreased water and energy use almost always come at the cost of increased complexity, with attendant increased maintenance costs and decreased lifespan. As such, the AGs of TN *et al.* state that DOE ignored lifecycle energy use and lifecycle cost and failed to consider an important aspect of the problem. (AGs of TN *et al*., No. 438 at p. 6 (citing *Motor Vehicle Mfrs. Ass'*n, 463 U.S. at 43))

[95] The "AGs of TN *et al*." include the Attorneys General of Tennessee, Alabama, Arkansas, Florida, Georgia, Idaho, Indiana, Iowa, Kentucky, Louisiana, Mississippi, Missouri, Montana, Nebraska, Ohio, Oklahoma, South Carolina, Texas, Utah, Virginia, and West Virginia.

In response to the March 2023 NOPR, Representatives Latta *et al*. commented that additional product complexity to meet amended standard levels could drive shorter product lifespans. (Representatives Latta *et al*., No. 456 at pp. 2–3)

CEI commented that DOE does not acknowledge that its rules have shortened the useful lives of clothes washers and other appliances and that DOE also ignores the resulting adverse environmental impacts, which include the greater energy and other resources that go into manufacturing additional clothes washers as well as additional landfill and other disposal requirements for discarded units.[96] (CEI, No. 454 at pp. 6–7) CEI asserted that the decline in RCW reliability and useful lifetime, especially since the 2007 standards, has been evident to those servicing machines over that time span. (*Id*. at pp. 2–3)

In the public webinar, Whirlpool commented that the average lifespan of an RCW should not only be based on historical data, as the additional stresses placed on the mechanical components (due to the combination of higher resistance and less water, which creates more tension, torque, and wear on the motor) could pose as a challenge in reaching the 13.7-year lifespan in the future. (Whirlpool, Public Webinar Transcript, No. 91 at pp. 35–36)

[96] DOE did not address CEI's comments about the greater energy and other resources that go into manufacturing additional RCWs as well as additional landfill and disposal costs for discarded units because it is outside the scope of a standards rulemaking.

In the public webinar, Mannino stated that most clothes washers fail after three to four years. Mannino asked how DOE arrived at its estimate. (Mannino, Public Webinar Transcript, No. 91 at p. 32)

DOE also received comments from 23 additional individual commenters expressing concerns regarding the standards' impact on the product's lifetime.

DOE notes that it does not have data to corroborate a causal connection between the stringency of efficiency standards and the expected service lifetime of RCWs. Moreover, commenters have not provided DOE additional information or data that demonstrates that more-efficient clothes washers have shorter or longer product lifetimes than less-efficient clothes washers. As a result, DOE has not identified differences in lifetime based on differences in efficiency.

As stated, DOE updated the Weibull lifetime distribution used for this direct final rule based on the recent data from RECS and AHS. The updated data indicates a slightly shorter lifetime and delayed replacement of RCWs than was considered in the March 2023 NOPR based on previous RECS and other data sources.

Furthermore, as discussed in chapter 5 of the TSD for this direct final rule, the incremental MPCs developed in this analysis reflect units currently available on the market. Therefore, to the extent that units on the market incorporate more robust mechanical components (such as bearings, motors, *etc*.), DOE's analysis already accounts for the cost of these components at higher efficiency levels.

See chapter 8 of the direct final rule TSD for further details.

7. Discount Rates

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

DOE applies weighted average discount rates calculated from consumer debt and asset data, rather than marginal or implicit discount rates.[97] The LCC analysis estimates net present value over the lifetime of the product, so the appropriate discount rate will reflect the general opportunity cost of household funds, taking this time scale into account. Given the long time horizon modeled in the LCC, the application of a marginal interest rate associated with an initial source of funds is inaccurate. Regardless of the method of purchase, consumers are expected to continue to rebalance their debt and asset holdings over the LCC analysis period, based on the restrictions consumers face in their debt payment requirements and the relative size of the interest rates available on debts and assets. DOE estimates the aggregate impact of this rebalancing using the historical distribution of debts and assets.

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

To establish residential discount rates for the LCC analysis, DOE identified all relevant household debt or asset classes in order to approximate a consumer's opportunity cost of funds related to appliance energy cost savings. It estimated the average percentage shares of the various types of debt and equity by household income group using data from the Federal Reserve Board's triennial Survey of Consumer Finances[98] ("SCF") starting in 1995 and ending in 2019. Using the SCF and other sources, DOE developed a distribution of rates for each type of debt and asset by income group to represent the rates that may apply in the year in which amended standards would take effect. DOE assigned each sample household a specific discount rate drawn from one of the distributions. The average rate across all types of household debt and equity and income groups, weighted by the shares of each type, is 4.3 percent. See chapter 8 of the direct final rule TSD for further details on the development of consumer discount rates.

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

To accurately estimate the share of consumers that would be affected by a potential energy conservation standard at a particular efficiency level, DOE's LCC analysis considered the projected distribution (market shares) of product efficiencies under the no-new-standards case (*i.e.*, the case without amended or new energy conservation standards).

To estimate the energy efficiency distribution of top-loading standard-size, front-loading compact, and front-loading standard-size RCWs for 2027 and 2028, DOE used

[98] The Federal Reserve Board, *Survey of Consumer Finances* (1995, 1998, 2001, 2004, 2007, 2010, 2013, 2016, and 2019). Available at *www.federalreserve.gov/econres/scfindex.htm.*

shipments-weighted energy efficiency ratio ("SWEER") for 2020 as a starting point, based on information provided by AHAM. (AHAM, No. 54 at pp. 2–3) To project the trend in efficiency, DOE considered recent trends in DOE's RCW CCD and the potential effect of labeling programs such as ENERGY STAR on RCWs. DOE estimated an annual efficiency improvement of 0.4 and 0.1 percent for top-loading standard-size and front-loading (compact and standard-size) clothes washers, respectively. For semi-automatic clothes washers, DOE used the CCD database to develop a product efficiency distribution under the no-new-standards case.

The estimated market shares for the no-new-standards case for RCWs are shown in Table IV.16 through Table IV.19. See chapter 8 of the direct final rule TSD for further information on the derivation of the efficiency distributions.

Table IV.16 No-New-Standards Case Market Share in 2027: Top-Loading and Semi-Automatic Residential Clothes Washers

Efficiency Level	Top-Loading Ultra-Compact			Top-Loading Standard-Size			Semi-Automatic		
	EER *(lb/kWh /cycle)*	**WER** *(lb/gal /cycle)*	**Share** *(%)*	**EER** *(lb/kWh /cycle)*	**WER** *(lb/gal /cycle)*	**Share** *(%)*	**EER** *(lb/kWh /cycle)*	**WER** *(lb/gal /cycle)*	**Share** *(%)*
Baseline	3.79	0.29	100%	3.50	0.38	61.0%	1.60	0.17	21.0%
1	--	--	--	3.89	0.47	5.9%	2.12	0.27	71.0%
2	--	--	--	4.27	0.57	27.4%	2.51	0.36	8.0%
3	--	--	--	4.78	0.63	4.7%	--	--	--
4	--	--	--	5.37	0.67	1.0%	--	--	--

Table IV.17 No-New-Standards Case Market Share in 2027: Front-Loading Residential Clothes Washers

Efficiency Level	Front-Loading Compact			Front-Loading Standard-Size		
	EER *(lb/kWh /cycle)*	**WER** *(lb/gal /cycle)*	**Share** *(%)*	**EER** *(lb/kWh /cycle)*	**WER** *(lb/gal /cycle)*	**Share** *(%)*
DFR Baseline	-	-	-	4.31	0.38	0%
NOPR Baseline	4.41	0.53	0%	5.02	0.64	2.0%
1	4.80	0.62	38.7%	5.31	0.69	5.6%
2	5.02	0.71	45.8%	5.52	0.77	45.1%
3	5.53	0.75	14.5%	5.73	0.77	38.0%
4	5.97	0.80	1.0%	5.97	0.85	9.2%

Table IV.18 No-New-Standards Case Market Share in 2028: Top-Loading and Semi-Automatic Residential Clothes Washers

Efficiency Level	Top-Loading Ultra-Compact			Top-Loading Standard-Size			Semi-Automatic		
	EER *(lb/kWh /cycle)*	**WER** *(lb/gal /cycle)*	**Share** *(%)*	**EER** *(lb/kWh /cycle)*	**WER** *(lb/gal /cycle)*	**Share** *(%)*	**EER** *(lb/kWh /cycle)*	**WER** *(lb/gal /cycle)*	**Share** *(%)*
Baseline	3.79	0.29	100%	3.50	0.38	59.5%	1.60	0.17	21.0%
1	--	--	--	3.89	0.47	6.7%	2.12	0.27	71.0%
2	--	--	--	4.27	0.57	27.4%	2.51	0.36	8.0%
3	--	--	--	4.78	0.63	5.4%	--	--	--
4	--	--	--	5.37	0.67	1.1%	--	--	--

Table IV.19 No-New-Standards Case Market Share in 2028: Front-Loading Residential Clothes Washers

Efficiency Level	Front-Loading Compact			Front-Loading Standard-Size		
	EER *(lb/kWh /cycle)*	**WER** *(lb/gal /cycle)*	**Share** *(%)*	**EER** *(lb/kWh /cycle)*	**WER** *(lb/gal /cycle)*	**Share** *(%)*
DFR Baseline	-	-	-	4.31	0.38	0.0%
NOPR Baseline	4.41	0.53	0.0%	5.02	0.64	2.0%
1	4.80	0.62	38.8%	5.31	0.69	5.4%
2	5.02	0.71	45.2%	5.52	0.77	45.0%
3	5.53	0.75	14.9%	5.73	0.77	38.4%
4	5.97	0.80	1.1%	5.97	0.85	9.2%

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

9. Payback Period Analysis

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

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

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

An anonymous commenter expressed concerns regarding the LCC and PBP associated with the proposed rule change to increase energy efficiency of RCWs. (Anonymous, No. 391 at p. 1) The anonymous commenter questioned the time it would take for the benefits to outweigh the costs, as the proposed rule suggests net positive outcomes over a period of less than the average product lifespan of 13 years, but also notes the 30-year timeframe for the cost-benefit analysis in asking how long until the benefits will be recognizable. The anonymous commented sought clarity on when the benefits will become noticeable and raises logistical concerns about the implementation of the rule change. (*Id.*)

As described in section V.B.1.a of this document (*see* Table V.4 through Table V.12), the simple payback period for top-loading and front-loading standard-size RCWs is 6.2 years and 1.4 years, respectively, which is less than half of estimated lifetime, *i.e.,* 13.4 years. The 30-year timeframe used to calculate cumulative operating costs in the LCC analysis, is determined based on product lifetimes with Weibull probability distributions.

DOE notes that the estimated simple payback period can be subject to change depending on several factors, such as households' RCW usage and utility bill rates, including energy and water price rates. In general, if a household runs their RCW more frequently at higher energy and water rates, it will result in a shorter payback period and vice versa.

G. Shipments Analysis

DOE uses projections of annual product shipments to calculate the national impacts of potential amended or new energy conservation standards on energy use, NPV, and future manufacturer cash flows.[99] The shipments model takes an accounting approach, tracking market shares of each product class and the vintage of units in the stock. Stock accounting uses product shipments as inputs to estimate the age distribution of in-service product stocks for all years. The age distribution of in-service product stocks is a key input to calculations of both the NES and NPV, because operating costs for any year depend on the age distribution of the stock.

To project RCW shipments under the no-new-standards case, DOE utilized historical shipments data from AHAM. DOE estimated RCW shipments by projecting shipments into two market segments: (1) replacement of existing RCWs; (2) new housing.

To project RCW replacement shipments, DOE developed retirement functions from RCW lifetime estimates and applied them to the existing products in the housing stock, which are tracked by vintage. To estimate shipments to new housing units, DOE used projections of new housing starts coupled with RCWs' saturation data. In other

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

words, to project the shipments for new housing units for any given year, DOE multiplied the housing projections by the estimated saturation of RCWs for new housing units. For new housing completions and mobile home placements, DOE used recorded data through 2022,[100] and adopted the projections from *AEO2023* for 2023–2050. DOE used the data contained in the 2020 RECS to characterize ownership of RCWs in households across various housing types, including multi-family housing.

DOE aggregated the above two market segments for any given year during the analysis period[101] (2027–2056) and divided total RCW shipments into its five product classes. For this direct final rule, DOE estimated the market share between top-loading and front-loading RCWs based on shipments trends and forecast data by clothes washer loading type provided by AHAM between 2010 and 2024.[102] To project market share between top-loading and front-loading RCWs after 2024, the 2012–2024 average is used for all years. DOE estimated market share for top-loading and front-loading RCWs would remain at 73.5 percent and 26.5 percent, respectively. DOE then disaggregated the top-loading RCW market share into three product classes (*i.e.*, ultra-compact, standard-size, and semi-automatic) and front-loading into two product classes (*i.e.*, compact and standard-size). In addition, DOE assumed the annual growth rate for semi-automatic and top-loading ultra-compact clothes washers would be at 0.2 percent. Table IV.20 shows the estimated market share and shipments for each product class.

[100] U.S. Census. Characteristics of New Housing. Available at *www.census.gov/construction/chars/*.
[101] The analysis period for TSL 2 (the Recommended TSL) is 2028–2057.
[102] AHAM, 2022 AHAM Data Trends & Forecasts, August 10, 2022.

Table IV.20 Market Share and Shipments by Product Class in 2027 and 2028

Product Class	Market Share in 2027 and 2028 (%)	Shipments in 2027 (*million*)	Shipments in 2028 (*million*)
Top-Loading, Ultra-Compact	0.6	0.06	0.07
Top-Loading, Standard-Size	71.3	7.73	7.83
Front-Loading, Compact	1.6	0.18	0.18
Front-Loading, Standard-Size	24.8	2.69	2.73
Semi-Automatic	1.6	0.17	0.17
Total	**100**	**10.84**	**10.98**

To project RCW shipments under a standards case, DOE used a price elasticity parameter, which relates the incremental total installed cost to total RCW shipments, and an efficiency elasticity parameter, which relates the change in the operating cost to RCW shipments. Both types of elasticity relate changes in demand to changes in the corresponding characteristic (price or efficiency). A regression analysis estimated these terms separately from each other and found that the price elasticity of demand for several appliances is on average –0.45.[103] Thus, for example, a price increase of 10 percent would result in a shipments decrease of 4.5 percent, all other factors held constant. The same regression analysis found that the efficiency elasticity is estimated to be on average 0.2 (*i.e.*, a 10-percent efficiency improvement, equivalent to a 10-percent decrease in operating costs, would result in a shipments increase of 2 percent, all else being equal).

DOE assumed when market impact occurs (*i.e.*, when shipments drop under a standards case), the affected consumers would either repair their product or purchase a used RCW rather than a new one. In the repair scenario, the model assumes that the product's life is extended by approximately 5 years. In the used product scenario, the

[103] Fujita, S., Estimating Price Elasticity using Market-Level Appliance Data. LBNL-188289 (August 2015). Available at *eta-publications.lbl.gov/sites/default/files/lbnl-188289.pdf*.

model assumes the remaining average lifetime for a used RCW is 7 years. Therefore, this market impact effectively influences the decision between repairing or replacing the product, as well as the decision between purchasing a used clothes washer or a new one.

For this direct final rule, DOE considered comments it had received regarding its shipments analysis for the March 2023 NOPR. The approach used for this direct final rule is largely the same as the approach DOE had used for the March 2023 NOPR analysis.

In response to the March 2023 NOPR, The CA IOUs commented that they agree that the relative market share for top-loading RCWs from 2012 on has remained reasonably stagnant, but they also noted that the relative market share for top-loading RCWs was more fluid before 2012. (CA IOUs, No. 460 at p. 7) The CA IOUs stated that relative market share movements from front-loading to top-loading RCWs correlate with DOE compliance dates for amended energy conservation standards. (*Id*.) The CA IOUs noted that the standard levels proposed in the March 2023 NOPR are the first significant change in relative installed cost between top-loading and front-loading RCWs since 2007, and based on prior trends, the CA IOUs expect the front-loading RCW relative market share to increase. (*Id*. at p. 8) The CA IOUs recommended that DOE should amend the top-loading and front-loading market shares to reflect some expected shift from top-loading to front-loading RCWs based on the correlation of first-cost to market share relative to past energy conservation standard compliance dates. (*Id*.)

Electrolux Home Products, Inc. ("Electrolux") commented that data from the September 2021 TSD[104] showed a projected market share loss for front-loading RCWs due to the standard at EL 3 proposed in the March 2023 NOPR. (Electrolux, No. 449 at p. 2) Electrolux further commented that these market trends between top-loading and front-loading RCWs should play a more significant role in the energy analysis due to the extensive energy and water savings that can be realized by consumers transitioning from top-loading RCWs to more efficient front-loading RCWs. (*Id*.) Electrolux requested that DOE set standards for front-loading RCWs at a better value than proposed in the March 2023 NOPR in order to reduce the expanding energy gap with top-loading RCWs. (*Id*.)

As stated in the March 2023 NOPR, DOE acknowledges the challenge of lacking historical retail pricing, sales data, and energy consumption data for top-loading and front-loading RCWs. These data are crucial for developing a regression model that accurately projects the market share between the two loading types of RCWs. In this direct final rule, DOE is not adopting the standards level proposed in the March 2023 NOPR. Instead, DOE is adopting a standards level that is one level below the efficiency level proposed in the March 2023 NOPR level for top-loading standard-size RCWs. Under the adopted standards, the incremental equipment price from the baseline model to an ENERGY STAR-rated top-loading standard-size RCW is $146, while the price difference between the adopted standard level top-loading RCW and the adopted standard level front-loading RCW is $227. Therefore, DOE does not expect that the adopted standards will drive consumers to shift from the top-loading to the front-loading RCW

[104] Available at www.regulations.gov/document/EERE-2017-BT-STD-0014-0030.

market because front-loading RCWs will continue to be more expensive. In line with the approach taken in the March 2023 NOPR, DOE assumed a frozen scenario for market shifting (*i.e.*, no market shifting) under the standards case in this direct final rule. 88 FR 13520, 13571.

See chapter 9 of the direct final rule TSD for details.

H. National Impact Analysis

The NIA assesses the national energy savings ("NES"), national water savings ("NWS"), and the NPV from a national perspective of total consumer[105] costs and savings that would be expected to result from new or amended standards at specific efficiency levels.[106] DOE calculates the NES, NWS, and NPV for the potential standard levels considered based on projections of annual product shipments, along with the annual energy and water consumption and total installed cost data from the energy and water use and LCC analyses. For the present analysis, DOE projected the energy and water savings, operating cost savings, product costs, and NPV of consumer benefits over the lifetime of RCWs sold from 2027 through 2056 for all TSLs other than 2028 through 2057 for TSL 2 (the Recommended TSL detailed in the Joint Agreement).

DOE evaluates the impacts of new or amended standards by comparing a case without such standards with standards-case projections. The no-new-standards case characterizes energy use and consumer costs for each product class in the absence of new

[105] "Consumer" in this context refers to consumers of the product being regulated.
[106] The NIA accounts for impacts in the 50 States and U.S. territories.

or amended energy conservation standards. For this projection, DOE considers historical trends in efficiency and various forces that are likely to affect the mix of efficiencies over time. DOE compares the no-new-standards case with projections characterizing the market for each product class if DOE adopted new or amended standards at specific energy efficiency levels (*i.e.*, the TSLs or standards cases) for that class. For the standards cases, DOE considers how a given standard would likely affect the market shares of products with efficiencies greater than the standard.

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

Table IV.21 summarizes the inputs and methods DOE used for the NIA analysis for the direct final rule. Discussion of these inputs and methods follows the table. *See* chapter 10 of the direct final rule TSD for further details.

Table IV.21 Summary of Inputs and Methods for the National Impact Analysis

Inputs	Method
Shipments	Annual shipments from shipments model.
Compliance Date of Standard	TSL 1, TSL 3, and TSL 4: 2027 TSL 2 (Recommended TSL): 2028
Efficiency Trends	No-new-standards case: Annual shipments-weighted efficiency improvement of 0.4 percent for top-loading standard-size and 0.1 percent for both front-loading compact and standard-size clothes washers. Standard cases: "Roll up" equipment to meet potential efficiency level.
Annual Energy and Water Consumption per Unit	Annual weighted-average values are a function of energy use at each TSL.
Total Installed Cost per Unit	Annual weighted-average values are a function of cost at each TSL. Incorporates projection of future product prices based on historical data.
Annual Energy Cost per Unit	Annual weighted-average values as a function of the annual energy and water consumption per unit and energy prices.
Repair and Maintenance Cost per Unit	Annual values change between non-ENERGY STAR and ENERGY STAR efficiency levels.
Energy and Water Price Trends	*AEO2023* projections (to 2050) and constant value based on average between 2046–2050 thereafter. Historical PPI extrapolated projection (to 2050) and constant value based on average between 2046–2050 thereafter.
Energy Site-to-Primary and FFC Conversion	A time-series conversion factor based on *AEO2023*.
Discount Rate	3 percent and 7 percent
Present Year	2024

1. Product Efficiency Trends

A key component of the NIA is the trend in energy efficiency projected for the no-new-standards case and each of the standards cases. Section IV.F.8 of this document describes how DOE developed an energy efficiency distribution for the no-new-standards case, which yields a shipment-weighted average efficiency, for each of the considered product classes for the year of anticipated compliance with an amended standard. To project the trend in efficiency absent amended standards for RCWs over the entire shipments projection period, DOE considered recent trends in its CCD data and the potential effect of programs such as ENERGY STAR. As discussed in section IV.F.8 of this document, DOE estimated an annual efficiency improvement of 0.4 percent and 0.1

percent for top-loading standard-size and front-loading (compact and standard-size) RCWs, respectively.

For the standards cases, DOE used a "roll-up" scenario to establish the shipment-weighted efficiency for the year that standards are assumed to become effective (2027 or 2028). In this scenario, the market shares of products in the no-new-standards case that do not meet the standard under consideration would "roll up" to meet the new standard level, and the market share of products above the standard would remain unchanged. See chapter 10 of the direct final rule TSD for details.

2. National Energy and Water Savings

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

In 2011, in response to the recommendations of a committee on "Point-of-Use and Full-Fuel-Cycle Measurement Approaches to Energy Efficiency Standards" appointed by the National Academy of Sciences, DOE announced its intention to use FFC measures of energy use and greenhouse gas and other emissions in the national impact analyses and emissions analyses included in future energy conservation standards rulemakings. 76 FR 51281 (Aug. 18, 2011). After evaluating the approaches discussed in the August 18, 2011 notice, DOE published a statement of amended policy in which DOE explained its determination that EIA's National Energy Modeling System ("NEMS") is the most appropriate tool for its FFC analysis and its intention to use NEMS for that purpose. 77 FR 49701 (Aug. 17, 2012). NEMS is a public domain, multi-sector, partial equilibrium model of the U.S. energy sector[107] that EIA uses to prepare its *Annual Energy Outlook.* The FFC factors incorporate losses in production and delivery in the case of natural gas (including fugitive emissions) and additional energy used to produce and deliver the various fuels used by power plants. The approach used for deriving FFC measures of energy use and emissions is described in appendix 10B and 13A of the direct final rule TSD.

Use of higher-efficiency products is sometimes associated with a direct rebound effect, which refers to an increase in utilization of the product due to the increase in efficiency.

[107] For more information on NEMS, refer to *The National Energy Modeling System: An Overview 2009*, DOE/EIA-0581(2009), October 2009. Available at *www.eia.gov/forecasts/aeo/index.cfm* (last accessed June 24, 2023).

For this direct final rule, DOE considered comments it had received in response to the March 2023 NOPR regarding potential rebound effects.

In response to the March 2023 NOPR, AHAM commented that changes to water level requirements would cause perceptions of inadequate cleaning performance and lead consumers to take actions (*e.g.*, using alternative wash options with extra water or re-washing clothes) that cause real energy performance to diverge from DOE's projections. AHAM suggested that DOE include such effects in the analysis of total energy and water savings by adjusting upwards over time the average per unit energy and water consumption. (AHAM, No. 464 at pp. 2–3) AHAM stated that although there may not yet be data demonstrating a rebound effect because current standards have not yet caused such an effect, standards that are excessively stringent—such as those DOE proposed in the March 2023 NOPR—could cause a rebound effect. (*Id*. at p. 24)

Whirlpool commented that the proposed standards would cause consumers to alter their purchasing behavior due to the perceived loss of utility, poor performance, and increased up-front cost of RCWs meeting the proposed standards. (Whirlpool, No. 462 at p. 5) Specifically, Whirlpool commented that consumers may delay purchases and repair older, less efficient appliances past their normal, expected life. (*Id*.) Whirlpool commented that this shift in behavior will likely have the opposite impact on energy use that DOE anticipates, as consumers will continue to use their older and less efficient appliances instead of purchasing newer, more efficient models. (*Id*.) Whirlpool commented that DOE overestimated the total energy and water savings from the proposed standard because consumers may compensate for decreased utility and functionality by opting for more energy- and water-intensive washing options, washing loads multiple times to make up for loss in performance or wash clothes multiple times to recover lost performance. (*Id*. at p. 13)

CEI noted that consumer behavior resulting from performance-related deficiencies may well lead to increased water use for some consumers. (CEI, No. 454 at p. 5)

The AGs of TN *et al*. commented that DOE's dismissal of Whirlpool's observation that "decreasing water levels and wash temperatures would negatively impact consumer perceptions that their clothes washers are working correctly" and DOE's defense that manufacturers had not provided quantitative data regarding "human reactions" is unjustified and that DOE should attempt the task of modeling consumer reactions. The AGs of TN *et al.* argued that DOE ignored the comment and that in doing so, DOE "entirely fail[s] to consider an important aspect of the problem." (AGs of TN *et al*., No. 438 at p. 6 (citing *Motor Vehicle Mfrs. Ass'n of U.S., Inc. v. State Farm Mut. Auto Ins. Co.*, 463 U.S. 29, 43 (1983))

DOE also received comments from over 50 individual commenters expressing concern that amended standards could lead to more energy- and water-intensive usage of RCWs, thereby counteracting any energy or water savings resulting from amended standards.

As discussed further in section V.B.4.a of this document, in response to the March 2023 NOPR, AHAM and manufacturers presented data and information indicating that there are uncertainties regarding potential impacts on certain aspects of product performance at the standard levels proposed in the March 2023 NOPR (*i.e.*, TSL 3) that could lead consumers to opt for more energy- and water-intensive washing, and that changes to consumer usage patterns to mitigate such impacts could jeopardize the energy and water savings that would be achieved at the proposed efficiency levels.

DOE notes that in response to the March 2023 NOPR, manufacturers did not provide any specific data nor express any specific concerns regarding clothes washer performance at TSL 2 (*i.e.*, the Recommended TSL corresponding to the standards level adopted in this direct final rule). DOE's own data demonstrates no negative impact at TSL 2 on the cleaning performance, wash temperature, and mechanical action scores of RCWs, indicating there would be no loss of consumer utility at TSL 2. Furthermore, as previously discussed, on February 14, 2024, DOE received a second joint statement from the same group of stakeholders that submitted the Joint Agreement (including AHAM, and Whirlpool as a member) in which the signatories reaffirmed the standards recommended in the Joint Agreement.[108] In particular, the letter states that the stakeholders do not anticipate the recommended standards will negatively affect features or performance, and that DOE's test data shows, and industry experience agrees, that the recommended standard levels for RCWs can maintain good cleaning performance and do not preclude the ability to provide high wash temperatures. For further discussion of

[108] This document is available in the docket at: www.regulations.gov/comment/EERE-2017-BT-STD-0014-0509.

clothes washer performance as it relates to amended standards, see section V.B.4.a of this document.

DOE acknowledges that this conclusion is contrary to its assumptions in the final rule that it published on December 16, 2020 ("December 2020 Final Rule"). 85 FR 81359. There, DOE assumed that consumers might need to re-run their clothes washers or clothes dryers through multiple cycles "to adequately clean or dry their clothing." *Id*. at 85 FR 81365. In this rulemaking, DOE has found no evidence suggesting that consumers are running their RCW multiple times at TSL 2, (*i.e.*, the Recommended TSL), which corresponds to the current ENERGY STAR efficiency level for both top-loading and front-loading standard-size RCW product classes. This is supported by data presented in section IV.E of this document and comments from Water Demand Management ("WaterDM"). (WaterDM, No. 508 at p. 3) According to the historical RECS data, average consumer usage of RCWs has steadily declined from 292 cycles per year per RCW in the 2005 RECS to 210 cycles per year per RCW in the 2020 RECS, while the average household size has remained essentially unchanged during the same period (average of 3 household members). This indicates a significant downward trend in the average number of cycles run on each RCW over the past 15 years, despite the implementation of RCW energy conservation standards. These include the first standard, Tier 1, introduced in 2004, followed by Tier 2 in 2007, and the current amended standard, Tier 1 in 2015 and Tier 2 in 2018. Additionally, data from WaterDM corroborates this trend, showing a decline in the average number of clothes washer loads per household per day from 0.81 in 1999 to 0.71 in 2023, despite the decrease in water use per load from 41 gallons to 25 gallons and increase in capacity of clothes washer during the same period.

The amount of water used per pound of clothes washed has decreased during this time and yet there is no evidence that cleaning performance was negatively impacted (through the usage of multiple cycles to clean a given load of clothes). These data indicate that amended energy conservation standards have not resulted in consumers re-running loads of laundry purportedly due to reduced cleaning performance.

Given that there is no evidence of any previous RCW standard increasing RCW cycles per year, and in fact, instead cycles per year have decreased over time through multiple standards, DOE determines that a standard at TSL 2 would not be expected to lead consumers to opt for more energy- and water-intensive washing.

To better understand and quantify the uncertainties of any impacts of potential standards at TSL 3 and TSL 4 on consumer behavior, for this direct final rule, DOE has conducted a sensitivity analysis of possible increased use of the "deep fill" option on top-loading standard-size RCWs at CEE Tier 1 (TSL 3) and max-tech (TSL 4), which are more stringent TSLs than being adopted in this direct final rule. Specifically, DOE considered the possibility that consumers might opt for more energy- and water-intensive washing using the deep fill option available on their top-loading RCWs. DOE assumed that in this case consumers would choose to wash their loads with more water, resulting in less energy and water savings compared to the standard projections. The sensitivity analysis compares the energy and water savings, as well as the NPV, between scenarios with and without the deep fill usage option, quantifying the impact of altered consumer behavior on the analytical results. The analysis does not model a change for product classes lacking a deep fill option, like front-loading RCWs, nor does it consider aspects of consumer behavior unrelated to usage intensity, such as the delayed replacement of older clothes washers.

The overall FFC national energy savings decrease by approximately 2 percent and national water savings decrease by less than 2 percent, compared to the default case. For details on the NIA sensitivity analysis results, see appendix 10E of the direct final rule TSD.

3. Net Present Value Analysis

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

As discussed in section IV.F.1 of this document, DOE developed RCW price trends based on historical PPI data. DOE applied the same trends to project prices for each product class at each considered efficiency level. By 2056, which is the end date of the projection period, the average RCW price is projected to drop 17.2 percent relative to 2022. Non-energy efficiency related features are excluded from the manufacturer production cost, therefore, the decline in price does not include any price adders associated with non-energy efficiency related features. DOE is not aware if such data exists and notes that the projected drop in price may not reflect real market prices. DOE's projection of product prices is described in appendix 10C of the direct final rule TSD.

To evaluate the effect of uncertainty regarding the price trend estimates, DOE investigated the impact of different product price projections on the consumer NPV for the considered TSLs for RCWs. In addition to the default price trend, DOE considered two product price sensitivity cases: (1) a high price-decline case based on PPI data for the period 1980–2022 and (2) a constant price trend at the 2022 value. Compared to the default price trend, which exhibits an annual price decline rate of 0.58 percent, the high price-decline case exhibits an annual decline rate of 1.15 percent, and the constant price case exhibits no annual decline. For the Recommended TSL under the high-price decline case, consumer NPV increases by 10 percent and 14 percent given discount rates of 3 percent and 7 percent, respectively. Under the constant price case, consumer NPV decreases by 12 percent and 16 percent given discount rates of 3 percent and 7 percent, respectively. The derivation of these price trends and the results of these sensitivity cases are described in appendix 10C of the direct final rule TSD.

The energy and water cost savings are calculated using the estimated energy and water savings in each year and the projected price of the appropriate form of energy and water. To estimate energy prices in future years, DOE multiplied the average regional energy prices by the projection of annual national-average residential energy price changes in the Reference case from *AEO2023*, which has an end year of 2050. To estimate price trends after 2050, the 2046–2050 average was used for all years. To estimate water prices in future years, DOE multiplied the average national water prices by the projection of annual national-average residential water price changes in the extrapolated future water price trend, which is based on the historical water price index from 1988 to 2022. As part of the NIA, DOE also analyzed scenarios that used inputs from variants of the *AEO2023* Reference case that have lower and higher economic growth. Those cases have lower and higher energy price trends compared to the Reference case. NIA results based on these cases are presented in appendix 10C of the direct final rule TSD.

In calculating the NPV, DOE multiplies the net savings in future years by a discount factor to determine their present value. For this direct final rule, DOE estimated the NPV of consumer benefits using both a 3-percent and a 7-percent real discount rate. DOE uses these discount rates in accordance with guidance provided by the Office of Management and Budget ("OMB") to Federal agencies on the development of regulatory analysis.[109] The discount rates for the determination of NPV are in contrast to the discount rates used in the LCC analysis, which are designed to reflect a consumer's perspective. The 7-percent real value is an estimate of the average before-tax rate of return to private capital in the U.S. economy. The 3-percent real value represents the "social rate of time preference," which is the rate at which society discounts future consumption flows to their present value.

[109] United States Office of Management and Budget. *Circular A-4: Regulatory Analysis*. September 17, 2003. Section E. Available at *www.whitehouse.gov/wp-content/uploads/legacy_drupal_files/omb/circulars/A4/a-4.pdf* (last accessed June 24, 2023).

I. Consumer Subgroup Analysis

In analyzing the potential impact of new or amended energy conservation standards on consumers, DOE evaluates the impact on identifiable subgroups of consumers that may be disproportionately affected by a new or amended national standard. The purpose of a subgroup analysis is to determine the extent of any such disproportional impacts. DOE evaluates impacts on particular subgroups of consumers by analyzing the LCC impacts and PBP for those particular consumers from alternative standard levels.

For this direct final rule, DOE analyzed the impacts of the considered standard levels on three subgroups: (1) low-income households, (2) senior-only households, and (3) well-water households. The analysis used subsets of the 2020 RECS sample composed of households that meet the criteria for the considered subgroups. DOE used the LCC and PBP spreadsheet model to estimate the impacts of the considered efficiency levels on these subgroups. Chapter 11 in the direct final rule TSD describes the consumer subgroup analysis. The sections below discuss the individual subgroups, and additional details are found in chapter 11 of the direct final rule TSD.

1. Low-income Households

Low-income households are significantly more likely to be renters or to live in subsidized housing units, compared to households that are not low-income. In these cases, the landlord purchases the equipment and may pay the energy bill as well.

For this direct final rule analysis, DOE divided low-income households into three sub-subgroups: 1) renters who pay energy bill; 2) renters who do not pay energy bill; and 3) homeowners. The 2020 RECS includes data on whether a household pays for the energy bill, allowing DOE to categorize households in the analysis narrowly,[110] excluding any costs or benefits that are accrued by either a landlord or subsidized housing agency. This allows DOE to determine in a more accurate manner whether low-income households are disproportionately affected by an amended energy conservation standard. Table IV.22 shows the distribution of low-income household clothes washer users with respect to whether they rent or own and whether they pay the energy bill.

Table IV.22 Characterization of Low-Income Households in the Sample for Clothes Washers

Type of Household*	Percentage of Low-Income Sample				Impact of Higher Efficiency on Energy Bill	Impact of First Cost Increase
	Top-Loading, Standard-Size	Front-Loading, Standard-Size	Semi-Automatic, Top-Loading, Ultra-Compact	Front-Loading, Compact		
Renters (Pay for Energy Bill)**	40%	43%	50%	57%	Full/Partial savings	None***
Renters (Do Not Pay for Energy Bill)**	4%	4%	5%	8%	None	None***
Owners	56%	53%	45%	36%	Full/Partial savings	Full

* RECS 2020 lists three categories: (1) Owned or being bought by someone in your household (here classified as "Owners" in this table); (2) Rented (here classified as "Renters" in this table); (3) Occupied without payment of rent (also classified as "Renters" in this table). Renters include occupants in subsidized housing including public housing, subsidized housing in private properties, and other households that do not pay rent. RECS 2020 does not distinguish homes in subsidized or public housing.
** RECS 2020 lists four categories for each of the fuels used by a household: (1) Household is responsible for paying for all used in this home; (2) All used in this home is included in the rent or condo fee; (3) Some is paid by the

[110] The energy bill includes fuel type of electricity, natural gas, or propane consumed by a household.

household, some is included in the rent or condo fee; and 4) Paid for some other way. "Do Not Pay for Energy Bill" includes only category (2). Partial energy bill savings would occur in cases of category (3).
*** Low-income renters typically do not purchase a clothes washer. Therefore, it is unclear if the renters would be asked to pay the full or partial of the total installed cost. As a result, DOE estimated there would be no impact of first cost increase for low-income renters and occupants in public housing and other households that do not pay rent.

For this direct final rule, DOE considered comments it had received regarding its consideration of low-income households in the March 2023 NOPR. DOE notes that although several of the comments discussed below are from AHAM, as previously discussed, on February 14, 2024, DOE received a second joint statement from the same group of stakeholders that submitted the Joint Agreement (including AHAM) in which the signatories reaffirmed the standards recommended in the Joint Agreement.[111] In particular, the letter states that "the recommended standards represent the maximum levels of efficiency that are technologically feasible and *economically justified"* (emphasis added). The approach used for this direct final rule is largely the same as the approach DOE had used for the March 2023 NOPR analysis.

In response to the March 2023 NOPR, AHAM stated that an updated energy conservation standard should be aligned with DOE's analytical principles and Executive Order 13985, which requires agencies to assess whether its programs and policies perpetuate systemic barriers to opportunities and benefits for people in underserved communities. AHAM comment that it is inappropriate to concentrate the negative impacts of the standard on low-income and traditionally underserved communities and that these consumers cannot pay more for more efficient RCWs and assume they will get

[111] This document is available in the docket at: www.regulations.gov/comment/EERE-2017-BT-STD-0014-0509.

a payback over time on their electric bill. (AHAM, No. 464 at pp. 11–12) AHAM commented the highest savings a renter would receive on their monthly bill under the standards proposed in the March 2023 NOPR for top-loading standard-size RCWs, according to DOE's analysis, would be 82 cents. (*Id*. at p. 32) AHAM further commented that the increased upfront costs attributable to the standards proposed in the March 2023 NOPR are high enough that they will likely be noticed by a landlord or a builder and, based on the comments by the associations representing those stakeholders, AHAM stated that those costs are likely to be passed onto renters, offsetting any savings. (*Id*. at p. 33)

Whirlpool commented that many low-income households are renters and that DOE has no evidence for its assumption that renters will benefit from operational savings with no cost impacts. (Whirlpool, No. 462 at p. 6) Whirlpool stated that landlords pass along their costs to consumers to the extent they are able, or elect to delay their purchase of a new clothes washer. (*Id*. at pp. 6–7) Whirlpool commented that DOE must account for the impact of increased product costs on rental costs for consumers. (*Id*. at p. 7)

CEI commented that the March 2023 NOPR discussion of consumer sub-groups misses the possibility of adverse impacts on low-income households. (CEI, No. 454 at p. 5) CEI commented that landlords will not absorb the higher purchase price of compliant RCWs, but instead will include the cost in rental rates, harming low-income renters. (*Id*.)

According to the RECS clothes washer sample, around 47 percent of low-income households that have a clothes washer are renters. In most cases, the property owner would purchase a new clothes washer. While the owner might seek to pass on some of the cost in the rent, the ability to do so is constrained to some extent by lease agreements that set rents for a specific period and larger market forces that influence rent levels in particular locations. In such circumstances, renters who pay the utility bill would see a significant net benefit from a higher-efficiency RCW over the product lifetime, and this is seen in the results of DOE's analysis (see chapter 11 of the direct final rule TSD). DOE notes that there continues to be a lack of data to corroborate the notion that landlords pass on some, or all, of increased appliance costs to tenants. However, for this direct final rule, DOE implemented a scenario assuming that landlords would pass some of the incremental RCW costs to renters in the LCC. The results indicate that this scenario would not impact DOE's decision on amended standards. For details of the sensitivity results, see appendix 11A of the direct final rule TSD.

AHAM commented that DOE has not established that there is a significant proportion of split incentive issues between tenants and landlords. (AHAM, No. 464 at p. 26) AHAM commented that continuing to assert the presence of a split incentive situation without any supporting data is arbitrary and capricious stating that no states require landlords to provide clothes washers and a significant portion of rental housing would have to have clothes washers provided by landlords, which DOE has not established. (*Id*.) AHAM stated that the maximum potential universe of low-income households where a split incentive might exist is a small fraction of all low-income households. (*Id*.) AHAM stated that a split incentive may exist in only a small fraction of low-income households, noting that using 2020 RECS, only 30 percent of low-income households with clothes washers and who pay their utilities are renters. (*Id*. at p. 26) AHAM noted that only 13 percent of those households live in housing units with two or more units and eight percent live in buildings with five or more units. (*Id*.) AHAM further noted that when low-income households live in units where the landlord provides clothes washers, they are most likely to be in multi-family buildings, and most likely in apartment buildings with five or more units because anecdotal experience is that clothes washers are rarely provided in single family rental units. (*Id*. at p. 27) AHAM concluded that the maximum percentage of low-income households with landlord supplied clothes washers is less than 10 percent of all low-income households. (*Id*.)

CEI commented that DOE overestimated the percentage of low-income households who are renters rather than homeowners. (CEI, No. 454 at p. 5)

The CA IOUs supported DOE's decision to divide the low-income subgroup into renters and non-renters. (CA IOUs, No. 460 at p. 6) The CA IOUs noted that renters have a lower share of ENERGY STAR appliances than non-renters, partially due to the split incentive market failure where landlords are responsible for purchasing major home appliances while renters are responsible for paying utility bills. (*Id*.)

The existence of a split incentive across a substantial number of U.S. households, in which a tenant pays for the cost of electricity while the building owner furnishes appliances, has been identified through a number of studies of residential appliance and equipment use broadly, and for clothes washers in low-income settings in specific.

Building from early work including Jaffe and Stavins (1994),[112] Murtishaw and Sathaye (2006)[113] discussed the presence of landlord–tenant split incentives (*i.e.*, the "principal-agent problem") in the context of refrigeration, water heating, space heating, and lighting in rental housing. While the study did not focus on the low-income household, they estimated that 35 percent of total residential site energy use is subject to split incentives based on these four products alone. In the specific context of clothes washers, Spurlock and Fujita (2022)[114] estimated that while clothes washers are more common for households above the poverty line, the majority of households at or below the threshold have a clothes washer in their home; 87 percent of low-income individuals who rented their homes were found to pay the electricity bill resulting from their energy use, such that they were likely subject to a scenario in which their landlord purchased the appliance, but they paid the operating costs. Spurlock and Fujita (2022), Houde and Spurlock (2016),[115] and citations therein (*e.g.*, Davis 2012)[116] also further elaborated on split incentives in rental housing and their association with generally lower efficiency among the appliances used by renters.

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112 A.B. Jaffe and R.N. Stavins (1994) The energy-efficiency gap What does it mean? Energy Policy, 22 (10) 804-810, Available at *doi.org/10.1016/0301-4215(94)90138-4*.

113 Murtishaw, S., & Sathaye, J. (2006). Quantifying the Effect of the Principal-Agent Problem on US Residential Energy Use. Lawrence Berkeley National Laboratory. Available at *escholarship.org/uc/item/6f14t11t*.

114 C.A. Spurlock and K.S. Fujita (2022) Equity implications of market structure and appliance energy efficiency regulation, Energy Policy, 165 (112943), Available at *doi.org/10.1016/j.enpol.2022.112943*.

115 S. Houde, C.A. Spurlock (2016) Minimum Energy Efficiency Standards for Appliances: Old and New Economic Rationales. Economics of Energy & Environmental Policy, 5(2), 65–84. Available at *www.jstor.org/stable/26189506*.

116 L.W. Davis (2012) Evaluating the slow adoption of energy efficient investments: are renters less likely to have energy efficient appliances? The Design and Implementation of US Climate Policy, University of Chicago Press (2012), pp. 301-316.

With regard to AHAM's assertion that the maximum percent of low-income households with landlord-provided clothes washers is less than 10 percent of all low-income households, DOE notes that AHAM's assertion only considers households with incomes under $34,000, who have clothes washers in their units, and who pay their energy bills. This differs from DOE's definition of low-income households, which is based on poverty thresholds established by the U.S. Census Bureau.[117] As described in chapter 11 of the direct final rule TSD, DOE defines low-income households by varying poverty thresholds based on household size and the number of related children under 18 years old. Consequently, using the same 2020 RECS data, DOE's analysis indicates that low-income renters who have an RCW and pay their energy bills constitute roughly 40 percent of all low-income households. Furthermore, within this group, approximately 43 percent reside in single-family houses, 20 percent in buildings with 2 to 4 units, and 25 percent in buildings with 5 or more units. As a result, DOE's analysis concludes that there is a substantial fraction of split-incentive issue among low-income households.

AHAM commented that low-income consumers typically purchase entry-level RCWs, the proposed rule[118] would disproportionately and negatively affect low-income households and lead them to incur debt, purchase a used clothes washer, repair a current one, or use the laundromat—meaning they will be forced to spend more time doing

[117] U.S. Census Bureau, How the Census Bureau Measures Poverty, Available at *www.census.gov/topics/income-poverty/poverty/guidance/poverty-measures.html*.

[118] DOE notes that the standards adopted in this direct final rule are the same as those proposed standards in the March 2023 NOPR for three of the five product classes, but are less stringent than the standards proposed in the March 2023 NOPR for the other two product classes.

laundry than other consumers or will not actually conserve water and energy or save money. (AHAM, No. 464 at p. 11)

AHAM commented that it commissioned Bellomy Research to conduct a study focusing on the impact of higher appliance prices on low-income households.[119] (AHAM, No. 464 at p. 27) AHAM commented that the study found that 52 percent of households earning under $50,000 annually would resort to buying a used clothes washer or delay purchasing one due to cost. (*Id*.) AHAM further commented that 72 percent of households with incomes below $25,000 would not pay more upfront for a more energy-efficient clothes washer that would save them in energy bills over the next ten years. These households were 1.7 times more likely to have a top-loading clothes washer with an agitator and one-third as likely to own a front-loading clothes washer. (*Id*. at p. 28) AHAM additionally commented that, 73 percent of households earning under $25,000 would experience negative to extremely negative impacts from being forced to buy a new clothes washer. (*Id*.) AHAM commented that these findings contradict DOE's theoretical analysis and highlight the need for government initiatives that recognize and mitigate impacts on underserved communities. (*Id*. at p. 27)

Representatives Latta *et al*. commented that low-income consumers in particular are least likely to be able to afford new appliances. (Representatives Latta *et al*., No. 456 at pp. 1–2) Representatives Latta *et al*. stated that DOE's analysis fails to consider the

[119] The Bellomy Research study was sponsored by Whirlpool. (Whirlpool, No.462 at p. 6).

unintended consequences of upfront cost increases, including high interest rate financing and lost energy savings from delayed replacement of older, less-efficient appliances. (*Id.*)

Salman cited concerns with DOE's proposed standards for RCWs,[120] over costs, particularly the impact on low-income households. (Salman, No. 446 at p. 1)

DOE's low-income LCC subgroup analysis uses inputs specific to low-income consumers to estimate the impact of adopted standards. There is evidence that prior efficiency standards, by acting on a market substantially more complex than the simplified model of perfect competition, have aligned with improvements in efficiency (and in some cases additional product attributes) while maintaining a constant price for "entry-level" products. For example, Spurlock and Fujita (2022) examined appliance point of sales data and noted that the 2004 and 2007 RCW efficiency standards were associated with 30-percent increase in product efficiency contemporaneous with no change in average price within the baseline market segment (*i.e.*, "entry-level" RCWs).

DOE notes that, while unable to review the specific survey instrument and resulting dataset, this summary of AHAM survey findings implies that the framing does not reflect the context of a revised minimum energy conservation standard. Specifically, these are impacts AHAM is claiming would occur based on the full cost of a new RCW and are not specifically relevant to the potential increased incremental cost of purchasing a new RCW in a standards case. The incremental cost, which is substantially less than the

[120] DOE notes that the standards adopted in this direct final rule are the same as those proposed March 2023 NOPR for three of the five product classes, but are less stringent than the standards proposed in the March 2023 NOPR for the other two product classes.

full cost of an RCW, varies depending on the considered standard levels. Additionally, as described in section IV.G of this document, DOE implemented an extended repair scenario and a second-hand market scenario to capture the market impact resulting from consumers' sensitivity to increased clothes washer prices.

AHAM commented that DOE's approach to assessing the cost of appliances for low-income households, which uses a static balance sheet, fails to consider capital availability and non-financial costs faced by these households, such as missed payments on essential expenses like food and housing. (AHAM, No. 464 at p. 29) AHAM presented data showing that the lowest 30 percent income groups have no discretionary income to save, making it impossible for them to rebalance their balance sheets after making a purchase. AHAM commented that DOE does not provide a theory or explanation for how low-income households with negative discretionary cash flow can realistically rebalance their balance sheets, undermining the accuracy of DOE's predictions. AHAM commented on disparities between DOE's projections and interest rates and data from sources like the Bureau of Consumer Financial Protection, suggesting that DOE's estimates are not reliable. (*Id*. at p. 30) AHAM commented that regardless of income, savings as low as the projected savings in this rule are not enough to be noticed on the monthly flow of funds, will not provide an opportunity to rebalance a balance sheet, and do not constitute a benefit to consumers. (AHAM, No. 464 at p. 32)

AHAM commented that DOE should undertake a full study of the effects of standards on low-income households beyond simply restating its belief that the balance sheet approach is appropriate in the face of comments and data demonstrating the inaccuracy of this belief. (AHAM, No. 464 at p. 31) AHAM further commented that DOE's assumption that consumers pay the water and sewer bill directly is an unproven and, often, incorrect, assumption. (*Id*. at p. 32)

Strauch expressed concern that future dollar savings are not accessible for immediate purchase, making it unaffordable for individuals with limited incomes or fixed budgets. (Strauch, No. 430 at p. 2)

DOE notes that the LCC is not predicting a purchase decision. Rather, it estimates the net present value of the financial impact of a given standard level over the lifetime of the product (*e.g.*, 13 years) assuming the standard-compliant product has already been installed, and allows for comparison of this value across different hypothetical minimum efficiency levels. It is applied to future-year energy costs and non-energy operations and maintenance costs in order to calculate the net present value of the appliance to a household at the time of installation. The consumer discount rate reflects the opportunity cost of receiving energy cost savings in the future, rather than at the time of purchase and installation. The opportunity cost of receiving operating cost savings in future years, rather than in the first year of the modeled period, is dependent on the rate of return that could be earned if invested into an interest-bearing asset or the interest cost accrual avoided by paying down debt. Consumers in all income groups generally hold a variety of assets (*e.g.*, certificates of deposit, stocks, bonds) and debts (*e.g.*, mortgage, credit cards, vehicle loan), which vary in amount over time as consumers allocate their earnings, make new investments, *etc*. Thus, the consumer discount rate is estimated as a weighted average of the rates and proportions of the various types of assets and debts held by households in each income group, as reported by the Survey of Consumer Finances. Furthermore, DOE notes that the Survey of Consumer Finances shows that consumers across all income groups generally rebalance their assets and debts over time.

Whirlpool commented that DOE's analysis appears to not account for the fact that a significant portion of consumers, especially low-income consumers, finance their appliance purchases, either through personal loans, in-house financing, rent-to-own, or by putting purchases on their credit cards. Whirlpool commented that it wasn't clear if DOE included the likely financing and actual rates paid by consumers in the analysis. Whirlpool commented that many more consumers than DOE anticipates may end up saving no money (and may spend more money) as a result of the proposed rule.[121] (Whirlpool, No. 462 at p. 6)

As discussed, the LCC analysis estimates the net present value of the financial impact of a given standard level over the lifetime of the product. In the case of top-loading standard-size RCWs, the price differential between EL 3 and baseline is $160. When a consumer purchased the more efficient unit on a credit card with a 25 percent APR, it would amount to an additional financing cost of about $3 per month in the first year of leaving the balance on the card. While the compound interest could start to accumulate if the balance was left unpaid for an extended period of time, it would be an

[121] DOE notes that the standards adopted in this direct final rule are the same as those proposed March 2023 NOPR for three of the five product classes, but are less stringent than the standards proposed in the March 2023 NOPR for the other two product classes.

unusual case as the Survey of Consumer Finances shows that consumers across all income groups generally rebalance their assets and debts.

AHAM commented that DOE's analysis overstates the operating costs savings from reduced water use in washing machines, as many households, especially in multi-family buildings, don't directly pay for water and sewer, as costs are often covered by landlords or included in common charges. AHAM commented that condominium owners bear the cost of efficient clothes washers, but don't see direct water bill savings because water and sewer chargers are included in many condominium fees, possibly leading to negative life cycle cost savings. AHAM suggested that DOE should separately analyze multi-family housing units that do not directly pay for water and sewer costs. (AHAM, No. 464 at pp. 39–40)

Whirlpool commented that many consumers in living arrangements where water is not sub-metered (*e.g.*, multi-family housing) are low-income renters, so DOE's estimated reduction in the cost of water is likely inapplicable. (Whirlpool, No. 462 at p. 6)

AHAM and Whirlpool identified two groups of consumers who may not see water bill savings as a result of an amended standard: (1) condominium owners in multi-family buildings where water and sewer costs are included in common charges and (2) low-income renters in multi-family housing where water is not sub-metered and/or costs are covered by landlords.

DOE notes that RECS does not identify whether or not a household pays its water bill. With regard to the first group, if assuming that owners in multi-family buildings who are identified in RECS as not paying their energy bill also do not pay their water bill, this group represents less than 0.5 percent of the national sample, indicating a relatively small group. With regard to the second group, in DOE's low-income subgroup analysis, DOE assumes that households that do not pay their energy bill also do not pay their water bill and therefore do not accrue any operating cost savings from considered standards. Therefore, this issue is already accounted for in the subgroup results.

2. Senior-only Households

Annual clothes washer usage for senior-only households is significantly less than the full household sample because the household size for senior-only families is typically either one or two people. A household size equal to or larger than three members accounts for less than 1 percent of senior-only households. Therefore, as described in section V.B.1 of this document, the percentage of senior-only RCW consumers experiencing a net cost at TSL 2 (the Recommended TSL) is greater (35 percent for top-loading standard-size RCWs) than in the full LCC sample (27 percent for top-loading standard-size RCWs). The simple payback period for senior-only households at TSL 2 is 1.7 years longer than in the full LCC sample.

For this direct final rule, DOE considered comments it had received regarding its consideration of senior-only households in the March 2023 NOPR. The approach used for this direct final rule is largely the same as the approach DOE had used for the March 2023 NOPR analysis.

In response to the March 2023 NOPR, Strauch expressed concern that senior households are unlikely to recover the added cost of energy-efficient products during their lifetime. (Strauch, No. 430 at p. 2) Strauch commented that even existing rebate programs do not sufficiently offset the increased up-front cost, particularly for senior households who may not benefit from these savings. (*Id*.)

Strauch did not provide supporting data to demonstrate that senior households are unlikely to recover from increased purchase price at the adopted standard level over the course of their lifetime. DOE is not able to perform an analysis on seniors who might not be able to recoup the savings due to their age. However, DOE has described in section V.B.1 of this document, at the Recommended TSL, the positive average LCC savings across all product classes for senior consumers — except for front-loading compact RCWs for which about more than 70 percent of senior consumers have positive cost savings — outweigh the negative average LCC savings of $1 for front-loading compact RCWs for senior consumers.

3. Well-water Households

In response to the March 2023 NOPR, AHAM commented that DOE should analyze well water households as a separate group due to substantial cost differences compared to municipal water users, noting that well water costs are about 6 percent of the combined cost of municipal water and sewer. AHAM commented that for top-loading standard-size RCWs at EL 3, using the real cash costs for water and sewer, the mean and median LCC savings are negative, resulting in a net cost for about 60 percent of these households. AHAM commented that the actual cash costs also reveal negative LCC savings for most front-loading compact clothes washer households and about half of front-loading standard-size clothes washer households. AHAM commented that DOE should therefore adjust its proposals acknowledging the burden on this group. (AHAM, No. 464 at p. 39)

Whirlpool commented that the March 2023 NOPR does not adequately consider the cost impacts on consumers residing in rural households. Whirlpool commented that many rural households use well and septic systems for which the cost of water and sewer is very low, leading to less savings than DOE anticipates. Additionally, Whirlpool stated that the water used by RCWs using well water has no societal benefit from water reductions because they are ultimately replenished by groundwater. (Whirlpool, No. 462 at pp. 5–6) Representatives Latta *et al*. commented that DOE overestimates savings for many rural consumers who use a well and septic system, for which water operating cost savings from the proposed standard are essentially zero. (Representatives Latta *et al*., No. 456 at p. 2)

As described in section IV.F.4 of this document, for this direct final rule, DOE has made adjustments to its method for estimating well water and septic costs. The updated average well water and septic tank prices is 8.8 percent[122] of the combined cost of municipal water and sewer costs. In addition, DOE has specifically assigned well water price and septic tank price to well users instead of using the composite water and wastewater prices. This means that the national LCC analysis accounts for the potential

[122] DOE's estimate is higher than that provided by AHAM (*i.e.*, 6 percent) because DOE factored in maintenance costs for septic systems, whereas AHAM did not.

financial burden on households using well water systems, and it acknowledges that some well water users might experience increased costs under the amended efficiency standards. In addition, DOE presents results for the well user subgroup in chapter 11 of the TSD.

Chapter 11 in the direct final rule TSD describes the consumer subgroup analysis.

J. Manufacturer Impact Analysis

1. Overview

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

The quantitative part of the MIA primarily relies on the Government Regulatory Impact Model ("GRIM"), an industry cash flow model with inputs specific to this rulemaking. The key GRIM inputs include data on the industry cost structure, unit production costs, product shipments, manufacturer markups, and investments in R&D

and manufacturing capital required to produce compliant products. The key GRIM outputs are the INPV, which is the sum of industry annual cash flows over the analysis period, discounted using the industry-weighted average cost of capital, and the impact to domestic manufacturing employment. The model uses standard accounting principles to estimate the impacts of more-stringent energy conservation standards on a given industry by comparing changes in INPV and domestic manufacturing employment between a no-new-standards case and the various standards cases. To capture the uncertainty relating to manufacturer pricing strategies following amended standards, the GRIM estimates a range of possible impacts under different manufacturer markup scenarios.

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

DOE conducted the MIA for this rulemaking in three phases. In Phase 1 of the MIA, DOE prepared a profile of the RCW manufacturing industry based on the market and technology assessment and publicly-available information. This included a top-down analysis of RCW manufacturers that DOE used to derive preliminary financial inputs for the GRIM (*e.g.*, revenues; materials, labor, overhead, and depreciation expenses; selling, general, and administrative expenses ("SG&A"); and R&D expenses). DOE also used public sources of information to further calibrate its initial characterization of the RCW manufacturing industry, including company filings of form 10-K from the SEC,[123] corporate annual reports, the U.S. Census Bureau's *Annual Survey of Manufactures* ("*ASM*"),[124] and reports from Dun & Bradstreet.[125]

In Phase 2 of the MIA, DOE prepared a framework industry cash-flow analysis to quantify the potential impacts of amended energy conservation standards. The GRIM uses several factors to determine a series of annual cash flows starting with the announcement of the standard and extending over a 30-year period following the compliance date of the standard. These factors include annual expected revenues, costs of sales, SG&A and R&D expenses, taxes, and capital expenditures. In general, energy conservation standards can affect manufacturer cash flow in three distinct ways: (1) creating a need for increased investment, (2) raising production costs per unit, and (3) altering revenue due to higher per-unit prices and changes in sales volumes.

In addition, during Phase 2, DOE developed interview guides to distribute to manufacturers of RCWs in order to develop other key GRIM inputs, including product and capital conversion costs, and to gather additional information on the anticipated effects of energy conservation standards on revenues, direct employment, capital assets, industry competitiveness, and subgroup impacts.

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123 U.S. Securities and Exchange Commission, Electronic Data Gathering, Analysis, and Retrieval (EDGAR) system. Available at www.sec.gov/edgar/search/ (last accessed June 30, 2023).
124 U.S. Census Bureau, *Annual Survey of Manufactures*. "Summary Statistics for Industry Groups and Industries in the U.S. (2022)." Available at *www.census.gov/programs-surveys/asm/data/tables.html* (last accessed June 30, 2023).
125 The Dun & Bradstreet Hoovers login is available at *app.dnbhoovers.com* (last accessed June 30, 2023).

In Phase 3 of the MIA, DOE conducted structured, detailed interviews with representative manufacturers. During these interviews, DOE discussed engineering, manufacturing, procurement, and financial topics to validate assumptions used in the GRIM and to identify key issues or concerns. As part of Phase 3, DOE also evaluated subgroups of manufacturers that may be disproportionately impacted by amended standards or that may not be accurately represented by the average cost assumptions used to develop the industry cash flow analysis. Such manufacturer subgroups may include small business manufacturers, low-volume manufacturers, niche players, and/or manufacturers exhibiting a cost structure that largely differs from the industry average. DOE identified one subgroup for a separate impact analysis: small business manufacturers. The small business subgroup is discussed in chapter 12 of the direct final rule TSD.

2. Government Regulatory Impact Model and Key Inputs

DOE uses the GRIM to quantify the changes in cash flow due to new or amended standards that result in a higher or lower industry value. The GRIM uses a standard, annual discounted cash-flow analysis that incorporates manufacturer costs, manufacturer markups, shipments, and industry financial information as inputs. The GRIM models changes in costs, distribution of shipments, investments, and manufacturer margins that could result from an amended energy conservation standard. The GRIM spreadsheet uses the inputs to arrive at a series of annual cash flows, beginning in 2024 (the base year of the analysis) and continuing 30 years after the analyzed compliance year.[126] DOE

[126] For the no-new-standards case and all TSLs except the Recommended TSL, the analysis period ranges from 2024–2056. For the Recommended TSL, the analysis period ranges from 2024–2057.

calculated INPVs by summing the stream of annual discounted cash flows during this period. For manufacturers of RCWs, DOE used a real discount rate of 9.3 percent, which was derived from industry financials and then modified according to feedback received during manufacturer interviews.

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

a. Manufacturer Production Costs

Manufacturing more efficient products is typically more expensive than manufacturing baseline products due to the use of more complex components, which are typically more costly than baseline components. The changes in the MPCs of covered products can affect the revenues, gross margins, and cash flow of the industry. DOE conducted this analysis using the physical teardown approach. The resulting bill of materials provides the basis for the MPC estimates. In this rulemaking, DOE relies on an efficiency-level approach, supplemented with the design-option approach for certain “gap fill" efficiency levels. The efficiency-level approach is appropriate for RCWs, given the availability of certification data to determine the market distribution of existing products and to identify efficiency level "clusters" that already exist on the market. For a complete description of the MPCs, see section IV.C of this document and chapter 5 of the direct final rule TSD.

b. Shipments Projections

The GRIM estimates manufacturer revenues based on total unit shipment projections and the distribution of those shipments by efficiency level. Changes in sales volumes and efficiency mix over time can significantly affect manufacturer finances. For this analysis, the GRIM uses the NIA's annual shipment projections derived from the shipments analysis from the base year (2024) to the end of the analysis period (30 years after the analyzed compliance date[127]). *See* section IV.G of this document and chapter 9 of the direct final rule TSD for additional details.

c. Capital and Product Conversion Costs

New or amended energy conservation standards could cause manufacturers to incur conversion costs to bring their production facilities and product designs into compliance. DOE evaluated the level of conversion-related expenditures that would be needed to comply with each considered efficiency level in each product class. For the MIA, DOE classified these conversion costs into two major groups: (1) capital conversion costs; and (2) product conversion costs. Capital conversion costs are

[127] *Id.*

investments in property, plant, and equipment necessary to adapt or change existing production facilities such that new compliant product designs can be fabricated and assembled. Product conversion costs are investments in research, development, testing, marketing, and other non-capitalized costs necessary to make product designs comply with new or amended energy conservation standards.

DOE relied on information derived from manufacturer interviews, the engineering analysis, and product teardowns to evaluate the level of capital and product conversion costs manufacturers would likely incur at the various TSLs. During interviews, DOE asked manufacturers to estimate the capital conversion costs (*e.g.,* changes in production processes, equipment, and tooling) required to meet the various efficiency levels. DOE also asked manufacturers to estimate the redesign effort, engineering resources, and marketing expenses required at various efficiency levels to quantify the product conversion costs. Based on manufacturer feedback, DOE also estimated "re-flooring" costs associated with replacing obsolete display models in big-box stores (*e.g.*, Lowe's, Home Depot, Best Buy) due to higher standards. Some manufacturers stated that with a new product release, big-box retailers discount outdated display models, and manufacturers share any losses associated with discounting the retail price. The estimated re-flooring costs for each efficiency level were incorporated into the product conversion cost estimates, as DOE modeled the re-flooring costs as a marketing expense. DOE also estimated industry costs associated with re-rating basic models in accordance with appendix J, as detailed in the June 2022 TP Final Rule. 87 FR 33316. Manufacturer data were aggregated to better reflect the industry as a whole and to protect confidential information. DOE then scaled up the aggregate capital and product conversion cost feedback from interviews to estimate total industry conversion costs.

DOE adjusted the conversion cost estimates developed in support of the March 2023 NOPR to 2022$ for this analysis.

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

d. Manufacturer Markup Scenarios

MSPs include direct manufacturing production costs (*i.e.*, labor, materials, and overhead estimated in DOE's MPCs) and all non-production costs (*i.e.*, SG&A, R&D, and interest), along with profit. To calculate the MSPs in the GRIM, DOE applied a multiplier (the manufacturer markup) to the MPCs estimated in the engineering analysis for each product class and efficiency level. Modifying these manufacturer markups in the standards case yields different sets of impacts on manufacturers. For the MIA, DOE modeled two standards-case scenarios to represent uncertainty regarding the potential impacts on prices and profitability for manufacturers following the implementation of amended energy conservation standards: (1) a preservation of gross margin percentage scenario; and (2) a preservation of operating profit scenario. These scenarios lead to different manufacturer markup values that, when applied to the MPCs, result in varying revenue and cash flow impacts.

Under the preservation of gross margin percentage scenario, DOE applied a single uniform “gross margin percentage” across all efficiency levels, which assumes that manufacturers would be able to maintain the same amount of profit as a percentage of revenues at all efficiency levels within a product class. As manufacturer production costs increase with efficiency, this scenario implies that the per-unit dollar profit will increase. DOE assumed a gross margin percentage of 18 percent for all product classes.[128] Manufacturers tend to believe it is optimistic to assume that they would be able to maintain the same gross margin percentage as their production costs increase, particularly for minimally efficient products. Therefore, this scenario represents a high bound of industry profitability under an amended energy conservation standard.

In the preservation of operating profit scenario, as the cost of production goes up under a standards case, manufacturers are generally required to reduce their manufacturer markups to a level that maintains base-case operating profit. DOE implemented this scenario in the GRIM by lowering the manufacturer markups at each TSL to yield approximately the same earnings before interest and taxes in the standards case as in the no-new-standards case in the year after the expected compliance date of the amended

[128] The gross margin percentage of 18 percent is based on a manufacturer markup of 1.22.

standards.[129] The implicit assumption behind this scenario is that the industry can only maintain its operating profit in absolute dollars after the standard takes effect.

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

3. Discussion of MIA Comments

For this direct final rule, DOE considered comments it had received regarding its manufacturer impact analysis presented in the March 2023 NOPR. The approach used for this direct final rule is largely the same as the approach DOE had used for the March 2023 NOPR analysis.

In response to the March 2023 NOPR, AHAM stated that it cannot comment on the accuracy of DOE's approach for including how manufacturers would potentially recover costs and investments due to amended standards, but AHAM stated its support for DOE's intent in the microwave ovens energy conservation standards rulemaking to include those conversion costs and investments in the actual costs of products and retail prices.[130] (AHAM, No. 464 at p. 40) AHAM urged DOE to apply the same conceptual approach used in the microwave ovens rulemaking in this RCW rulemaking and all future rulemakings. (*Id.*)

[129] For TSL 2 (the Recommended TSL), the modeled compliance date is 2028. For the remaining TSLs, the modeled compliance date is 2027.
[130] Technical Support Document: Energy Efficiency Program For Commercial And Industrial Equipment: Microwave Ovens. Available at *www.regulations.gov/document/EERE-2017-BT-STD-0023-0022*.

DOE models different standards-case manufacturer markup scenarios to represent uncertainty regarding the potential impacts on prices and profitability for manufacturers following the implementation of amended energy conservation standards. The analyzed manufacturer markup scenarios vary by rulemaking as they are meant to reflect the potential range of financial impacts for manufacturers of the specific covered product or equipment. As discussed in section IV.J.2.d of this document, for RCWs, DOE modeled two standards-case manufacturer markup scenarios to represent the uncertainty regarding the potential impacts on prices and profitability for manufacturers following the implementation of amended energy conservation standards. For the March 2023 NOPR, DOE applied the preservation of gross margin percentage scenario to reflect an upper bound of industry profitability and a preservation of operating profit scenario to reflect a lower bound of industry profitability under amended standards. 88 FR 13520, 13576–13577 DOE used these scenarios to reflect the range of realistic profitability impacts under more-stringent standards. Manufacturing more efficient RCWs is generally more expensive than manufacturing baseline RCWs, as reflected by the MPCs estimated in the engineering analysis. Under the preservation of gross margin scenario for RCWs, incremental increases in MPCs at higher efficiency levels result in an increase in per-unit dollar profit per unit sold. In interviews, multiple manufacturers asserted that they would likely need to reduce manufacturer markups under more stringent standards to remain competitive in the marketplace. Therefore, the preservation of gross margin scenario represents the upper bound of industry profitability under amended standards. Applying the approach used in the microwave ovens rulemaking (*i.e.*, a conversion cost recovery scenario) would result in manufacturers increasing manufacturer markups under amended standards. Based on information gathered during confidential interviews in support of the March 2023 NOPR and a review of financial statements of companies engaged in manufacturing RCWs, DOE does not expect that the RCW industry would increase manufacturer markups as a direct result of amended standards absent non-energy efficiency-related features. Furthermore, in response to the March 2023 NOPR, DOE did not receive any public or confidential data indicating that industry would increase manufacturer markups in response to more stringent standards. Therefore, DOE used the two manufacturer markup scenarios from the March 2023 NOPR for this direct final rule analysis.

AHAM commented that laundry products (RCWs and consumer clothes dryers) are designed and used in pairs. (AHAM, No. 464 at p. 44) AHAM encouraged DOE to issue final rules for RCWs and consumer clothes dryers on the same date so that the compliance dates for these products are aligned. (*Id.*) AHAM stated that there will be an additional design cycle for either or both clothes washers and clothes dryers if the effective dates for the two products are out of sync. (*Id.*) AHAM commented that the existing DOE analysis does not capture this situation, which creates a significant technical and financial burden for manufacturers. (*Id.*) AHAM commented that coordinated compliance dates would greatly reduce burden on manufacturers and retailers. (*Id.*)

DOE is adopting the Recommended TSL in this direct final rule. The Joint Agreement included recommendations for other appliance standards rulemakings: RCWs; consumer clothes dryers; consumer conventional cooking products; dishwashers;

refrigerators, refrigerator-freezers, and freezers; and miscellaneous refrigeration products. The signatories indicate that the Joint Agreement for the six rulemakings should be considered as a joint recommendation of standards, to be adopted in its entirety. (Joint Agreement, No. 505 at p. 3) The Joint Agreement specifies a compliance date of March 1, 2028, for both RCWs and consumer clothes dryers. (*Id.*) Therefore, DOE did not adjust its conversion cost estimates to account for the time and investments associated with an additional design cycle as DOE assumed the compliance dates for RCWs and consumer clothes dryers would align.

Representatives Latta *et al*. urged DOE to evaluate options to address the cumulative regulatory impact on domestic appliance manufacturers of the unprecedented number of recently proposed standards, which also include consumer clothes dryers, consumer conventional cooking products, refrigerators, refrigerator-freezers, and freezers—with more to come. (Representatives Latta *et al*., No. 456 at p. 3) Representatives Latta *et al*. recommended that, given the serious concerns and ongoing uncertainty in the market, DOE should work with appliance manufacturers to incorporate their feedback before moving to finalize new efficiency standards. (*Id.*)

NMHC and NAA commented that this rulemaking comes as part of a series of similar rulemakings DOE is proposing to change performance standards for essential residential appliances. (NMHC and NAA, No. 451 at p. 4) NMHC and NAA stated that DOE took over 100 actions related to energy efficiency standards in 2022 and noted that DOE's August 2021 Report to Congress on Energy Conservation Standards Activity showed DOE had promulgated 71 energy conservation standards rulemaking notices since the last report in July 2019. (*Id*.) NMHC and NAA commented that they are concerned the number of changes for marginal efficiency gains will outpace the ability of the manufacturing sector and supplier partners to alleviate existing product shortages and delays, while creating new barriers to cost-effective and timely appliance procurement. (*Id*.) Accordingly, NMHC and NAA recommended DOE consider the collective impacts of these requirements. (*Id*.)

AHAM also urged DOE to consider cumulative regulatory burden in its analysis and decision-making process. (AHAM, No. 464 at p. 41) AHAM commented that the nature of EPCA's requirements that energy conservation standards be reviewed every 6 years creates a never-ending cycle in which manufacturers need to constantly update or redesign products to meet new or amended standards. (*Id*.) AHAM commented that many home appliance rulemakings will likely have compliance dates in 2027. (*Id*.) AHAM noted that the proposed levels for RCWs, refrigerators, refrigerator-freezers and freezers, consumer conventional cooking products, miscellaneous refrigeration products, room air conditioners, and microwave ovens will require significant redesign of products. (*Id*. at p. 42) AHAM asserted that engineers will therefore need to spend all their time redesigning products, test technicians will spend their time conducting testing to support re-design and certify products, and other will speed significant time on business planning, marketing, labeling, *etc*.—pulling resources from other development efforts. (*Id*.) AHAM commented that manufacturers will also need to re-tool factories as a result of standards for some of these rulemakings. (*Id*.) AHAM commented that since there is a short lead-in compliance period under EPCA and that compliance will likely be required in a similar timeframe, there is significant regulatory burden for the home appliance industry. (*Id*.)

AHAM asserted that DOE's analysis does not adequately account for cumulative regulatory burden. (*Id.*) AHAM encouraged DOE to acknowledge the cumulative regulatory burden its proposals place on industry. (*Id.*) AHAM stated that DOE needs to acknowledge the cumulative regulatory burden its proposals place on industry and suggested DOE could reduce cumulative regulatory burden by spacing out the timing of final rules, allowing more lead-time by delaying the publication of final rules in the *Federal Register* after they have been issued, and reducing the stringency of standards such that fewer products would require redesign. (*Id.*) AHAM encouraged DOE to incorporate combined conversion costs across rulemakings into the GRIM in order to quantify cumulative regulatory burden, and to consider the potential impact of these rulemakings more broadly on the economy and on inflation. (*Id.*)

Regarding stakeholders' requests to consider cumulative regulatory burden in its analysis and decision-making process, DOE analyzes cumulative regulatory burden in accordance with section 13(g) of the Process Rule. For this direct final rule, DOE examined Federal, product-specific regulations that could affect RCW manufacturers that take effect approximately 3 years before or after the 2028 compliance date. Table V.20 in section V.B.2.e of this document presents the DOE energy conservations standards that would impact manufacturers of RCWs in the 2025 to 2031 timeframe. As shown in Table V.20, DOE considers the potential cumulative regulatory burden from other DOE energy conservation standards rulemakings for consumer clothes dryers, consumer conventional cooking products, refrigerators, refrigerator-freezers, and freezers, miscellaneous refrigeration products, room air conditioners, and microwave ovens in this direct final rule analysis.

Regarding AHAM’s suggestion about spacing out the timing of final rules for home appliance rulemakings to reduce regulatory burden, DOE has statutory requirements under EPCA on the timing of rulemakings. For RCWs, consumer clothes dryers, consumer conventional cooking products, dishwashers, refrigerators, refrigerator-freezers and freezers, miscellaneous refrigeration products, and room air conditioners, amended standards apply to covered products manufactured 3 years after the date on which any new or amended standard is published. (42 U.S.C. 6295(m)(4)(A)(i)) For miscellaneous refrigeration products, amended standards apply 5 years after the date on which any new or amended standard is published. (42 U.S.C. 6295(l)(2)) However, the multi-product Joint Agreement recommends alternative compliance dates. As discussed in section II.B.3 of this document, the Joint Agreement recommendations are in accordance with the statutory requirements of 42 U.S.C. 6295(p)(4) for the issuance of a direct final rule DOE. Therefore, as compared to the EPCA-required lead time of 3-years, RCW manufacturers have more lead time to meet amended standards at the Recommend TSL.

Regarding the pace of DOE’s activity on energy conservation rulemakings, DOE has statutory requirements under EPCA on the timing of appliance rulemakings. For RCWs, EPCA provides that, not later than 6 years after the issuance of any final rule establishing or amending a standard, DOE must publish either a notice of determination that standards for the product do not need to be amended, or a NOPR including new proposed energy conservation standards (proceeding to a final rule, as appropriate). (42 U.S.C. 6295(m)(1)) Regarding incorporating the combined conversion costs across rulemakings into the GRIM, DOE is concerned that combined results would make it more difficult to discern the direct impact of the amended standard on covered manufacturers, particularly for rulemakings where there is only partial overlap of manufacturers. If DOE were to combine the conversion costs from multiple regulations, as requested, it would be appropriate to match the combined conversion costs with the combined revenues of the regulated products. For rulemakings with only a partial overlap of manufacturers, conversion costs would be spread over a larger revenue base and result in less severe INPV impacts when evaluated on a percent change basis.

Whirlpool commented that DOE's analysis fails to consider significant costs to both manufacturers and consumers, as well as the likely diminution in market competition and product utility and performance. (Whirlpool, No. 462 at p. 4) Whirlpool stated that DOE must consider all costs that manufacturers must bear to develop and market products that meet the proposed standard and that the proposed standard will result in wholesale removal of certain products and features from the market.[131] (*Id.*) Whirlpool commented that the standards proposed in the March 2023 NOPR would reduce competition by narrowing the range of RCWs available, including functionally phasing out small- and mid-size top-loading RCWs, while making it difficult to distinguish them based on features, such as traditional agitators. (*Id.* at p. 14) Whirlpool also expressed concern that product consolidation could cause industry consolidation. (*Id.*)

[131] DOE notes that the standards adopted in this direct final rule are the same as the proposed in the March 2023 NOPR for three of the five product classes, but are less stringent than the standards proposed in the March 2023 NOPR for the other two product classes.

Fisher *et al*. commented that by regulating based on one or two characteristics, and by prioritizing energy efficiency over other compelling factors, DOE is stifling the free market, hindering broader innovation, and discouraging the production of products that consumers actually want to buy. (Fisher *et al.*, No. 463 at p. 4) Fisher *et al*. commented that EPCA specifically calls for DOE to consider the impact of lessening competition—which is likely given the significantly higher standards for RCWs—and prevents the Secretary from implementing or amending a standard that will cause the unavailability in the United States of any covered product type (or class). Fisher *et al.* stated that given that DOE is proposing significantly higher standard for different classes of RCWs, it is possible for these regulations to impact competition, unintended, or otherwise.[132] (*Id.* at p. 3) Additionally, Fisher *et al*. added that energy efficiency regulations adversely affect lower-income consumers, which is a consumer subgroup that DOE targets as part of its analysis in the March 2023 NOPR and a group already harmed by consistently high inflation. (*Id.* at p. 5) Fisher *et al*. commented that the proposed standards are not economically justified and should be thrown out stating that they have the potential to substantially impact competition and the availability of products. (*Id.*)

Regarding the impact on product utility and consumer features, DOE considers features that provide consumer utility in its analysis of energy conservation standards (*see* section V.B.4 of this document for additional details). Specifically, one of the seven statutory factors for prescribing amended standards for covered products, such as RCWs,

[132] DOE notes that the standards adopted in this direct final rule are the same as the proposed in the March 2023 NOPR for three of the five product classes, but are less stringent than the standards proposed in the March 2023 NOPR for the other two product classes.

includes evaluating the impact of potential standard levels to ensure that amended standards would not lessen the utility or performance of the considered products (*see* section III.E.1 of this document for a discussion of how DOE has addressed each of those seven factors in this rulemaking). Regarding the potential loss of features such as traditional agitators, DOE notes that the adopted standards for RCWs do not preclude the ability to offer agitators. *See* section V.B.4.c of this document for additional details.

Regarding concerns that amended standards would phase out small- and mid-size top-loading RCWs, DOE modeled incremental increases in capacity for top-loading standard-size RCWs based on the most common design strategy currently used by manufacturers at these efficiency levels as well as information gathered during manufacturer interviews about the likely design path to improve efficiency. As discussed further in section V.B.4.b of this document, DOE's engineering analysis indicates that the efficiencies required by the Recommended TSL are technically achievable across the entire capacity range of top-loading standard-size RCWs. Therefore, while the MPCs for the top-loading standard-size product class reflect increases in capacity at EL 2, EL 3, and EL 4, meeting the Recommended TSL (corresponding to EL 2 for the top-loading standard-size product class) is technologically feasible at smaller capacities. Thus, the Recommended TSL does not require manufacturers to increase the capacity of small- and mid-size models. Such units can feasibly achieve the adopted standard level through the use of other available design options. In chapter 5 of the direct final rule TSD, DOE provides example design pathways that manufacturers could use to achieve higher efficiency without increasing capacity as a design option.

Regarding the impact on competition, DOE notes that it will provide DOJ with copies of this direct final rule and TSD for review to determine the impact, if any, of any lessening of competition likely to result from a standard. DOE will consider DOJ's comments on the rule in determining whether to withdraw the direct final rule. *See* section V.B.5 of this document for additional details. DOE also notes that the majority of RCW OEMs already offer RCWs that meet the Recommended TSL. Of the nine OEMs with top-loading standard-size products, six OEMs offer models that meet the Recommended TSL efficiencies. These six OEMs of top-loading standard-size RCWs collectively account for over 95 percent of overall top-loading standard-size RCW shipments. Of the seven OEMs with front-loading standard-size products, six OEMs offer models that meet the Recommended TSL efficiencies. These six OEMs of front-loading standard-size RCWs collectively account for over 98 percent of overall front-loading standard-size RCW shipments. Given that most companies already offer products that meet the Recommended TSL, DOE does not anticipate amended standards would significantly lessen the level of competition in the RCW market.

Representatives Latta *et al*. expressed concern about the negative impact of the standards proposed in the March 2023 NOPR on the U.S. home appliance manufacturing industry, as the TSD estimates that the standards proposed in the March 2023 NOPR for RCWs could eliminate 8,121 American jobs as manufacturers reassess their production locations. (Representatives Latta *et al*., No. 456 at p. 3) Representatives Latta *et al*. commented that DOE should take no actions that cause harm to the domestic manufacturing industry and result in a significant loss of American jobs. (*Id*.)

Regarding the potential for a reduction in direct employment as a result of amended standards, DOE notes that the standards adopted in this direct final rule are the same as the proposed in the March 2023 NOPR for three of the five product classes, but are less stringent than the standards proposed in the March 2023 NOPR for the other two product classes. DOE provides a range of potential quantitative impacts to direct employment and a discussion of the potential qualitative impacts to direct employment in section V.B.2.b of this document. The upper bound of the direct employment analysis corresponds to an increase in the number of domestic workers that results from amended energy conservation standards if manufacturers continue to produce the same scope of covered products within the United States after compliance takes effect. To establish a conservative lower bound of direct employment impacts, DOE assumes all manufacturers would shift production to foreign countries. The estimated 8,121 domestic production worker jobs cited by Representatives Latta *et al*. reflected the conservative lower bound should all manufacturers move production facilities outside of the United States. As stated in the March 2023 NOPR, at lower TSLs, DOE believes the likelihood of changes in production location due to amended standards are low due to the relatively minor production line updates required. Compared to the levels proposed in the March 2023 NOPR, DOE is adopting lower efficiency levels for top-loading and front-loading standard-size product classes. In confidential interviews conducted in advance of the March 2023 NOPR, DOE's contractors discussed the potential impact of more stringent standards on production location decisions under non-disclosure agreements ("NDAs"). *See* appendix 12A of the direct final rule TSD for a blank copy of the interview guide. During confidential interviews, manufacturers did not express concerns about the need to relocate production facilities to remain competitive at the Recommended TSL (*i.e.*, TSL 2). Nearly all OEMs already manufacture top-loading and front-loading standard-size RCWs that meet the adopted levels in domestic manufacturing facilities. Of the nine OEMs with top-loading standard-size products, six OEMs offer models that meet TSL 2 efficiencies. These six OEMs that currently offer top-loading standard-size RCW models that meet TSL 2 efficiencies collectively account for over 95 percent of overall top-loading standard-size RCW shipments. Of the seven OEMs with front-loading standard-size products, six OEMs offer models that meet TSL 2 efficiencies.

Salman commented that amended standards could disproportionately affect small manufacturers, including training and hiring costs, and potentially endanger jobs. Salman further commented that “low-skilled” workers would be particularly affected by this, and that industry consolidation may result. (Salman, No. 446 at pp. 1–2) Salman recommended that DOE provide financial support that helps them transform their machinery and retrain their workforce. (*Id.* at p. 2)

DOE discusses the potential impacts of amended standards on the one small domestic original equipment manufacturer (“OEM”) of RCWs in the NOPR published elsewhere in this issue of the *Federal Register* and chapter 12 of the direct final rule TSD. Regarding the potential for industry consolidation, as discussed in section III.E.1.e of this document, DOE will transmit a copy of this direct final rule to the Attorney General with a request that DOJ provide its determination on this issue. DOE will consider DOJ's comments on the rule in determining whether to withdraw the direct final rule. DOE will also publish and respond to the DOJ's comments in the *Federal Register* in a separate notice. Additionally, DOE analyzes the potential impacts of amended standards on U.S. direct employment for the overall RCW industry in section V.B.2.b of this document.

Regarding the suggestion for DOE to provide financial support to small manufacturers, additional compliance flexibilities may be available to small manufacturers through other means. EPCA provides that a manufacturer whose annual gross revenue from all of its operations does not exceed $8 million may apply for an exemption from all or part of an energy conservation standard for a period not longer than 24 months after the effective date of a final rule establishing the standard. (42 U.S.C. 6295(t)) Additionally, manufacturers subject to DOE's energy efficiency standards may apply to DOE's Office of Hearings and Appeals for exception relief under certain circumstances. Manufacturers should refer to 10 CFR part 430, subpart E, and 10 CFR part 1003 for additional details.

K. Emissions Analysis

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

The analysis of electric power sector emissions of CO_2, NO_X, SO_2, and Hg uses emissions intended to represent the marginal impacts of the change in electricity consumption associated with amended or new standards. The methodology is based on results published for the *AEO*, including a set of side cases that implement a variety of efficiency-related policies. The methodology is described in appendix 13A in the direct final rule TSD. The analysis presented in this notice uses projections from *AEO2023*. Power sector emissions of CH_4 and N_2O from fuel combustion are estimated using Emission Factors for Greenhouse Gas Inventories published by the Environmental Protection Agency (EPA).[133]

The on-site operation of RCWs involves combustion of fossil fuels and results in emissions of CO_2, NO_X, SO_2, CH_4, and N_2O where these products are used. Site emissions of these gases were estimated using Emission Factors for Greenhouse Gas Inventories and, for NO_X and SO_2, emissions intensity factors from an EPA publication.[134]

FFC upstream emissions, which include emissions from fuel combustion during extraction, processing, and transportation of fuels, and "fugitive" emissions (direct

[133] Available at www.epa.gov/sites/production/files/2021-04/documents/emission-factors_apr2021.pdf (last accessed June 12, 2022).
[134] U.S. Environmental Protection Agency. External Combustion Sources. In *Compilation of Air Pollutant Emission Factors*. AP-42. Fifth Edition. Volume I: Stationary Point and Area Sources. Chapter 1. Available at *www.epa.gov/air-emissions-factors-and-quantification/ap-42-compilation-air-emissions-factors#Proposed/* (last accessed June 12, 2022).

leakage to the atmosphere) of CH_4 and CO_2, are estimated based on the methodology described in chapter 15 of the direct final rule TSD.

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

1. Air Quality Regulations Incorporated in DOE's Analysis

DOE's no-new-standards case for the electric power sector reflects the *AEO*, which incorporates the projected impacts of existing air quality regulations on emissions. *AEO2023* reflects, to the extent possible, laws and regulations adopted through mid-November 2022, including the emissions control programs discussed in the following paragraphs and certain provisions of the Inflation Reduction Act.[135]

SO_2 emissions from affected electric generating units ("EGUs") are subject to nationwide and regional emissions cap-and-trade programs. Title IV of the Clean Air Act sets an annual emissions cap on SO_2 for affected EGUs in the 48 contiguous States and the District of Columbia ("D.C."). (42 U.S.C. 7651 *et seq.*) SO_2 emissions from numerous States in the eastern half of the United States are also limited under the Cross-State Air Pollution Rule ("CSAPR"). 76 FR 48208 (Aug. 8, 2011). CSAPR requires these States to reduce certain emissions, including annual SO_2 emissions, and went into effect

[135] For further information, see the Assumptions to *AEO2023* report that sets forth the major assumptions used to generate the projections in the Annual Energy Outlook. Available at *www.eia.gov/outlooks/aeo/assumptions/* (last accessed June 24, 2023).

as of January 1, 2015.[136] The *AEO* incorporates implementation of CSAPR, including the update to the CSAPR ozone season program emission budgets and target dates issued in 2016. 81 FR 74504 (Oct. 26, 2016). Compliance with CSAPR is flexible among EGUs and is enforced through the use of tradable emissions allowances. Under existing EPA regulations, for states subject to SO_2 emissions limits under CSAPR, any excess SO_2 emissions allowances resulting from the lower electricity demand caused by the adoption of an efficiency standard could be used to permit offsetting increases in SO_2 emissions by another regulated EGU.

However, beginning in 2016, SO_2 emissions began to fall as a result of the Mercury and Air Toxics Standards ("MATS") for power plants.[137] 77 FR 9304 (Feb. 16, 2012). The final rule establishes power plant emission standards for mercury, acid gases, and non-mercury metallic toxic pollutants. Because of the emissions reductions under the MATS, it is unlikely that excess SO_2 emissions allowances resulting from the lower electricity demand would be needed or used to permit offsetting increases in SO_2 emissions by another regulated EGU. Therefore, energy conservation standards that

[136] CSAPR requires states to address annual emissions of SO_2 and NO_X, precursors to the formation of fine particulate matter ("$PM_{2.5}$") pollution, in order to address the interstate transport of pollution with respect to the 1997 and 2006 $PM_{2.5}$ National Ambient Air Quality Standards ("NAAQS"). CSAPR also requires certain states to address the ozone season (May-September) emissions of NO_X, a precursor to the formation of ozone pollution, in order to address the interstate transport of ozone pollution with respect to the 1997 ozone NAAQS. 76 FR 48208 (Aug. 8, 2011). EPA subsequently issued a supplemental rule that included an additional five states in the CSAPR ozone season program; 76 FR 80760 (Dec. 27, 2011) (Supplemental Rule), and EPA issued the CSAPR Update for the 2008 ozone NAAQS. 81 FR 74504 (Oct. 26, 2016).
[137] In order to continue operating, coal power plants must have either flue gas desulfurization or dry sorbent injection systems installed. Both technologies, which are used to reduce acid gas emissions, also reduce SO_2 emissions.

decrease electricity generation will generally reduce SO_2 emissions. DOE estimated SO_2 emissions reduction using emissions factors based on *AEO2023*.

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

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

L. Monetizing Emissions Impacts

As part of the development of this direct final rule, for the purpose of complying with the requirements of Executive Order 12866, DOE considered the estimated monetary benefits from the reduced emissions of CO_2, CH_4, N_2O, NO_X, and SO_2 that are expected to result from each of the TSLs considered. In order to make this calculation analogous to the calculation of the NPV of consumer benefit, DOE considered the reduced emissions expected to result over the lifetime of products shipped in the projection period for each TSL. This section summarizes the basis for the values used for monetizing the emissions benefits and presents the values considered in this direct final rule.

To monetize the benefits of reducing GHG emissions, this analysis uses the interim estimates presented in the *Technical Support Document: Social Cost of Carbon, Methane, and Nitrous Oxide Interim Estimates Under Executive Order 13990* published in February 2021 by the IWG.

1. Monetization of Greenhouse Gas Emissions

DOE estimates the monetized benefits of the reductions in emissions of CO_2, CH_4, and N_2O by using a measure of the SC of each pollutant (*e.g.*, SC-CO_2). These estimates represent the monetary value of the net harm to society associated with a marginal increase in emissions of these pollutants in a given year, or the benefit of avoiding that increase. These estimates are intended to include (but are not limited to) climate-change-related changes in net agricultural productivity, human health, property damages from increased flood risk, disruption of energy systems, risk of conflict, environmental migration, and the value of ecosystem services.

DOE exercises its own judgment in presenting monetized climate benefits as required by applicable Executive Orders, and DOE would reach the same conclusion presented in this direct final rule in the absence of the social cost of greenhouse gases. That is, the social costs of greenhouse gases, whether measured using the February 2021 interim estimates presented by the Interagency Working Group on the Social Cost of Greenhouse Gases or by another means,[138] did not affect the rule ultimately adopted by DOE.

DOE estimated the global social benefits of CO_2, CH_4, and N_2O reductions using SC-GHG values that were based on the interim values presented in the *Technical Support Document: Social Cost of Carbon, Methane, and Nitrous Oxide Interim Estimates under Executive Order 13990*, published in February 2021 by the IWG ("February 2021 SC-GHG TSD"). The SC-GHG is the monetary value of the net harm to society associated with a marginal increase in emissions in a given year, or the benefit of avoiding that increase. In principle, the SC-GHG includes the value of all climate change impacts, including (but not limited to) changes in net agricultural productivity, human health effects, property damage from increased flood risk and natural disasters, disruption of energy systems, risk of conflict, environmental migration, and the value of ecosystem services. The SC-GHG therefore, reflects the societal value of reducing emissions of the

[138] See section IV.L.3 of this document which describes the sensitivity analysis DOE conducted using EPA's updated 2023 SC-GHG estimates.

gas in question by one metric ton. The SC-GHG is the theoretically appropriate value to use in conducting benefit-cost analyses of policies that affect CO_2, N_2O and CH_4 emissions. As a member of the IWG involved in the development of the February 2021 SC-GHG TSD, DOE agrees that the interim SC-GHG estimates represent the most appropriate estimate of the SC-GHG for this rule, which was developed using the interim estimates. DOE continues to evaluate recent developments in the scientific literature, including the updated 2023 SC-GHG estimates published by EPA in December 2023 within their rulemaking on oil and natural gas sector sources.[139]

The SC-GHG estimates presented here were developed over many years, using transparent process, peer-reviewed methodologies, the best science available at the time of that process, and with input from the public. Specifically, in 2009, the IWG, which included DOE and other executive branch agencies and offices was established to ensure that agencies were using the best available science and to promote consistency in the social cost of carbon (SC-CO_2) values used across agencies. The IWG published SC-CO_2 estimates in 2010 that were developed from an ensemble of three widely cited integrated assessment models (IAMs) that estimate global climate damages using highly aggregated representations of climate processes and the global economy combined into a single modeling framework. The three IAMs were run using a common set of input assumptions in each model for future population, economic, and CO_2 emissions growth, as well as equilibrium climate sensitivity—a measure of the globally averaged temperature response to increased atmospheric CO_2 concentrations. These estimates were updated in 2013

[139] Available at www.epa.gov/system/files/documents/2023-12/eo12866_oil-and-gas-nsps-eg-climate-review-2060-av16-final-rule-20231130.pdf.

based on new versions of each IAM. In August 2016 the IWG published estimates of the social cost of methane (SC-CH_4) and nitrous oxide (SC-N_2O) using methodologies that are consistent with the methodology underlying the SC-CO_2 estimates. The modeling approach that extends the IWG SC-CO_2 methodology to non-CO_2 GHGs has undergone multiple stages of peer review. The SC-CH_4 and SC-N_2O estimates were developed by Marten *et al*.[140] and underwent a standard double-blind peer review process prior to journal publication. In 2015, as part of the response to public comments received to a 2013 solicitation for comments on the SC-CO_2 estimates, the IWG announced a National Academies of Sciences, Engineering, and Medicine review of the SC-CO_2 estimates to offer advice on how to approach future updates to ensure that the estimates continue to reflect the best available science and methodologies. In January 2017, the National Academies released their final report, Valuing Climate Damages: Updating Estimation of the Social Cost of Carbon Dioxide, and recommended specific criteria for future updates to the SC-CO_2 estimates, a modeling framework to satisfy the specified criteria, and both near-term updates and longer-term research needs pertaining to various components of the estimation process.[141] Shortly thereafter, in March 2017, President Trump issued Executive Order 13783, which disbanded the IWG, withdrew the previous TSDs, and directed agencies to ensure SC-CO_2 estimates used in regulatory analyses are consistent with the guidance contained in OMB's Circular A-4, "including with respect to the consideration of domestic versus international impacts and the consideration of

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

[141] National Academies of Sciences, Engineering, and Medicine. Valuing Climate Damages: Updating Estimation of the Social Cost of Carbon Dioxide. 2017. The National Academies Press: Washington, DC. Available at *nap.nationalacademies.org/catalog/24651/valuing-climate-damages-updating-estimation-of-the-social-cost-of*.

appropriate discount rates” (EO 13783, Section 5(c)) Benefit-cost analyses following E.O. 13783 used SC-GHG estimates that attempted to focus on the U.S.-specific share of climate change damages as estimated by the models and were calculated using two discount rates recommended by Circular A-4, 3 percent and 7 percent. All other methodological decisions and model versions used in SC-GHG calculations remained the same as those used by the IWG in 2010 and 2013, respectively.

On January 20, 2021, President Biden issued Executive Order 13990, which re-established the IWG and directed it to ensure that the U.S. Government’s estimates of the social cost of carbon and other greenhouse gases reflect the best available science and the recommendations in the National Academies 2017 report. The IWG was tasked with first reviewing the SC-GHG estimates currently used in Federal analyses and publishing interim estimates within 30 days of the E.O. that reflect the full impact of GHG emissions, including by taking global damages into account. The interim SC-GHG estimates published in February 2021 are used here to estimate the climate benefits for this proposed rulemaking. The E.O. instructs the IWG to undertake a fuller update of the SC-GHG estimates that takes into consideration the advice in the National Academies 2017 report and other recent scientific literature. The February 2021 SC-GHG TSD provides a complete discussion of the IWG’s initial review conducted under E.O.13990. In particular, the IWG found that the SC-GHG estimates used under E.O. 13783 fail to reflect the full impact of GHG emissions in multiple ways.

First, the IWG found that the SC-GHG estimates used under E.O. 13783 fail to fully capture many climate impacts that affect the welfare of U.S. citizens and residents, and those impacts are better reflected by global measures of the SC-GHG. Examples of omitted effects from the E.O. 13783 estimates include direct effects on U.S. citizens, assets, and investments located abroad, supply chains, U.S. military assets and interests abroad, and tourism, and spillover pathways such as economic and political destabilization and global migration that can lead to adverse impacts on U.S. national security, public health, and humanitarian concerns. In addition, assessing the benefits of U.S. GHG mitigation activities requires consideration of how those actions may affect mitigation activities by other countries, as those international mitigation actions will provide a benefit to U.S. citizens and residents by mitigating climate impacts that affect U.S. citizens and residents. A wide range of scientific and economic experts have emphasized the issue of reciprocity as support for considering global damages of GHG emissions. If the United States does not consider impacts on other countries, it is difficult to convince other countries to consider the impacts of their emissions on the United States. The only way to achieve an efficient allocation of resources for emissions reduction on a global basis—and so benefit the U.S. and its citizens—is for all countries to base their policies on global estimates of damages. As a member of the IWG involved in the development of the February 2021 SC-GHG TSD, DOE agrees with this assessment and, therefore, in this proposed rule DOE centers attention on a global measure of SC-GHG. This approach is the same as that taken in DOE regulatory analyses from 2012 through 2016. A robust estimate of climate damages that accrue only to U.S. citizens and residents does not currently exist in the literature. As explained in the February 2021 SC-GHG TSD, existing estimates are both incomplete and an underestimate of total damages that accrue to the citizens and residents of the U.S.

because they do not fully capture the regional interactions and spillovers discussed above, nor do they include all of the important physical, ecological, and economic impacts of climate change recognized in the climate change literature. As noted in the February 2021 SC-GHG TSD, the IWG will continue to review developments in the literature, including more robust methodologies for estimating a U.S.-specific SC–GHG value, and explore ways to better inform the public of the full range of carbon impacts. As a member of the IWG, DOE will continue to follow developments in the literature pertaining to this issue.

Second, the IWG found that the use of the social rate of return on capital (7 percent under current OMB Circular A-4 guidance) to discount the future benefits of reducing GHG emissions inappropriately underestimates the impacts of climate change for the purposes of estimating the SC-GHG. Consistent with the findings of the National Academies and the economic literature, the IWG continued to conclude that the consumption rate of interest is the theoretically appropriate discount rate in an intergenerational context,[142] and recommended that discount rate uncertainty and relevant

[142] Interagency Working Group on Social Cost of Carbon. Social Cost of Carbon for Regulatory Impact Analysis under Executive Order 12866. 2010. United States Government. Available at: *www.epa.gov/sites/default/files/2016-12/documents/scc_tsd_2010.pdf* (last accessed April 15, 2022); Interagency Working Group on Social Cost of Carbon. Technical Update of the Social Cost of Carbon for Regulatory Impact Analysis Under Executive Order 12866. 2013. Available at: *www.federalregister.gov/documents/2013/11/26/2013-28242/technical-support-document-technical-update-of-the-social-cost-of-carbon-for-regulatory-impact* (last accessed April 15, 2022); Interagency Working Group on Social Cost of Greenhouse Gases, United States Government. Technical Support Document: Technical Update on the Social Cost of Carbon for Regulatory Impact Analysis-Under Executive Order 12866. August 2016. Available at: www.epa.gov/sites/default/files/2016-12/documents/sc_co2_tsd_august_2016.pdf (last accessed January 18, 2022); Interagency Working Group on Social Cost of Greenhouse Gases, United States Government. Addendum to Technical Support Document on Social Cost of Carbon for Regulatory Impact Analysis under Executive Order 12866: Application of the Methodology to Estimate the Social Cost of Methane and the Social Cost of Nitrous Oxide. August 2016. Available at: www.epa.gov/sites/default/files/2016-12/documents/addendum_to_sc-ghg_tsd_august_2016.pdf (last accessed January 18, 2022).

aspects of intergenerational ethical considerations be accounted for in selecting future discount rates.

Furthermore, the damage estimates developed for use in the SC-GHG are estimated in consumption-equivalent terms, and so an application of OMB Circular A-4's guidance for regulatory analysis would then use the consumption discount rate to calculate the SC-GHG. DOE agrees with this assessment and will continue to follow developments in the literature pertaining to this issue. DOE also notes that while OMB Circular A-4, as published in 2003, recommends using 3-percent and 7-percent discount rates as "default" values, Circular A-4 also reminds agencies that "different regulations may call for different emphases in the analysis, depending on the nature and complexity of the regulatory issues and the sensitivity of the benefit and cost estimates to the key assumptions." On discounting, Circular A-4 recognizes that "special ethical considerations arise when comparing benefits and costs across generations," and Circular A-4 acknowledges that analyses may appropriately "discount future costs and consumption benefits…at a lower rate than for intragenerational analysis." In the 2015 Response to Comments on the Social Cost of Carbon for Regulatory Impact Analysis, OMB, DOE, and the other IWG members recognized that "Circular A-4 is a living document" and "the use of 7 percent is not considered appropriate for intergenerational discounting. There is wide support for this view in the academic literature, and it is recognized in Circular A-4 itself." Thus, DOE concludes that a 7-percent discount rate is not appropriate to apply to value the social cost of greenhouse gases in the analysis presented in this analysis.

To calculate the present and annualized values of climate benefits, DOE uses the same discount rate as the rate used to discount the value of damages from future GHG emissions, for internal consistency. That approach to discounting follows the same approach that the February 2021 SC-GHG TSD recommends "to ensure internal consistency—*i.e.*, future damages from climate change using the SC-GHG at 2.5 percent should be discounted to the base year of the analysis using the same 2.5 percent rate." DOE has also consulted the National Academies' 2017 recommendations on how SC-GHG estimates can "be combined in RIAs with other cost and benefits estimates that may use different discount rates." The National Academies reviewed several options, including "presenting all discount rate combinations of other costs and benefits with [SC-GHG] estimates."

As a member of the IWG involved in the development of the February 2021 SC-GHG TSD, DOE agrees with the above assessment and will continue to follow developments in the literature pertaining to this issue. While the IWG works to assess how best to incorporate the latest, peer reviewed science to develop an updated set of SC-GHG estimates, it set the interim estimates to be the most recent estimates developed by the IWG prior to the group being disbanded in 2017. The estimates rely on the same models and harmonized inputs and are calculated using a range of discount rates. As explained in the February 2021 SC-GHG TSD, the IWG has recommended that agencies revert to the same set of four values drawn from the SC-GHG distributions based on three discount rates as were used in regulatory analyses between 2010 and 2016 and were subject to public comment. For each discount rate, the IWG combined the distributions across models and socioeconomic emissions scenarios (applying equal weight to each) and then selected a set of four values recommended for use in benefit-cost analyses: an average value resulting from the model runs for each of three discount rates (2.5 percent, 3 percent, and 5 percent), plus a fourth value, selected as the 95th percentile of estimates based on a 3 percent discount rate. The fourth value was included to provide information on potentially higher-than-expected economic impacts from climate change. As explained in the February 2021 SC-GHG TSD, and DOE agrees, this update reflects the immediate need to have an operational SC-GHG for use in regulatory benefit-cost analyses and other applications that was developed using a transparent process, peer-reviewed methodologies, and the science available at the time of that process. Those estimates were subject to public comment in the context of dozens of proposed rulemakings as well as in a dedicated public comment period in 2013.

There are a number of limitations and uncertainties associated with the SC-GHG estimates. First, the current scientific and economic understanding of discounting approaches suggests discount rates appropriate for intergenerational analysis in the context of climate change are likely to be less than 3 percent, near 2 percent or lower.[143] Second, the IAMs used to produce these interim estimates do not include all of the important physical, ecological, and economic impacts of climate change recognized in the climate change literature and the science underlying their "damage functions"—*i.e.*, the core parts of the IAMs that map global mean temperature changes and other physical impacts of climate change into economic (both market and nonmarket) damages—lags

[143] Interagency Working Group on Social Cost of Greenhouse Gases. 2021. Technical Support Document: Social Cost of Carbon, Methane, and Nitrous Oxide Interim Estimates under Executive Order 13990. February. United States Government. Available at *www.whitehouse.gov/briefing-room/blog/2021/02/26/a-return-to-science-evidence-based-estimates-of-the-benefits-of-reducing-climate-pollution/*.

behind the most recent research. For example, limitations include the incomplete treatment of catastrophic and non-catastrophic impacts in the integrated assessment models, their incomplete treatment of adaptation and technological change, the incomplete way in which inter-regional and intersectoral linkages are modeled, uncertainty in the extrapolation of damages to high temperatures, and inadequate representation of the relationship between the discount rate and uncertainty in economic growth over long time horizons. Likewise, the socioeconomic and emissions scenarios used as inputs to the models do not reflect new information from the last decade of scenario generation or the full range of projections. The modeling limitations do not all work in the same direction in terms of their influence on the SC-CO_2 estimates. However, as discussed in the February 2021 SC-GHG TSD, the IWG has recommended that, taken together, the limitations suggest that the interim SC-GHG estimates used in this direct final rule likely underestimate the damages from GHG emissions. DOE concurs with this assessment.

DOE's derivations of the SC-CO_2, SC-N_2O, and SC-CH_4 values used for this direct final rule are discussed in the following sections, and the results of DOE's analyses estimating the benefits of the reductions in emissions of these GHGs are presented in section V.B.6 of this document.

a. Social Cost of Carbon

The SC-CO_2 values used for this direct final rule were based on the values developed for the February 2021 SC-GHG TSD, which are shown in Table IV.23 in five-year increments from 2020 to 2050. The set of annual values that DOE used, which was adapted from estimates published by EPA,[144] is presented in appendix 14A of the direct final rule TSD. These estimates are based on methods, assumptions, and parameters identical to the estimates published by the IWG (which were based on EPA modeling), and include values for 2051 to 2070. DOE expects additional climate benefits to accrue for products still operating after 2070, but a lack of available SC-CO_2 estimates for emissions years beyond 2070 prevents DOE from monetizing these potential benefits in this analysis.

Table IV.23 Annual SC-CO_2 Values from 2021 Interagency Update, 2020–2050 (2020$ per Metric Ton CO_2)

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

DOE multiplied the CO_2 emissions reduction estimated for each year by the SC-CO_2 value for that year in each of the four cases. DOE adjusted the values to 2022$ using the implicit price deflator for gross domestic product ("GDP") from the Bureau of Economic Analysis. To calculate a present value of the stream of monetary values, DOE

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

discounted the values in each of the four cases using the specific discount rate that had been used to obtain the SC-CO_2 values in each case.

For this direct final rule, DOE considered comments it had received regarding its approach for monetizing greenhouse gas emissions in the March 2023 NOPR. The approach used for this direct final rule is largely the same as the approach DOE had used for the March 2023 NOPR analysis.

In response to the March 2023 NOPR, the AGs of TN *et al*. commented that DOE's misguided use of the SC-GHG estimates is a significant problem with the proposed standards. (AGs of TN *et al.*, No. 438 at p. 1) The AGs of TN *et al*. attached as evidence their comment letter in response to DOE's proposed standards for consumer conventional cooking products, in which they expressed detailed concerns about the IWG estimates. The AGs of TN *et al*. noted that the reversal of the preliminary injunction that a coalition of States received in *Louisiana v. Biden*, 585 F. Supp. 3d 840 (W.D. La. 2022) does not change the criticisms in the aforementioned comment letter. (AGs of TN *et al.*, No. 438 at p. 2)

CEI reiterated its comments in response to a NOPR for residential furnaces published on July 7, 2022, which noted numerous flaws with the IWG 2021 estimates, nearly all of which serve to overstate the calculated benefits of avoided emissions. CEI commented that IWG used improperly low discount rates, relied on climate models that have consistently overstated actual warming and on baseline emission scenarios that assume an increasingly coal-centric global energy system through 2100 and beyond, while downplaying the capacity for adaptation to mitigate climate impacts. (CEI, No. 454 at pp. 6–7) CEI stated the other questionable assumptions, including the claimed climate benefits out 300 years into the future and the use of global rather than national benefits, are skewed toward inflating the end result. (*Id*. at p. 7)

Fisher *et al*. commented that researchers at the Heritage Foundation found that under very reasonable assumptions, these models can offer a plethora of different estimates of the SCC, ranging from extreme damages to overall benefits. Fisher *et al*. stated that this research makes it apparent that the vast potential estimates of the SCC suggest that the economic impact of climate change is highly questionable. Fisher *et al.* commented that the variability in the SCC that is used to justify this rule renders the rule as arbitrary and capricious. (Fisher *et al*., No. 463 at p. 6)

Strauch stated that the social cost of carbon is a dubious concept, suggesting that its validity is increasingly doubted due to discrepancies between climate models and observed temperatures. (Strauch, No. 430 at p. 3)

DOE notes that the standards in this direct final rule are not based on the SC-GHG and that DOE would issue the same standards even in the absence of the climate benefits.

The IWG's SC-GHG estimates were developed over many years, using a transparent process, peer-reviewed methodologies, the best science available at the time of that process, and with input from the public. A number of criticisms raised in the comment letter attached by the AGs of TN *et al.* were addressed by the IWG in its February 2021 SC-GHG TSD, and previous parts of this section summarized the IWG's conclusions on key issues, including the question of discount rates cited by CEI. The IWG's 2016 TSD and the 2017 National Academies report provide detailed discussions of the ways in which the modeling underlying the development of the SC-GHG estimates addressed quantified sources of uncertainty. In the February 2021 SC-GHG TSD, the IWG stated that the models used to produce the interim estimates do not include all of the important physical, ecological, and economic impacts of climate change recognized in the climate change literature. For these same impacts, the science underlying their "damage functions" lags behind the most recent research. In the judgment of the IWG, these and other limitations suggest that the range of four interim SC-GHG estimates presented in the TSD likely underestimate societal damages from GHG emissions. The IWG is in the process of assessing how best to incorporate the latest peer-reviewed science and the recommendations of the National Academies to develop an updated set of SC-GHG estimates.

AHAM objected to DOE using the social cost of carbon and other monetization of emissions reductions benefits in its analysis of the factors EPCA requires DOE to balance in determining the appropriate standard. AHAM stated that while it may be acceptable for DOE to continue its current practice of examining the social cost of carbon and monetization of other emissions reductions benefits as informational so long as the underlying interagency analysis is transparent and vigorous, the monetization analysis should not impact the TSL DOE selects as a new or amended standard. AHAM commented that it is inappropriate for DOE to rely upon the highly subjective and everchanging monetization estimates in justifying an energy conservation standard. (AHAM, No. 464 at p. 46) Additionally, AHAM stated they do not necessarily object to DOE considering the benefits, they object to DOE relying upon those benefits to justify a rule given the uncertain and ever-evolving nature of those estimates. AHAM commented that EPCA requires DOE to balance the factors, such that DOE must consider EPCA's factors together and achieve a balance of impacts and benefits. (*Id.*)

The AGs of TN *et al*. stated that the rote application of the IWG estimates is inappropriate. (AGs of TN *et al.*, No. 438 at p. 2) The AGs of TN *et al.* stated that even if it is important to take into account emissions reductions when considering the need for national energy conservation, the IWG estimates are unlawful and poor methods for doing so. The AGs of TN *et al*. commented that the IWG's SC-GHG estimates are fundamentally flawed and are an unreliable metric on which to base administrative action. The AGs of TN *et al*. requested that DOE revisit its reliance on those numbers in this and other standards. (*Id*.)

As stated in section III.F.1.f of this document, DOE accounts for the environmental and public health benefits associated with the more efficient use of energy, including those connected to global climate change, as they are important to take into account when considering the need for national energy conservation. (See 42 U.S.C. 6295(o)(2)(B)(i)(IV)) In addition, Executive Order 13563, which was re-affirmed on January 21, 2021, stated that each agency must, among other things: "select, in choosing among alternative regulatory approaches, those approaches that maximize net benefits (including potential economic, environmental, public health and safety, and other advantages; distributive impacts; and equity).” For these reasons, DOE includes the monetized value of emissions reductions in its evaluation of potential standard levels. While the benefits associated with reduction of GHG emissions inform DOE’s evaluation of potential standards, the action of proposing or adopting specific standards is not “based on” the SC-GHG values, as DOE would reach the same conclusion regarding the economic justification of standards presented in this direct final rule without considering the social cost of greenhouse gases. At the Recommended TSL, the average LCC savings for all product classes is positive. In addition, the FFC national energy savings are significant and the NPV of consumer benefits is positive using both a 3-percent and 7-percent discount rate. Even when measured at the more conservative discount rate of 7 percent, the NPV of consumer benefits is over 11 times higher than the maximum estimated manufacturers’ loss in INPV.

Fisher *et al*. commented that even assuming the climate has the highest sensitivity to CO_2 emissions under the variety of possibilities envisioned by the IPCC, the proposed standards do not have any tangible impacts on global temperatures, and therefore the DOE should refrain from considering environmental impacts in its assessment of the proposed standards. (Fisher *et al.*, No. 463 at p. 7)

In the context of global CO_2 emissions, any single policy action is likely to have a relatively small impact. As long as that impact can be quantified in a reasonable manner, however, it is consistent with sound regulatory analysis to include such impacts. As noted above, while the benefits associated with reduction of GHG emissions inform DOE’s evaluation of potential standards, the action of proposing or adopting specific standards is not "based on" the SC-GHG values, as DOE would reach the same conclusion regarding the economic justification of standards presented in this direct final rule without considering the social cost of greenhouse gases.

b. Social Cost of Methane and Nitrous Oxide

The SC-CH_4 and SC-N_2O values used for this direct final rule were based on the values developed for the February 2021 SC-GHG TSD. Table IV.24 shows the updated sets of SC-CH_4 and SC-N_2O estimates from the latest interagency update in 5-year increments from 2020 to 2050. The full set of annual values used is presented in appendix 14A of the direct final rule TSD. To capture the uncertainties involved in regulatory impact analysis, DOE has determined it is appropriate to include all four sets of SC-CH_4 and SC-N_2O values, as recommended by the IWG. DOE derived values after 2050 using the approach described above for the SC-CO_2.

Table IV.24 Annual SC-CH_4 and SC-N_2O Values from 2021 Interagency Update, 2020–2050 (2020$ per Metric Ton)

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

DOE multiplied the CH_4 and N_2O emissions reduction estimated for each year by the SC-CH_4 and SC-N_2O estimates for that year in each of the cases. DOE adjusted the values to 2022$ using the implicit price deflator for GDP from the Bureau of Economic Analysis. To calculate a present value of the stream of monetary values, DOE discounted the values in each of the cases using the specific discount rate that had been used to obtain the SC-CH_4 and SC-N_2O estimates in each case.

c. Sensitivity Analysis Using Updated 2023 SC-GHG Estimates

In December 2023, EPA issued a new set of SC-GHG ("2023 SC-GHG") estimates in connection with a final rulemaking under the Clean Air Act.[145] For this rulemaking, DOE used these updated 2023 SC-GHG values to conduct a sensitivity analysis of the value of GHG emissions reductions associated with alternative standards for RCWs. This sensitivity analysis provides an expanded range of potential climate benefits associated with amended standards. The final year of the 2023 SC-GHG estimates is 2080; therefore, DOE did not monetize the climate benefits of GHG emissions reductions occurring after 2080.

The overall climate benefits are larger when using the higher, updated 2023 SC-GHG estimates, compared to the climate benefits using the older IWG SC-GHG estimates. However, DOE's conclusion that the standards are economically justified remains the same regardless of which SC-GHG estimates are used.

The results of the sensitivity analysis are presented in appendix 14C of the direct final rule TSD.

[145] Available at: www.epa.gov/environmental-economics/scghg.

2. Monetization of Other Emissions Impacts

For this direct final rule, DOE estimated the monetized value of NO_X and SO_2 emissions reductions from electricity generation using benefit per ton estimates for that sector from the EPA's Benefits Mapping and Analysis Program.[146] DOE used EPA's values for PM2.5-related benefits associated with NO_X and SO_2 and for ozone-related benefits associated with NO_X for 2025 and 2030, and 2040, calculated with discount rates of 3 percent and 7 percent. DOE used linear interpolation to define values for the years not given in the 2025 to 2040 period; for years beyond 2040, the values are held constant. DOE combined the EPA regional benefit-per-ton estimates with regional information on electricity consumption and emissions from *AEO2023* to define weighted-average national values for NO_X and SO_2 (*see* appendix 14B of the direct final rule TSD).

DOE also estimated the monetized value of NO_X and SO_2 emissions reductions from site use of natural gas in RCWs using benefit per ton estimates from the EPA's Benefits Mapping and Analysis Program. Although none of the sectors covered by EPA refers specifically to residential and commercial buildings, the sector called "area sources" would be a reasonable proxy for residential and commercial buildings.[147] The EPA document provides high and low estimates for 2025 and 2030 at 3- and 7-percent

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

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

discount rates.[148] DOE used the same linear interpolation and extrapolation as it did with the values for electricity generation.

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

M. Utility Impact Analysis

The utility impact analysis estimates the changes in installed electrical capacity and generation projected to result for each considered TSL. The analysis is based on published output from the NEMS associated with *AEO2023*. NEMS produces the *AEO* Reference case, as well as a number of side cases that estimate the economy-wide impacts of changes to energy supply and demand. For the current analysis, impacts are quantified by comparing the levels of electricity sector generation, installed capacity, fuel consumption and emissions in the *AEO2023* Reference case and various side cases. Details of the methodology are provided in the appendices to chapters 13 and 15 of the direct final rule TSD.

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

[148] "Area sources" are a category in the 2018 document from EPA, but are not used in the 2021 document cited previously. Available at *www.epa.gov/sites/default/files/2018-02/documents/sourceapportionmentbpttsd_2018.pdf*.

estimates of selected utility impacts of potential new or amended energy conservation standards.

N. Employment Impact Analysis

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

One method for assessing the possible effects on the demand for labor of such shifts in economic activity is to compare sector employment statistics developed by the BLS. BLS regularly publishes its estimates of the number of jobs per million dollars of economic activity in different sectors of the economy, as well as the jobs created elsewhere in the economy by this same economic activity. Data from BLS indicate that expenditures in the utility sector generally create fewer jobs (both directly and indirectly) than expenditures in other sectors of the economy.[149] There are many reasons for these differences, including wage differences and the fact that the utility sector is more capital-intensive and less labor-intensive than other sectors. Energy conservation standards have the effect of reducing consumer utility bills. Because reduced consumer expenditures for energy likely lead to increased expenditures in other sectors of the economy, the general effect of efficiency standards is to shift economic activity from a less labor-intensive sector (*i.e.*, the utility sector) to more labor-intensive sectors (*e.g.*, the retail and service sectors). Thus, the BLS data suggest that net national employment may increase due to shifts in economic activity resulting from energy conservation standards.

DOE estimated indirect national employment impacts for the standard levels considered in this direct final rule using an input/output model of the U.S. economy called Impact of Sector Energy Technologies version 4 ("ImSET").[150] ImSET is a special-purpose version of the "U.S. Benchmark National Input-Output" ("I-O") model, which was designed to estimate the national employment and income effects of energy-saving technologies. The ImSET software includes a computer-based I-O model having structural coefficients that characterize economic flows among 187 sectors most relevant to industrial, commercial, and residential building energy use.

[149] *See* U.S. Department of Commerce–Bureau of Economic Analysis. *Regional Multipliers: A User Handbook for the Regional Input-Output Modeling System ("RIMS II")*. 1997. U.S. Government Printing Office: Washington, DC. Available at *https://www.bea.gov/resources/methodologies/RIMSII-user-guide* (last accessed July 1, 2021).
[150] Livingston, O. V., S. R. Bender, M. J. Scott, and R. W. Schultz. *ImSET 4.0: Impact of Sector Energy Technologies Model Description and User's Guide*. 2015. Pacific Northwest National Laboratory: Richland, WA. PNNL-24563.

DOE notes that ImSET is not a general equilibrium forecasting model, and that the uncertainties involved in projecting employment impacts, especially changes in the later years of the analysis. Because ImSET does not incorporate price changes, the employment effects predicted by ImSET may over-estimate actual job impacts over the long run for this rule. Therefore, DOE used ImSET only to generate results for near-term timeframes (2027–2031), where these uncertainties are reduced. For more details on the employment impact analysis, see chapter 16 of the direct final rule TSD.

O. Regulatory Impact Analysis

For any regulatory action that the Administrator of the Office of Information and Regulatory Affairs ("OIRA") within OMB determines is a significant regulatory action under section 3(f)(1) of E.O. 12866, section 6(a)(3)(C) of E.O. 12866 requires Federal agencies to provide an assessment, including the underlying analysis, of costs and benefits of potentially effective and reasonably feasible alternatives to the planned regulation, identified by the agencies or the public (including improving the current regulation and reasonably viable non-regulatory actions), and an explanation why the planned regulatory action is preferable to the identified potential alternatives. 58 FR 51735, 51741. As discussed further in section VII.A of this document, OIRA has determined that this final regulatory action constitutes a "significant regulatory action" within the scope of section 3(f)(1) of E.O. 12866, as amended by E.O. 14094. Accordingly, DOE conducted a regulatory impact analysis ("RIA") for this direct final rule.

As part of the RIA, DOE identifies major alternatives to standards that represent feasible policy options to reduce the energy and water consumption of the covered product. DOE evaluates each alternative in terms of its ability to achieve significant energy and water savings at a reasonable cost, and compares the effectiveness of each alternative to the effectiveness of the finalized standard. DOE recognizes that voluntary or other non-regulatory efforts by manufacturers, utilities, and other interested parties can substantially affect energy and water efficiency or reduce energy and water consumption. DOE bases its assessment on the recorded impacts of any such initiatives to date, but also considers information presented by interested parties regarding the impacts current initiatives may have in the future. Further details regarding the RIA are provided in chapter 17 of the direct final rule TSD.

NMHC and NAA commented that the proposed rulemaking accompanies a series of similar rulemakings DOE is proposing, all seeking to change the performance standards for essential residential appliances. (NMHC and NAA, No. 451 at p. 4) NMHC and NAA recommended that DOE consider the collective impacts of these requirements and recognize that, in practice, the effect of individual pricing increases is magnified when housing providers must manage cost escalations across multiple products at once. (*Id*.)

While EPCA does not specifically require DOE to consider the cumulative burden of standards on appliance purchasers when evaluating the economic justification of specific standards, DOE is sympathetic to the potential for such a burden. DOE is aware that the compliance dates of revised standards for a number of major appliances (clothes washers, consumer clothes dryers, dishwashers, and consumer conventional cooking products) are in 2027 or 2028, and those for refrigerators are in 2029 or 2030. However, consumers' replacement of older appliances with standards-compliant ones would occur gradually over time. In addition, the incremental cost increase of the adopted standards is relatively small on a percentage basis for most of these appliances.

Strauch commented that DOE's analysis does not appear to address the cumulative regulatory burden on consumers, commenting that consumer choice is diminished as many rulemakings are being pushed out in a short time frame. (Strauch, No. 430 at p. 3) Salman commented that DOE providing vouchers to low-income families to purchase new, energy efficient RCWs could lower the short-term cost barrier and facilitate wider adoption of sustainable laundry solutions. (Salman, No. 446 at p. 2)

AWE recommended that the federal government increase funding, rebates, direct install programs, tax credits, and other incentives to replace older, less-efficient RCWs. (AWE, No. 444 at p. 6) AWE recommended that DOE use whatever authorities and funding available to help minimize additional up-front costs for consumers and accelerate the replacement of older RCWs. (*Id.*) AWE stated that, according to data from the REU 2016 study, rebates offered by local water utilities for RCWs have resulted in significant water savings since 1999. (*Id.*)

As discussed, E.O. 12866 directs DOE to assess potentially effective and reasonably feasible alternatives to the planned regulation, and to provide an explanation why the planned regulatory action is preferable to the identified potential alternatives. As part of the RIA, DOE analyzed five non-regulatory policy alternatives to the finalized standards for RCWs, including consumer rebates, consumer tax credits, manufacturer tax credits, voluntary energy efficiency targets, and bulk government purchases. The energy saving benefits from the alternative policies, range from 0.01 percent to 9.5 percent of the benefits from the Recommended TSL. Chapter 17 of the direct final rule TSD provides DOE's analysis of the impacts of these alternatives to the planned regulation.

Notwithstanding the requirements of E.O. 12866, as discussed, DOE is required by EPCA to establish or amend standards for a covered product that are designed to achieve the maximum improvement in energy efficiency, which the Secretary determines is technologically feasible and economically justified. (42 U.S.C. 6295(o)(2)(A)) DOE has determined that amended standards enacted by this direct final rule achieve the maximum improvement in energy efficiency that is technologically feasible and economically justified.

P. Other Comments

As discussed previously, DOE considered relevant comments, data, and information obtained during its own rulemaking process in determining whether the recommended standards from the Joint Agreement are in accordance with 42 U.S.C. 6295(o). And while some of those comments were directed at specific aspects of DOE's analysis of the Joint Agreement under 42 U.S.C. 6295(o), others were more generally applicable to DOE's energy conservation standards rulemaking program as a whole. The ensuing discussion focuses on these general comments concerning energy conservation standards issued under EPCA.

1. Commerce Clause

The AGs of TN *et al*. commented that DOE's approach to Congress's Commerce Clause is improper because precedent dictates that Congress can only regulate intrastate activity under the Commerce Clause when that activity "substantially affects interstate commerce." (AGs of TN *et al*., No. 438 at p. 3) The AGs of TN *et al*. commented that for the proposed standards to reach the intrastate market for RCWs, DOE must show that the intrastate activity covered by 42 U.S.C. 6291(17) and 6302(5) substantially affects the interstate market for those products and the proposed standards show no constitutional basis for applying the standards to intrastate commerce in RCWs. (*Id.* at pp. 3–4) The AGs of TN *et al*. added that if such an analysis showed the intrastate market did not substantially affect the interstate market (and so was not properly the subject of Federal regulation), then DOE would be obligated to redo its cost-benefit analysis since the proposed standards would apply to a more limited set of products—those traveling interstate. Additionally, the AGs of TN *et al.* stated that even if DOE finds that intrastate commerce in clothes washers substantially affects interstate commerce, it should still exclude purely intrastate activities from any promulgated standard. (*Id.* at p. 4)

The AGs of TN *et al*. commented that the involvement of water conservation and water efficiency adds to the issue. (*Id.*) The AGs of TN *et al*. cited two cases involving State water rights and commented that because the proposed standards regulate water use, they trench on the States' authority in that area. (*Id*.) The AGs of TN *et al*. commented that since the proposed standards involve the regulation of consumer goods and water use, fields traditionally belonging to the States, it suggests that EPCA does not provide DOE such sweeping authority. (*Id*. at p. 5) The AGs of TN *et al*. commented that all intrastate activity should be excluded from the proposed standards, even if such activity substantially affects interstate commerce in RCWs. (*Id*.)

NYS PSC recommended that DOE reject arguments from commenters who suggest that DOE lacks the authority to implement the proposed standards for RCWs, stating that (1) the United States Constitution empowers Congress , and (2) violate the concept of the separation of powers. (NYS PSC, No. 450 at p. 4) NYS PSC stated that the U.S. Constitution empowers Congress to enact legislation to regulate interstate commerce and it is well-settled that objects that move in interstate commerce are subject to federal regulation and within Congress's authority to provide that objects moving in interstate commerce meet certain standards. NYS PSC added that there is no support for the notion that the delegation of authority to DOE to set energy efficiency standards runs afoul of the Constitutional prohibition on executive agencies exercising legislative powers under either the "nondelegation" doctrine or "major questions" doctrine; noting that there is an "intelligible principle" provided by Congress to guide DOE's regulations and an express command from Congress to regulate this field of economic activity. (*Id.*)

DOE also received 13 comments from individual commenters questioning DOE's authority to promulgate energy efficiency standards.

In response to the AGs of TN *et al.*, DOE believes the scope of the standard proposed in the March 2023 NOPR and the amended standard adopted in this direct final rule properly includes all RCWs distributed in commerce for personal use or consumption because intrastate activity regulated by 42 U.S.C. 6291(17) and 6302 is inseparable from and substantially affects interstate commerce. DOE has clear authority under EPCA to regulate the energy use of a variety of consumer products and certain commercial and industrial equipment, including the subject RCWs. *See* 42 U.S.C. 6295. Based on this statutory authority, DOE has a long-standing practice of issuing standards with the same scope as the standards in this direct final rule. For example, DOE has maintained a similar scope of products (except for the differentiation of a semi-automatic product class[151] and the suds-saving product class[152]) in the direct final rule that amended the current standards for RCWs, which was published on May 31, 2012 (77 FR 32308) and the prior final rule that amended standards for RCWs, which published on January 12, 2001. (66 FR 3314). DOE disagrees with the AGs of TN *et al.*'s contention that the Commerce clause, the Tenth Amendment, States' water rights, or any canons of statutory construction limit DOE's clear and long-standing authority under EPCA to adopt the standard, including its scope, in this direct final rule. A further discussion regarding the AGs of TN *et al.'s* federalism concerns can be found at section VII.E of this document.

2. Test Cloth

Both appendix J and appendix J2 require that testing on clothes washers be conducted using specialized test cloth that conforms to the specifications outlined in 10 CFR part 430, subpart B, appendix J3 ("appendix J3"). These specifications include fiber content, thread count, fabric weight, and weave type, among other requirements. Test cloth is manufactured in batches called "lots," which are quantities of test cloth that have

[151] The May 2012 Direct Final Rule for RCWs removed the semi-automatic product class because DOE was not aware of any RCWs on the market at that time. 77 FR 32308, 32317.
[152] Similarly, the suds-saving product class was removed in the May 2012 Direct Final Rule because DOE did not identify any RCWs in that product class on the market at that time. *Id*.

been manufactured with the same batches of cotton and polyester during one continuous process.

In response to the March 2023 NOPR, AHAM[153] commented that manufacturers of RCWs do not have an adequate supply of uniform test cloth to evaluate redesigns for the potential new standards. (AHAM, No. 503 at p. 4) AHAM further commented that Lot 25A, the latest lot of test cloth produced for the clothes washer industry, fails to meet the defined specifications for thread diameter, and the weave is inconsistent with the specification cloth used by manufacturers during product testing for the past 8 years. (*Id.*)

DOE is currently working closely with industry via the AHAM Test Cloth Task Force in its evaluation of the suitability of Lot 25A as well as to develop short-term and long-term solutions to mitigate any potential concerns regarding the availably of test cloth for the clothes washer industry.

3. National Academy of Sciences Report

The National Academies of Sciences, Engineering, and Medicine ("NAS") periodically appoint a committee to peer review the assumptions, models, and methodologies that DOE uses in setting energy conservation standards for covered products and equipment. The most recent such peer review was conducted in a series of

[153] AHAM's supplemental comment (No. 503) was received 64 days after the comment submission deadline. DOE generally will not consider late filed comments, but may exercise its discretion to do so where necessary and appropriate. In this case, DOE is considering AHAM's comment because its tardiness has not disrupted DOE's consideration of this matter and because the comment regards a subject important to this matter.

meetings in 2020, and NAS issued the report[154] in 2021 detailing its findings and recommendations on how DOE can improve its analyses and align them with best practices for cost-benefit analysis.

AHAM stated that despite previous requests from AHAM and others, DOE has failed to review and incorporate the recommendations of the NAS report, instead indicating that it will conduct a separate rulemaking process without such a process having been initiated. (AHAM, No. 464 at pp. 24–25) AHAM further stated that DOE seems to be ignoring the recommendations in the NAS Report and even conducting analysis that is opposite to the recommendations. AHAM commented that DOE cannot continue to perpetuate the errors in its analytical approach that have been pointed out by stakeholders and the NAS report as to do so will lead to arbitrary and capricious rules. (*Id.*)

As discussed, the rulemaking process for establishing new or amended standards for covered products and equipment are specified at appendix A to subpart C of 10 CFR part 430, and DOE periodically examines and revises these provisions in separate rulemaking proceedings. The recommendations in the NAS report, which pertain to the processes by which DOE analyzes energy conservation standards, will be considered by DOE in a separate rulemaking process.

[154] National Academies of Sciences, Engineering, and Medicine. 2021. *Review of Methods Used by the U.S. Department of Energy in Setting Appliance and Equipment Standards*. Washington, DC: The National Academies Press. Available at *doi.org/10.17226/25992* (last accessed August 2, 2023).

V. Analytical Results and Conclusions

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

A. Trial Standard Levels

In general, DOE typically evaluates potential new or amended standards for products and equipment by grouping individual efficiency levels for each class into TSLs. Use of TSLs allows DOE to identify and consider manufacturer cost interactions between the product classes, to the extent that there are such interactions, and price elasticity of consumer purchasing decisions that may change when different standard levels are set.

In the analysis conducted for this direct final rule, DOE analyzed the benefits and burdens of four TSLs for RCWs. DOE developed TSLs that combine efficiency levels for each analyzed product class. DOE presents the results for the TSLs in this document, while the results for all efficiency levels that DOE analyzed are in the direct final rule TSD.

Table V.1 through Table V.3 present the TSLs and the corresponding efficiency levels that DOE has identified for potential amended energy conservation standards for RCWs. TSL 4 represents the maximum technologically feasible ("max-tech") energy and water efficiency for all product classes. TSL 3 represents the ENERGY STAR Most-Efficient level for front-loading RCWs and CCE Tier 1 for top-loading RCWs. TSL 2—which corresponds to the Recommended TSL in the Joint Agreement—represents the ENERGY STAR Most Efficient level for front-loading compact RCWs, and ENERGY STAR v. 8.1 for top-loading and front-loading standard-size RCWs. TSL 1 represents EL 1 across all product classes.

Table V.1 Trial Standard Levels for Top-Loading Residential Clothes Washers

TSL	Top-Loading, Ultra-Compact			Top-Loading, Standard-Size		
	Efficiency Level	**EER** *(lb/kWh/cycle)*	**WER** *(lb/gal/cycle)*	**Efficiency Level**	**EER** *(lb/kWh/cycle)*	**WER** *(lb/gal/cycle)*
1	Baseline	3.79	0.29	1	3.89	0.47
2	Baseline	3.79	0.29	2	4.27	0.57
3	Baseline	3.79	0.29	3	4.78	0.63
4	Baseline	3.79	0.29	4	5.37	0.67

Table V.2 Trial Standard Levels for Front-Loading Residential Clothes Washers

TSL	Front-Loading, Compact			Front-Loading, Standard-Size		
	Efficiency Level	**EER** *(lb/kWh/cycle)*	**WER** *(lb/gal/cycle)*	**Efficiency Level**	**EER** *(lb/kWh/cycle)*	**WER** *(lb/gal/cycle)*
1	1	4.80	0.62	1	5.31	0.69
2	2	5.02	0.71	2	5.52	0.77
3	2	5.02	0.71	3	5.73	0.77
4	4	5.97	0.80	4	5.97	0.85

Table V.3 Trial Standard Levels for Semi-Automatic Residential Clothes Washers

TSL	Semi-Automatic		
	Efficiency Level	**EER** *(lb/kWh/cycle)*	**WER** *(lb/gal/cycle)*
1	1	2.12	0.27
2	1	2.12	0.27
3	1	2.12	0.27
4	2	2.51	0.36

While representative ELs were included in the TSLs, DOE considered all efficiency levels as part of its analysis.[155]

B. Economic Justification and Energy Savings

1. Economic Impacts on Individual Consumers

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

a. Life-Cycle Cost and Payback Period

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

[155] Efficiency levels that were analyzed for this direct final rule are discussed in section IV.C.2 of this document. Results by efficiency level are presented in TSD chapters 8, 10, and 12.

rate. Chapter 8 of the direct final rule TSD provides detailed information on the LCC and PBP analyses.

Table V.4 through Table V.12 show the LCC and PBP results for the TSLs considered for each product class. In the first of each pair of tables, the simple payback is measured relative to the baseline product. In the second table, the impacts are measured relative to the efficiency distribution in the no-new-standards case in the compliance year (*see* section IV.F.8 of this document). Because some consumers purchase products with higher efficiency in the no-new-standards case, the average savings are less than the difference between the average LCC of the baseline product and the average LCC at each TSL. The savings refer only to consumers who are affected by a standard at a given TSL. Those who already purchase a product with efficiency at or above a given TSL are not affected. Consumers for whom the LCC increases at a given TSL experience a net cost.

Table V.4 Average LCC and PBP Results for Top-Loading Ultra-Compact Residential Clothes Washers

TSL	Efficiency Level	Average Costs *2022$*				Simple Payback *years*	Average Lifetime *years*
		Installed Cost	First Year's Operating Cost	Lifetime Operating Cost	LCC		
1, 3, 4	Baseline	$840	$84	$913	$1,753	--	13.4
2**	Baseline	$836	$84	$919	$1,755	--	13.4

Note: The results for each TSL are calculated assuming that all consumers use products at that efficiency level. The PBP is measured relative to the baseline product.
** All the TSLs except TSL 2 (the Recommended TSL) have a compliance year of 2027. TSL 2 has a compliance year of 2028.

Table V.5 Average LCC and PBP Results for Top-Loading Standard-Size Residential Clothes Washers

TSL	Efficiency Level	Average Costs *2022$*				Simple Payback *years*	Average Lifetime *years*
		Installed Cost	First Year's Operating Cost	Lifetime Operating Cost	LCC		
--	Baseline	$690	$174	$1,917	$2,607	--	13.4
1	1	$770	$156	$1,715	$2,485	4.4	13.4
2**	2	$833	$151	$1,661	$2,494	6.2	13.4
3	3	$851	$146	$1,598	$2,448	5.7	13.4
4	4	$856	$143	$1,569	$2,425	5.4	13.4

Note: The results for each TSL are calculated assuming that all consumers use products at that efficiency level. The PBP is measured relative to the baseline product.
** All the TSLs except TSL 2 (the Recommended TSL) have a compliance year of 2027. TSL 2 has a compliance year of 2028.

Table V.6 Average LCC Savings Relative to the No-New-Standards Case for Top-Loading Standard-Size Residential Clothes Washers

TSL	Efficiency Level	Life-Cycle Cost Savings	
		Average LCC Savings* *2022$*	Percent of Consumers that Experience Net Cost
1	1	$122	16%
2**	2	$111	27%
3	3	$116	28%
4	4	$133	26%

* The savings represent the average LCC for affected consumers.
** All the TSLs except TSL 2 (the Recommended TSL) have a compliance year of 2027. TSL 2 has a compliance year of 2028.

Table V.7 Average LCC and PBP Results for Front-Loading Compact Residential Clothes Washers

TSL	Efficiency Level	Average Costs *2022$*				Simple Payback *years*	Average Lifetime *years*
		Installed Cost	First Year's Operating Cost	Lifetime Operating Cost	LCC		
--	Baseline	$774	$93	$1,024	$1,798	--	13.4
1	1	$827	$88	$959	$1,786	9.6	13.4
2**	2	$861	$84	$918	$1,779	9.3	13.4
3	2	$865	$84	$913	$1,778	9.5	13.4
4	4	$904	$77	$838	$1,742	8.0	13.4

Note: The results for each TSL are calculated assuming that all consumers use products at that efficiency level. The PBP is measured relative to the baseline product.
** All the TSLs except TSL 2 (the Recommended TSL) have a compliance year of 2027. TSL 2 has a compliance year of 2028.

Table V.8 Average LCC Savings Relative to the No-New-Standards Case for Front-Loading Compact Residential Clothes Washers

TSL	Efficiency Level	Life-Cycle Cost Savings	
		Average LCC Savings* *2022$*	Percent of Consumers that Experience Net Cost
1	1	$0	0%
2**	2	$9	21%
3	2	$8	22%
4	4	$38	35%

* The savings represent the average LCC for affected consumers.
** All the TSLs except TSL 2 (the Recommended TSL) have a compliance year of 2027. TSL 2 has a compliance year of 2028.

Table V.9 Average LCC and PBP Results for Front-Loading Standard-Size Residential Clothes Washers

TSL	Efficiency Level	Average Costs *2022$*				Simple Payback *years*	Average Lifetime *years*
		Installed Cost	First Year's Operating Cost	Lifetime Operating Cost	LCC		
--	DFR Baseline	$1,027	$172	$1,922	$2,948	--	13.4
--	NOPR Baseline	$1,027	$137	$1,510	$2,536	--	13.4
1	1	$1,066	$131	$1,445	$2,511	0.9	13.4
2**	2	$1,088	$125	$1,389	$2,477	1.4	13.4
3	3	$1,105	$123	$1,359	$2,464	1.6	13.4
4	4	$1,120	$118	$1,303	$2,423	1.7	13.4

Note: The results for each TSL are calculated assuming that all consumers use products at that efficiency level. The PBP is measured relative to the baseline product.
** All the TSLs except TSL 2 (the Recommended TSL) have a compliance year of 2027. TSL 2 has a compliance year of 2028.

Table V.10 Average LCC Savings Relative to the No-New-Standards Case for Front-Loading Standard-Size Residential Clothes Washers

TSL	Efficiency Level	Life-Cycle Cost Savings	
		Average LCC Savings* *2022$*	Percent of Consumers that Experience Net Cost
1	1	$26	1%
2**	2	$46	2%
3	3	$15	20%
4	4	$49	16%

* The savings represent the average LCC for affected consumers.
** All the TSLs except TSL 2 (the Recommended TSL) have a compliance year of 2027. TSL 2 has a compliance year of 2028.

Table V.11 Average LCC and PBP Results for Semi-Automatic Residential Clothes Washers

TSL	Efficiency Level	Average Costs *2022$*				Simple Payback *years*	Average Lifetime *years*
		Installed Cost	First Year's Operating Cost	Lifetime Operating Cost	LCC		
--	Baseline	$525	$134	$1,456	$1,981	--	13.4
1, 3	1	$538	$107	$1,156	$1,694	0.5	13.4
2**	1	$536	$107	$1,164	$1,700	0.5	13.4
4	2	$547	$95	$1,023	$1,569	0.6	13.4

Note: The results for each TSL are calculated assuming that all consumers use products at that efficiency level. The PBP is measured relative to the baseline product.
** All the TSLs except TSL 2 (the Recommended TSL) have a compliance year of 2027. TSL 2 has a compliance year of 2028.

Table V.12 Average LCC Savings Relative to the No-New-Standards Case for Semi-Automatic Residential Clothes Washers

TSL	Efficiency Level	Life-Cycle Cost Savings	
		Average LCC Savings* *2022$*	Percent of Consumers that Experience Net Cost
1, 3	1	$280	0%
2**	1	$284	0%
4	2	$188	0%

* The savings represent the average LCC for affected consumers.
** All the TSLs except TSL 2 (the Recommended TSL) have a compliance year of 2027. TSL 2 has a compliance year of 2028.

b. Consumer Subgroup Analysis

In the consumer subgroup analysis, DOE estimated the impact of the considered TSLs on low-income households and senior-only households. Table V.13 through Table V.16 compares the average LCC savings and PBP at each efficiency level for the consumer subgroups with similar metrics for the entire consumer sample for each RCW product class. In most cases, the average LCC savings for low-income households at the considered efficiency levels are higher and payback periods are lower relative to the results for all households across all product classes. However, LCC savings for senior-only households are significantly different when compared to the average for all households across all product classes, *i.e.*, lower LCC savings and longer payback periods. Chapter 11 of the direct final rule TSD presents the complete LCC and PBP results for the subgroups.

Table V.13 Comparison of LCC Savings and PBP for Consumer Subgroups and All Households; Top-Loading Standard-Size Residential Clothes Washers

	Low-Income Households	Senior-Only Households	Well-Users Households	All Households
Average LCC Savings (2022$)				
TSL 1	$149	$73	$22	$122
TSL 2**	$162	$48	($31)	$111
TSL 3	$156	$59	$6	$116
TSL 4	$176	$72	$38	$133
Payback Period (years)				
TSL 1	2.5	6.0	8.3	4.4
TSL 2**	3.5	8.4	13.5	6.2
TSL 3	3.2	7.7	10.9	5.7
TSL 4	3.0	7.3	9.1	5.4
Consumers with Net Benefit (%)				
TSL 1	47%	39%	27%	45%
TSL 2**	45%	30%	16%	39%
TSL 3	71%	57%	44%	67%
TSL 4	77%	64%	56%	73%
Consumers with Net Cost (%)				
TSL 1	10%	22%	33%	16%
TSL 2**	16%	35%	50%	27%
TSL 3	17%	37%	50%	28%
TSL 4	16%	35%	43%	26%

** All the TSLs except TSL 2 (the Recommended TSL) have a compliance year of 2027. TSL 2 has a compliance year of 2028.

Table V.14 Comparison of LCC Savings and PBP for Consumer Subgroups and All Households; Front-Loading Compact Residential Clothes Washers

	Low-Income Households	Senior-Only Households	Well-Users Households	All Households
Average LCC Savings (2022$)				
TSL 1	$0	$0	$0	$0
TSL 2**	$39	($1)	($13)	$9
TSL 3	$38	($2)	($13)	$8
TSL 4	$75	$21	$24	$38
Payback Period (years)				
TSL 1	2.7	12.2	16.3	9.6
TSL 2**	2.6	11.8	16.6	9.3
TSL 3	2.6	12.0	16.6	9.5
TSL 4	2.2	10.0	11.1	8.0
Consumers with Net Benefit (%)				
TSL 1	0%	0%	0%	0%
TSL 2**	27%	14%	8%	17%
TSL 3	27%	14%	8%	17%
TSL 4	75%	56%	55%	64%
Consumers with Net Cost (%)				
TSL 1	0%	0%	0%	0%
TSL 2**	7%	25%	31%	21%
TSL 3	7%	25%	31%	22%
TSL 4	13%	43%	44%	35%

** All the TSLs except TSL 2 (the Recommended TSL) have a compliance year of 2027. TSL 2 has a compliance year of 2028.

Table V.15 Comparison of LCC Savings and PBP for Consumer Subgroups and All Households; Front-Loading Standard-Size Residential Clothes Washers

	Low-Income Households	Senior-Only Households	Well-Users Households	All Households
Average LCC Savings (2022$)				
TSL 1	$38	$5	($1)	$26
TSL 2**	$60	$21	($0.4)	$46
TSL 3	$19	$8	$11	$15
TSL 4	$55	$31	$18	$49
Payback Period (years)				
TSL 1	0.5	1.2	2.2	0.9
TSL 2**	0.7	1.9	3.3	1.4
TSL 3	0.8	2.1	3.5	1.6
TSL 4	0.8	2.3	3.8	1.7
Consumers with Net Benefit (%)				
TSL 1	1%	1%	1%	1%
TSL 2**	5%	4%	2%	5%
TSL 3	34%	27%	33%	31%
TSL 4	72%	68%	58%	75%
Consumers with Net Cost (%)				
TSL 1	1%	1%	1%	1%
TSL 2**	1%	3%	5%	2%
TSL 3	13%	24%	18%	20%
TSL 4	12%	23%	33%	16%

** All the TSLs except TSL 2 (the Recommended TSL) have a compliance year of 2027. TSL 2 has a compliance year of 2028.

Table V.16 Comparison of LCC Savings and PBP for Consumer Subgroups and All Households; Semi-Automatic Residential Clothes Washers

	Low-Income Households	Senior-Only Households	Well-Users Households	All Households
Average LCC Savings (2022$)				
TSL 1, 3	$307	$211	$166	$280
TSL 2**	$310	$214	$167	$284
TSL 4	$204	$141	$116	$188
Payback Period (years)				
TSL 1, 3	0.2	0.7	0.8	0.5
TSL 2**	0.2	0.6	0.8	0.5
TSL 4	0.2	0.7	0.9	0.6
Consumers with Net Benefit (%)				
TSL 1, 3	19%	21%	21%	21%
TSL 2**	19%	21%	21%	21%
TSL 4	83%	92%	90%	92%
Consumers with Net Cost (%)				
TSL 1, 3	0%	0%	0%	0%
TSL 2**	0%	0%	0%	0%
TSL 4	0%	0%	2%	0%

** All the TSLs except TSL 2 (the Recommended TSL) have a compliance year of 2027. TSL 2 has a compliance year of 2028.

c. Rebuttable Presumption Payback

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

Table V.17 presents the rebuttable-presumption payback periods for the considered TSLs for RCWs. While DOE examined the rebuttable-presumption criterion, it considered whether the standard levels considered for this rule are economically justified through a more detailed analysis of the economic impacts of those levels, pursuant to 42 U.S.C. 6295(o)(2)(B)(i), that considers the full range of impacts to the consumer, manufacturer, Nation, and environment. The results of that analysis serve as the basis for DOE to definitively evaluate the economic justification for a potential standard level, thereby supporting or rebutting the results of any preliminary determination of economic justification.

Table V.17 Rebuttable-Presumption Payback Periods

Product Class	Trial Standard Level			
	1	2	3	4
	years			
Top-Loading Ultra-Compact*	n.a.	n.a.	n.a.	n.a.
Top-Loading Standard-Size	3.7	5.1	4.6	4.2
Front-Loading Compact	6.5	6.7	6.8	5.8
Front-Loading Standard-Size	0.9	1.3	1.5	1.6
Semi-Automatic	0.3	0.3	0.3	0.4

*The entry "n.a." means not applicable because the evaluated standard is the baseline.

2. Economic Impacts on Manufacturers

DOE performed an MIA to estimate the impact of amended energy conservation standards on manufacturers of RCWs. The next section describes the expected impacts on manufacturers at each considered TSL. Chapter 12 of the direct final rule TSD explains the analysis in further detail.

a. Industry Cash Flow Analysis Results

In this section, DOE provides GRIM results from the analysis, which examines changes in the industry that would result from a standard. The following tables summarize the estimated financial impacts (represented by changes in INPV) of potential amended energy conservation standards on manufacturers of RCWs, as well as the conversion costs that DOE estimates manufacturers of RCWs would incur at each TSL.

The impact of potential amended energy conservation standards were analyzed under two scenarios: (1) the preservation of gross margin percentage; and (2) the preservation of operating profit, as discussed in section IV.J.2.d of this document. The preservation of gross margin percentage applies a "gross margin percentage" of 18 percent for all product classes and all efficiency levels.[156] This scenario assumes that a manufacturer's per-unit dollar profit would increase as MPCs increase in the standards cases and represents the upper-bound to industry profitability under potential amended energy conservation standards.

The preservation of operating profit scenario reflects manufacturers' concerns about their inability to maintain margins as MPCs increase to reach more-stringent efficiency levels. In this scenario, while manufacturers make the necessary investments required to convert their facilities to produce compliant products, operating profit does not change in absolute dollars and decreases as a percentage of revenue. The preservation of operating profit scenario results in the lower (or more severe) bound to impacts of potential amended standards on industry.

Each of the modeled scenarios results in a unique set of cash flows and corresponding INPV for each TSL. INPV is the sum of the discounted cash flows to the industry from the base year through the end of the analysis period (30 years from the analyzed compliance year).[157] The "change in INPV" results refer to the difference in industry value between the no-new-standards case and standards case at each TSL. To provide perspective on the short-run cash flow impact, DOE includes a comparison of free cash flow between the no-new-standards case and the standards case at each TSL in the year before amended standards would take effect. This figure provides an

[156] The gross margin percentage of 18 percent is based on a manufacturer markup of 1.22.
[157] The analysis period ranges from 2024 to 2056 for the no-new-standards case and all TSLs, except for TSL 2 (the Recommended TSL). The analysis period for TSL 2 ranges from 2024 to 2057 due to the 2028 compliance year.

understanding of the magnitude of the required conversion costs relative to the cash flow generated by the industry in the no-new-standards case.

Conversion costs are one-time investments for manufacturers to bring their manufacturing facilities and product designs into compliance with potential amended standards. As described in section IV.J.2.c of this document, conversion cost investments occur between the year of publication of the direct final rule and the year by which manufacturers must comply with the amended standard. The conversion costs can have a significant impact on the industry's short-term cash flow and generally result in lower free cash flow in the period between the publication of the direct final rule and the compliance date of potential amended standards. Conversion costs are independent of the manufacturer markup scenarios and are not presented as a range in this analysis.

Table V.18 Manufacturer Impact Analysis Results for Residential Clothes Washers

	Unit	**No-New-Standards Case**	**TSL 1**	**TSL 2**	**TSL 3**	**TSL 4**
INPV	*2022$ millions*	1,707.9	1,639.0 to 1,710.7	1,429.6 to 1,560.9	1,053.8 to 1,234.5	535.8 to 738.2
Change in INPV*	*%*	-	(4.0) to 0.2	(16.3) to (8.6)	(38.3) to (27.7)	(68.6) to (56.8)
Free Cash Flow (2026)**	*2022$ millions*	136.6***	113.2	29.9	(166.7)	(428.8)
Change in Free Cash Flow (2026)**	*%*	-	(17.1)	(97.8)	(222.0)	(413.9)
Product Conversion Costs	*2022$ millions*	-	27.3	91.9	197.5	253.2
Capital Conversion Costs	*2022$ millions*	-	31.8	228.1	527.1	1,068.0
Total Conversion Costs	*2022$ millions*	-	59.0	320.0	724.6	1,321.2

*Parentheses denote negative (-) values.
**TSL 2 (the Recommended TSL) represents the change in free cash flow in 2027, a year before the 2028 compliance date.
*** In 2027, the no-new-standards free cash flow is $136.4 million.

The majority of the INPV impacts are associated with standard-size product classes because top-loading standard-size and front-loading standard-size RCWs comprise approximately 96 percent of the total RCW domestic shipments. More specifically, the majority of the INPV impacts are associated with top-loading RCWs due to the high volume of shipments, the high percentage of shipments at minimum efficiency, and the likely design paths required to meet more stringent standards. Top-loading RCWs account for approximately 74 percent of current standard-size RCW shipments in 2027. DOE's shipments analysis estimates approximately 66 percent of top-loading shipments are currently at the baseline efficiency level. Additionally, the engineering analysis, informed by conversations with manufacturers, indicates that the likely design path to meet the efficiencies required at TSL 3 and TSL 4 would require notable capital investments. In particular, many manufacturers would likely increase tub capacity of top-loading standard-size units with capacities of less than 4.7 ft^3 to meet these higher efficiencies. In contrast, DOE's shipments analysis assumes no front-loading RCW shipments are at the DFR Baseline efficiency level and DOE's engineering analysis suggests that increases in tub capacity would not be required for front-loading RCW models to reach max-tech. Thus, as DOE considers increasingly stringent TSLs, the top-loading standard-size product class tends to drive industry investments and negative INPV impacts. *See* chapter 5 of the direct final rule TSD for a detailed discussion of design paths to reach higher efficiencies.

At TSL 1, the standard represents the least stringent efficiencies (EL 1) for all product classes. The change in INPV is expected to range from -4.0 to 0.2 percent. At this level, free cash flow is estimated to decrease by 17.1 percent compared to the no-new-standards case value of $136.6 million in the year 2026, the year before the 2027 standards year. DOE's shipments analysis estimates approximately 54 percent of current shipments meet this level.[158]

At TSL 1, DOE expects most manufacturers would incur limited conversion costs to reach the efficiencies required. The conversion costs primarily stem from changes required for top-loading standard-size RCWs. DOE's shipments analysis estimates approximately 34 percent of current top-loading standard-size RCWs meet this level (EL 1). In contrast, nearly all the front-loading standard-size RCWs currently meet the efficiencies required at this level. Industry capital conversion costs include tooling updates and costs associated with transitioning models with porcelain wash baskets to stainless steel wash baskets. Product conversion costs may be necessary for product development and testing. DOE expects industry to incur some re-flooring costs. DOE estimates capital conversion costs of $31.8 million and product conversion costs of $27.3 million. Conversion costs total $59.0 million.

At TSL 1, the shipment-weighted average MPC for all RCWs is expected to increase by 6.4 percent relative to the no-new-standards case shipment-weighted average MPC for all RCWs in 2027. In the preservation of gross margin percentage scenario, the slight increase in cashflow slightly outweighs the $59.0 million in conversion costs, causing a minor positive change in INPV at TSL 1 under this scenario. Under the preservation of operating profit scenario, the manufacturer markup decreases in 2028, the

[158] Current shipments refer to annual product shipments in 2024 from the shipments analysis.

year after the analyzed 2027 compliance year. This reduction in the manufacturer markup and the $59.0 million in conversion costs incurred by manufacturers cause a slightly negative change in INPV at TSL 1 under the preservation of operating profit scenario.

At TSL 2 (*i.e.*, the Recommended TSL), the standard represents the ENERGY STAR v. 8.1 efficiency levels for the front-loading and top-loading standard-size product classes, the ENERGY STAR Most Efficient level for the front-loading compact product class, and a gap fill level for the semi-automatic product class. The change in INPV is expected to range from -16.3 to -8.6 percent. At this level, free cash flow is estimated to decrease by 97.8 percent compared to the no-new-standards case value of $136.4 million in the year 2027, the year before the Recommended TSL standards year. DOE's shipments analysis estimates approximately 49 percent of current shipments meet this level. For the top-loading standard-size RCWs, front-loading compact RCWs, and front-loading standard-size RCWs, TSL 2 corresponds to EL 2. For the remaining product classes, the efficiencies required at TSL 2 are the same as TSL 1. For top-loading standard-size RCWs, approximately 31 percent of current shipments meet the efficiencies required by TSL 2. However, most manufacturers with top-loading standard-size models offer products at or above the efficiencies required. Of the nine OEMs with top-loading standard-size products, six OEMs offer models that meet the efficiencies required. To meet TSL 2, DOE expects manufacturers would incorporate wash plate designs, direct drive motors, and hardware features enabling spin speed increases into top-loading standard-size RCWs. Beyond these design options, some manufacturers may choose to increase the tub capacities of certain top-loading standard-size RCWs (*i.e.*, models with capacities of less than 4.4 ft^3) to meet the TSL 2 efficiencies.[159] Increasing RCW capacity could require a new cabinet, tub, and drum designs, which would necessitate costly investments in manufacturing equipment and tooling. For front-loading standard-size RCWs, approximately 92 percent of shipments meet the efficiencies required by TSL 2. Of the seven OEMs with front-loading standard-size products, six OEMs offer models that meet the efficiencies required. Product conversion costs may be necessary for designing, prototyping, and testing new or updated platforms. Additionally, DOE expects industry to incur more re-flooring costs compared to the prior TSL as more display units would need to be replaced. DOE estimates capital conversion costs of $228.1 million and product conversion costs of $91.9 million. Conversion costs total $320.0 million.

At TSL 2, the shipment-weighted average MPC for all RCWs is expected to increase by 12.1 percent relative to the no-new-standards case shipment-weighted average MPC for all RCWs in 2028. In the preservation of gross margin percentage scenario, the increase in cashflow is outweighed by the $320.0 million in conversion costs, causing a negative change in INPV at TSL 2 under this scenario. Under the preservation of operating profit scenario, the manufacturer markup decreases in 2029, the year after the analyzed compliance year. This reduction in the manufacturer markup and the $320.0 million in conversion costs incurred by manufacturers cause a moderate negative change in INPV at TSL 2 under the preservation of operating profit scenario.

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[159] *See* section V.B.4.b of this document for further discussion of DOE's determination of alternate pathways that could be used to achieve higher efficiency levels that would not require an increase in capacity.

At TSL 3, the standard represents the ENERGY STAR Most Efficient level for the front-loading product classes, the CEE Tier 1 level for the top-loading standard-size product class, and a gap fill level for the semi-automatic product class. The change in INPV is expected to range from -38.3 to -27.7 percent. At this level, free cash flow is estimated to decrease by 222.0 percent compared to the no-new-standards case value of $136.6 million in the year 2026, the year before the 2027 standards year. DOE's shipments analysis estimates approximately 18 percent of current shipments meet this level.

For the front-loading and top-loading standard-size product classes, TSL 3 corresponds to EL 3. For the remaining product classes, TSL 3 corresponds to the same efficiency level as TSL 2. At this level, the increase in conversion costs is mainly driven by the top-loading standard-size product class. Currently, approximately 3 percent of top-loading standard-size shipments meet TSL 3 efficiencies. Of the nine OEMs with top-loading standard-size products, only two offer models that meet the efficiencies required at TSL 3. The remaining seven OEMs would need to redesign all their existing top-loading standard-size platforms to meet this level.

To meet TSL 3, top-loading RCW designs would likely need to incorporate hardware features to enable faster spin speeds. These hardware updates may include reinforced wash baskets, more robust suspension and balancing system, and more advanced sensors. An increasing portion of top-loading standard-size RCWs (*i.e.*, those models with capacities less than 4.7 ft^3) may choose to increase tub capacity.[160] Increasing RCW capacity could require new cabinet, tub, and drum designs. The changes would necessitate investments in new equipment and tooling. DOE expects industry to incur more re-flooring costs compared to prior TSLs as more display units would need to be replaced. DOE estimates capital conversion costs of $527.1 million and product conversion costs of $197.5 million. Conversion costs total $724.6 million.

At TSL 3, the large conversion costs result in a free cash flow dropping below zero in the years before the standards year. The negative free cash flow calculation indicates manufacturers may need to access cash reserves or outside capital to finance conversion efforts.

At TSL 3, the shipment-weighted average MPC for all RCWs is expected to increase by 14.4 percent relative to the no-new-standards case shipment-weighted average MPC for all RCWs in 2027. In the preservation of gross margin percentage scenario, the increase in cashflow is outweighed by the $724.6 million in conversion costs, causing a large change in INPV at TSL 3 under this scenario. Under the preservation of operating profit scenario, the manufacturer markup decreases in 2028, the year after the analyzed compliance year. This reduction in the manufacturer markup and the $724.6 million in conversion costs incurred by manufacturers cause a significant negative change in INPV at TSL 3 under the preservation of operating profit scenario.

[160] *See* section V.B.4.b of this document for further discussion of DOE's determination of alternate pathways that could be used to achieve higher efficiency levels that would not require an increase in capacity.

At TSL 4, the standard represents the max-tech energy and water efficiencies for all product classes. The change in INPV is expected to range from -68.6 to -56.8 percent. At this level, free cash flow is estimated to decrease by 413.9 percent compared to the no-new-standards case value of $136.6 million in the year 2026, the year before the 2027 standards year. DOE's shipments analysis estimates approximately 4 percent of current shipments meet this level.

As previously discussed, the max-tech efficiencies required for standard-size RCWs drive the increase in conversion costs from the prior TSLs. Currently, less than 1 percent of top-loading standard-size RCW shipments and approximately 9 percent of front-loading standard-size RCW shipments meet max-tech levels. Out of the nine top-loading standard-size OEMs, only one offers models that meet the efficiencies required by TSL 4. Out of the seven front-loading standard-size OEMs, only two offer models that meet the efficiencies required by TSL 4. Max-tech would require most manufacturers to significantly redesign their RCW platforms. DOE expects most standard-size RCW manufacturers would need to further increase spin speeds as compared to prior TSLs. An increasing portion of top-loading standard-size RCWs (*i.e.*, models with capacities of less than 5.0 ft^3) may choose to increase tub capacity to achieve the RMC values required at this level.[161] In interviews, two manufacturers stated that max-tech levels would require a total renovation of existing production facilities. Some manufacturers further stated that their product portfolio would be limited due to the lack of differentiation possible under a

[161] *See* section V.B.4.b of this document for further discussion of DOE's determination of alternate pathways that could be used to achieve higher efficiency levels that would not require an increase in capacity.

max-tech standard, which would potentially limit their ability to serve certain consumer segments and hurt profitability. DOE expects industry would incur approximately the same re-flooring costs as TSL 3 since few models exist at the higher levels. At TSL 4, reaching max-tech efficiency levels is a billion-dollar investment for industry. DOE estimates capital conversion costs of $1,068.0 million and product conversion costs of $253.2 million. Conversion costs total $1,321.2 million.

At TSL 4, the large conversion costs result in a free cash flow dropping below zero in the years before the standards year. The negative free cash flow calculation indicates manufacturers may need to access cash reserves or outside capital to finance conversion efforts.

At TSL 4, the shipment-weighted average MPC for all RCWs is expected to increase by 15.9 percent relative to the no-new-standards case shipment-weighted average MPC for all RCWs in 2027. In the preservation of gross margin percentage scenario, the increase in cashflow is outweighed by the $1,321.2 million in conversion costs, causing a significant negative change in INPV at TSL 4 under this scenario. Under the preservation of operating profit scenario, the manufacturer markup decreases in 2028, the year after the analyzed compliance year. This reduction in the manufacturer markup and the $1,321.2 million in conversion costs incurred by manufacturers cause a significant negative change in INPV at TSL 4 under the preservation of operating profit scenario.

b. Direct Impacts on Employment

To quantitatively assess the potential impacts of amended energy conservation standards on direct employment in the RCWs industry, DOE used the GRIM to estimate the domestic labor expenditures and number of direct employees in the no-new-standards case and in each of the standards cases during the analysis period. For the direct final rule, DOE used the most up-to-date information available. DOE calculated these values using statistical data from the 2021 *ASM*,[162] BLS employee compensation data,[163] results of the engineering analysis, and manufacturer interviews conducted in support of the March 2023 NOPR.

Labor expenditures related to product manufacturing depend on the labor intensity of the product, the sales volume, and an assumption that wages remain fixed in real terms over time. The total labor expenditures in each year are calculated by multiplying the total MPCs by the labor percentage of MPCs. The total labor expenditures in the GRIM were then converted to total production employment levels by dividing production labor expenditures by the average fully burdened wage multiplied by the average number of hours worked per year per production worker. To do this, DOE relied on the *ASM* inputs: Production Workers Annual Wages, Production Workers Annual Hours, Production Workers for Pay Period, and Number of Employees. DOE also relied on BLS employee compensation data to determine the fully burdened wage ratio. The fully burdened wage

[162] U.S. Census Bureau, *Annual Survey of Manufactures*. "Summary Statistics for Industry Groups and Industries in the U.S (2021)." Available at *www.census.gov/programs-surveys/asm/data/tables.html* (last accessed June 30, 2023).
[163] U.S. Bureau of Labor Statistics. "Employer Costs for Employee Compensation – March 2023." June 16, 2023. Available at *www.bls.gov/news.release/archives/ecec_06162023.pdf* (last accessed June 30, 2023).

ratio factors in paid leave, supplemental pay, insurance, retirement and savings, and legally required benefits.

The number of production employees is then multiplied by the U.S. labor percentage to convert total production employment to total domestic production employment. The U.S. labor percentage represents the industry fraction of domestic manufacturing production capacity for the covered product. This value is derived from manufacturer interviews, product database analysis, and publicly available information. DOE estimates that 92 percent of RCWs are produced domestically.

The domestic production employees estimate covers production line workers, including line supervisors, who are directly involved in fabricating and assembling products within the OEM facility. Workers performing services that are closely associated with production operations, such as materials handling tasks using forklifts, are also included as production labor. DOE's estimates only account for production workers who manufacture the specific products covered by this direct final rule.

Non-production workers account for the remainder of the direct employment figure. The non-production employees estimate covers domestic workers who are not directly involved in the production process, such as sales, engineering, human resources, and management.[164] Using the amount of domestic production workers calculated above,

[164] The comprehensive description of production and non-production workers is available at "Definitions and Instructions for the Annual Survey of Manufacturers, MA-10000" (pp. 13–14) *www2.census.gov/programs-surveys/asm/technical-documentation/questionnaire/2021/instructions/MA_10000_Instructions.pdf* (last accessed June 30, 2023).

non-production domestic employees are extrapolated by multiplying the ratio of non-production workers in the industry compared to production employees. DOE assumes that this employee distribution ratio remains constant between the no-new-standards case and standards cases.

Using the GRIM, DOE estimates that in the absence of new energy conservation standards, there would be 9,070 domestic production and non-production workers for RCWs in 2027. Table V.19 shows the range of the impacts of energy conservation standards on U.S. manufacturing employment in the RCW industry. The following discussion provides a qualitative evaluation of the range of potential impacts presented in Table V.19.

Table V.19 Domestic Direct Employment Impacts for Residential Clothes Washer Manufacturers in the Analyzed Compliance Year

	No-New-Standards Case	**TSL 1**	**TSL 2**	**TSL 3**	**TSL 4**
Direct Employment (Production Workers + Non-Production Workers) in 2027**	9,070***	10,400	11,821	11,785	11,857
Potential Changes in Direct Employment Workers*	-	(8,097) to 1,330	(8,097) to 2,638	(8,097) to 2,715	(8,097) to 2,787

*DOE presents a range of potential direct employment impacts. Numbers in parentheses indicate negative numbers.
**TSL 2 (the Recommended TSL) represents the direct employment in 2028.
*** In 2028, the no-new-standards case direct employment estimate is 9,183.

The direct employment impacts shown in Table V.19 represent the potential domestic employment changes that could result following the compliance date for the RCWs covered in this rulemaking. The upper bound estimate corresponds to an increase in the number of domestic workers that results from amended energy conservation standards if manufacturers continue to produce the same scope of covered products within the United States after compliance takes effect. To establish a conservative lower bound, DOE assumes all manufacturers would shift production to foreign countries. At lower TSLs, DOE believes the likelihood of changes in production location due to amended standards are low due to the relatively minor production line updates required. However, as amended standards increase in stringency and both the complexity and cost of production facility updates increases, manufacturers are more likely to revisit their production location decisions. At max-tech, manufacturers representing a large portion of the market noted concerns about the level of investment, about the potential need to relocate production lines in order to remain competitive, and about the conversion period of 3 years being insufficient to make the necessary manufacturing line updates. At the Recommended TSL (*i.e.*, TSL 2), DOE expects that the likelihood of changes in production location as a direct result of amended standards are relatively low. Nearly all OEMs already produce top-loading standard-size and front-loading standard-size RCWs that meet the TSL 2 efficiencies in U.S. manufacturing facilities. Of the nine OEMs with top-loading standard-size products, six OEMs offer models that meet TSL 2 efficiencies. These six OEMs that currently offer top-loading standard-size RCW models that meet TSL 2 efficiencies collectively account for over 95 percent of overall top-loading standard-size RCW shipments. Of the seven OEMs with front-loading standard-size products, six OEMs offer models that meet TSL 2 efficiencies.

Additional detail on the analysis of direct employment can be found in chapter 12 of the direct final rule TSD. Additionally, the employment impacts discussed in this section are independent of the employment impacts from the broader U.S. economy, which are documented in chapter 16 of the direct final rule TSD.

c. Impacts on Manufacturing Capacity

As discussed in section V.B.2.a of this document, meeting the efficiencies required for each TSL would require varying levels of resources and investment. A standard level requiring notably faster spin speeds, namely TSL 3 and TSL 4, would necessitate product redesign to account for the increased spin speeds as well as the noise, vibration, and fabric care concerns related to the spin speeds required to meet these higher TSLs. These updates may include designing and manufacturing reinforced wash baskets, instituting a more robust suspension and balancing system, increasing the number of sensors, and incorporating more advanced sensors. For top-loading standard-size RCWs, manufacturers could potentially choose to increase tub capacity of smaller models to meet the efficiencies required at higher TSLs. Many manufacturers would need to invest in new tooling and equipment to either produce entirely new wash basket lines or ramp up production of their existing larger-capacity wash baskets. Based on a review of current CCD model listings and manufacturer feedback during confidential interviews, DOE's engineering analysis reflects a design path in which TSL 2 is achieved with a capacity increase from 4.0 ft^3 to 4.4 ft^3, TSL 3 is achieved with a capacity increase to 4.7 ft^3, and TSL 4 is achieved with a capacity increase to 5.0 ft^3 for the top-loading standard-size product class. In interviews, some manufacturers expressed concerns—particularly at max-tech—that the 3-year period between the announcement of a final rule and the compliance date of the amended energy conservation standard might be insufficient to update production facilities and design, test, and manufacture the necessary number of products to meet demand. For the remaining TSLs, including TSL 2 (the Recommended TSL), most manufacturers could likely maintain manufacturing capacity levels and continue to meet market demand under amended energy conservation standards. Furthermore, at the Recommended TSL, manufacturers will have a 4-year period between the announcement of the direct final rule and the compliance date of the amended energy conservation standards. Thus, DOE does not expect manufacturers will face long-term capacity constraints due to the standard levels detailed in this direct final rule.

d. Impacts on Subgroups of Manufacturers

Using average cost assumptions to develop industry cash-flow estimates may not capture the differential impacts among subgroups of manufacturers. Small manufacturers, niche players, or manufacturers exhibiting a cost structure that differs substantially from the industry average could be affected disproportionately. DOE investigated small businesses as a manufacturer subgroup that could be disproportionally impacted by energy conservation standards and could merit additional analysis. DOE did not identify any other adversely impacted manufacturer subgroups for this rulemaking based on the results of the industry characterization.

DOE analyzes the impacts on small businesses in a separate analysis for the standards proposed in the NOPR published elsewhere in this issue of the *Federal Register* and in chapter 12 of the direct final rule TSD. In summary, the Small Business Administration ("SBA") defines a "small business" as having 1,500 employees or less for

NAICS 335220, "Major Household Appliance Manufacturing."[165] Based on this classification, DOE identified one domestic OEM that qualifies as a small business. For a discussion of the impacts on the small business manufacturer subgroup, *see* chapter 12 of the direct final rule TSD.

e. Cumulative Regulatory Burden

One aspect of assessing manufacturer burden involves looking at the cumulative impact of multiple DOE standards and the regulatory actions of other Federal agencies and States that affect the manufacturers of a covered product or equipment. While any one regulation may not impose a significant burden on manufacturers, the combined effects of several existing or impending regulations may have serious consequences for some manufacturers, groups of manufacturers, or an entire industry. Multiple regulations affecting the same manufacturer can strain profits and lead companies to abandon product lines or markets with lower expected future returns than competing products. For these reasons, DOE conducts an analysis of cumulative regulatory burden as part of its rulemakings pertaining to appliance efficiency.

For the cumulative regulatory burden analysis, DOE examines Federal, product-specific regulations that could affect RCW manufacturers that take effect approximately 3 years before or after the 2028 compliance date. This information is presented in Table V.20.

[165] U.S. Small Business Administration. "Table of Small Business Size Standards." (Effective March 17, 2023). Available at *www.sba.gov/document/support-table-size-standards* (last accessed June 30, 2023).

Table V.20 Compliance Dates and Expected Conversion Expenses of Federal Energy Conservation Standards Affecting Residential Clothes Washer Original Equipment Manufacturers

Federal Energy Conservation Standard	Number of OEMs*	Number of OEMs Affected by This Rule**	Approx. Standards Compliance Year	Industry Conversion Costs *(Millions)*	Industry Conversion Costs / Equipment Revenue***
Portable Air Conditioners 85 FR 1378 (January 10, 2020)	9	2	2025	$320.9 (2015$)	6.7%
Consumer Clothes Dryers† 87 FR 51734 (August 23, 2022)	15	13	2027	$149.7 (2020$)	1.8%
Miscellaneous Refrigeration Products† 88 FR 19382 (March 31, 2023)	38	6	2029	$126.9 (2021$)	3.1%
Automatic Commercial Ice Makers† 88 FR 30508 (May 11, 2023)	23	1	2027	$15.9 (2022$)	0.6%
Dishwashers† 88 FR 32514 (May 19, 2023)	21	12	2027	$125.6 (2021$)	2.1%
Refrigerated Bottled or Canned Beverage Vending Machines† 88 FR 33968 (May 25, 2023)	5	1	2028	$1.5 (2022$)	0.2%

Room Air Conditioners 88 FR 34298 (May 26, 2023)	8	4	2026	$24.8 (2021$)	0.4%
Microwave Ovens 88 FR 39912 (June 20, 2023)	18	10	2026	$46.1 (2021$)	0.7%
Commercial Water Heating Equipment 88 FR 69686 (October 6, 2023)	15	1	2026	$42.7 (2022$)	5.3%
Consumer Water Heaters† 88 FR 49059 (July 28, 2023)	22	3	2030	$228.1 (2022$)	1.3%
Consumer Boilers† 88 FR 55128 (August 14, 2023)	24	1	2030	$98.0 (2022$)	3.6%
Dehumidifiers† 88 FR 76510 (November 6, 2023)	20	4	2028	$6.9 (2022$)	0.4%
Consumer Furnaces 88 FR 87502 (December 18, 2023)	15	1	2029	$162.0 (2022$)	1.8%
Commercial Refrigerators, Refrigerator-Freezers, and Freezers† 88 FR 70196 (October 10, 2023)	83	3	2028	$226.4 (2022$)	1.6%
Refrigerators, Refrigerator-Freezers, and Freezers 89 FR 30262 (January 17, 2024)	63	11	2029 and 2030‡	$830.3 (2022$)	1.3%
Consumer Conventional Cooking Products 89 FR 11434 (February 14, 2024)	35	8	2028	$66.7 (2022$)	0.3%

* This column presents the total number of OEMs identified in the energy conservation standard rule that is contributing to cumulative regulatory burden.
** This column presents the number of OEMs producing RCWs that are also listed as OEMs in the identified energy conservation standard that is contributing to cumulative regulatory burden.
*** This column presents industry conversion costs as a percentage of equipment revenue during the conversion period. Industry conversion costs are the upfront investments manufacturers must make to sell compliant products/equipment. The revenue used for this calculation is the revenue from just the covered product/equipment associated with each row. The conversion period is the time frame over which conversion costs are made and lasts from the publication year of the final rule to the compliance year of the energy conservation standard. The conversion period typically ranges from 3 to 5 years, depending on the rulemaking.
† These rulemakings are at the NOPR stage, and all values are subject to change until finalized through publication of a final rule.
‡ For the refrigerators, refrigerator-freezers, and freezers energy conservation standards direct final rule, the compliance year (2029 or 2030) varies by product class.

As shown in Table V.20, the rulemakings with the largest overlap of RCW OEMs include consumer clothes dryers, consumer conventional cooking products, dishwashers, refrigerators, refrigerator-freezers, and freezers, and miscellaneous refrigeration products, which are all part of the multi-product Joint Agreement submitted by interested parties.[166] As detailed in the Joint Agreement, the signatories indicated that their recommendations should be considered a "complete package." The signatories further stated that "each part of this agreement is contingent upon the other parts being implemented." (Joint Agreement, No. 505 at p. 3)

The multi-product Joint Agreement states the "jointly recommended compliance dates will achieve the overall energy and economic benefits of this agreement while allowing necessary lead-times for manufacturers to redesign products and retool manufacturing plants to meet the recommended standards across product categories." (Joint Agreement, No. 505 at p. 2) The staggered compliance dates help mitigate manufacturers' concerns about their ability to allocate sufficient resources to comply with multiple concurrent amended standards and about the need to align compliance dates for products that are typically designed or sold as matched pairs (such as RCWs and consumer clothes dryers). *See* section IV.J.3 of this document for stakeholder comments about cumulative regulatory burden. *See* Table V.21 for a comparison of the estimated compliance dates based on EPCA-specified timelines and the compliance dates detailed in the Joint Agreement.

[166] The microwave ovens energy conservation standards final rule (88 FR 39912), which has 10 overlapping OEMs, was published prior to the joint submission of the multi-product Joint Agreement.

Table V.21 Expected Compliance Dates for Multi-Product Joint Agreement

Rulemaking	Estimated Compliance Year based on EPCA Requirements	Compliance Year in the Joint Agreement
Consumer Clothes Dryers	2027	2028
RCWs	2027	2028
Consumer Conventional Cooking Products	2027	2028
Dishwashers	2027	2027*
Refrigerators, Refrigerator-Freezers, and Freezers	2027	2029 or 2030 depending on the product class
Miscellaneous Refrigeration Products	2029	2029

*Estimated compliance year. The Joint Agreement states, "3 years after the publication of a final rule in the *Federal Register.*" (Joint Agreement, No. 505 at p. 2)

3. National Impact Analysis

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

a. Significance of Energy and Water Savings

To estimate the energy and water savings attributable to potential amended standards for RCWs, DOE compared their energy and water consumption under the no-new-standards case to their anticipated energy and water consumption under each TSL. The savings are measured over the entire lifetime of products purchased in the 30-year period that begins in the year of anticipated compliance with amended standards (2027–2056).[167] Table V.22 and Table V.23 present DOE's projections of the national energy

[167] The analysis period for TSL 2 (the Recommended TSL) is 2028–2057.

and water savings for each TSL considered for RCWs. The savings were calculated using the approach described in section IV.H of this document.

Table V.22 Cumulative National Energy Savings for Residential Clothes Washers; 30 Years of Shipments (2027–2056)*

	Trial Standard Level			
	1	**2**	**3**	**4**
	quads			
Primary energy	0.56	0.64	1.29	2.03
FFC energy	0.58	0.67	1.34	2.12

* The analysis period for TSL 2 (the Recommended TSL) is 2028–2057.

Table V.23 Cumulative National Water Savings for Residential Clothes Washers; 30 Years of Shipments (2027–2056)*

	Trial Standard Level			
	1	**2**	**3**	**4**
	trillion gallons			
Water Savings	1.16	1.89	2.33	2.73

* The analysis period for TSL 2 (the Recommended TSL) is 2028–2057.

OMB Circular A-4[168] requires agencies to present analytical results, including separate schedules of the monetized benefits and costs that show the type and timing of benefits and costs. Circular A-4 also directs agencies to consider the variability of key elements underlying the estimates of benefits and costs. For this rulemaking, DOE undertook a sensitivity analysis using 9 years, rather than 30 years, of product shipments. The choice of a 9-year period is a proxy for the timeline in EPCA for the review of certain energy conservation standards and potential revision of and compliance with such

[168] U.S. Office of Management and Budget. *Circular A-4: Regulatory Analysis*. Available at *www.whitehouse.gov/omb/information-for-agencies/circulars/* (last accessed June 24, 2023). DOE used the prior version of Circular A-4 (2003) as a result of the effective date of the new version.

revised standards.[169] The review timeframe established in EPCA is generally not synchronized with the product lifetime, product manufacturing cycles, or other factors specific to RCWs. Thus, such results are presented for informational purposes only and are not indicative of any change in DOE's analytical methodology. The NES and NWS sensitivity analysis results based on a 9-year analytical period are presented in Table V.24 and Table V.25. The impacts are counted over the lifetime of RCWs purchased during the period 2027–2035.[170]

Table V.24 Cumulative National Energy Savings for Residential Clothes Washers; 9 Years of Shipments (2027–2035)*

	Trial Standard Level			
	1	**2**	**3**	**4**
	quads			
Primary energy	0.23	0.27	0.46	0.66
FFC energy	0.24	0.28	0.48	0.69

* The analysis period for TSL 2 (the Recommended TSL) is 2028–2036.

Table V.25 Cumulative National Water Savings for Residential Clothes Washers; 9 Years of Shipments (2027–2035)*

	Trial Standard Level			
	1	**2**	**3**	**4**
	trillion gallons			
Water Savings	0.47	0.71	0.84	0.95

* The analysis period for TSL 2 (the Recommended TSL) is 2028–2036.

[169] EPCA requires DOE to review its standards at least once every 6 years, and requires, for certain products, a 3-year period after any new standard is promulgated before compliance is required, except that in no case may any new standards be required within 6 years of the compliance date of the previous standards. (42 U.S.C. 6295(m)) While adding a 6-year review to the 3-year compliance period adds up to 9 years, DOE notes that it may undertake reviews at any time within the 6-year period and that the 3-year compliance date may yield to the 6-year backstop. A 9-year analysis period may not be appropriate given the variability that occurs in the timing of standards reviews and the fact that for some products, the compliance period is 5 years rather than 3 years.

[170] The analysis period for TSL 2 (the Recommended TSL) is 2028–2036.

b. Net Present Value of Consumer Costs and Benefits

DOE estimated the cumulative NPV of the total costs and savings for consumers that would result from the TSLs considered for RCWs. In accordance with OMB's guidelines on regulatory analysis,[171] DOE calculated NPV using both a 7-percent and a 3-percent real discount rate. Table V.26 shows the consumer NPV results with impacts counted over the lifetime of products purchased during the period 2027–2056.[172]

Table V.26 Cumulative Net Present Value of Consumer Benefits for Residential Clothes Washers; 30 Years of Shipments (2027–2056)*

Discount Rate	**Trial Standard Level**			
	1	**2**	**3**	**4**
	billion 2022$			
3 percent	8.48	8.71	14.68	21.12
7 percent	3.78	3.28	5.96	8.76

* The analysis period for TSL 2 (the Recommended TSL) is 2028–2057.

The NPV results based on the aforementioned 9-year analytical period are presented in Table V.27. The impacts are counted over the lifetime of products purchased during the period 2027–2035.[171] As mentioned previously, such results are presented for informational purposes only and are not indicative of any change in DOE's analytical methodology or decision criteria.

[171] U.S. Office of Management and Budget. *Circular A-4: Regulatory Analysis*. September 17, 2003. Available at: *obamawhitehouse.archives.gov/omb/circulars_a004_a-4* (last accessed July 1, 2021).
[172] The analysis period for TSL 2 (the Recommended TSL) is 2028–2057.

Table V.27 Cumulative Net Present Value of Consumer Benefits for Residential Clothes Washers; 9 Years of Shipments (2027–2035)*

Discount Rate	Trial Standard Level			
	1	**2**	**3**	**4**
	billion 2022$			
3 percent	4.03	4.37	6.57	8.79
7 percent	2.24	2.11	3.45	4.75

* The analysis period for TSL 2 (the Recommended TSL) is 2028–2057.

The previous results reflect the use of a default trend to estimate the change in price for RCWs over the analysis period (*see* section IV.F.1 of this document). DOE also conducted a sensitivity analysis that considered one scenario with a higher rate of price decline than the reference case and one scenario with no price decline. The results of these alternative cases are presented in appendix 10C of the direct final rule TSD. In the high-price-decline case, the NPV of consumer benefits is higher than in the default case. In the no-price-decline case, the NPV of consumer benefits is lower than in the default case.

c. Indirect Impacts on Employment

DOE estimates that amended energy conservation standards for RCWs will reduce energy and water expenditures for consumers of those products, with the resulting net savings being redirected to other forms of economic activity. These expected shifts in spending and economic activity could affect the demand for labor. As described in section IV.N of this document, DOE used an input/output model of the U.S. economy to estimate indirect employment impacts of the TSLs that DOE considered. There are uncertainties involved in projecting employment impacts, especially changes in the later years of the analysis. Therefore, DOE generated results for near-term timeframes (2027–2031),[173] where these uncertainties are reduced.

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

4. Impact on Utility or Performance of Products

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

As discussed in the following sections, DOE has concluded that the standards adopted in this direct final rule will not lessen the utility or performance of the RCWs under consideration in this rulemaking. Manufacturers of these products currently offer units that meet or exceed the adopted standards.

[173] The analysis period for TSL 2 (the Recommended TSL) is 2028–2032.

a. Performance Characteristics

EPCA authorizes DOE to design test procedures that measure energy efficiency, energy use, water use, or estimated annual operating cost of a covered product during a representative average use cycle or period of use. (42 U.S.C. 6293(b)(3)) Representative average use of a clothes washer reflects, in part, a consumer using the clothes washer to achieve an acceptable level of cleaning performance. DOE recognizes that in general, a consumer-acceptable level of cleaning performance can be easier to achieve through the use of higher amounts of energy and water use during the clothes washer cycle. Conversely, maintaining acceptable cleaning performance can be more difficult as energy and water levels are reduced. As such, improving one aspect of clothes washer performance, such as reducing energy and/or water use as a result of energy conservation standards, may require manufacturers to make a trade-off with one or more other aspects of performance, such as cleaning performance, depending on which performance characteristics are prioritized by the manufacturer. Currently, DOE's test procedures address the energy and water efficiency of clothes washers, but do not prescribe a method for testing clothes washer cleaning performance or other consumer-relevant attributes of performance.

DOE has identified through its market research certain high-efficiency RCWs that achieve equal or better cleaning performance than lower-efficiency RCWs in third-party performance reviews. For example, in the March 2023 NOPR, DOE referenced performance ratings published by Consumer Reports,[174] which DOE recognizes is one

[174] Consumer Reports ratings of clothes washers. Available at: *www.consumerreports.org/appliances/washing-machines/* (last accessed September 23, 2022).

popular resource for consumers seeking independent reviews of consumer products. 88 FR 13520, 13599. According to information provided on its website, the test method used by Consumer Reports appears to be similar in nature to AHAM's cleaning performance test procedure, but inconsistent with the test conditions prescribed by DOE's appendix J test procedure;[175] nevertheless, its test results provide an objective measure of the performance capabilities for products currently on the market. *Id*.

In the March 2023 NOPR, DOE sought comment on whether the Consumer Reports test produces cleaning performance results that are representative of an average use cycle as measured by the DOE test procedure. *Id*. DOE also sought comment on how relative cleaning performance results would vary if tested under test conditions consistent with the DOE appendix J test procedure. *Id*. DOE received no comments in response to these specific requests for comment.

In addition to considering the Consumer Reports ratings, in support of the March 2023 NOPR, DOE conducted performance testing on a representative sample of top-loading standard-size and front-loading standard-size units, which collectively represent around 98 percent of RCW shipments. *Id*. at 88 FR 13599. DOE provided the detailed results of its testing in a performance characteristics test report made available in the docket for this rulemaking. In particular, DOE evaluated wash temperatures, stain removal, mechanical action (*i.e.*, "wear and tear"), and cycle duration across the range of

[175] Consumer Reports describes its washing performance test as reflecting the degree of color change to swatches of fabric that were included in an 8-pound test load of mixed cotton items using the unit's "most aggressive" normal cycle.

efficiency levels considered in the analysis. Specifically, DOE evaluated wash temperatures and cycle time based on test data performed according to DOE's new appendix J test procedure; additionally, DOE evaluated cleaning performance and fabric care based on additional testing performed according to the soil/stain removal and mechanical action tests specified in AHAM's HLW-2-2020 test method: Performance Evaluation Procedures for Household Clothes Washers ("AHAM HLW-2-2020"). *Id*. The AHAM HLW-2- 2020 test method does not prescribe specific test conditions for performing the test (*e.g.*, inlet water temperatures conditions, load size, test cycle, or wash/rinse temperature selection). *Id*. For each RCW in its test sample, DOE tested the Hot Wash/Cold Rinse ("Hot") temperature selection[176] in the Normal cycle[177] using the large load size[178] specified in appendix J, as well as using the inlet water temperatures and ambient conditions specified in appendix J. *Id*. at 88 FR 13600. DOE specifically analyzed the Hot cycle with the large load size because (1) DOE's understanding at the time of the March 2023 NOPR was that the Hot temperature selection would be the temperature selection most likely targeted for reduced wash temperature as a design option for achieving a higher energy efficiency rating; (2) the large load size is more challenging to clean than the small load size; and (3) all units in the test sample offer a Hot temperature selection (allowing for consistent comparison across units). *Id*. DOE stated in the March 2023 NOPR that it expects that the Hot temperature selection with the

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[176] Figure 2.12.1.2 of appendix J provides a flow chart defining the Hot Wash/Cold Rinse temperature selection. Generally, the Hot Wash/ Cold Rinse temperature selection corresponds to the hottest available wash temperature less than 140 °F, with certain exceptions as provided in Figure 2.12.1.2.
[177] Section 1 of appendix J defines the Normal cycle as the cycle recommended by the manufacturer (considering manufacturer instructions, control panel labeling, and other markings on the clothes washer) for normal, regular, or typical use for washing up to a full load of normally soiled cotton clothing.
[178] Table 5.1 of appendix J defines the small and large load sizes to be tested according to the clothes washer's measured capacity.

large load size is the cycle combination most likely to experience the types of performance compromises described by AHAM and manufacturers. *Id*. In sum, DOE selected the most conservative assumptions for its performance testing investigation to allow DOE to better understand the potential impacts on performance at various efficiency levels for RCWs. *Id*.

In the March 2023 NOPR, DOE requested comment on its use of the Hot temperature selection with the large load size to evaluate potential impacts on clothes washer performance as a result of amended standards. *Id*.

AHAM commented that the warm wash ("Warm") temperature selection would be the selection most likely targeted for reduced wash temperature as a design option for achieving higher efficiency—rather than Hot, as DOE asserted in the March 2023 NOPR—because the Warm setting is more heavily weighted in the test procedure due to its larger usage factor. (AHAM, No. 464 at pp. 4–5)

In response to AHAM's comment, DOE acknowledges that each degree of temperature reduction on the Warm temperature setting would provide a greater improvement to measured efficiency than each degree of temperature reduction on the Hot temperature setting, given the higher usage factor of the Warm temperature setting in the DOE test procedures. Despite this, DOE notes that the Hot temperature setting—which on the large majority of clothes washers provides the highest temperature available in the Normal cycle—would be the temperature setting that provides the highest level of cleaning performance for soils and stains that require heated water for adequate removal.[179] As such, testing the Hot setting[180] provides a measure of the maximum soil and stain removal performance that can be achieved in the Normal cycle for soils and stains that require heated water for adequate removal. Measuring the maximum soil and stain removal performance of a clothes washer provides an indication of how the maximum performance of a clothes washer may be impacted at different efficiency levels. For these reasons, DOE has determined that an analysis of cleaning performance using the Hot temperature setting[181] is appropriate for determining whether the highest level of performance that can be achieved by the clothes washer on the Normal cycle would be negatively impacted at higher standard levels.

Additionally, as discussed in detail in the March 2023 NOPR, DOE also performed the Soil/Stain Removal test and Mechanical Action test specified in industry standard AHAM HLW-2-2020. 88 FR 13520, 13600. The Soil/Stain Removal test evaluates the performance of household clothes washers in removing representative soils and stains from fabric. *Id*. The Mechanical Action test measures the amount of "wear and tear" applied by the clothes washer to the textiles. *Id*.

[179] On models that provide an "Extra Hot" temperature setting in the Normal cycle, the Extra Hot setting would be expected to provide the highest cleaning performance of such soils and stains.
[180] Or, alternatively, the Extra Hot setting on clothes washers that provide an Extra Hot setting in the Normal cycle.
[181] Or, alternatively, the Extra Hot setting on clothes washers that provide an Extra Hot setting in the Normal cycle.

DOE requested comment on its use of the Soil/Stain Removal test and Mechanical Action test specified in AHAM HLW-2-2020 as the basis for evaluating performance-related concerns expressed by AHAM and manufacturers. *Id*.

The performance characteristics test report that accompanied the March 2023 NOPR provides detailed test results in table and graphical format. *Id*. The discussion throughout the remainder of this section summarizes the key preliminary conclusions from the test results as presented in the March 2023 NOPR. *Id*.

To evaluate whether more-stringent standards may reduce water temperatures below the 85 °F threshold and thus potentially decrease cleaning performance for fatty soils, DOE analyzed the wash temperature of the hottest temperature selection available in the Normal cycle for each RCW in the test sample. *Id*. For front-loading standard-size RCWs, DOE's test data showed no identifiable correlation between efficiency and the hottest available wash temperature in the Normal cycle. *Id*. At the proposed standard level (*i.e.*, NOPR TSL 4, corresponding to EL 3), considering units both slightly higher and slightly lower than EL 3, the hottest available wash temperature in the Normal cycle ranged from around 70 °F to around 140 °F. *Id*. This closely matched the range of the hottest wash temperatures available on units at lower efficiency levels, which ranged from around 80 °F to around 155 °F. *Id*. Notably, at EL 3, multiple models from multiple manufacturers provided wash temperatures higher than the 85 °F threshold and would therefore be able to dissolve and clean fatty soils. *Id*.

For top-loading standard-size RCWs, DOE's test data showed that for units at EL 2 and below, the hottest available wash temperature in the Normal cycle ranged from around 70 °F to around 110 °F. *Id*. At EL 3 (considering units both slightly higher and slightly lower than EL 3), the hottest available wash temperature in the Normal cycle ranged from around 80 °F to around 100 °F. *Id*. Several models from multiple manufacturers demonstrated temperatures higher than the 85 °F threshold and would therefore be able to dissolve and clean fatty soils. *Id*.

Based on this data, DOE tentatively concluded that the proposed standard level (*i.e.*, NOPR TSL 4), would not require a substantive reduction in hot water temperature on the hottest temperature selection in the Normal cycle, and would not preclude the ability to provide wash temperatures above the 85 °F threshold. *Id*.

In the March 2023 NOPR, DOE requested comment on its wash temperature data presented in the performance characteristics test report and on its tentative conclusions derived from this data. *Id*. DOE requested any additional data that DOE should consider about wash temperatures at the proposed standard level. *Id*.

To evaluate whether more-stringent standards would result in a decrease in stain removal performance, DOE conducted the Soil/Stain Removal test specified in AHAM HLW-2-2020 using the Hot temperature selection with the largest load size, as described. *Id*. In particular, one of the stains evaluated in the AHAM HLW-2-2020 Soil/Stain

Removal test is sebum—an oily, waxy substance produced by skin glands.[182] *Id*. For front-loading standard-size RCWs, DOE's test data showed no observable correlation between efficiency and the total cleaning score as measured by the AHAM test method.[183] *Id*. At EL 3 (considering units both slightly higher and slightly lower than EL 3), total cleaning scores ranged from around 86 to around 99 (higher is better). *Id*. At lower efficiency levels, total cleaning scores ranged from around 90 to around 96. *Id*.

For top-loading standard-size RCWs, DOE's test data showed that for units at EL 2 and below, total cleaning scores ranged from around 90 to around 98. *Id*. DOE discussed in the March 2023 NOPR that the clustering of data at or above a score of 90 (as measured on the Hot temperature selection with the large load size) likely represents a market-representative threshold of stain removal performance as measured with this cycle configuration. *Id*. DOE's total cleaning scores at EL 3 for stain removal also included a score of 90, which indicated that manufacturers can produce RCWs at EL 3, while maintaining a level of stain removal that is market-representative. *Id*. at 88 FR 13601. DOE also looked at the implementation of prioritizing hardware design options over reduced wash temperatures. *Id*. When hardware design options are implemented, DOE's analysis suggested that the proposed standard level would not preclude the ability to

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[182] The standardized soil/stain strips used in the AHAM HLW-2-2020 test consist of square test fabric swatches carrying five different types of stains: red wine, chocolate and milk, blood, carbon black/mineral oil, and pigment/sebum.

[183] The Total Cleaning Score represents cleaning performance—as measured by the amount of stain removed from the standardized soil/stain strips—as a percentage of the cleaning performance achieved by a reference "maximum" wash cycle performed on a reference clothes washer. The Total Cleaning Score may be less than or greater than 100%. A higher Total Cleaning Score represents better cleaning performance.

provide total cleaning scores for top-loading units equally as high as the highest scores currently achieved by units at lower efficiency levels. *Id*.

In the March 2023 NOPR, DOE requested comment on its stain removal data presented in the performance characteristics test report and on its conclusions derived from this data. *Id*. In particular, DOE requested comment on whether the clustering of data at or above a score of 90 (as measured on the Hot temperature selection with the large load size) corresponds to a market-representative threshold of stain removal performance as measured with this cycle configuration. *Id*. DOE additionally requested comment on its analysis indicating that implementing additional hardware design options, rather than reducing wash temperatures, on EL 2 units could enable total cleaning scores at EL 3 that are equally as high as the highest scores currently achieved by units at lower efficiency levels. *Id*.

To evaluate whether more-stringent standards would result in an increase in wear and tear on clothing, DOE conducted the Mechanical Action test specified in AHAM HLW-2-2020 concurrently with the Soil/Stain Removal test as described. *Id*. at 88 FR 13601.

For top-loading standard-size RCWs, DOE's test data showed that units at EL 3 have lower (*i.e.*, better) mechanical action scores than baseline-rated units, indicating that the higher-efficiency units provide less wear and tear than the baseline units in the test sample. *Id*. Specifically, at EL 3, mechanical action scores ranged from around 150 to around 175, closely matching the range at EL 2, which ranged from around 150 to around

170. *Id*. At lower efficiency levels, mechanical action scores ranged from around 190 to around 230. *Id*. The data suggested that the better mechanical action scores at the higher efficiency levels may correlate with the use of wash plates (*i.e.*, impellers) at those levels, compared to the use of traditional agitators at the lower efficiency levels. *Id*.

For front-loading standard-size RCWs, DOE's test data showed that for units at or below EL 2, mechanical action scores range from around 135 to around 180. *Id*. At EL 3 (considering units both slightly higher and slightly lower than EL 3), mechanical action scores ranged from around 160 to around 210. *Id*. Although some units at EL 3 had higher (*i.e.*, worse) mechanical action scores than the lower-efficiency units, the low end of the range was less than (*i.e.*, better than) some of the baseline-rated units. *Id*. DOE stated in the March 2023 NOPR that it was not aware of any industry-accepted threshold for acceptable mechanical action performance, and there was no significant clustering of DOE's data to suggest any particular market-representative threshold. *Id*.

Based on this data from the March 2023 NOPR, DOE tentatively concluded that the proposed standard level (*i.e.*, NOPR TSL 4) would not preclude the ability to provide mechanical action scores comparable to the scores for units at lower efficiency levels. *Id.*

DOE requested comment on its mechanical action data presented in the performance characteristics test report and on its conclusions derived from this data. *Id*. In particular, DOE requested comment on whether there is a market-representative threshold of mechanical action performance as measured on the Hot temperature selection using the large load size. *Id.* DOE also requested comment on whether better mechanical action scores at higher top-loading efficiency levels are attributable to the use of wash plates rather than traditional agitators in those higher-efficiency units. *Id.*

To evaluate whether more-stringent standards would result in an increase in cycle time, DOE measured the average cycle time as defined in appendix J for each unit in the test sample. *Id*. For both top-loading standard-size and front-loading standard-size RCWs, DOE's test data showed no observable correlation between efficiency and average cycle time. *Id*. For top-loading standard-size RCWs, the average cycle time for the entire product class was around 50 minutes, as measured according to the appendix J test procedure. *Id*. At EL 3 (considering units both slightly higher and slightly lower than EL 3), cycle time ranged from around 35 minutes to around 65 minutes. *Id*. This closely matched the range of units at lower efficiency levels, which ranged from around 35 minutes to around 70 minutes. *Id*. For front-loading standard-size RCWs, the average cycle time for the entire product class was around 45 minutes, as measured according to the appendix J test procedure. *Id*. At EL 3 (considering units both slightly higher and slightly lower than EL 3), cycle time ranged from around 40 minutes to around 55 minutes. *Id*. This closely matched the range of units at lower efficiency levels, which ranged from around 35 minutes to around 65 minutes. *Id*.

Based on this data, DOE tentatively concluded that the proposed standard level (*i.e.*, NOPR TSL 4), would not result in an increase in average cycle time as measured by appendix J. *Id*.

In the March 2023 NOPR, DOE requested comment on its cycle time data presented in the performance characteristics test report and on its conclusions derived from this data. *Id.*

In summary, DOE tentatively concluded in the March 2023 NOPR that the proposed standard level (*i.e.*, NOPR TSL 4) can be achieved with key performance attributes (*e.g.*, wash temperatures, stain removal, mechanical action, and cycle duration) that are largely comparable to the performance of lower-efficiency units available on the market today. *Id*. Based on DOE's testing of models that currently meet the proposed standards, DOE stated in the March 2023 NOPR that it would not expect performance to be compromised at the proposed standard level. *Id.*

In the March 2023 NOPR, DOE sought comment on its testing and assessment of performance attributes (*i.e.*, wash temperatures, stain removal, mechanical action, and cycle duration), particularly at the proposed standard level (*i.e.*, NOPR TSL 4). *Id*. DOE sought additional data that stakeholders would like DOE to consider on performance attributes at NOPR TSL 4 efficiencies as well as the current minimum energy conservation standards. *Id*.

ASAP, ACEEE, and NYSERDA supported DOE's performance testing methodology and agreed with DOE that clothes washer performance (including wash temperature, stain removal, mechanical action, and cycle time) would not be negatively impacted by the standards proposed in the March 2023 NOPR. (ASAP, ACEEE, and NYSERDA, No. 458 at pp. 3–4) ASAP, ACEE, and NYSERDA noted that manufacturers have previously commented that reducing water temperatures below 85°F could make it difficult to remove fatty soils from both, but that DOE's analysis demonstrates that by prioritizing hardware improvements in meeting the proposed standards for top-loading units could provide cleaning performance equivalent to the highest performance achieved by units at lower efficiency levels. (*Id.* at p. 4) ASAP, ACEEE, and NYSERDA commented that, in agreement with DOE testing results, Consumer Reports ratings indicate that efficient top-loading models, using impellers rather than agitators, generally perform better than less-efficient units. (*Id*.) ASAP, ACEEE, and NYSERDA further commented that top-loading models meeting the proposed standard have lower (*i.e.*, better) mechanical action scores than baseline units, indicating that the higher-efficiency machines cause less wear and tear on clothing than inefficient baseline unit. (*Id*.)

NEEA *et al.* commented that NEEA research, Consumer Reports testing, and consumer ratings on national retailers' websites confirm that top-loading RCWs that meet NOPR TSL 5 have excellent cleaning performance and receive high ratings from consumers, demonstrating no correlation between efficiency and cleaning performance. (NEEA *et al.*, No. 455 at pp. 3–4)

The CA IOUs supported DOE's conclusion that RCWs meeting NOPR TSL 4 will maintain their cleaning performance. (CA IOUs, No. 460 at p. 8) The CA IOUs commented that DOE's testing and analysis provide sufficient justification that along with sustained cleaning performance, the standard levels proposed in the March 2023

NOPR will not increase clothing wear and tear, or require longer average cycle times. (*Id*. at p. 10)

Samsung supported DOE's efforts and detailed testing and analysis to consider the impact of the standard levels proposed in the March 2023 NOPR on performance. (Samsung, No. 461 at p. 3) Samsung commented that DOE's testing, data, and results support the proposed levels at NOPR TSL 4, providing a systematic and comprehensive evaluation of potential impacts on key performance metrics. (*Id*.) Samsung commented that DOE's performance test data show that there is no loss in cleaning performance or increase in wear and tear when comparing top-loading machines with agitators and wash plates. (*Id*. at p. 4)

CEI commented that neither the March 2023 NOPR nor the accompanying TSD mention mold, but that mold accumulation in RCWs—rare in pre-2007-standards models—is now a common problem, particularly in front-loading models. (*Id*. at p. 4) CEI listed unpleasant odors, compromised clothes washer performance, and stains on washed items as outcomes of mold and commented that the situation requires many consumers to periodically run the clothes washer empty with a cleaning agent designed to eliminate mold. (*Id.*) CEI added that such cleaning agents have become strong sellers, which is evidence of how widespread the mold issue has become and that this process of washing the clothes washer adds to energy and water use. (*Id.*) CEI commented that rather than acknowledge this issue, the standard levels proposed in the March 2023 NOPR increase the energy and water restrictions that caused the mold problem in the first place. (*Id*.)

During the public webinar, Mannino commented that cleaning performance and mold concerns started in the 2000s. (Mannino, Public Webinar Transcript, No. 91 at p. 85) Mannino expressed concern that after three to five years of use clothes no longer smell or look clean after a clothes washer cycle and that these problems may not appear when testing brand new models. (*Id.* at pp. 62–63).

With regard to concerns about mold accumulation and odors, commenters have not presented any evidentiary basis for asserting that such concerns are a result of energy conservation standards applicable to RCWs. DOE understands that front-loading clothes washers are inherently more prone to retaining moisture—which in turn may contribute to the growth of mold or other odor-causing buildup—in components such as the rubber gasket that seals the front door opening, which by necessity has a complex geometry with folds and crevices that can retain moisture when the clothes washer is not in use. DOE notes that the "first generation" of front-loading clothes washers was widely introduced to the U.S. market in the early 2000s, prior to the establishment of any performance-based energy conservation standards for front-loading clothes washers. DOE is aware that at least four major RCW manufacturers have settled class-action litigation suits regarding concerns over mold and odors in these first-generation product lines sold on the market during the 2000s.[184] DOE is also aware that in response to such concerns, manufacturers

[184] (1) *In re: LG Front Load Washing Machine Class Action Litigation*, Case No. 2:08-cv-00051-MCA-LDW, U.S. District Court for the District of New Jersey, applicable to certain models purchased between 2002 and 2006; (2) *In re: Whirlpool Corp. Front-Loading Washers Settlement*, Case No. 1:08-WP-65000, U.S. District Court for the Northern District of Ohio, applicable to certain models purchased between 2001 and 2010; (3) *Grasso, et al. v. Electrolux Home Products Inc.*, Case No. 8:16-cv-00911, U.S. District Court for the Middle District of Florida, applicable to certain models purchased between 2004 and 2011; and (4) *Cobb v. BSH Home Appliances Corporation*, Case No. 8:10-cv-00711, U.S. District Court for the Central District of California, applicable to certain models purchased between 2004 and 2011.

implemented a variety of design strategies in their "second generation" front-loading designs to prevent the growth of mold or other odor-causing buildup. In particular, DOE has observed through market research and reverse-engineering teardowns the use of the following such design strategies in front-loading models currently on the market: drain holes in the bottom of the rubber door gasket; air vents connecting interior spaces within the clothes washer to the outside air; internal fans that circulate air through the wash drum after cycle completion; the use of antimicrobial materials for certain internal components exposed to moisture; and door hinge designs that keep the door slightly ajar when not in use. DOE is not aware of any data, nor have any interested parties provided such data, to indicate that mold or odor concerns—to the extent that such concerns may persist despite the aforementioned product design innovations—would be any more prevalent at higher efficiency levels than at the current standard levels.

CEI stated that EPCA does not prioritize efficiency above all else and that EPCA prohibits setting an efficiency standard that would sacrifice any desired product characteristic. (CEI, No. 454 at pp. 2–3) CEI commented that a reduction in the quality of RCWs has already occurred due to previous efficiency standards applied by DOE in 1994, 2004, 2007, 2015, and 2018, noting that the standards in 2007 and beyond have been particularly problematic and that several respects of RCW quality have declined since then. (*Id*. at p. 3) CEI commented that problems stem from the fact that compliant models must use considerably less water per cycle, and that the traditional agitator in many models has been replaced by what CEI characterizes as more-efficient, but less-effective alternatives. (*Id*.) CEI commented that these problems would be exacerbated by the proposed rule, which would require further reductions in energy and water use. (*Id*.)

CEI commented that DOE had not acknowledged adverse impacts of its earlier standards and continues to ignore real-world evidence that consumer utility has suffered. (*Id*.)

During the public webinar, Mannino commented that consumers in some cases load larger capacity top-loading RCWs completely to the top with clothing, which causes the clothing to not come out clean. (Mannino, Public Webinar Transcript, No. 91 at p. 84)

Strauch expressed concern about negative impacts to RCW performance with higher efficiency levels. (Strauch, No. 430 at p. 1) Strauch specifically expressed concern about lower wash temperatures, higher spin speeds, and increased spin duration as a result of the standards proposed in the March 2023 NOPR. (*Id*.) Strauch further expressed concern about decreased utility and performance at the proposed standard level and stated that the proposal should therefore be reconsidered. (*Id*. at p. 3) Additionally, DOE received comments from around 120 individual commenters expressing concerns regarding cleaning performance. Of these, 11 individuals emphasized what they described as the burden of cleaning very dirty loads. DOE also received comments from around 50 individuals expressing specific concerns about extended cycle time.

Representatives Latta *et al*. commented that the standards proposed in the March 2023 NOPR[185] would likely lead to longer and faster spin speeds, with resulting negative

[185] DOE notes that the standards adopted in this direct final rule are the same as the proposed in the March 2023 NOPR for three of the five product classes, but are less stringent than the standards proposed in the March 2023 NOPR for the other two product classes.

consequences for consumers including longer cycle times, increased noise, and increased wrinkling and tangling. (Representatives Latta *et al*., No. 456 at p. 2)

Representatives Latta *et al*. further expressed concern that the impact of the standards proposed in the March 2023 NOPR on product performance were not adequately reviewed and addressed by DOE as required under EPCA. (*Id*. at p. 2) Representatives Latta *et al*. commented that to meet the standards proposed in the March 2023 NOPR, manufacturers would likely produce units that reduce water use and water temperatures, which could result in reduced cleaning and rinsing performance. (*Id.*) Representatives Latta *et al*. stated faster spin speeds would also drive greater potential for load imbalance issues, and increased product complexity could drive higher costs and shorter product lifespans. (*Id*. at pp. 2-3)

GE Appliances ("GEA") commented that the standards proposed in the March 2023 NOPR will lead to increased cycle times. (GEA, No. 457 at p. 3) GEA commented that DOE's analysis shows the RMC requirements resulting from the standards proposed in the March 2023 NOPR will require higher spin speed (which takes greater time for the clothes washer to reach) and longer spin times. (*Id.*) GEA pointed out that DOE previously recognized the importance of cycle time to consumer satisfaction and used cycle time impact as a factor in evaluating standards impact and should do so in this rulemaking as well. (*Id.*)

GEA further commented that the increased spin speeds required by the standards proposed in the March 2023 NOPR will lead to a higher incidence of canceled cycles because all modern top-loading RCWs use software monitoring of machine performance to assure safety during the spin cycle by detecting out-of-balance loads. (*Id.*) GEA commented that the standards proposed in the March 2023 NOPR will require exceptionally high spin speeds for top-loading RCWs—likely at least 900 RPM—and when an out-of-balance condition occurs, the machine will first attempt to rebalance the load though the ability to do so can be limited. (*Id.*) GEA commented that if an out-of-balance condition continues to exist, the wash cycle will be canceled before it is complete, leading either to a higher RMC than intended or truly wet clothes that a consumer is likely to rewash. (*Id.*)

AHAM commented that there is a correlation between several cleaning scores and tested IMEF in DOE's test data, contrary to DOE's statements. (AHAM, No. 464 at p. 3) AHAM commented that DOE did not evaluate whether there is a correlation between water use/efficiency and cleaning performance. (*Id.*) AHAM noted that the two top-loading RCWs in DOE's test sample that meet the standards proposed in the March 2023 NOPR have the lowest cleaning scores in the test sample. (*Id*. at p. 4) AHAM further commented that DOE should not rely primarily on modeled data to conclude that higher ELs will not negatively impact cleaning performance, particularly in light of AHAM's data, which demonstrate the opposite. (*Id*.) AHAM acknowledged that it is possible to address performance challenges using expensive technology options present in the most fully featured products currently on the market, but that DOE did not account for those costs in its analysis. (*Id*. at p. 10) AHAM commented that low-income consumers should not have to sacrifice performance to meet their price requirements. (*Id*.)

AHAM provided data indicating that there is a decrease in cleaning performance by about 5 points for both the Warm and Hot temperature settings when the wash temperature is decreased by around 30 °F to what AHAM characterizes as the temperatures that would be required under the proposed standards. (*Id*. at p. 5)

AHAM commented that it believes decreased water levels are likely to be the largest contributor to decreased performance, in part because the standards proposed in the March 2023 NOPR would make equal load distribution more difficult, leading to more frequent out-of-balance loads. (*Id*. at p. 5) AHAM noted that an increase in out-of-balance loads would increase water usage on some percentage of loads in top-loading RCWs designed to meet the standards proposed in the March 2023 NOPR, which would undercut DOE's projected savings. (*Id*.) AHAM also commented that load turnover will be significantly decreased as a result of the lower water levels and provided data from manufacturers that indicated an 86–87-percent difference in load turnover between a unit meeting current standards and a prototype meeting DOE's minimum WER for top-loading standard-size RCWs. (*Id*. at pp. 5–6) AHAM stated that it will be harder to remove soils from the full load without sufficient turnover of the load. (*Id*. at p. 7)

AHAM further provided manufacturer testing data that showed the impact of low load turnover and of the standards proposed in the March 2023 NOPR on the ability of an RCW to remove larger particles (such as mud, sand, hair, and vomit). (*Id*. at p. 7) AHAM indicated that the test unit modified to meet the proposed standards required a 10-minute increase in cycle time to achieve cleaning performance scores comparable to (but still under) that of a unit meeting the current standards. (*Id*.) AHAM commented, with supporting photographs, that a modified unit meeting the proposed standards was unable to remove muddy towel sediment despite the increase in cycle time, creating a potential health issue when consumers attempt to wash out soils like vomit. (*Id*. at pp. 8–9)

AHAM commented that there is significant consumer push-back on reduced water quantity and motion, and their perceived effect on wash performance. (*Id*. at p. 10) AHAM asserted that consumers who perceive that their clothes washers do not use enough water complain to manufacturers, rely more on higher water cycles, or engage in “hacks” such as manually adding more water to wet the clothes prior to the start of the cycle and that these practices are counter to DOE’s energy and water efficiency goals. (*Id*. at pp. 10–11) AHAM commented that not enough time has elapsed to demonstrate that the water level per cycle is a distinct feature of value to consumers, but that low water levels are a product characteristic that significant portions of consumers dislike. (*Id*. at p. 11)

Whirlpool commented that the standards proposed in the March 2023 NOPR would lessen the utility and performance of clothes washers, particularly for small- and mid-sized RCWs. (Whirlpool, No. 462 at p. 7) Whirlpool commented that the proposal would result in fewer product features and model types, reducing the utility of numerous clothes washers, degrading their overall performance, fundamentally altering consumer choices, and changing how consumers will do their laundry. (*Id*.)

Whirlpool commented that DOE’s performance evaluation in the March 2023 NOPR lacks comprehensive analysis on noise and vibration, wrinkling, tangling, rinse performance, particulate removal and residues, water level, and load motion. (*Id*. at p. 11) Whirlpool further commented that the March 2023 NOPR also fails to provide justification for the limited performance evaluation, ignoring several performance metrics that Whirlpool claims matter most to consumers. (*Id.*)

Whirlpool commented that DOE's data does not support the conclusion that performance will be satisfactory or reach consumer-acceptable limits for the evaluated performance metrics at the standard level proposed in the March 2023 NOPR. (*Id*. at p. 11) Whirlpool further commented that DOE's analysis does not address the capacity of high-performing models that exist at higher efficiency levels. (*Id*. at pp. 11–12) Whirlpool commented that DOE's analysis only examines the performance of currently available models and does not include expense. (*Id*. at p. 12) Whirlpool commented that there is a consumer-relevant difference in retail price between the premium models that DOE evaluated and the cost DOE estimated for the purchase of an RCW meeting the standard level proposed in the March 2023 NOPR. (*Id*.)

Whirlpool commented that providing a consumer-acceptable level of load motion is one of the biggest challenges to redesigning a top-loading RCW to meet the standards proposed in the March 2023 NOPR. (*Id*. at p. 12) Whirlpool commented that based on its own consumer testing, Whirlpool supported AHAM's data that the rollover rate falls below the minimum consumer acceptance threshold to meet the standards proposed in the March 2023 NOPR. (*Id*.) Whirlpool commented that a test cycle designed to meet the proposed standards failed to meet the consumer-acceptance threshold for load motion by over 82 percent and only offers 13 percent of the load motion compared to a model certified at the current standard (which exceeds the threshold by 200 percent). (*Id.*)

Whirlpool commented that faster spin speeds would create consumer-perceptible challenges with wrinkling and tangling from fabric becoming compressed. (*Id*. at pp. 12–13) Whirlpool further commented that consumers may believe their clothes never got wet as they may observe dry spots on their clothes at the end of the cycle due to enhanced moisture extraction, with lower water levels reinforcing that perception. (*Id.*)

DOE greatly appreciates the test data and information submitted by AHAM and individual manufacturers for DOE's review. This additional data and information provided has helped inform DOE's evaluation of potential amended standards for RCWs. Specifically, the additional data and information provided by AHAM indicates that there are uncertainties regarding potential impacts on certain aspects of product performance at the standard levels proposed in the March 2023 NOPR and that changes to consumer usage patterns to mitigate such impacts could jeopardize the energy and water savings that would be achieved at the proposed efficiency levels.

As discussed in section V.C of this document, DOE is finalizing the amended standard level at TSL 2, the Recommended TSL. For both top-loading and front-loading standard-size RCWs, TSL 2 corresponds to EL 2, which is equivalent to the current ENERGY STAR qualification criteria for each product class. DOE notes that this amended standard level for both top-loading and front-loading standard-size RCWs is less stringent than the level proposed in the March 2023 NOPR (*i.e.*, TSL 3), which corresponded to EL 3 for both product classes.

As discussed in the March 2023 NOPR, DOE tentatively concluded that the proposed standard level for top-loading standard-size RCWs could be achieved with key performance attributes (*e.g.*, wash temperatures, stain removal, mechanical action, and cycle duration) that are largely comparable to the performance of lower-efficiency units available on the market today. 88 FR 13520, 13601. Specifically, with regard to wash temperatures, DOE tentatively concluded that the proposed standard level would not require a substantive reduction in hot water temperatures and, in particular, would not preclude the ability to provide wash temperatures above the important 85 °F threshold mentioned by manufacturers. *Id*. at 88 FR 13600. With regard to stain removal, DOE tentatively concluded that a market-representative level of performance can be maintained at EL 3, and that maintaining the highest level of performance currently achieved at lower efficiency levels would be technically achievable at EL 3. *Id*. at 88 FR 13601. With regard to mechanical action, DOE tentatively concluded that the proposed standard level would not require preclude the ability to provide mechanical action scores comparable to the scores for units at lower efficiency levels. *Id*. With regard to cycle time, DOE tentatively concluded that the proposed standard level would not result in an increase in average cycle time. *Id*.

However, manufacturers presented additional data suggesting that other attributes of clothes washer performance not specifically evaluated by DOE may be negatively impacted at TSLs 3 and 4 for particularly heavily soiled clothing loads, given current design technologies and approaches. DOE understands that consumers expect that a clothes washer provides a consumer-acceptable level of cleaning performance across a range of potential clothing loads. DOE further understands that consumers that experience any such negative impacts on product performance could potentially alter their usage patterns, for example by using more energy-intensive settings more frequently (*e.g.*, Extra-Hot temperature setting); using more water-intensive cycle options (*e.g.*, Deep Fill option; extra rinse cycles); using non-regulated cycles (*e.g.*, Heavy Duty cycle); or re-washing clothing that has not been cleaned sufficiently. Such changes to consumer usage patterns may counteract the energy and water savings that DOE has estimated would be achieved at TSLs 3 and 4. As discussed previously in section IV.H.2 of this document, DOE conducted a sensitivity analysis on the potential impact to energy and water savings that would result from changes to consumer usage patterns at TSL 3 and TSL 4.

Conversely, at TSL 2 (*i.e.*, the Recommended TSL corresponding to the standards level adopted in this direct final rule), DOE's data demonstrates no negative impact on the performance or cycle time of both top-loading and front-loading RCWs. Specifically, for top-loading standard-size RCWs, DOE's test data show wash temperatures in the Normal cycle as high as 110 °F at EL 2, matching the highest wash temperatures observed in units at lower efficiency levels. DOE test data for top-loading standard-size RCWs also indicate cleaning scores as high as 98 at EL 2, representing the highest scores among DOE's entire test sample, and higher than the scores observed at lower efficiency levels. Regarding mechanical action, DOE's test data show that for top-loading standard-size RCWs at EL 2, the mechanical action scores range from around 150 to around 170—

significantly lower (*i.e.*, better) than the range at lower efficiency levels. DOE's test data further show that for top-loading standard-size RCWs, the range of cycle times at EL 2 is no higher than for units at lower efficiency levels. Specifically, among units in DOE's test sample that meet or exceed EL 2, cycle time ranges from around 35 minutes to around 65 minutes. This closely matches the range of units at lower efficiency levels, which range from around 35 minutes to around 70 minutes.

For front-loading standard-size RCWs, DOE's test data showed no identifiable correlation between efficiency and the hottest available wash temperature in the Normal cycle. Among units that meet or exceed EL 2, the hottest available wash temperatures in the Normal cycle range from around 70 °F to around 140 °F. This closely matches the range of the hottest wash temperatures available on units at lower efficiency levels, which ranged from around 80 °F to around 155 °F. DOE's test data also shows no observable correlation between efficiency and cleaning score. Among units that meet or exceed EL 2, cleaning scores range from around 86 to around 99. At lower efficiency levels, total cleaning scores ranged from around 90 to around 96. Regarding mechanical action, DOE's test data shows that at EL 2, mechanical action scores range from around 160 to around 195 (lower is better), compared to a range of around 135 to around 180 for units at lower efficiency levels. DOE's test data further show that for front-loading standard-size RCWs, the range of cycle times at EL 2 is no higher than for units at lower efficiency levels. Specifically, among units in DOE's test sample that meet or exceed EL 2, cycle time ranges from around 40 minutes to around 55 minutes. This closely matches the range of units at lower efficiency levels, which range from around 35 minutes to around 65 minutes.

DOE notes that in response to the March 2023 NOPR, manufacturers did not provide any specific data nor express any specific concerns regarding clothes washer performance at TSL 2 (corresponding to EL 2). Based on the information available, including DOE test results as summarized in the preceding paragraphs, DOE concludes that no lessening of product utility or performance would occur at TSL 2. As previously discussed, on February 14, 2024, DOE received a second joint statement from the same group of stakeholders that submitted the Joint Agreement in which the signatories reaffirmed the standards recommended in the Joint Agreement.[186] In particular, the letter states that DOE's test data show, and industry experience agrees, that the recommended standard levels for RCWs can maintain good cleaning performance and do not preclude the ability to provide high wash temperatures.

The test data presented in the March 2023 NOPR contradict certain conclusions and presumptions made by DOE in previous rulemakings with regards to cycle times. In particular, in a NOPR published on August 13, 2020 ("August 2020 NOPR"), which preceded the December 2020 Final Rule, DOE stated its presumption that the shortest possible cycle times currently available on the market represent the models for which manufacturers have prioritized cycle time while maintaining adequate performance across the other performance aspects; and that based on this presumption, the current energy conservation standards may be precluding manufacturers from bringing models to the market with substantially shorter cycle times. 85 FR 49297, 49305 reiterated at 85 FR 81359, 81361. DOE further asserted that offering products with shorter cycle times would

[186] This document is available in the docket at: www.regulations.gov/comment/EERE-2017-BT-STD-0014-0509.

require more per-cycle energy and/or water use than would be permitted under the current standards in order to maintain the same level of performance in other areas (*e.g.*, cleaning, noise, *etc.*). *Id*.

DOE has determined, contrary to the August 2020 NOPR's assumptions, that current energy conservation standards have not prevented the sale of RCWs with shorter cycle times. DOE's test data presented in the March 2023 NOPR indicates no discernable correlation between efficiency level and cycle time for either top-loading standard-size or front-loading standard-size RCWs (*i.e*., the RCW product classes subject to the December 2020 Final Rule) Indeed, for top-loading standard-size RCWs, the most efficient model in DOE's test sample has the same cycle time of 48 minutes as the least efficient minimally-complaint model in DOE's test sample. The models with the lowest cycle times of 35 and 36 minutes achieve higher efficiency levels EL 1 and EL 3, respectively. Similarly, for front-loading standard-size RCWs, the most efficient model in DOE's test sample has a cycle time of 41 minutes, substantially similar to the baseline unit with a cycle time of 36 minutes. The model with the lowest cycle time of 33 minutes achieves higher efficiency level EL 1. Based on this data, DOE reaches a different conclusion than was reached in the December 2020 Final Rule. In particular, noting that DOE's data shows no discernable correlation between efficiency and cycle time, this data does not support DOE's prior assertion that the current energy conservation standards may be precluding manufacturers from bringing models to the market with substantially shorter cycle times, or DOE's prior presumption that offering products with shorter cycle times would require more per-cycle energy and/or water use than would be permitted under the current standards.

Furthermore, in the second joint statement submitted February 14, 2024 by the signatories of the Joint Agreement, the signatories acknowledge that DOE's investigative testing shows that cycle times at the recommended levels for RCWs are the same as RCWs on the market today.

Finally, for the reasons discussed above, DOE has also determined that the standards adopted in this rule will not require increased cycle times.

As discussed, the adopted standards level for standard-size RCWs corresponds to the ENERGY STAR level for each product class. The ENERGY STAR certified product list indicates a wide range of models currently available on the market at this level. Currently, approximately 31 percent of all top-loading standard-size shipments meet this level. Of the nine OEMs offering top-loading standard-size RCWs, six OEMs offer 166 basic models that meet the final standard level. These six OEMs that currently offer top-loading standard-size RCW models that meet the final standard level collectively account for over 95 percent of overall top-loading standard-size RCW shipments. Currently, approximately 92 percent of all front-loading standard-size shipments meet this level. Of the seven OEMs with front-loading standard-size products, six OEMs offer 169 basic models (representing approximately 89 percent of all front-loading standard-size basic models).

Samsung recommended that DOE formalize its performance test plan or a similar approach to qualify the test cycle, similar to the approach used in the recently finalized dishwasher test procedure. (Samsung, No. 461 at p. 3) Samsung commented that ensuring products perform their basic functions during energy tests is of utmost importance, and if manufacturers compromise performance to achieve higher efficiency, it may diminish consumer trust in the U.S. Federal Trade Commission ("FTC") EnergyGuide label and DOE minimum efficiency standards. (*Id*.) Samsung stated that the modes of operation tested, typically the default mode, must demonstrate a minimum level of acceptable functionality, because if the tested default mode fails to meet expectations, the consumer may resort to using more energy-consuming modes, defeating the purpose of energy efficiency standards. (*Id*.)

EPCA authorizes DOE to design test procedures that measure energy efficiency, energy use, water use (in the case of showerheads, faucets, water closets and urinals), or estimated annual operating cost of a covered product during a representative average use cycle or period of use. (42 U.S.C. 6293(b)(3) As discussed, DOE's test procedures address the energy and water efficiency of RCWs, but do not prescribe a method for testing clothes washer cleaning performance or other consumer-relevant attributes of performance.

DOE's test procedure for clothes washers requires testing using the Normal cycle,[187] and consequently compliance with the applicable standards is determined based on the measured energy and water use of the Normal cycle. As the clothes washer market continuously evolves to higher levels of efficiency—either as a result of mandatory

[187] As discussed, the Normal cycle is defined as the cycle recommended by the manufacturer (considering manufacturer instructions, control panel labeling, and other markings on the clothes washer) for normal, regular, or typical use for washing up to a full load of normally soiled cotton clothing. Section 1 of appendix J.

minimum standards or in response to voluntary programs such as ENERGY STAR—it becomes increasingly more important that DOE ensures that its test procedure continues to reflect representative use. As such, the Normal cycle that is used to test the clothes washer for energy and water performance must be one that provides a consumer-acceptable level of cleaning performance, even as efficiency increases.

DOE has previously considered in the June 2022 TP Final Rule whether to propose amendments to the test procedure to define what constitutes "washing up to a full load of normally soiled cotton clothing" (*i.e.*, the cleaning performance) to ensure that DOE's clothes washer test procedure accurately and fully tests clothes washers during a representative average use cycle. 87 FR 33316, 33352. After evaluating the existing ENERGY STAR test procedure for determining clothes washer cleaning performance and the industry test method AHAM HLW-2-2020, DOE determined in the June 2022 TP Final Rule that it was unable to assess whether the additional burden that would be introduced by these cleaning performance test methods would be outweighed by the benefits of incorporating either test. *Id.* Although test procedure development is outside the scope of this rulemaking, DOE continues to evaluate the merits of establishing a cleaning performance test method for clothes washers. DOE would consider any proposals regarding cleaning performance test methods under a separate test procedure rulemaking.

b. Continued Availability of Small-Capacity Clothes Washers

In the March 2023 NOPR, DOE discussed how its engineering analysis accompanying the March 2023 NOPR indicated that increases in capacity would likely be required to achieve higher efficiency levels beyond EL 1 for the top-loading standard-size product class.[188] 88 FR 13520, 13540. In chapter 5 of the TSD accompanying the March 2023 NOPR, DOE discussed its findings that at EL 2, top-loading standard-size RCWs currently on the market have capacities of approximately 4.4 ft^3 (an increase compared to a typical capacity of 4.0 ft^3 at EL 1); units at EL 3 have capacities of approximately 4.7 ft^3; and units at EL 4 have capacities of approximately 5.0 ft^3. (*See* section 5.5.3.2 of the NOPR TSD).

Whirlpool commented that DOE's proposal will effectively phase out small- and mid-sized capacity "standard-size" RCWs. (Whirlpool, No. 462 at p. 7) Whirlpool commented that the standards proposed in the March 2023 NOPR fail to account for the inherent benefit that large-capacity RCWs receive in the calculation of efficiency metrics. (*Id.*) Whirlpool further commented that it is unaware of any top-loading RCWs currently available on the market that are at 4.7 ft^3 and meet the proposed EL 3 standards, contradictory to DOE's assumption. (*Id.* at p. 8) Whirlpool commented that lower-income consumers and consumers with limited space cannot afford to accommodate physically larger RCWs and that smaller-capacity units also tend to be more affordable. (*Id.*) Whirlpool stated that it has previously offered RCWs with capacities exceeding 6.0 ft^3, but many consumers had difficulty installing these in their homes due to the increase in physical dimensions and trouble accessing the bottom of the clothes washer basket. (*Id.*) Whirlpool added that the elimination of small- and mid-size capacity RCWs would be

[188] DOE notes that it did not model the use of capacity increase as a design option for any other product classes in the March 20223 NOPR, having tentatively determined that capacity increase is not necessary to achieve higher efficiencies for those product classes. 88 FR 13520, 13543.

extremely harmful to U.S. manufacturers, as an overwhelming majority of sales are for RCWs smaller than 4.7 ft^3. (*Id.*) Whirlpool further commented that for small RCWs to extract the same amount of water, faster spin speeds are required because of the smaller basket size, but are limited by safety considerations. (*Id*. at p. 13)

Whirlpool further commented that larger-capacity RCWs can more easily meet the standards proposed in the March 2023 NOPR with better RMC and therefore fewer additional technology options added to the product, lesser performance degradation, and lower incremental product costs than small- or mid-sized RCWs. (*Id*. at p. 12) Whirlpool commented that a small- to mid-size RCW would need to increase spin speed to dramatically reduce moisture extraction during the spin phase and would need to implement other technology options (lower water temperatures, lower water levels, and more efficient controls) compared to a larger-capacity RCW. (*Id*.)

Representatives Latta *et al*. expressed concern that the standards proposed in the March 2023 NOPR are biased in favor of larger-capacity RCWs and eliminates a consumer's choice to buy smaller RCWs that better meet their needs and space requirements. (Representatives Latta *et al*., No. 456 at p. 2) Representatives Latta *et al*. commented that the TSD indicates RCW capacities would need to be increased to meet the new standards—with top-loading RCW capacity increasing to 4.7 ft^3 or more—which creates potential accessibility challenges due to the increased height of the machine. (*Id.*)

AHAM commented that products with smaller capacities provide a utility to consumers because they can be used in tighter spaces, can be moved from place to place, or can be used together with a standard-size RCW. (AHAM, No. 464 at p. 14) AHAM stated its agreement with DOE's statement in the RFI published on August 2, 2019, that these products, because of their smaller size, cannot achieve the same levels of efficiency as larger products. (*Id*.) AHAM commented that increases in capacity for top-loading RCWs are required to achieve higher efficiency levels beyond EL 1, demonstrating that a capacity bias still exists in the new EER and WER metrics. (*Id*. at pp. 12–13) AHAM commented that DOE must ensure that it accounts for that bias in order to ensure that small- and average-sized capacities are not eliminated from the market or overly burdened. (*Id*.) AHAM noted that front-loading RCWs have technological limitations such as drum diameter and volume and top-loading RCWs have the unique installation and usage conditions that limit the attainable efficiency of smaller units. (*Id*. at pp. 14–15) AHAM commented that capacity itself is an option DOE projects will be used to increase efficiency and that the larger the capacity, the easier it is to incorporate various other technology options as well. (*Id*.) AHAM commented that under EPCA, capacity provides consumer utility and is an appropriate basis for establishing product class and that the standards proposed in the March 2023 NOPR will decrease the ability of manufacturers to provide smaller capacities, despite DOE's claim that it has addressed the capacity bias inherent in the test procedure. (*Id*. (citing 42 U.S.C. 6295(q)) AHAM commented that DOE must do more to ensure utility associated with various capacities is not lost as a result of its standards, particularly because once DOE finalizes standards, there is no opportunity to fix the problem due to EPCA's anti-backsliding provision. (*Id*. (*citing* 42 U.S.C. 6295(o)(1))

EPCA prohibits DOE from prescribing an amended or new standard that 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)

DOE notes that its observations and tentative determinations in the March 2023 NOPR regarding top-loading RCW capacity were based on DOE's observations of models currently on the market, which are subject to the current IMEF and IWF metrics as measured under the current appendix J2 test procedure. Under the current metrics, the lack of lower-capacity units at higher efficiency levels suggests that increasing capacity is required to achieve higher efficiency levels beyond EL 1. Accordingly, the "path" that DOE modeled for achieving higher efficiency levels incorporated increases in capacity at EL 2, EL 3, and EL 4, reflecting the existing market.

However, DOE notes that the new EER and WER metrics defined in appendix J, by measuring efficiency on a per-pound of clothing basis rather than a per-cubic foot of capacity basis, significantly reduce the inherent large-capacity bias provided by the current IMEF and IWF metrics.[189] As such, under the new EER and WER metrics, smaller-capacity units will no longer be inherently disadvantaged in comparison to

[189] In the June 2022 TP Final Rule, DOE noted that under the current metrics in appendix J2, energy use (*i.e.*, the denominator of the IMEF equation) scales with weighted-average load size, whereas capacity (*i.e.*, the numerator of the IMEF equation) scales with maximum load size. 87 FR 33316, 33349. This provides an inherent numerical advantage to large-capacity clothes washers that is disproportionate to the efficiency advantage that can be achieved through "economies of scale" associated with washing larger loads. *Id*. This relationship applies similarly to water efficiency through the IWF equation. *Id*.

larger-capacity units and will be able to achieve higher levels of efficiency than are achievable under the current IMEF and IWF metrics. As a result, DOE expects that the new EER and WER metrics will significantly reduce the correlation between RCW capacity and efficiency (*i.e.*, DOE expects that manufacturers will no longer need to increase capacity as a necessary means for achieving higher efficiency levels).

Furthermore, as previously discussed, on February 14, 2024, DOE received a second joint statement from the same group of stakeholders that submitted the Joint Agreement (including AHAM, of which Whirlpool is a member) in which the signatories reaffirmed the standards recommended in the Joint Agreement.[190] In particular, the letter states that the stakeholders do not anticipate the recommended standards will negatively affect features, which DOE assumes would also include capacity.

For this direct final rule, DOE updated its engineering analysis to show multiple "paths" that manufacturers could take to reach higher efficiency levels, based on the use of the new EER and WER metrics. Specifically, for top-loading standard-size RCWs, DOE modeled multiple approaches that manufacturers could use to achieve higher efficiency levels under the new metrics, without increasing capacity. In particular, the updated analysis shows viable pathways to achieve the amended standards enacted by this direct final rule for top-loading standard-size units of any capacity. Through this analysis, DOE has determined that an increase in capacity is not required as a means for achieving the amended standards enacted by this direct final rule. Accordingly, DOE has

[190] This document is available in the docket at: www.regulations.gov/comment/EERE-2017-BT-STD-0014-0509.

also determined that the amended standards would not preclude the availability of smaller-capacity RCWs on the market.

Chapter 5 of the direct final rule TSD provides tables of the representative breakdown among machine energy use, heating energy use, drying energy use, and low-power-mode energy use for each of these approaches to achieving the higher efficiencies of top-loading standard-size product classes.

c. Design Characteristics

This section discusses comments received from manufacturers regarding certain design characteristics: consumer control over water levels, porcelain wash baskets, and agitators. DOE notes that as previously discussed, on February 14, 2024, DOE received a second joint statement from the same group of stakeholders that submitted the Joint Agreement (including AHAM, of which GEA and Whirlpool are members) in which the signatories reaffirmed the standards recommended in the Joint Agreement.[191] In particular, the letter states that the stakeholders do not anticipate the recommended standards will negatively affect features or performance, which DOE assumes would include those design characteristics considered here.

Consumer Control Over Water Levels

DOE discussed in chapter 5 of the NOPR TSD that most typically, current baseline top-loading standard-size RCWs provide both manual and automatic (adaptive)

[191] This document is available in the docket at: www.regulations.gov/comment/EERE-2017-BT-STD-0014-0509.

water fill controls; or user-adjustable automatic controls, which enable the user to customize the amount of water used during the wash cycle. Some units may provide only manual controls or only automatic water fill control. (*See* section 5.5.3.2 of the NOPR TSD)

In response to the March 2023 NOPR, GEA commented that its consumer research has shown that consumers rate the ability to control the water level in their clothes washers in the top quartile of attributes they value, and that the standards proposed in the March 2023 NOPR will result in the elimination of manual consumer control over water levels in top-loading RCWs. (GEA, No. 457 at p. 2) GEA explained they completed consumer preference research and the manual consumer control feature is in the top quartile for attributes consumers value in washing machines across all potential features, including durability, warranty coverage, product life, and wash performance. (*Id*.) Additionally, GEA stated that the standards proposed in the March 2023 NOPR will reduce the amount of water used per-load in a top-loading RCW and will result in a visible difference to consumers. (*Id*. at p. 3)

DOE also received comments from around 40 individual commenters expressing concerns that the standards proposed in the March 2023 NOPR would reduce RCW water levels.

DOE notes that the amended standards enacted by this direct final rule for top-loading standard-size RCWs do not preclude the ability to offer consumer control over water levels, as demonstrated by the current availability of top-loading standard-size

RCWs at the adopted standard level that offer a variety of cycle options that allow the consumer to modulate water levels, including but not limited to Deep Fill,[192] Deep Wash,[193] Water Plus,[194] Extra Rinse,[195] Prewash,[196] and Pre Soak.[197]

Porcelain Baskets

DOE discussed in chapter 5 of the NOPR TSD that the baseline top-loading standard-size RCW design uses an enameled steel (*i.e.*, porcelain) wash basket, and that manufacturers would need to switch to a stainless steel wash basket at EL 1 to accommodate the faster spin speeds required to achieve EL 1 efficiency. (*See* section 5.5.3.2 of the NOPR TSD)

In response to the March 2023 NOPR, Whirlpool commented that the proposed standards will remove porcelain baskets from the market. (Whirlpool, No. 462 at p. 11)

Strauch commented in opposition of the loss of porcelain drums at the proposed standard level. (Strauch, No. 430 at p. 2)

DOE evaluated the use of a stainless steel wash basket (as one of the hardware changes enabling spin speed increase) within its screening analysis—the purpose of

[192] See for example, Maytag MVW7232HC at www.maytag.com/washers-and-dryers/washers/top-load-washers/p.smart-top-load-washer-with-extra-power-button-5.3-cu.-ft.mvw7232hc.html?.
[193] See for example, LG WT7400CV at www.lg.com/us/washers-dryers/lg-wt7400cv-top-load-washer.
[194] *Id.*
[195] See for example, Kenmore 21652 at www.kenmore.com/products/kenmore-2621652n-21652-top-load-27-washer-white/.
[196] *Id.*
[197] See for example Samsung WA50R5200AW at www.samsung.com/us/home-appliances/washers/top-load/wa5200-5-0-cu--ft--top-load-washer-with-active-waterjet-wa50r5200aw-us/.

which is to determine which design options to retain as the basis for considering higher efficiency levels. This change in wash basket material meets all five screening criteria as described in section IV.B of this document. Specifically, stainless steel wash baskets are technologically feasible; practicable to manufacture, install, and service on the scale necessary to serve the relevant market at the time of the compliance date of the standard; do not have a significant adverse impact on the product's utility; do not have a significant adverse impact on the product's safety; and are not a proprietary technology. Furthermore, DOE is not aware of any distinct consumer utility provided by the use of porcelain wash baskets, nor have any commenters identified any such consumer utility. For these reasons, DOE considers the use of stainless steel wash baskets to be a viable approach for improving energy and/or water efficiency and to therefore be considered as a "design option" in the subsequent engineering analysis.

To the extent that manufacturers currently produce porcelain wash baskets, DOE accounts for the product redesign and capital investments associated with transitioning models with porcelain wash baskets to stainless steel wash baskets in the MIA. DOE also accounts for the potential stranded assets that may result from amending standards, including the early retirement of equipment and tooling associated with producing porcelain wash baskets. See chapter 12 of the direct final rule TSD for additional information on conversion costs and stranded assets.

Agitators

The inner drum of a baseline top-loading standard-size RCW typically contains a vertically oriented agitator in the center of the drum, which undergoes a twisting motion.

The motion of the agitator, which is powered by an electric motor, circulates the clothes around the center of the wash basket. Some agitators have a corkscrew-like design that also circulates the clothing vertically from the bottom to the top of the basket. Higher-efficiency top-loading RCWs typically use a disk-shaped “wash plate,” rather than a vertical agitator, to move the clothes within the basket. The rotation of the wash plate underneath the clothing circulates the clothes throughout the wash drum.

In the March 2023 NOPR, DOE proposed to adopt an amended standard for top-loading, standard-size RCWs that corresponded to the CEE Tier 1 level. As discussed in the March 2023 NOPR, DOE’s market analysis indicated that top loading models currently on the market at the CEE Tier 1 level use wash plates (*i.e.*, do not have agitators). 88 FR 13520, 13602. DOE stated in the March 2023 NOPR that it was aware of top-loading RCWs without an agitator that achieve equal or better cleaning performance than top-loading RCWs with a traditional-style agitator in Consumer Reports performance reviews. *Id.*

DOE sought comment on any aspects of cleaning performance that provide differentiation between the use of an agitator or a wash plate that are not reflected in the Consumer Reports washing performance ratings evaluated in the March 2023 NOPR. 88 FR 13520, 13602. DOE sought comment on whether any lessening of the utility or performance of top-loading standard-size RCWs, in accordance with 42 U.S.C. 6295(o)(2)(B)(i)(IV), would result from a potential standard that would preclude the use of a traditional agitator. *Id*. In particular, DOE sought information and data on how such utility or performance would be measured or evaluated. *Id*.

GEA commented that the standards proposed in the March 2023 NOPR would eliminate the use of traditional agitators in top-loading RCWs. (*Id*. at pp. 2–3) GEA noted that agitators in top-loading RCWs are such an important feature that GEA includes it as a specific filter for consumers on its website, as do major retailers. (*Id*.)

Whirlpool commented that the standards proposed in the March 2023 NOPR would remove key consumer-friendly features like agitators from the market. (Whirlpool, No. 462 at p. 11) Whirlpool commented that the elimination of agitators would be concerning, as shipment data show that the majority of consumers greatly prefer agitators for top-loading RCWs. (*Id*.) Whirlpool further commented that there is a strong consumer perception that performance is enhanced by the presence of a traditional agitator due to observed load motion. (*Id*.) Whirlpool asserted that agitators encourage even distribution of the loads and minimize out-of-balance conditions. (*Id*.)

Strauch commented in opposition of the loss of agitators at the proposed standard level. (Strauch, No. 430 at p. 2)

During the public webinar, Mannino commented that consumers are saying they do not see as much load turnover in large RCWs with wash plates compared to RCWs with agitators and noted that in one technician's experience, RCWs with agitators have better cleaning performance. (*Id*. at p. 85)

Representatives Latta *et al*. commented that the standards proposed in the March 2023 NOPR would likely result in the elimination of consumer-desired features such as agitators. (Representatives Latta *et al*., No. 456 at p. 2)

DOE notes that the standards adopted in this direct final rule for RCWs do not preclude the ability to offer agitators. All major top-loading standard-size RCW manufacturers offer models at the ENERGY STAR level—which is equivalent to the amended standard level enacted by this direct final rule—that include an agitator.[198]

d. Conclusion

For the reasons discussed in the previous sections, and based on the additional confirming statements from the Joint Agreement signatories, DOE has concluded that the standards adopted in this direct final rule will not lessen the utility or performance of the RCWs under consideration in this rulemaking.

5. Impact of Any Lessening of Competition

DOE considered any lessening of competition that would be likely to result from new or amended standards. As discussed in section III.E.1.e of this document, EPCA directs the Attorney General of the United States ("Attorney General") to determine the impact, if any, of any lessening of competition likely to result from a proposed standard

[198] See, for example, GE PTW705BPTDG at www.geappliances.com/appliance/GE-Profile-5-3-cu-ft-Capacity-Washer-with-Smarter-Wash-Technology-and-FlexDispense-PTW705BPTDG; Kenmore 29152 at www.kenmore.com/products/kenmore-29152-4-4-cu-ft-energy-star-174-he-top-load-washer-w-triple-action-agitator-white/; LG WT7155CW at www.lg.com/us/washers-dryers/lg-wt7155cw-top-load-washer; Maytag MVW7230HW at www.maytag.com/washers-and-dryers/washers/top-load-washers/p.smart-capable-top-load-washer-with-extra-power-button-5.2-cu.-ft.mvw7230hw.html; and Samsung WA49B5205AW at www.samsung.com/us/home-appliances/washers/top-load/4-9-cu--ft--capacity-top-load-washer-with-activewave--agitator-and-active-waterjet-in-white-wa49b5205aw-us/.

and to transmit such determination in writing to the Secretary within 60 days of the publication of a proposed rule, together with an analysis of the nature and extent of the impact. To assist the Attorney General in making this determination, DOE will provide the DOJ with copies of this direct final rule and the TSD for review.

6. Need of the Nation to Conserve Energy

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

Energy conservation resulting from potential energy conservation standards for RCWs is expected to yield environmental benefits in the form of reduced emissions of certain air pollutants and greenhouse gases. Table V.28 provides DOE's estimate of cumulative emissions reductions expected to result from the TSLs considered in this rulemaking. The emissions were calculated using the multipliers discussed in section IV.K of this document. DOE reports annual emissions reductions for each TSL in chapter 13 of the direct final rule TSD.

Table V.28 Cumulative Emissions Reduction for Residential Clothes Washers Shipped during the period 2027–2056*

Trial Standard Level				
	1	**2**	**3**	**4**
Electric Power Sector Emissions				
CO_2 (*million metric tons*)	11.6	12.6	28.1	49.9
CH_4 (*thousand tons*)	0.8	0.9	1.7	2.6
N_2O (*thousand tons*)	0.1	0.1	0.2	0.4
NO_X (*thousand tons*)	6.7	7.0	17.0	32.8
SO_2 (*thousand tons*)	3.1	3.6	6.8	10.1
Hg (*tons*)	0.0	0.0	0.0	0.1
Upstream Emissions				
CO_2 (*million metric tons*)	1.2	1.3	3.1	5.8
CH_4 (*thousand tons*)	116.0	123.7	292.5	551.8
N_2O (*thousand tons*)	0.0	0.0	0.0	0.0
NO_X (*thousand tons*)	19.3	20.7	48.5	90.9
SO_2 (*thousand tons*)	0.1	0.1	0.1	0.2
Hg (*tons*)	0.0	0.0	0.0	0.0
Total FFC Emissions				
CO_2 (*million metric tons*)	12.9	14.0	31.2	55.8
CH_4 (*thousand tons*)	116.7	124.6	294.1	554.5
N_2O (*thousand tons*)	0.1	0.1	0.2	0.4
NO_X (*thousand tons*)	26.0	27.7	65.5	123.7
SO_2 (*thousand tons*)	3.2	3.6	7.0	10.3
Hg (*tons*)	0.0	0.0	0.0	0.1

* The analysis period for TSL 2 (the Recommended TSL) is 2028–2057.

As part of the analysis for this rule, DOE estimated monetary benefits likely to result from the reduced emissions of CO_2 that DOE estimated for each of the considered TSLs for RCWs. Section IV.L of this document discusses the estimated SC-CO_2 values that DOE used Table V.29 presents the value of CO_2 emissions reduction at each TSL for each of the SC-CO_2 cases. The time-series of annual values is presented for the selected TSL in chapter 14 of the direct final rule TSD.

Table V.29 Present Value of CO_2 Emissions Reduction for Residential Clothes Washers Shipped during the period 2027–2056*

TSL	SC-CO_2 Case			
	Discount Rate and Statistics			
	5%	3%	2.5%	3%
	Average	Average	Average	95th percentile
	million 2022$			
1	152	615	947	1,873
2	160	655	1,011	1,993
3	354	1,456	2,250	4,427
4	618	2,563	3,971	7,790

* The analysis period for TSL 2 (the Recommended TSL) is 2028–2057.

As discussed in section IV.L.2 of this document, DOE estimated the climate benefits likely to result from the reduced emissions of methane and N_2O that DOE estimated for each of the considered TSLs for RCWs. Table V.30 presents the value of the CH_4 emissions reduction at each TSL, and Table V.31 presents the value of the N_2O emissions reduction at each TSL. The time-series of annual values is presented for the selected TSL in chapter 14 of the direct final rule TSD.

Table V.30 Present Value of Methane Emissions Reduction for Residential Clothes Washers Shipped during the period 2027–2056*

TSL	SC-CH_4 Case			
	Discount Rate and Statistics			
	5%	3%	2.5%	3%
	Average	Average	Average	95th percentile
	million 2022$			
1	62	174	239	462
2	65	184	253	487
3	152	432	595	1,144
4	280	806	1,115	2,135

* The analysis period for TSL 2 (the Recommended TSL) is 2028–2057.

Table V.31 Present Value of Nitrous Oxide Emissions Reduction for Residential Clothes Washers Shipped during the period 2027–2056*

TSL	SC-N_2O Case			
	Discount Rate and Statistics			
	5%	3%	2.5%	3%
	Average	Average	Average	95th percentile
	million 2022$			
1	0.5	1.8	2.8	4.9
2	0.5	2.0	3.1	5.4
3	1.1	4.0	6.1	10.7
4	1.6	6.2	9.5	16.5

* The analysis period for TSL 2 (the Recommended TSL) is 2028–2057.

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

DOE also estimated the monetary value of the economic benefits associated with NO_X and SO_2 emissions reductions anticipated to result from the considered TSLs for RCWs. The dollar-per-ton values that DOE used are discussed in section IV.L of this document. Table V.32 presents the present value for NO_X emissions reduction for each TSL calculated using 7-percent and 3-percent discount rates, and Table V.33 presents similar results for SO_2 emissions reductions. The results in these tables reflect application of EPA's low dollar-per-ton values, which DOE used to be conservative. The time-series of annual values is presented for the selected TSL in chapter 14 of the direct final rule TSD.

Table V.32 Present Value of NO_X Emissions Reduction for Residential Clothes Washers Shipped during the period 2027–2056*

TSL	7% Discount Rate	3% Discount Rate
	million 2022$	
1	593	1,279
3	608	1,357
4	1,349	3,030
5	2,329	5,379

* The analysis period for TSL 2 (the Recommended TSL) is 2028–2057.

Table V.33 Present Value of SO_2 Emissions Reduction for Residential Clothes Washers Shipped during the period 2027–2056*

TSL	7% Discount Rate	3% Discount Rate
	million 2022$	
1	112	235
3	120	263
4	229	498
5	324	718

* The analysis period for TSL 2 (the Recommended TSL) is 2028–2057.

Not all the public health and environmental benefits from the reduction of greenhouse gases, NO_X, and SO_2 are captured in the values above, and additional unquantified benefits from the reductions of those pollutants as well as from the reduction of direct PM and other co-pollutants may be significant. DOE has not included monetary benefits of the reduction of Hg emissions because the amount of reduction is very small.

7. Other Factors

The Secretary of Energy, in determining whether a standard is economically justified, may consider any other factors that the Secretary deems to be relevant. (42 U.S.C. 6295(o)(2)(B)(i)(VII)) No other factors were considered in this analysis.

8. Summary of Economic Impacts

Table V.34 presents the NPV values that result from adding the estimates of the economic benefits resulting from reduced GHG, NO_X, and SO_2 emissions to the NPV of consumer benefits calculated for each TSL considered in this rulemaking. The consumer benefits are domestic U.S. monetary savings that occur as a result of purchasing the covered products, and are measured for the lifetime of products shipped in 2027–2056.[199] The climate benefits associated with reduced GHG emissions resulting from the adopted standards are global benefits, and are also calculated based on the lifetime of RCWs shipped during the period 2027–2056.[200]

[199] The analysis period for TSL 2 (the Recommended TSL) is 2028–2057.
[200] *Id.*

Table V.34 Consumer NPV Combined with Present Value of Climate Benefits and Health Benefits

Category	TSL 1	TSL 2	TSL 3	TSL 4
Using 3% discount rate for Consumer NPV and Health Benefits (billion 2022$)				
5% Average SC-GHG case	10.2	10.6	18.7	28.1
3% Average SC-GHG case	10.8	11.2	20.1	30.6
2.5% Average SC-GHG case	11.2	11.6	21.1	32.3
3% 95th percentile SC-GHG case	12.3	12.8	23.8	37.2
Using 7% discount rate for Consumer NPV and Health Benefits (billion 2022$)				
5% Average SC-GHG case	4.7	4.2	8.0	12.3
3% Average SC-GHG case	5.3	4.8	9.4	14.8
2.5% Average SC-GHG case	5.7	5.3	10.4	16.5
3% 95th percentile SC-GHG case	6.8	6.5	13.1	21.4

C. Conclusion

When considering new or amended energy conservation standards, the standards that DOE adopts for any type (or class) of covered product must be designed to achieve the maximum improvement in energy efficiency that the Secretary determines is technologically feasible and economically justified. (42 U.S.C. 6295(o)(2)(A)) In determining whether a standard is economically justified, the Secretary must determine whether the benefits of the standard exceed its burdens by, to the greatest extent practicable, considering the seven statutory factors discussed previously. (42 U.S.C. 6295(o)(2)(B)(i)) The new or amended standard must also result in significant conservation of energy. (42 U.S.C. 6295(o)(3)(B))

For this direct final rule, DOE considered the impacts of amended standards for RCWs at each TSL, beginning with the maximum technologically feasible level, to determine whether that level was economically justified. Where the max-tech level was not justified, DOE then considered the next most efficient level and undertook the same evaluation until it reached the highest efficiency level that is both technologically feasible and economically justified and saves a significant amount of energy.

To aid the reader as DOE discusses the benefits and/or burdens of each TSL, tables in this section present a summary of the results of DOE's quantitative analysis for each TSL. In addition to the quantitative results presented in the tables, DOE also considers other burdens and benefits that affect economic justification. These include the impacts on identifiable subgroups of consumers who may be disproportionately affected by a national standard and impacts on employment.

DOE also notes that the economics literature provides a wide-ranging discussion of how consumers trade off upfront costs and energy savings in the absence of government intervention. Much of this literature attempts to explain why consumers appear to undervalue energy efficiency improvements. There is evidence that consumers undervalue future energy savings as a result of (1) a lack of information; (2) a lack of sufficient salience of the long-term or aggregate benefits; (3) a lack of sufficient savings to warrant delaying or altering purchases; (4) excessive focus on the short term, in the form of inconsistent weighting of future energy cost savings relative to available returns on other investments; (5) computational or other difficulties associated with the evaluation of relevant tradeoffs; and (6) a divergence in incentives (for example, between renters and owners, or builders and purchasers). Having less than perfect foresight and a high degree of uncertainty about the future, consumers may trade off these types of investments at a higher than expected rate between current consumption and uncertain future energy cost savings.

It is important to recognize that while DOE is promulgating two separate regulatory actions for energy efficiency standards for RCWs and consumer clothes dryers, clothes washers and dryers are complementary products, and they are sometimes sold and purchased together as joint goods. This type of consumer purchasing behavior is not typical of DOE energy efficiency standards. These products are available in a variety of combinations and the efficiency and/or product class of one product does not restrict the efficiency and/or product class of the other. The efficiency levels are independent of each other. Hence, DOE does not directly model the joint purchasing decision of clothes washers and dryers in this rule. It is possible that if only one machine fails, consumers could replace one machine or could replace both machines jointly. If consumers replace both machines when one fails, aggregate lifecycle costs would be the combination of impacts as presented in both final rules.

Consumers value a variety of attributes in RCWs. These attributes can factor into consumer purchasing decisions along with installation and operating cost. For example, DOE understands certain consumers make purchasing decisions on non-efficiency attributes such as color or other visual features such as control panel layout, which may overlap with efficiency considerations related to and a potential preference for mechanical over electronic controls.

One specific attribute related to the joint use of clothes washers and dryers worth noting is the moisture content of clothes as consumers wash and dry them. DOE recognizes that amended RCW standards could result in less total moisture needing to be removed from the clothing in a clothes dryer, whereas amended consumer clothes dryer standards could result in a less energy-intensive process for removing that moisture. As explained in section IV.E of this document, the amended dryer test procedure in appendix D2 includes incoming RMC values (*i.e.*, a starting lower moisture content for the load) that are more representative of the resulting moisture content seen in high-efficiency clothes washers. Due to the uniqueness of the Joint Recommendation where the clothes washer and dryer proposals and compliance dates were aligned, the consumer clothes dryer rulemaking encompasses these lower initial moisture values as a starting point for the energy use analysis, so the effect of faster spin speeds resulting in less "wet" clothes is already captured by DOE. The relative comparison of efficiency levels for a given product would remain the same, even if the baseline energy consumption were adjusted due to an increase in efficiency in the complementary product.

General considerations for consumer welfare and preferences as well as the special cases of complementary goods are areas DOE plans to explore in a forthcoming RFI related to the agency's updates to its overall analytic framework.

In DOE's current regulatory analysis, potential changes in the benefits and costs of a regulation due to changes in consumer purchase decisions are included in two ways. First, if consumers forego the purchase of a product in the standards case, this decreases sales for product manufacturers, and the impact on manufacturers attributed to lost revenue is included in the MIA. Second, DOE accounts for energy savings attributable only to products actually used by consumers in the standards case; if a standard decreases the number of products purchased by consumers, this decreases the potential energy savings from an energy conservation standard. DOE provides estimates of shipments and changes in the volume of product purchases in chapter 9 of the direct final rule TSD. However, DOE's current analysis does not explicitly control for heterogeneity in consumer preferences, preferences across subcategories of products or specific features, or consumer price sensitivity variation according to household income.[201]

1. Benefits and Burdens of TSLs Considered for Residential Clothes Washer Standards

Table V.35 and Table V.36 summarize the quantitative impacts estimated for each TSL for RCWs. The national impacts are measured over the lifetime of RCWs purchased in the 30-year period that begins in the anticipated year of compliance with amended standards (2027–2056 for all TSLs except TSL 2, *i.e.*, the "Recommended TSL" for RCWs, and 2028–2057 for TSL 2). The energy savings, emissions reductions, and value of emissions reductions refer to full-fuel-cycle results. DOE is presenting monetized benefits of GHG emissions reductions in accordance with the applicable Executive Orders and DOE would reach the same conclusion presented in this notice in the absence of the social cost of greenhouse gases, including the Interim Estimates presented by the Interagency Working Group. The efficiency levels contained in each TSL are described in section V.A of this document.

[201] P.C. Reiss and M.W. White. Household Electricity Demand, Revisited. *Review of Economic Studies*. 2005. 72(3): pp. 853–883. doi: *10.1111/0034-6527.00354*.

Table V.35 Summary of Analytical Results for Residential Clothes Washer TSLs: National Impacts

Category	TSL 1	TSL 2	TSL 3	TSL 4
Cumulative FFC National Energy Savings				
Quads	0.58	0.67	1.34	2.12
Cumulative FFC Emissions Reduction				
CO_2 (*million metric tons*)	12.88	13.96	31.22	55.77
CH_4 (*thousand tons*)	116.74	124.57	294.14	554.46
N_2O (*thousand tons*)	0.11	0.12	0.24	0.38
NO_X (*thousand tons*)	26.03	27.74	65.47	123.66
SO_2 (*thousand tons*)	3.18	3.65	6.97	10.33
Hg (*tons*)	0.02	0.02	0.05	0.07
Present Value of Benefits and Costs (*3% discount rate, billion 2022$*)				
Consumer Operating Cost Savings	12.99	17.92	26.18	34.19
Climate Benefits*	0.79	0.84	1.89	3.38
Health Benefits**	1.51	1.62	3.53	6.10
Total Benefits†	15.30	20.38	31.60	43.66
Consumer Incremental Product Costs‡	4.51	9.20	11.50	13.07
Consumer Net Benefits	8.48	8.71	14.68	21.12
Total Net Benefits	10.79	11.18	20.10	30.59
Present Value of Benefits and Costs (*7% discount rate, billion 2022$*)				
Consumer Operating Cost Savings	6.61	8.65	12.90	16.61
Climate Benefits*	0.79	0.84	1.89	3.38
Health Benefits**	0.70	0.73	1.58	2.65
Total Benefits†	8.11	10.22	16.37	22.64
Consumer Incremental Product Costs‡	2.83	5.37	6.94	7.86
Consumer Net Benefits	3.78	3.28	5.96	8.76
Total Net Benefits	5.28	4.85	9.43	14.79

Note: This table presents the costs and benefits associated with RCWs shipped during the period 2027−2056 for all TSLs except for TSL 2 (the Recommended TSL). These results include benefits to consumers which accrue after 2056 from the products shipped during the period 2027−2056. For TSL 2, this table presents the costs and benefits associated with RCWs shipped during the period 2028−2057.

* Climate benefits are calculated using four different estimates of the SC-CO_2, SC-CH_4 and SC-N_2O. Together, these represent the global SC-GHG. For presentational purposes of this table, the climate benefits associated with the average SC-GHG at a 3-percent discount rate are shown; however, DOE emphasizes the importance and value of considering the benefits calculated using all four sets of SC-GHG estimates. To monetize the benefits of reducing GHG emissions, this analysis uses the interim estimates presented in the *Technical Support Document: Social Cost of Carbon, Methane, and Nitrous Oxide Interim Estimates Under Executive Order 13990* published in February 2021 by the IWG.

** Health benefits are calculated using benefit-per-ton values for NO_X and SO_2. DOE is currently only monetizing (for NO_X and SO_2) $PM_{2.5}$ precursor health benefits and (for NO_X) ozone precursor health benefits, but will continue to assess the ability to monetize other effects such as health benefits from reductions in direct $PM_{2.5}$ emissions. The health benefits are presented at real discount rates of 3 and 7 percent. *See* section IV.L of this document for more details.

† Total and net benefits include consumer, climate, and health benefits. For presentation purposes, total and net benefits for both the 3-percent and 7-percent cases are presented using the average SC-GHG with 3-percent discount rate.

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

Table V.36 Summary of Analytical Results for Residential Clothes Washer TSLs: Manufacturer and Consumer Impacts

Category	TSL 1	TSL 2**	TSL 3	TSL 4
Industry NPV (million 2022$) (No-new-standards case INPV = 1,707.9)	1,639.0 to 1,710.7	1,429.6 to 1,560.9	1,053.8 to 1,234.5	535.8 to 738.2
Industry NPV (% change)	(4.0) to 0.2	(16.3) to (8.6)	(38.3) to (27.7)	(68.6) to (56.8)
Consumer Average LCC Savings (2022$)				
Top-Loading Ultra-Compact	n.a	n.a	n.a	n.a
Top-Loading Standard-Size	$122	$111	$116	$133
Front-Loading Compact	$0	$9	$8	$38
Front-Loading Standard-Size	$26	$46	$15	$49
Semi-Automatic	$280	$284	$280	$188
Shipment-Weighted Average*	$98	$96	$91	$111
Consumer Simple PBP (years)				
Top-Loading Ultra-Compact	n.a	n.a	n.a	n.a
Top-Loading Standard-Size	4.4	6.2	5.7	5.4
Front-Loading Compact	9.6	9.3	9.5	8.0
Front-Loading Standard-Size	0.9	1.4	1.6	1.7
Semi-Automatic	0.5	0.5	0.5	0.6
Shipment-Weighted Average*	3.6	4.9	4.6	4.4
Percent of Consumers that Experience a Net Cost				
Top-Loading Ultra-Compact	n.a	n.a	n.a	n.a
Top-Loading Standard-Size	16%	27%	28%	26%
Front-Loading Compact	0%	21%	22%	35%
Front-Loading Standard-Size	1%	2%	20%	16%
Semi-Automatic	0%	0%	0%	0%
Shipment-Weighted Average*	12%	20%	25%	23%

Parentheses indicate negative (-) values. The entry "n.a." means not applicable because there is no change in the standard at certain TSLs.
* Weighted by shares of each product class in total projected shipments in 2027 except for TSL 2 (the Recommended TSL).
** For TSL 2 (the Recommended TSL), shipment-weighted averages are weighted by shares of each product class in total projected shipments in 2028.

DOE first considered TSL 4, which represents the max-tech efficiency levels for all product classes. Specifically for top-loading standard-size RCWs, DOE's expected design path for TSL 4 (which represents EL 4 for this product class) incorporates the use of a direct drive motor, stainless steel basket and more robust suspension and balancing systems (as methods for enabling faster spin speeds), a wash plate (as a means for enabling reduced water levels), reduced hot and warm wash water temperatures compared to temperatures available on baseline units, spray rinse, the fastest achievable spin speeds, and an increase in tub size compared to the baseline (as a means for reducing energy and water use on a per-pound of clothing basis).[202] Among these design options, use of a direct drive motor, stainless steel basket and more robust suspension and balancing systems, reduced wash water temperatures, and fastest achievable spin speeds reduce energy use only; spray rinse reduces water use only; and the wash plate and increase in tub size reduce both energy and water use together.[203]

For front-loading standard-size RCWs, DOE's expected design path for TSL 4 (which represents EL 4 for this product class) incorporates the use of the most efficient available direct drive motor, the implementation of advanced sensors, the fastest achievable spin speeds, and lower cold water volume (but with no change to total hot water use). Among these design options, the direct drive motor, more advanced sensors, and faster spin speeds reduce energy use only; whereas the lower cold water volume reduces water use only.

TSL 4 would save an estimated 2.12 quads of energy and 2.73 trillion gallons of water, an amount DOE considers significant. Under TSL 4, the NPV of consumer benefit would be $8.76 billion using a discount rate of 7 percent, and $21.12 billion using a discount rate of 3 percent.

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[202] As discussed previously, DOE's direct final rule analysis indicates that an increase in tub capacity is not required to achieve EL 5; however, manufacturers are currently implementing this design option in EL 5 models currently available on the market.

[203] As discussed previously in section IV.A.2 of this document, because the energy used to heat the water consumed by the RCW is included as part of the EER energy use metric, technologies that decrease hot water use also inherently decrease energy use.

The cumulative emissions reductions at TSL 4 are 55.77 Mt of CO_2, 10.33 thousand tons of SO_2, 123.66 thousand tons of NO_X, 0.07 tons of Hg, 554.46 thousand tons of CH_4, and 0.38 thousand tons of N_2O. The estimated monetary value of the climate benefits from reduced GHG emissions (associated with the average SC-GHG at a 3-percent discount rate) at TSL 4 is $3.38 billion. The estimated monetary value of the health benefits from reduced SO_2 and NO_X emissions at TSL 4 is $2.65 billion using a 7-percent discount rate and $6.10 billion using a 3-percent discount rate.

Using a 7-percent discount rate for consumer benefits and costs, health benefits from reduced SO_2 and NO_X emissions, and the 3-percent discount rate case for climate benefits from reduced GHG emissions, the estimated total NPV at TSL 4 is $14.79 billion. Using a 3-percent discount rate for all benefits and costs, the estimated total NPV at TSL 4 is $30.59 billion. The estimated total NPV is provided for additional information; however, DOE primarily relies upon the NPV of consumer benefits when determining whether a standard level is economically justified.

At TSL 4, the average LCC impact is a savings of $133 for top-loading standard-size, $38 for front-loading compact, $49 for front-loading standard-size, and $188 for semi-automatic clothes washers. The simple payback period is 5.4 years for top-loading standard-size, 8.0 years for front-loading compact, 1.7 years for front-loading standard-size, and 0.6 years for semi-automatic clothes washers. The fraction of consumers experiencing a net LCC cost is 26 percent for top-loading standard-size, 35 percent for front-loading compact, 16 percent for front-loading standard-size, and zero percent for semi-automatic clothes washers. For the top-loading standard-size product class, which represents 71 percent of the market, TSL 4 would increase the first cost by $166, in comparison to an installed cost of $690 for baseline units. For the front-loading standard-size product class, which represents 25 percent of the market, TSL 4 would increase the first cost by $93, compared to an installed cost of $1,027 for baseline units. At TSL 4, the standard for top-loading ultra-compact RCWs is at the baseline, resulting in no LCC impact, no simple PBP, and no consumers experiencing a net LCC cost. Additionally, as a result of lower costs associated with well water and septic tanks in rural areas, about 40 percent of well-water households would experience a net LCC cost at TSL 4.

At TSL 4, the projected change in INPV ranges from a decrease of $1,172.0 million to a decrease of $969.6 million, which correspond to a decrease of 68.6 percent and 56.8 percent, respectively. The loss in INPV is largely driven by industry conversion costs as manufacturers work to redesign their portfolios of model offerings and re-tool entire factories to comply with amended standards at this level. Industry conversion costs could reach $1,321.2 million at this TSL.

Conversion costs at max-tech are significant, as nearly all existing RCW models would need to be redesigned to meet the required efficiencies. Currently, approximately 4 percent of RCW annual shipments meet the max-tech levels. For top-loading standard-size RCWs, which DOE projects will account for 71 percent of annual shipments in 2027, less than 1 percent of current shipments meet this level. Of the nine OEMs offering top-loading standard-size products, one OEM offers five basic models (representing approximately 1 percent of all top-loading standard-size basic models) that meet the efficiencies required by TSL 4. The remaining eight OEMs would need to overhaul their existing platforms and make significant updates to their production facilities. Those manufacturers may need to incorporate increased tub capacities, wash plate designs, direct drive motors, reinforced wash baskets, robust suspension and balancing systems, and advanced sensors. These product changes require significant investment. In interviews, several manufacturers expressed concerns about their ability to meet existing market demand given the required scale of investment, redesign effort, and 3-year compliance timeline.

At TSL 3 and higher, manufacturers expressed concerns and presented data regarding potential impacts to product performance, including wash temperatures, cleaning and rinsing performance, and fabric care. At TSL 4, such concerns and uncertainties would be further exacerbated. Consumers that experience any such negative impacts on product performance could potentially alter their usage patterns, for example by using more energy-intensive settings more frequently (*e.g.*, Extra-Hot temperature setting); using more water-intensive cycle options (*e.g.*, Deep Fill option; extra rinse cycles); using non-regulated cycles (*e.g.*, Heavy Duty cycle); or re-washing clothing that has not been cleaned sufficiently. Such changes to consumer usage patterns may counteract the energy and water savings that DOE has estimated would be achieved at TSL 4. For these reasons, DOE cannot be certain that the designs associated with TSL 4 efficiencies would not negatively impact certain aspects of standard-size RCW performance and consequently may jeopardize the energy and water savings that would be achieved at these efficiency levels. DOE emphasizes that its findings in this regard are based on the data available at this time and are predicated on the current state of clothes washer technology. Additional data that could become available, as well as future advances in washing technologies and design strategies, could alleviate any such concerns or uncertainties regarding product performance and could lead DOE to reach a different conclusion in a future rulemaking.

Based upon the above considerations, the Secretary concludes that at TSL 4 for RCWs, the benefits of energy and water savings, positive NPV of consumer benefits, and emission reductions would be outweighed by the potential for negative consumer utility impacts, which may jeopardize the energy and water savings that would be achieved at TSL 4, and the impacts on manufacturers, including the large potential reduction in INPV. DOE estimated the potential loss in INPV to be as high as 68 percent. The potential losses in INPV are primarily driven by large conversion costs that must be made ahead of the compliance date. At max-tech, manufacturers would need to make significant upfront investments to update nearly all product lines and manufacturing facilities. Manufacturers expressed concern that they would not be able to complete product and production line updates within the 3-year conversion period. Consequently, the Secretary has concluded that TSL 4 is not economically justified.

DOE then considered TSL 3, which represents the ENERGY STAR Most Efficient level for the front-loading product classes, the CEE Tier 1 level for the top-loading standard-size product class, and a gap fill level for the semi-automatic product classes.[204] Specifically, for top-loading standard-size RCWs, DOE's expected design path

[204] Table IV.6 and Table IV.8 of this document provide the and ENERGY STAR Most Efficient and CEE Tier 1 equivalencies between the current metrics (IMEF and IWF) and the new metrics (EER and WER) for the top-loading and front-loading standard-size product classes, respectively.

for TSL 3 (which represents EL 3 for this product class) incorporates many of the same technologies and design strategies as described for TSL 4. At TSL 3, top-loading standard-size units would incorporate a direct drive motor, stainless steel basket and more robust suspension and balancing systems (as methods for enabling faster spin speeds), a wash plate (as a means for enabling reduced water levels), and spray rinse, consistent with TSL 4. Models at TSL 3 would also incorporate slightly reduced hot wash water temperatures compared to temperatures available on baseline units, faster spin speeds compared to the baseline (although not as fast as TSL 4), and an increase in tub size compared to the baseline (as a means for reducing energy and water use on a per-pound of clothing basis).[205] Among these design options, use of a direct drive motor, stainless steel basket and more robust suspension and balancing systems, reduced wash water temperatures, and faster spin speeds reduce energy use only; spray rinse reduces water use only; and the wash plate and increase in tub size reduce both energy and water use together.

For front-loading standard-size RCWs, DOE's expected design path for TSL 3 (which represents EL 3 for this product class) incorporates the use of the most efficient direct drive motor available, spin speeds that are faster than the baseline level but not as fast as at TSL 4, and lower water volume (but with no change to total hot water heating).

[205] As discussed previously, DOE's direct final rule analysis indicates that an increase in tub capacity is not required to achieve EL 3; however, manufacturers are currently implementing this design option in EL 3 models currently available on the market.

Among these design options, the direct drive motor and faster spin speeds reduce energy use only; whereas the lower water volume reduces water use only.

TSL 3 would save an estimated 1.34 quads of energy and 2.33 trillion gallons of water, an amount DOE considers significant. Under TSL 3, the NPV of consumer benefit would be \$5.96 billion using a discount rate of 7 percent, and \$14.68 billion using a discount rate of 3 percent.

The cumulative emissions reductions at TSL 3 are 31.22 Mt of CO_2, 6.97 thousand tons of SO_2, 65.47 thousand tons of NO_X, 0.05 tons of Hg, 294.14 thousand tons of CH_4, and 0.24 thousand tons of N_2O. The estimated monetary value of the climate benefits from reduced GHG emissions (associated with the average SC-GHG at a 3-percent discount rate) at TSL 3 is \$1.89 billion. The estimated monetary value of the health benefits from reduced SO_2 and NO_X emissions at TSL 3 is \$1.58 billion using a 7-percent discount rate and \$3.53 billion using a 3-percent discount rate.

Using a 7-percent discount rate for consumer benefits and costs, health benefits from reduced SO_2 and NO_X emissions, and the 3-percent discount rate case for climate benefits from reduced GHG emissions, the estimated total NPV at TSL 3 is \$9.43 billion. Using a 3-percent discount rate for all benefits and costs, the estimated total NPV at TSL 3 is \$20.10 billion. The estimated total NPV is provided for additional information; however, DOE primarily relies upon the NPV of consumer benefits when determining whether a standard level is economically justified.

At TSL 3, the average LCC impact is a savings of $116 for top-loading standard-size, $8 for front-loading compact, $15 for front-loading standard-size, and $280 for semi-automatic clothes washers. The simple payback period is 5.7 years for top-loading standard-size, 9.5 years for front-loading compact, 1.6 years for front-loading standard-size, and 0.5 years for semi-automatic clothes washers. The fraction of consumers experiencing a net LCC cost is 28 percent for top-loading standard-size, 22 percent for front-loading compact, 20 percent for front-loading standard-size, and zero percent for semi-automatic clothes washers. For the top-loading standard-size product class, TSL 3 would increase the first cost by $160, in comparison to an installed cost of $690 for baseline units. For the front-loading standard-size product class, TSL 3 would increase the first cost by $78, compared to an installed cost of $1,027 for baseline units. At TSL 3, the standard for top-loading ultra-compact RCWs is at the baseline, resulting in no LCC impact, no simple PBP, and no consumers experiencing a net LCC cost. Overall, across all product classes, around 25 percent of consumers would experience a net LCC cost at TSL 3. DOE estimates that about 16 percent of low-income households would experience a net LCC cost at TSL 3, and as a result of having generally smaller households and lower annual usage, about 33 percent of senior-only households would experience a net LCC cost at TSL 3. Additionally, as a result of lower costs associated with well water and septic tanks in rural areas, about 41 percent of well-water households would experience a net LCC cost at TSL 3.

At TSL 3, the projected change in INPV ranges from a decrease of $654.1 million to a decrease of $473.3 million, which correspond to a decrease of 38.3 percent and 27.7 percent, respectively. The loss in INPV is largely driven by industry conversion costs as manufacturers work to redesign their portfolios of model offerings and update production facilities to comply with amended standards at this level. Industry conversion costs could reach $724.6 million at this TSL.

For top-loading standard-size products, approximately 3 percent of shipments meet TSL 3. Of the nine OEMs offering top-loading standard-size products, two OEMs offer 20 basic models (representing approximately 4 percent of all top-loading standard-size basic models) that meet the efficiencies required by TSL 3. At this level, the remaining seven manufacturers would likely implement largely similar design options as at TSL 4, but to a lesser extent for the increase in tub size and hardware changes associated with faster spin speeds (*e.g.,* reinforced wash baskets, robust suspension and balancing systems, and advanced sensors)—which are faster than the baseline level but not as fast as TSL 4. Although top-loading standard-size RCW manufacturers indicated that meeting TSL 3 efficiencies would require a less-extensive redesign than meeting TSL 4 efficiencies, these product changes would still require significant investment.

As discussed above, manufacturers expressed concerns and presented data regarding potential impacts to product performance, including wash temperatures, cleaning and rinsing performance, and fabric care. DOE's analysis of third-party clothes washer performance ratings as well as DOE's own performance testing on a representative sample of top-loading standard-size and front-loading standard-size RCWs suggested that TSL 3 can be achieved with key performance attributes (*e.g.,* wash temperatures, stain removal, mechanical action, and cycle duration) that are largely comparable to the performance of lower-efficiency units available on the market today.

However, manufacturers presented additional data suggesting that other attributes of clothes washer performance not specifically evaluated by DOE may be negatively impacted at TSL 3 for particularly heavily soiled clothing loads, given current design technologies and approaches. For these reasons, DOE cannot be certain that the designs associated with TSL 3 efficiencies would not negatively impact certain aspects of standard-size RCW performance and consequently may jeopardize the energy and water savings that would be achieved at these efficiency levels. As with TSL 4, DOE emphasizes that its findings in this regard are based on the data available at this time and are predicated on the current state of clothes washer technology. Additional data that could become available, as well as future advances in washing technologies and design strategies, could alleviate any such concerns or uncertainties regarding product performance and could lead DOE to reach a different conclusion in a future rulemaking.

Based upon the above considerations, the Secretary concludes that at TSL 3 for RCWs, the benefits of energy and water savings, positive NPV of consumer benefits, and emission reductions would be outweighed by the potential for negative consumer utility impacts, which may jeopardize the energy and water savings that could be achieved at TSL 3, and the impacts on manufacturers, including the large potential reduction in INPV. DOE estimates the potential loss in INPV to be as high as 38 percent. The potential losses in INPV are primarily driven by large conversion costs associated with redesigning top-loading standard-size RCWs that must be made ahead of the compliance date. Consequently, the Secretary has concluded that TSL 3 is not economically justified.

DOE then considered the Recommended TSL, which represents the ENERGY STAR v.8.1 level for the top-loading and front-loading standard-size product classes, the ENERGY STAR Most Efficient level for the front-loading compact, and a gap fill level for the semi-automatic product classes.[206] DOE's expected design path for top-loading standard-size RCWs at the Recommended TSL (which represents EL 2 for this product class) incorporates a direct drive motor, stainless steel basket and more robust suspension and balancing systems (as methods for enabling faster spin speeds), and spray rinse. Models at the Recommended TSL would also require faster spin speeds compared to the baseline (although not as fast as at TSL 3), lower water volume (but with no change to total hot water heating energy), and may include an increase in tub size compared to the baseline (as a potential means for reducing energy and water use on a per-pound of clothing basis).[207] Among these design options, use of a direct drive motor, stainless steel basket and more robust suspension and balancing systems, and faster spin speeds reduce energy use only; spray rinse reduces water use only; and the lower water volume reduces water use only. Any potential increase in tub size would reduce both energy and water use together.

For front-loading standard-size RCWs, DOE's expected design path for the Recommended TSL (which represents EL 2 for this product class) incorporates the use of a direct drive motor, spin speeds that are faster than the baseline level but not as fast as at

[206] Table IV.6 and Table IV.8 of this document provide the ENERGY STAR v.8.1 and ENERGY STAR Most Efficient equivalencies between the current metrics (IMEF and IWF) and the new metrics (EER and WER) for the top-loading and front-loading standard-size product classes, respectively.
[207] As discussed previously, DOE's direct final rule analysis indicates that an increase in tub capacity is not required to achieve EL 2; however, manufacturers are currently implementing this design option in EL 2 models currently available on the market.

TSL 3, and lower water volume (but with no change to total hot water heating energy). Among these design options, the direct drive motor and faster spin speeds reduce energy use only; whereas the lower water volume reduces water use only.

The Recommended TSL would save an estimated 0.67 quads of energy and 1.89 trillion gallons of water, an amount DOE considers significant. Under the Recommended TSL, the NPV of consumer benefit would be $3.28 billion using a discount rate of 7 percent, and $8.71 billion using a discount rate of 3 percent.

The cumulative emissions reductions at the Recommended TSL are 13.96 Mt of CO_2, 3.65 thousand tons of SO_2, 27.74 thousand tons of NO_X, 0.02 tons of Hg, 124.57 thousand tons of CH_4, and 0.12 thousand tons of N_2O. The estimated monetary value of the climate benefits from reduced GHG emissions (associated with the average SC-GHG at a 3-percent discount rate) at the Recommended TSL is $0.84 billion. The estimated monetary value of the health benefits from reduced SO_2 and NO_X emissions at the Recommended TSL is $0.73 billion using a 7-percent discount rate and $1.62 billion using a 3-percent discount rate.

Using a 7-percent discount rate for consumer benefits and costs, health benefits from reduced SO_2 and NO_X emissions, and the 3-percent discount rate case for climate benefits from reduced GHG emissions, the estimated total NPV at the Recommended TSL is $4.85 billion. Using a 3-percent discount rate for all benefits and costs, the estimated total NPV at the Recommended TSL is $11.18 billion. The estimated total NPV is provided for additional information; however, DOE primarily relies upon the

NPV of consumer benefits when determining whether a standard level is economically justified.

At the Recommended TSL, the average LCC impact is a savings of $111 for top-loading standard-size, $9 for front-loading compact, $46 for front-loading standard-size, and $284 for semi-automatic clothes washers. The simple payback period is 6.2 years for top-loading standard-size, 9.3 years for front-loading compact, 1.4 years for front-loading standard-size, and 0.5 years for semi-automatic clothes washers. The fraction of consumers experiencing a net LCC cost is 27 percent for top-loading standard-size, 21 percent for front-loading compact, 2 percent for front-loading standard-size, and zero percent for semi-automatic clothes washers. For the top-loading standard-size product class, The Recommended TSL would increase the first cost by $146, in comparison to an installed cost of $687 for baseline units in 2028. For the front-loading standard-size product class, the Recommended TSL would increase the first cost by $67, compared to an installed cost of $1,021 for baseline units in 2028. At the Recommended TSL, the standard for top-loading ultra-compact RCWs is at the baseline, resulting in no LCC impact, no simple PBP, and no consumers experiencing a net LCC cost. Overall, across all product classes, around 20 percent of consumers would experience a net LCC cost at the Recommended TSL. DOE estimates that about 12 percent of low-income households would experience a net LCC cost at the Recommended TSL, and as a result of smaller households and lower annual usage, about 26 percent of senior-only households would experience a net LCC cost at the Recommended TSL. Additionally, as a result of lower costs associated with well water and septic tanks in rural areas, about 37 percent of well-water households would experience a net LCC cost at the Recommended TSL.

At the Recommended TSL, the projected change in INPV ranges from a decrease of $278.3 million to a decrease of $146.9 million, which corresponds to decreases of 16.3 percent and 8.6 percent, respectively. Industry conversion costs could reach $320.0 million at this TSL.

At this level, many existing top-loading standard-size products would need to be redesigned to meet the Recommended TSL efficiencies; however, there are a wide range of top-loading standard-size models currently available on the market due to manufacturers' participation in the ENERGY STAR program. Currently, approximately 49 percent of RCW shipments meet the Recommended TSL efficiencies, including approximately 31 percent of all top-loading standard-size shipments. Of the nine OEMs with top-loading standard-size products, six OEMs offer 166 basic models (representing approximately 30 percent of all top-loading standard-size basic models) that meet the Recommended TSL efficiencies. These six OEMs that currently offer top-loading standard-size RCW models that meet the Recommended TSL efficiencies collectively account for over 95 percent of overall top-loading standard-size RCW shipments. At this level, a substantial number of front-loading standard-size products are available on the market due to manufacturers' participation in the ENERGY STAR program. Currently, approximately 92 percent of front-loading standard-size shipments meet the Recommended TSL. Of the seven OEMs with front-loading standard-size products, six OEMs offer 169 basic models (representing approximately 89 percent of all front-loading standard-size basic models) that meet the Recommended TSL efficiencies.

For all TSLs considered in this direct final rule—except for the Recommended TSL—DOE is bound by the 3-year lead time requirements in EPCA when determining compliance dates (*i.e.*, compliance with amended standards required in 2027). For the Recommended TSL, DOE's analysis utilized the March 1, 2028, compliance date specified in the Joint Agreement as it was an integral part of the multi-product joint recommendation. A 2028 compliance year provides manufacturers additional flexibility to spread capital requirements, engineering resources, and conversion activities over a longer period of time depending on the individual needs of each manufacturer. Furthermore, these delayed compliance dates provide additional lead time and certainty for suppliers of components that improve efficiency.

At the Recommended TSL, DOE's data demonstrates no negative impact on consumer utility for both top-loading and front-loading RCWs. Manufacturers did not provide any specific data nor express any specific concerns regarding clothes washer performance at the Recommended TSL. In addition, in the second joint statement from the same group of stakeholders that submitted the Joint Agreement states that DOE's test data and industry experience agrees that the recommended standard level for RCWs can maintain good cleaning performance and do not preclude the ability to provide high wash temperatures.[208] Based on the information available, DOE concludes that no lessening of product utility or performance would occur at the Recommended TSL.

[208] This document is available in the docket at: www.regulations.gov/comment/EERE-2017-BT-STD-0014-0509.

After considering the analysis and weighing the benefits and burdens, the Secretary has concluded that at a standard set at the Recommended TSL for RCWs would be economically justified. At the Recommended TSL, the average LCC savings for all product classes is positive. An estimated 27 percent of top-loading standard-size users, 21 percent of front-loading compact, 2 percent of front-loading standard-size, and zero percent of semi-automatic clothes washer consumers experience a net cost. At the Recommended TSL, the positive average LCC savings across all product classes and cost savings for approximately two-thirds of RCWs consumers, outweigh the negative average LLC savings of $20 for well-water households and the 37 percent of these households that might experience a net cost. DOE notes that its analysis ensures that the financial implications for households with wells and/or septic systems are comprehensively incorporated into the national LCC analysis. In addition, the FFC national energy savings are significant and the NPV of consumer benefits is positive using both a 3-percent and 7-percent discount rate. Notably, the benefits to consumers vastly outweigh the cost to manufacturers. At the Recommended TSL, the NPV of consumer benefits, even measured at the more conservative discount rate of 7 percent is over 11 times higher than the maximum estimated manufacturers' loss in INPV. The standard levels at the Recommended TSL are economically justified even without weighing the estimated monetary value of emissions reductions. When those emissions reductions are included—representing $ 0.84 billion in climate benefits (associated with the average SC-GHG at a 3-percent discount rate), and $ 1.62 billion (using a 3-percent discount rate) or $ 0.73 billion (using a 7-percent discount rate) in health benefits—the rationale becomes stronger still.

As stated, DOE conducts the walk-down analysis to determine the TSL that represents the maximum improvement in energy efficiency that is technologically feasible and economically justified as required under EPCA. The walk-down is not a comparative analysis, as a comparative analysis would result in the maximization of net benefits instead of energy savings that are technologically feasible and economically justified, which would be contrary to the statute. 86 FR 70892, 70908. Although DOE has not conducted a comparative analysis to select the amended energy conservation standards, DOE notes that as compared to TSL 4 and TSL 3, the Recommended TSL has a lower maximum decrease in INPV and lower manufacturer conversion costs.

Accordingly, the Secretary has concluded that the Recommended TSL would offer the maximum improvement in efficiency that is technologically feasible and economically justified and would result in the significant conservation of energy.

Therefore, based on the previous considerations, DOE adopts the energy conservation standards for RCWs at the Recommended TSL.

While DOE considered each potential TSL under the criteria laid out in 42 U.S.C. 6295(o) as discussed above, DOE notes that the Recommended TSL for RCWs adopted in this direct final rule is part of a multi-product Joint Agreement covering six rulemakings (RCWs; consumer clothes dryers; consumer conventional cooking products; dishwashers; refrigerators, refrigerator-freezers, and freezers; and miscellaneous refrigeration products). The signatories indicate that the Joint Agreement for the six rulemakings should be considered as a joint statement of recommended standards, to be adopted in its entirety. (Joint Agreement, No. 505 at p. 3) As discussed in section V.B.2.e of this document, many RCW OEMs also manufacture consumer clothes dryers; consumer conventional cooking products; dishwashers; refrigerators, refrigerator-freezers, and freezers; and miscellaneous refrigeration products. Therefore, there are potential integrated benefits to the Joint Agreement. Rather than requiring compliance with five amended standards in a single year (2027),[209] the negotiated multi-product Joint Agreement staggers the compliance dates for the five amended standards over a 4-year period (2027–2030). In response to the March 2023 NOPR, AHAM expressed concerns about the timing of ongoing home appliance rulemakings. Specifically, AHAM commented that the combination of the stringency of DOE's proposals, the short lead-in time under EPCA to comply with standards, and the overlapping timeframe of multiple standards affecting the same manufacturers represents significant cumulative regulatory burden for the home appliance industry. (AHAM, No. 464 at pp. 41–42) AHAM has submitted similar comments to other ongoing home appliance rulemakings.[210]

As AHAM is a key signatory of the Joint Agreement, DOE understands that the compliance dates recommended in the Joint Agreement would help reduce cumulative

[209] The analyses for residential clothes washers (88 FR 13520); consumer clothes dryers (87 FR 51734); consumer conventional cooking products (88 FR 6818); dishwashers (88 FR 32514); and refrigerators, refrigerator-freezers, and freezers (88 FR 12452) utilized a 2027 compliance year for analysis at the proposed rule stage. Miscellaneous refrigeration products (88 FR 12452) utilized a 2029 compliance year for the NOPR analysis.

[210] AHAM has submitted written comments regarding cumulative regulatory burden for the other five rulemakings included in the multi-product Joint Agreement. AHAM's written comments on cumulative regulatory burden are available at: *www.regulations.gov/comment/EERE-2014-BT-STD-0058-0046* (pp. 12–13) for consumer clothes dryers; *www.regulations.gov/comment/EERE-2014-BT-STD-0005-2285* (pp. 44–47) for consumer conventional cooking products; *www.regulations.gov/comment/EERE-2019-BT-STD-0039-0051* (pp. 21–24) for dishwashers; *www.regulations.gov/comment/EERE-2017-BT-STD-0003-0069* (pp. 20–22) for refrigerators, refrigerator-freezers, and freezers; and *www.regulations.gov/comment/EERE-2020-BT-STD-0039-0031* (pp. 12–15) for miscellaneous refrigeration products.

regulatory burden. These compliance dates help relieve concern on the part of some manufacturers about their ability to allocate sufficient resources to comply with multiple concurrent amended standards and about the need to align compliance dates for products that are typically designed or sold as matched pairs. The Joint Agreement also provides additional years of regulatory certainty for manufacturers and their suppliers.

For RCWs and consumer clothes dryers specifically, aligned compliance dates would help reduce cumulative regulatory burden for the 13 OEMs that manufacture both RCWs and consumer clothes dryers. In response to the March 2023 NOPR, AHAM commented that laundry products (RCWs and consumer clothes dryers) are designed and used in pairs. (AHAM, No. 464 at p. 44) AHAM stated that an additional design cycle for clothes washers and/or clothes dryers may be necessary if the effective compliance dates for the two products were out of sync and this would undermine the investment and associated recovery assumptions underlying the MIA from the consumer clothes dryer rulemaking. (*Id*.)

The amended energy conservation standards for RCWs, which are expressed in EER and WER, are shown in Table V.37.

Table V.37 Amended Energy Conservation Standards for Residential Clothes Washers

Product Class	Minimum Energy Efficiency Ratio *(lb/kWh/cycle)*	Minimum Water Efficiency Ratio *(lb/gal/cycle)*
Automatic Clothes Washers		
Top-Loading Ultra-Compact (less than 1.6 ft^3 capacity)	3.79	0.29
Top-Loading Standard-Size (1.6 ft^3 or greater capacity)	4.27	0.57
Front-Loading Compact (less than 3.0 ft^3 capacity)	5.02	0.71
Front-Loading Standard-Size (3.0 ft^3 or greater capacity)	5.52	0.77
Semi-Automatic Clothes Washers	2.12	0.27

2. Annualized Benefits and Costs of the Adopted Standards

The benefits and costs of the adopted standards can also be expressed in terms of annualized values. The annualized net benefit is (1) the annualized national economic value (expressed in 2022$) of the benefits from operating products that meet the adopted standards (consisting primarily of operating cost savings from using less energy), minus increases in product purchase costs, and (2) the annualized monetary value of the climate and health benefits.

Table V.38 shows the annualized values for RCWs under the Recommended TSL, expressed in 2022$. The results under the primary estimate are as follows.

Using a 7-percent discount rate for consumer benefits and costs and health benefits from reduced NO_X and SO_2 emissions, and the 3-percent discount rate case for climate benefits from reduced GHG emissions, the estimated cost of the standards adopted in this rule is $530.1 million per year in increased equipment costs, while the estimated annual benefits are $853.9 million in reduced equipment operating costs, $46.9

million in climate benefits, and $71.9 million in health benefits. In this case, the net benefit would amount to $442.5 million per year.

Using a 3-percent discount rate for all benefits and costs, the estimated cost of the standards is $513.1 million per year in increased equipment costs, while the estimated annual benefits are $998.9 million in reduced operating costs, $46.9 million in climate benefits, and $90.3 million in health benefits. In this case, the net benefit would amount to $623.0 million per year.

Table V.38 Annualized Benefits and Costs of Adopted Standards (Recommended TSL) for Residential Clothes Washers (2028−2057)

	Million 2022$/year		
	Primary Estimate	**Low-Net-Benefits Estimate**	**High-Net-Benefits Estimate**
3% discount rate			
Consumer Operating Cost Savings	998.9	957.2	1,020.9
Climate Benefits*	46.9	45.2	47.5
Health Benefits**	90.3	87.1	91.6
Total Benefits†	1,136.1	1,089.5	1,160.0
Consumer Incremental Product Costs‡	513.1	551.8	468.6
Net Benefits	623.0	537.7	691.4
Change in Producer Cash Flow (INPV‡‡)	(27) - (14)	(27) - (14)	(27) - (14)
7% discount rate			
Consumer Operating Cost Savings	853.9	821.2	871.7
Climate Benefits* (3% discount rate)	46.9	45.2	47.5
Health Benefits**	71.9	69.6	72.8
Total Benefits†	972.6	935.9	992.0
Consumer Incremental Product Costs‡	530.1	564.6	489.5
Net Benefits	442.5	371.3	502.5
Change in Producer Cash Flow (INPV‡‡)	(27) - (14)	(27) - (14)	(27) - (14)

Note: This table presents the costs and benefits associated with RCWs shipped in 2028−2057. These results include consumer, climate, and health benefits that accrue after 2057 from the products shipped in 2028−2057. The Primary, Low Net Benefits, and High Net Benefits Estimates utilize projections of energy prices from the *AEO2023* Reference case, Low Economic Growth case, and High Economic Growth case, respectively. In addition, incremental equipment costs reflect a medium decline rate in the Primary Estimate, a low decline rate in the Low Net Benefits Estimate, and a high decline rate in the High Net Benefits Estimate. The methods used to derive projected price trends are explained in sections IV.F.1 and IV.H.3 of this document. Note that the Benefits and Costs may not sum to the Net Benefits due to rounding.

* Climate benefits are calculated using four different estimates of the global SC-GHG (*see* section IV.L of this document). For presentational purposes of this table, the climate benefits associated with the average SC-GHG at a 3 percent discount rate are shown, but DOE does not have a single central SC-GHG point estimate, and it emphasizes the importance and value of considering the benefits calculated using all four sets of SC-GHG estimates. To monetize the benefits of reducing GHG emissions, this analysis uses the interim estimates presented in the *Technical Support Document: Social Cost of Carbon, Methane, and Nitrous Oxide Interim Estimates Under Executive Order 13990* published in February 2021 by the IWG.

** Health benefits are calculated using benefit-per-ton values for NO_X and SO_2. DOE is currently only monetizing (for SO_2 and NO_X) $PM_{2.5}$ precursor health benefits and (for NO_X) ozone precursor health benefits, but will continue to assess the ability to monetize other effects such as health benefits from reductions in direct $PM_{2.5}$ emissions. *See* section IV.L of this document for more details.

† Total benefits for both the 3-percent and 7-percent cases are presented using the average SC-GHG with 3-percent discount rate, but DOE does not have a single central SC-GHG point estimate.

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

‡‡ Operating Cost Savings are calculated based on the life cycle costs analysis and national impact analysis as discussed in detail below. *See* sections IV.F and IV.H of this document. DOE's national impact analysis includes all impacts (both costs and benefits) along the distribution chain beginning with the increased costs to the manufacturer to manufacture the product and ending with the increase in price experienced by the consumer. DOE also separately conducts a detailed analysis on the impacts on manufacturers (MIA). *See* section IV.J of this document. In the detailed MIA, DOE models manufacturers' pricing decisions based on assumptions regarding investments, conversion costs, cashflow, and margins. The MIA produces a range of impacts, which is the rule's expected impact on the INPV. The change in INPV is the present value of all changes in industry cash flow, including changes in production costs, capital expenditures, and manufacturer profit margins. The annualized change in INPV is calculated using the industry weighted average cost of capital value of 9.3 percent that is estimated in the MIA (*see* chapter 12 of the direct final rule TSD for a complete description of the industry weighted average cost of capital). For RCWs, the annualized change in INPV ranges from -$27 million to -$14 million. DOE accounts for that range of likely impacts in analyzing whether a TSL is economically justified. *See* section V.C of this document. DOE is presenting the range of impacts to the INPV under two manufacturer markup scenarios: the Preservation of Gross Margin scenario, which is the manufacturer markup scenario used in the calculation of Consumer Operating Cost Savings in this table, and the Preservation of Operating Profit scenario, where DOE assumed manufacturers would not be able to increase per-unit operating profit in proportion to increases in manufacturer production costs. DOE includes the range of estimated annualized change in INPV in the above table, drawing on the MIA explained further in section IV.J of this document to provide additional context for assessing the estimated impacts of this direct final rule to society, including potential changes in production and consumption, which is consistent with OMB's Circular A-4 and E.O. 12866. If DOE were to include the annualized change in INPV into the annualized net benefit calculation for this direct final rule, the annualized net benefits, using the primary estimate, would range from $596 million to $609 million at 3-percent discount rate and would range from $415 million to $428 million at 7-percent discount rate. Parentheses () indicate negative values.

VI. Severability

DOE added a new paragraph (ii) into section 10 CFR 430.32(g)(2) to provide that each energy and water conservation for each RCW category is separate and severable from one another, and that if any energy or water conservation standard is stayed or determined to be invalid by a court of competent jurisdiction, the remaining standards shall continue in effect. This severability clause is intended to clearly express the Department's intent that should an energy or water conservation standard for any product class be stayed or invalidated, the other conservation standards shall continue in effect. In the event a court were to stay or invalidate one or more energy or water conservation standards for any product class as finalized, the Department would want the remaining energy conservation standards as finalized to remain in full force and legal effect.

VII. Procedural Issues and Regulatory Review

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

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

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

B. Review Under the Regulatory Flexibility Act

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

DOE is not obligated to prepare a regulatory flexibility analysis for this rulemaking because there is not a requirement to publish a general notice of proposed rulemaking under the Administrative Procedure Act. See 5 U.S.C. 601(2), 603(a). As discussed previously, DOE has determined that the Joint Agreement meets the necessary requirements under EPCA to issue this direct final rule for energy conservation standards for RCWs under the procedures in 42 U.S.C. 6295(p)(4). DOE notes that the NOPR for energy conservation standards for RCWs published elsewhere in this issue of the *Federal Register* contains an IRFA.

C. Review Under the Paperwork Reduction Act

Under the procedures established by the Paperwork Reduction Act of 1995 ("PRA"), a person is not required to respond to a collection of information by a Federal agency unless that collection of information displays a currently valid OMB Control Number.

OMB Control Number 1910-1400, Compliance Statement Energy/Water Conservation Standards for Appliances, is currently valid and assigned to the certification reporting requirements applicable to covered products, including RCWs.

DOE's certification and compliance activities ensure accurate and comprehensive information about the energy and water use characteristics of covered products and covered equipment sold in the United States. Manufacturers of all covered products and covered equipment must submit a certification report before a basic model is distributed in commerce, annually thereafter, and if the basic model is redesigned in such a manner to increase the consumption or decrease the efficiency of the basic model such that the certified rating is no longer supported by the test data. Additionally, manufacturers must report when production of a basic model has ceased and is no longer offered for sale as part of the next annual certification report following such cessation. DOE requires the manufacturer of any covered product or covered equipment to establish, maintain, and retain the records of certification reports, of the underlying test data for all certification testing, and of any other testing conducted to satisfy the requirements of part 429, part 430, and/or part 431. Certification reports provide DOE and consumers with comprehensive, up-to-date efficiency information and support effective enforcement.

Revised certification data will be required for RCWs to demonstrate compliance with the amended standards enacted in this direct final rule, which are based on different metrics than the current standards. However, DOE is not amending certification or reporting requirements for RCWs in this direct final rule. Instead, DOE may consider proposals to amend the certification requirements and reporting for RCWs under a separate rulemaking regarding appliance and equipment certification. DOE will address changes to OMB Control Number 1910-1400 at that time, as necessary.

Notwithstanding any other provision of the law, no person is required to respond to, nor shall any person be subject to a penalty for failure to comply with, a collection of information subject to the requirements of the PRA, unless that collection of information displays a currently valid OMB Control Number.

D. Review Under the National Environmental Policy Act of 1969

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

E. Review Under Executive Order 13132

E.O. 13132, "Federalism," 64 FR 43255 (Aug. 10, 1999), imposes certain requirements on Federal agencies formulating and implementing policies or regulations that preempt State law or that have federalism implications. The Executive order requires agencies to examine the constitutional and statutory authority supporting any action that would limit the policymaking discretion of the States and to carefully assess the necessity for such actions. The Executive order also requires agencies to have an accountable process to ensure meaningful and timely input by State and local officials in the development of regulatory policies that have Federalism implications. On March 14, 2000, DOE published a statement of policy describing the intergovernmental consultation process it will follow in the development of such regulations. 65 FR 13735.

In the March 2023 NOPR, DOE tentatively determined that the proposed rule would not have a substantial direct effect on the States, on the relationship between the national government and the States, or on the distribution of power and responsibilities among the various levels of government. 88 FR 13520, 13616. Furthermore, DOE stated that EPCA governs and prescribes Federal preemption of State regulations as to energy conservation for the products that are the subject of this proposed rule and that States can petition DOE for exemption from such preemption to the extent, and based on criteria, set forth in EPCA. *Id.* (*citing* 42 U.S.C. 6297). Accordingly, DOE concluded that no further action was required by E. O. 13132.

The AGs of TN *et al*. commented that DOE's conclusion regarding E.O. 13132 in the March 2023 NOPR is incorrect because the proposed standards have significant federalism implications within the meaning of E.O. 13132. (AGs of TN *et al*., No. 438 at p. 3) The AGs of TN *et al*. commented that if the proposed standards are promulgated, "[a]ny State regulation which sets forth procurement standards" relating to clothes washers is "superseded" unless those "standards are more stringent than the corresponding Federal energy conservation standards" and preempting, even in part, State procurement rules directly affects the States and alters the Federal-State relationship by directly regulating the States. (*Id*.) The AGs of TN *et al*. commented that States own appliances like clothes washers, which indicates the proposed standards implicate reliance interests DOE must take into consideration. (*Id*. citing *Dep't of Homeland Sec. v. Regents of the Univ. of Cal.*, 140 S. Ct. 1891, 1913 (2020)) The AGs of TN *et al*. added that the standards will have an effect on the States that could give rise to "substantial direct compliance costs," and since the proposed efficiency standards are "not required by statute," section 6(b) of E.O. 13132 applies. (*Id*.)

DOE reiterates that this direct final rule does not have significant federalism implications. DOE has examined this rule and has determined that it would not have a substantial direct effect on the States, on the relationship between the national government and the States, or on the distribution of power and responsibilities among the various levels of government. EPCA governs and expressly prescribes Federal preemption of State regulations as to energy conservation for the products that are the subject of this direct final rule. States can petition DOE for exemption from such preemption to the extent, and based on criteria, set forth in EPCA. (42 U.S.C. 6297) Therefore, no further action is required by Executive Order 13135.

Even if DOE were to find otherwise, with regards to the AGs of TN *et al.*'s arguments regarding section 6(c) of E.O. 13132, DOE notes that the AGs of TN *et al*. do not provide any examples of a state procurement rule that conflicts with the standards adopted in this rulemaking and DOE is not aware of any such conflicts. While it is possible that a State may have to revise its procurement standards to reflect the new standards, States can petition DOE for exemption from such preemption to the extent, and based on criteria, set forth in EPCA. Absent such information, DOE concludes that no further action would be required by E.O. 13132 even if the Executive order were applicable here. Moreover, assuming the hypothetical preemption alleged by the AGs of TN *et al.* were to present itself, DOE notes, that like all interested parties, states were presented with an opportunity to engage in the rulemaking process early in the development of the proposed rule. Prior to publishing the proposed rulemaking, on August 2, 2019, DOE published an RFI to collect data and information to help DOE determine whether any new or amended standards for RCWs would result in a significant amount of additional energy savings and whether those standards would be technologically feasible and justified. 84 FR 37794. DOE then published a notification of availability of a preliminary technical support document on September 29, 2021, and sought public comment again. 86 FR 53886. DOE extended the comment period on that document by 45 days. 86 FR 59889. Finally, DOE published a notification of data availability to present the results of additional testing conducted to develop the translations between the current and then proposed test procedure. 87 FR 21816. As such, states were provided the opportunity to meaningful and substantial input as envisioned by the Executive order.

With regards to the AGs of TN *et al.*'s arguments regarding section 6(b) of E.O. 13132, the potential effect alleged by the AGs of TN *et al.* is the same effect experienced by all RCW consumers – models manufactured after a specific date must meet the revised efficiency standards. This impact does not constitute a "substantial" impact as required by the Executive Order. Further, contrary to the assertions of the AGs of TN e*t al.*, the direct final rule is required by law. As noted previously, where DOE determines that a proposed amended standard is designed to achieve the maximum improvement in energy efficiency and is both technologically feasible and economically justified, it must adopt it. Therefore, section 6(b) is inapplicable. Executive Order 13132 section 6(b) (applicable to regulation "that is not required by statute").

F. Review Under Executive Order 12988

With respect to the review of existing regulations and the promulgation of new regulations, section 3(a) of E.O. 12988, "Civil Justice Reform," imposes on Federal agencies the general duty to adhere to the following requirements: (1) eliminate drafting errors and ambiguity, (2) write regulations to minimize litigation, (3) provide a clear legal standard for affected conduct rather than a general standard, and (4) promote simplification and burden reduction. 61 FR 4729 (Feb. 7, 1996). Regarding the review required by section 3(a), section 3(b) of E.O. 12988 specifically requires that Executive agencies make every reasonable effort to ensure that the regulation (1) clearly specifies the preemptive effect, if any, (2) clearly specifies any effect on existing Federal law or regulation, (3) provides a clear legal standard for affected conduct while promoting simplification and burden reduction, (4) specifies the retroactive effect, if any, (5) adequately defines key terms, and (6) addresses other important issues affecting clarity and general draftsmanship under any guidelines issued by the Attorney General. Section 3(c) of E.O. 12988 requires Executive agencies to review regulations in light of applicable standards in section 3(a) and section 3(b) to determine whether they are met or it is unreasonable to meet one or more of them. DOE has completed the required review and determined that, to the extent permitted by law, this direct final rule meets the relevant standards of E.O. 12988.

G. Review Under the Unfunded Mandates Reform Act of 1995

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

DOE has concluded that this direct final rule may require expenditures of $100 million or more in any one year by the private sector. Such expenditures may include (1) investment in research and development and in capital expenditures by RCW manufacturers in the years between the direct final rule and the compliance date for the new standards and (2) incremental additional expenditures by consumers to purchase higher-efficiency RCWs, starting at the compliance date for the applicable standard.

Section 202 of UMRA authorizes a Federal agency to respond to the content requirements of UMRA in any other statement or analysis that accompanies the direct final rule. (2 U.S.C. 1532(c)) The content requirements of section 202(b) of UMRA relevant to a private sector mandate substantially overlap the economic analysis requirements that apply under section 325(o) of EPCA and Executive Order 12866. The **SUPPLEMENTARY INFORMATION** section of this document and the TSD for this direct final rule respond to those requirements.

Under section 205 of UMRA, DOE is obligated to identify and consider a reasonable number of regulatory alternatives before promulgating a rule for which a written statement under section 202 is required. (2 U.S.C. 1535(a)) DOE is required to select from those alternatives the most cost-effective and least burdensome alternative that achieves the objectives of the rule unless DOE publishes an explanation for doing otherwise, or the selection of such an alternative is inconsistent with law. As required by 42 U.S.C. 6295(m), this direct final rule establishes amended energy conservation standards for RCWs that are designed to achieve the maximum improvement in energy efficiency that DOE has determined to be both technologically feasible and economically justified, as required by 6295(o)(2)(A) and 6295(o)(3)(B). A full discussion of the alternatives considered by DOE is presented in chapter 17 of the TSD for this direct final rule.

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

Section 654 of the Treasury and General Government Appropriations Act, 1999 (Pub. L. 105-277) requires Federal agencies to issue a Family Policymaking Assessment for any rule that may affect family well-being. Although this direct final rule would not have any impact on the autonomy or integrity of the family as an institution as defined, this rule could impact a family's well-being. When developing a Family Policymaking Assessment, agencies must assess whether: (1) the action strengthens or erodes the stability or safety of the family and, particularly, the marital commitment; (2) the action strengthens or erodes the authority and rights of parents in the education, nurture, and supervision of their children; (3) the action helps the family perform its functions, or substitutes governmental activity for the function; (4) the action increases or decreases disposable income or poverty of families and children; (5) the proposed benefits of the action justify the financial impact on the family; (6) the action may be carried out by State or local government or by the family; and whether (7) the action establishes an implicit or explicit policy concerning the relationship between the behavior and personal responsibility of youth, and the norms of society.

DOE has considered how the proposed benefits of this rule compare to the possible financial impact on a family (the only factor listed that is relevant to this final rule). As part of its rulemaking process, DOE must determine whether the energy conservation standards contained in this direct final rule are economically justified. As discussed in section V.C.1 of this document, DOE has determined that the standards are economically justified because the benefits to consumers far outweigh the costs to manufacturers. Families will also see LCC savings as a result of this final rule. Moreover, as discussed further in section V.B.1 of this document, DOE has determined that for low-income households, average LCC savings and PBP at the considered efficiency levels are improved (*i.e.*, higher LCC savings and lower payback period) as compared to the average for all households. Further, the standards will also result in climate and health benefits for families.

I. Review Under Executive Order 12630

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

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

Section 515 of the Treasury and General Government Appropriations Act, 2001 (44 U.S.C. 3516, note) provides for Federal agencies to review most disseminations of information to the public under information quality guidelines established by each agency pursuant to general guidelines issued by OMB. OMB's guidelines were published at 67 FR 8452 (Feb. 22, 2002), and DOE's guidelines were published at 67 FR 62446 (Oct. 7, 2002). Pursuant to OMB Memorandum M-19-15, Improving Implementation of the Information Quality Act (April 24, 2019), DOE published updated guidelines which are

available at
www.energy.gov/sites/prod/files/2019/12/f70/DOE%20Final%20Updated%20IQA%20Guidelines%20Dec%202019.pdf. DOE has reviewed this direct final rule under the OMB and DOE guidelines and has concluded that it is consistent with applicable policies in those guidelines.

K. Review Under Executive Order 13211

E.O. 13211, "Actions Concerning Regulations That Significantly Affect Energy Supply, Distribution, or Use," 66 FR 28355 (May 22, 2001), requires Federal agencies to prepare and submit to OIRA at OMB, a Statement of Energy Effects for any significant energy action. A "significant energy action" is defined as any action by an agency that promulgates or is expected to lead to promulgation of a final rule, and that (1) is a significant regulatory action under Executive Order 12866, or any successor order; and (2) is likely to have a significant adverse effect on the supply, distribution, or use of energy, or (3) is designated by the Administrator of OIRA as a significant energy action. For any significant energy action, the agency must give a detailed statement of any adverse effects on energy supply, distribution, or use should the proposal be implemented, and of reasonable alternatives to the action and their expected benefits on energy supply, distribution, and use.

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

L. Information Quality

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

In response to OMB's Bulletin, DOE conducted formal peer reviews of the energy conservation standards development process and the analyses that are typically used and prepared a report describing that peer review.[211] Generation of this report involved a rigorous, formal, and documented evaluation using objective criteria and qualified and independent reviewers to make a judgment as to the

[211] The 2007 "Energy Conservation Standards Rulemaking Peer Review Report" is available at *energy.gov/eere/buildings/downloads/energy-conservation-standards-rulemaking-peer-review-report-0* (last accessed July 10, 2023).

technical/scientific/business merit, the actual or anticipated results, and the productivity and management effectiveness of programs and/or projects. Because available data, models, and technological understanding have changed since 2007, DOE has engaged with the National Academy of Sciences to review DOE's analytical methodologies to ascertain whether modifications are needed to improve DOE's analyses. DOE is in the process of evaluating the resulting report.[212]

M. Congressional Notification

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

VIII. Approval of the Office of the Secretary

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

List of Subjects in 10 CFR Part 430

Administrative practice and procedure, Confidential business information, Energy conservation, Household appliances, Imports, Intergovernmental relations, Reporting and recordkeeping requirements, Small businesses.

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

Signing Authority

This document of the Department of Energy was signed on February 29, 2024, by Jeffrey Marootian, Principal Deputy Assistant Secretary for Energy Efficiency and Renewable Energy, pursuant to delegated authority from the Secretary of Energy. That document with the original signature and date is maintained by DOE. For administrative purposes only, and in compliance with requirements of the Office of the Federal Register, the undersigned DOE Federal Register Liaison Officer has been authorized to sign and submit the document in electronic format for publication, as an official document of the Department of Energy. This administrative process in no way alters the legal effect of this document upon publication in the *Federal Register*.

Signed in Washington, DC, on February 29, 2024.

X Jeffrey M. Marootian

Digitally signed by Jeffrey M. Marootian
Date: 2024.02.29 14:38:36 -05'00'

Jeffrey Marootian
Principal Deputy Assistant Secretary for
Energy Efficiency and Renewable Energy
U.S. Department of Energy

For the reasons set forth in the preamble, DOE amends part 430 of chapter II, subchapter D, of title 10 of the Code of Federal Regulations, as set forth below:

PART 430 - ENERGY CONSERVATION PROGRAM FOR CONSUMER PRODUCTS

1. The authority citation for part 430 continues to read as follows:

Authority: 42 U.S.C. 6291-6309; 28 U.S.C. 2461 note.

2. Amend §430.32 by revising paragraph (g) to read as follows:

§ 430.32 Energy and water conservation standards and their compliance dates.

*   *   *   *   *

(g) Clothes washers

(1) Clothes washers manufactured on or after January 1, 2018, shall have an Integrated Modified Energy Factor no less than, and an Integrated Water Factor no greater than:

Product class	**Integrated modified energy factor** *(cu.ft./kWh/cycle)*	**Integrated water factor** *(gal/cycle/cu.ft.)*
(i) Top-loading, Compact (less than 1.6 ft^3 capacity)	1.15	12.0
(ii) Top-loading, Standard (1.6 ft^3 or greater capacity)	1.57	6.5
(iii) Front-loading, Compact (less than 1.6 ft^3 capacity)	1.13	8.3
(iv) Front-loading, Standard (1.6 ft^3 or greater capacity)	1.84	4.7

(2) Clothes washers manufactured on or after March 1, 2028

(i) shall have an Energy Efficiency Ratio and a Water Efficiency Ratio no less than:

Product Class	**Energy Efficiency Ratio** *(lb/kWh/cycle)*	**Water Efficiency Ratio** *(lb/gal/cycle)*
(A) Automatic Clothes Washers:		
(*1*) Top-Loading Ultra-Compact (less than 1.6 ft^3 capacity)	3.79	0.29
(*2*) Top-Loading Standard-Size (1.6 ft^3 or greater capacity)*	4.27	0.57
(*3*) Front-Loading Compact (less than 3.0 ft^3 capacity)**	5.02	0.71
(*4*) Front-Loading Standard-Size (3.0 ft^3 or greater capacity)†	5.52	0.77
(B) Semi-Automatic Clothes Washers	2.12	0.27

* The energy conservation standards in this table do not apply to top-loading standard-size clothes washers with an average cycle time less than 30 minutes.
** The energy conservation standards in this table do not apply to front-loading clothes washers with a capacity greater than or equal to 1.6 ft^3 and less than 3.0 ft^3 with an average cycle time of less than 45 minutes.
† The energy conservation standards in this table do not apply to front-loading standard-size clothes washers with an average cycle time less than 45 minutes.

(ii) The provisions of paragraph (g)(2) of this section are separate and severable from one another. Should a court of competent jurisdiction hold any provision(s) of this section to be stayed or invalid, such action shall not affect any other provisions of this section.

*   *   *   *   *