DEPARTMENT OF ENERGY

10 CFR Part 430

[EERE–2014–BT–STD–0058]

RIN 1904–AF59

Energy Conservation Program: Energy Conservation Standards for Consumer Clothes Dryers

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 consumer clothes dryers. In this direct final rule, DOE is adopting amended energy conservation standards for consumer clothes dryers. 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 July 10, 2024. If adverse comments are received by July 1, 2024 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 consumer clothes dryers 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 April 11, 2024.

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 web page can be found at *www.regulations.gov/docket/EERE-2014-BT-STD-0058.* The docket web page 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.*

Mr. Matthew Schneider, U.S. Department of Energy, Office of the General Counsel, GC–33, 1000 Independence Avenue SW, Washington, DC 20585–0121. Telephone: (240) 597–6265. Email: *Matthew.Schneider@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 clothes dryers, 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 consumer clothes dryers.

The adopted standard levels in this direct final rule were proposed in a letter submitted to DOE jointly by groups representing manufacturers, energy and environmental advocates, consumer groups, and a utility. This letter, titled ''Energy Efficiency Agreement of 2023'' (hereafter, the ''Joint Agreement'',) [3] recommends specific energy conservation standards for consumer clothes dryers that, in the commenters' view, would satisfy the EPCA requirements in 42 U.S.C. 6295(o). DOE subsequently received letters of support from States—including New York, California, and Massachusetts [4]—and utilities—including San Diego Gas and Electric (''SDG&E'') and Southern California Edison (''SCE'') [5]—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 elsewhere in this **Federal Register** a notice of proposed rulemaking (''NOPR'') that contains standards identical 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.

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 the combined energy factor (''CEF_{D2}''), measured in pounds per kilowatt-hour (''lb/kWh''), as determined in accordance with DOE's consumer clothes dryer test procedure at title 10 of the Code of Federal Regulations (''CFR'') part 430, subpart B, appendix D2 (''appendix D2''). The CEF metric includes active mode, standby mode, and off mode energy use. The amended standards recommended in the Joint Agreement are represented as trial standard level (''TSL'') 3 (hereinafter the ''Recommended TSL'') and are described in section V.A of this document. The Joint Agreement's standards for consumer clothes dryers apply to all products listed in Table I.1 and manufactured in, or imported into, the United States starting on March 1, 2028.

[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] Available at *www.regulations.gov/comment/EERE-2014-BT-STD-0058-0055.*

[4] Available at *www.regulations.gov/comment/EERE-2014-BT-STD-0058-0056.*

[5] Available at *www.regulations.gov/comment/EERE-2014-BT-STD-0058-0057.*

TABLE I.1—ENERGY CONSERVATION STANDARDS FOR CONSUMER CLOTHES DRYERS

[Compliance starting March 1, 2028]

Product class	Minimum CEFD2 (lb/kWh)
(i) Electric, Standard (4.4 cubic feet (''ft³'') or greater capacity)	3.93
(ii) Electric, Compact (120 volts (''V'')) (less than 4.4 ft³ capacity)	4.33
(iii) Vented Electric, Compact (240V) (less than 4.4 ft³ capacity)	3.57
(iv) Vented Gas, Standard (4.4 ft³ or greater capacity)	3.48
(v) Vented Gas, Compact (less than 4.4 ft³ capacity)	2.02
(vi) Ventless Electric, Compact (240V) (less than 4.4 ft³ capacity)	2.68
(vii) Ventless Electric, Combination Washer-Dryer	2.33

A. Benefits and Costs to Consumers

Table I.2 summarizes DOE's evaluation of the economic impacts of the adopted standards on consumers of consumer clothes dryers, as measured by the average life-cycle cost (''LCC'') savings and the simple payback period (''PBP'').[6] The average LCC savings are positive for all product classes, and the PBP is less than the average lifetime of consumer clothes dryers, which is estimated to be 14 years (*see* section IV.F of this document).

TABLE I.2—IMPACTS OF ADOPTED ENERGY CONSERVATION STANDARDS ON CONSUMERS OF CONSUMER CLOTHES DRYERS

Consumer clothes dryer class	Average LCC savings (2022$)	Simple payback period (years)
Electric, Standard (4.4 ft³ or greater capacity)	$252	0.6
Electric, Compact (120V) (less than 4.4 ft³ capacity)	66	2.2
Vented Electric, Compact (240V) (less than 4.4 ft³ capacity)	90	2.0
Vented Gas, Standard (4.4 ft³ or greater capacity)	102	1.9
Ventless Electric, Compact (240V) (less than 4.4 ft³ capacity)	99	0.4
Ventless Electric, Combination Washer-Dryer	11	0.0

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

B. Impact on Manufacturers

The industry net present value (''INPV'') is the sum of the discounted cash flows to the industry from the base year (2024) through the end of the analysis period, which is 30 years from the analyzed compliance date.[7] Using a real discount rate of 7.5 percent, DOE estimates that the INPV for manufacturers of consumer clothes dryers in the case without amended standards is $2.12 billion in 2022$.[8] Under the adopted standards, which align with the Recommended TSL for consumer clothes dryers, DOE estimates the change in INPV to range from −6.8 percent to −5.7 percent, which is a decrease of approximately $144.2 million to a decrease of approximately $119.7 million. In order to bring products into compliance with amended standards, it is estimated that industry will incur total conversion costs of $180.7 million.

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

C. National Benefits and Costs[9]

DOE's analyses indicate that the adopted energy conservation standards for consumer clothes dryers would save a significant amount of energy. Relative to the case without amended standards, the lifetime energy savings for consumer clothes dryers purchased in the 30-year period that begins in the anticipated year of compliance with the amended standards (2028–2057), amount to 2.7 quadrillion British thermal units (''Btu''), or quads.[10] This represents a savings of 11 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 consumer clothes dryers ranges from $ 9.23 billion (at a 7-percent discount rate) to $20.08 billion (at a 3-percent discount rate). This NPV expresses the estimated total value of future operating-cost savings minus the estimated increased product and installation costs for consumer clothes dryers purchased during the period 2028–2057.

In addition, the adopted standards for consumer clothes dryers are projected to yield significant environmental benefits. DOE estimates that the standards will result in cumulative emission reductions (over the same period as for

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

[7] DOE's analysis period extends 30 years from the compliance year. The analysis period for the MIA ranges from 2024–2056 for the no-new-standards case and all TSLs, except for TSL 3 (the Recommended TSL). The analysis period for the Recommended TSL ranges from 2024–2057 due to the 2028 compliance year.

[8] The no-new-standards case INPV of $2.12 billion 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.

[9] All monetary values in this document are expressed in 2022 dollars and, where appropriate, are discounted to 2024 unless explicitly stated otherwise.

[10] 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.

energy savings) of 57.1 million metric tons (''Mt'') [11] of carbon dioxide (''CO_2''), 13.9 thousand tons of sulfur dioxide (''SO_2''), 116.5 thousand tons of nitrogen oxides (''NO_X''), 527.6 thousand tons of methane (''CH_4''), 0.5 thousand tons of nitrous oxide (''N_2O''), and 0.1 tons of mercury (''Hg'').[12] The estimated cumulative reduction in CO_2 emissions through 2030 amounts to 1.3 Mt, which is equivalent to the emissions resulting from the annual electricity use of more than 260 thousand homes.

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'').[13] 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 $3.3 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,[14] as discussed in section IV.L of this document. DOE estimated the present value of the health benefits would be $2.6 billion using a 7-percent discount rate, and $6.3 billion using a 3-percent discount rate.[15] DOE is currently only monetizing health benefits from changes in ambient fine particulate matter ($PM_{2.5}$) concentrations from two precursors (SO_2 and NO_X), and from changes in ambient ozone from one precursor (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 consumer clothes dryers. 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 CONSUMER CLOTHES DRYERS

	Billion (2022$)
3% discount rate	
Consumer Operating Cost Savings	21.1
Climate Benefits *	3.3
Health Benefits **	6.3
Total Benefits †	30.7
Consumer Incremental Product Costs ‡	1.0
Net Monetized Benefits	20.1
Change in Producer Cash Flow (INPV ‡‡)	(0.14)–(0.12)
7% discount rate	
Consumer Operating Cost Savings	9.8
Climate Benefits * (3% discount rate)	3.3
Health Benefits **	2.6
Total Benefits †	15.8
Consumer Incremental Product Costs ‡	0.6
Net Monetized Benefits	9.2
Change in Producer Cash Flow (INPV ‡‡)	(0.14)–(0.12)

Note: This table presents the costs and benefits associated with consumer clothes dryers 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 a 3-percent discount rate.

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

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

[12] DOE calculated emissions reductions relative to the no-new-standards case, which reflects key assumptions in the *Annual Energy Outlook 2023* (''*AEO2023*''). *AEO2023* represents current Federal and State legislation and final implementation of regulations as of the time of its preparation. *See* section IV.K of this document for further discussion of *AEO2023* assumptions that affect air pollutant emissions.

[13] 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''*). www.whitehouse.gov/wp-content/uploads/2021/02/TechnicalSupportDocument_SocialCostofCarbonMethaneNitrousOxide.pdf.*

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

[15] DOE estimates the economic value of these emissions reductions resulting from the considered trial standard levels (''TSLs'') for the purpose of complying with the requirements of Executive Order 12866.

‡‡ 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 (the MIA). *See* section IV.J of this document and chapter 12 of the direct final rule technical support document (''TSD''). In the detailed MIA, DOE models manufacturers' pricing decisions based on assumptions regarding investments, conversion costs, cashflow, and margins. The MIA produces a range of impacts, which is the rule's expected impact on the INPV. The change in INPV is the present value of all changes in industry cash flow, including changes in production costs, capital expenditures, and manufacturer profit margins. Change in INPV is calculated using the industry weighted average cost of capital value of 7.5 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 consumer clothes dryers, those values are −$144 million to −$120 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 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 INPV into the net benefit calculation for this direct final rule, the net benefits would range from $19.96 billion to $19.98 billion at 3-percent discount rate and would range from $9.06 billion to $9.08 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.[16]

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 consumer clothes dryers 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 consumer clothes dryers shipped in 2028–2057. Total benefits for both the 3-percent and 7-percent cases are presented using the average GHG social costs with a 3-percent discount rate. Estimates of SC–GHG values are presented for all four SC–GHG discount rates in section IV.L of this document.

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

Using a 7-percent discount rate for consumer benefits and costs and health benefits from reduced NO_X and SO_2 emissions, and the 3-percent discount rate case for climate benefits from reduced GHG emissions, the estimated cost of the standards adopted in this rule is $60.0 million per year in increased equipment costs, while the estimated annual benefits are $971.4 million in reduced equipment operating costs, $185.5 million in climate benefits, and $259.9 million in health benefits. In this case, the net benefit would amount to $1,357 million per year.

Using a 3-percent discount rate for all benefits and costs, the estimated cost of the standards is $57.2 million per year in increased equipment costs, while the estimated annual benefits are $1,177 million in reduced operating costs, $185.5 million in climate benefits, and $349.4 million in health benefits. In this case, the net benefit would amount to $1,654 million per year.

TABLE I.4—ANNUALIZED BENEFITS AND COSTS OF ADOPTED STANDARDS FOR CONSUMER CLOTHES DRYERS (2028–2057)

	Million/year (2022$)		
	Primary estimate	Low-net-benefits estimate	High-net-benefits estimate
3% discount rate			
Consumer Operating Cost Savings	1,177	1,103	1,230
Climate Benefits *	185.5	178.9	187.8
Health Benefits **	349.4	337.2	353.7
Total Benefits †	1,712	1,619	1,771
Consumer Incremental Product Costs	57.2	58.9	54.4
Net Benefits	1,654	1,560	1,717
Change in Producer Cash Flow (INPV ‡‡)	(12)–(10)	(12)–(10)	(12)–(10)
7% discount rate			
Consumer Operating Cost Savings	971.4	915.5	1,014
Climate Benefits * (3% discount rate)	185.5	178.9	187.8
Health Benefits **	259.9	251.5	262.8
Total Benefits †	1,417	1,346	1,464
Consumer Incremental Product Costs ‡	60.0	61.2	57.7
Net Benefits	1,357	1,285	1,407

[16] To convert the time-series of costs and benefits into annualized values, DOE calculated a present value in 2024, the year used for discounting the NPV of total consumer costs and savings. For the benefits, DOE calculated a present value associated with each year's shipments in the year in which the shipments occur (*e.g.,* 2020 or 2030), and then discounted the present value from each year to 2024. Using the present value, DOE then calculated the fixed annual payment over a 30-year period, starting in the compliance year, that yields the same present value.

TABLE I.4—ANNUALIZED BENEFITS AND COSTS OF ADOPTED STANDARDS FOR CONSUMER CLOTHES DRYERS (2028–2057)—Continued

	Million/year (2022$)		
	Primary estimate	Low-net-benefits estimate	High-net-benefits estimate
Change in Producer Cash Flow (INPV ‡‡)	(12)–(10)	(12)–(10)	(12)–(10)

Note: This table presents the costs and benefits associated with consumer clothes dryers shipped in 2028–2057. These results include benefits to consumers which 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 constant 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 up 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 a 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 (the MIA). *See* section IV.J of this document and chapter 12 of the direct final rule TSD. 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 7.5 percent that is estimated in the manufacturer impact analysis (*see* chapter 12 of the direct final rule TSD for a complete description of the industry weighted average cost of capital). For consumer clothes dryers, those values are −$12 million to −$10 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 Markup 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 chapter 12 of this direct final rule TSD, 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 INPV into the annualized net benefit calculation for this direct final rule, the annualized net benefits, using the primary estimate, would range from $1,642 million to $1,644 at 3-percent discount rate and would range from $1,345 million to $1,347 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 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 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 consumer clothes dryers is $60.0 million per year in increased product costs, while the estimated annual benefits are $971.4 million in reduced product operating costs, $185.5 million in climate benefits, and $259.9 million in health benefits. The net benefit amounts to $1,357 million per year. DOE notes that the net benefits are substantial even in the absence of the climate benefits,[17] and DOE would adopt the same standards in the absence of such benefits.

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.[18] For example, some covered products and equipment have most of their energy consumption occur during periods of peak energy demand.

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

[18] 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).

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 2.7 quads FFC, the equivalent of the primary annual energy use of 18 million homes. In addition, they are projected to reduce cumulative CO_2 emissions by 57.1 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.

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 consumer clothes dryers. Consistent with this authority, DOE is also simultaneously publishing elsewhere in this **Federal Register** a 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 consumer clothes dryers.

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 consumer clothes dryers, the subject of this document. (42 U.S.C. 6292(a)(8)) EPCA prescribed energy conservation standards for these products (42 U.S.C. 6295(g)(3)), and directed DOE to conduct future rulemakings to determine whether to amend these standards. (42 U.S.C. 6295(g)(4)) 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))

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. (42 U.S.C. 6297(d))

Subject to certain criteria and conditions, DOE is required to develop test procedures to measure the energy efficiency, energy use, or estimated annual operating cost of each covered product. (42 U.S.C. 6295(o)(3)(A) and 42 U.S.C. 6295(r)) Manufacturers of covered products must use the prescribed DOE test procedure as the basis for certifying to DOE that their 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 consumer clothes dryers appear at title 10 of the Code of Federal Regulations (''CFR'') part 430, subpart B, appendix D1 (''appendix D1'') and appendix D2 (''appendix D2'').

DOE must follow specific statutory criteria for prescribing new or amended standards for covered products, including consumer clothes dryers. 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)(3)(B)) 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 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 consider 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 Energy Independence and Security Act of 2007 (''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 consumer clothes dryers 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 directly 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 April 21, 2011, (''April 2011 Direct Final Rule'') DOE prescribed the current energy conservation standards for consumer clothes dryers manufactured on and after January 1, 2015. 76 FR 22454.[19] These standards are set forth in DOE's regulations at 10 CFR 430.32(h)(3) and are shown in Table II.1. These standards are consistent with a prior joint proposal submitted to DOE by interested parties representing manufacturers, energy and environmental advocates, and consumer groups.[20]

The current standards are defined in terms of a minimum allowable CEF, as measured according to appendix D1. Even though DOE maintained the same energy efficiency descriptor for both appendix D1 and appendix D2, DOE notes that the CEF values are not equivalent because of the extensive differences in test methods.[21] To avoid potential confusion that would result from using the same efficiency descriptor for both test procedures as it relates to the standards discussed in this document, DOE is including a ''D1'' or ''D2'' subscript when referring to the appendix D1 CEF and appendix D2 CEF, respectively (''CEF_{D1}'' and ''CEF_{D2}'').

[19] DOE published a confirmation of effective date and compliance date for the direct final rule on August 24, 2011. 76 FR 52854.

[20] Available at: *www.regulations.gov/comment/EERE-2007-BT-STD-0010-0049.*

[21] While the current standards are based on CEF as determined in accordance with appendix D1, manufacturers are permitted to use the appendix D2 test procedure to comply with the current standards, as long as they use a single appendix for all representations. Beginning on the compliance date of the amended standards established by this direct final rule, manufacturers will be required to use appendix D2 to comply with the amended standards.

TABLE II.1—FEDERAL ENERGY EFFICIENCY STANDARDS FOR CONSUMER CLOTHES DRYERS AS MEASURED UNDER APPENDIX D1

Product class	CEF_{D1} *(lb/kWh)*
(i) Vented Electric, Standard (4.4 ft^3 or greater capacity)	3.73
(ii) Vented Electric, Compact (120V) (less than 4.4 ft^3 capacity)	3.61
(iii) Vented Electric, Compact (240V) (less than 4.4 ft^3 capacity)	3.27
(iv) Vented Gas	3.30
(v) Ventless Electric, Compact (240V) (less than 4.4 ft^3 capacity)	2.55
(vi) Ventless Electric, Combination Washer-Dryer	2.08

2. Current Test Procedure

On October 8, 2021, DOE published a final rule for the test procedure rulemaking (86 FR 56608) (the ''October 2021 TP Final Rule''), in which it amended appendix D1 and appendix D2, both entitled ''Uniform Test Method for Measuring the Energy Consumption of Clothes Dryers,'' to provide additional detail in response to questions from manufacturers and test laboratories, including additional detail regarding the testing of ''connected'' models, dryness level selection, and the procedures for maintaining the required heat input rate for gas consumer clothes dryers; additional detail for the test procedures for performing inactive and off mode power measurements; specifications for the final moisture content (''FMC'') required for testing automatic termination control dryers; specification of a narrower scale resolution for the weighing scale used to determine moisture content of test loads; and specification that the test load must be weighed within 5 minutes after a test cycle has terminated. In addition, as part of the October 2021 TP Final Rule, DOE amended the test procedures to update the estimated number of annual use cycles for consumer clothes dryers; provide further direction for additional provisions within the test procedures; specify rounding requirements for all reported values; apply consistent use of nomenclature and correct typographical errors; remove obsolete sections of the test procedures, including appendix D; and update the reference to the applicable industry test procedure to the version certified by the American National Standards Institute (''ANSI''). 86 FR 56608, 56610.

DOE's current energy conservation standards for consumer clothes dryers are expressed in terms of CEF_{D1}. (*See* 10 CFR 430.32(h)(3).) Appendix D1 tests timed drying cycles, and accounts for clothes dryers with automatic termination controls by applying a higher field use factor to units that have this feature. Appendix D2 tests ''normal'' automatic termination cycles and more accurately measures the effects of automatic cycle termination.

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)) The appendix D2 test procedure, which is required for use to demonstrate compliance with the amended energy conservation standards established in this direct final rule, measures the energy consumption of a representative use cycle that dries a load of laundry from an initial moisture content of 57.5 percent to an FMC of less than 2 percent. 86 FR 56624–56625. For timer clothes dryers, the test load is dried until the FMC is between 1 and 2.5 percent of the bone-dry weight of the test load. The measured energy consumption is then normalized to determine the energy consumption required to dry the test load to 2-percent FMC, with a field use factor applied to account for the over-drying energy consumption. For automatic termination control clothes dryers, appendix D2 specifies that a ''normal'' program be selected for the test cycle, and for clothes dryers that do not have a ''normal'' program, the cycle recommended by the manufacturer for drying cotton or linen shall be selected. If the drying temperature and drying level settings can be chosen independently of the program, they shall be set at the maximum drying temperature setting, and at a ''normal'' or ''medium'' dryness level setting. The test is considered valid if the FMC of the test load is 2 percent or less after the completion of the test cycle. If the FMC is greater than 2 percent, the test is considered invalid and a new run shall be conducted using the highest dryness level setting.

The current 2-percent FMC requirement using the DOE test cloth was adopted as representative of approximately 5-percent FMC for ''real-world'' clothing, based on data submitted in a joint petition for rulemaking.[22] DOE determined in the final rule published on August 14, 2013, that established the appendix D2 Test procedure that the specified 2-percent FMC using the DOE test load was representative of consumer expectations for dryness of clothing in field use. 78 FR 49608, 49620–49622, 49610–49611. DOE did not amend the FMC requirements in the October 2021 TP Final Rule. 86 FR 56626.

DOE has conducted the rulemaking analysis for this direct final rule based on CEF_{D2} because compliance with the amended energy conservation standards established in this direct final rule must be determined based on the use of appendix D2. DOE discusses additional details in section IV.C.1 of this document about how it developed the engineering baseline, in terms of CEF_{D2}, from the current consumer clothes dryer standards that are in terms of CEF_{D1}.

3. The Joint Agreement

On September 25, 2023, DOE received a joint statement of recommended standards (*i.e.,* the Joint Agreement) for various home appliance products, including consumer clothes dryers, submitted jointly by groups representing manufacturers, energy and environmental advocates, consumer groups, and a utility.[23] In addition to the

[22] The petition was submitted by AHAM, Whirlpool Corporation, General Electric Company, Electrolux, LG Electronics, Inc., BSH, Alliance Laundry Systems, Viking Range, Sub-Zero Wolf, Friedrich A/C, U-Line, Samsung, Sharp Electronics, Miele, Heat Controller, AGA Marvel, Brown Stove, Haier, Fagor America, Airwell Group, Arcelik, Fisher & Paykel, Scotsman Ice, Indesit, Kuppersbusch, Kelon, and DeLonghi, American Council for an Energy Efficient Economy, Appliance Standards Awareness Project, Natural Resources Defense Council, Alliance to Save Energy, Alliance for Water Efficiency, Northwest Power and Conservation Council, and Northeast Energy Efficiency Partnerships, Consumer Federation of America and the National Consumer Law Center. See Docket No. EERE–2011–BT–TP–0054, No. 3.

[23] 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

recommended standards for consumer clothes dryers, the Joint Agreement also included separate recommendations for several other covered products.[24] 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 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 residential clothes washers (''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.[25] In the letter, the signatories clarified that ''short-cycle'' product classes for RCWs, 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 consumer clothes dryers.

The Joint Agreement recommends amended standard levels for consumer clothes dryers as presented in Table II.2. (Joint Agreement, No. 55 at p. 9) [26] Details of the Joint Agreement recommendations for other products are provided in the Joint Agreement posted in the docket.[27]

TABLE II.2—RECOMMENDED AMENDED ENERGY CONSERVATION STANDARDS FOR CONSUMER CLOTHES DRYERS

Product class	Minimum energy efficiency ratio (lb/kWh)	Compliance date
Electric, Standard (4.4 cubic feet (''ft^3'') or greater capacity)	*3.93*	March 1, 2028
Electric, Compact (120 volts (''V'')) (less than 4.4 ft^3 capacity)	*4.33*	
Vented Electric, Compact (240V) (less than 4.4 ft^3 capacity)	*3.57*	
Vented Gas, Standard (4.4 ft^3 or greater capacity)	*3.48*	
Vented Gas, Compact (less than 4.4 ft^3 capacity)	*2.02*	
Ventless Electric, Compact (240V) (less than 4.4 ft^3 capacity)	*2.68*	
Ventless Electric, Combination Washer-Dryer	*2.33*	

When the Joint Agreement was submitted, DOE was conducting a rulemaking to consider amending the standards for consumer clothes dryers. As part of that process, DOE published a NOPR and announced a public meeting on August 23, 2022 (''August 2022 NOPR'') seeking comment on its proposed amended standard to inform its decision consistent with its obligations under EPCA and the Administrative Procedure Act (''APA''). 87 FR 51734. DOE subsequently held a public webinar on September 13, 2022, to discuss and receive comments on the NOPR TSD.

Although DOE is adopting the Joint Agreement as a direct final rule and no

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.

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

[25] This document is available in the docket at: *www.regulations.gov/comment/EERE-2014-BT-STD-0058-0058*.

[26] The parenthetical reference provides a reference for information located in the docket of DOE's rulemaking to develop energy conservation standards for consumer clothes dryers. (Docket No. EERE–2014–BT–STD–0058, which is maintained at *www.regulations.gov*). The references are arranged as follows: (commenter name, comment docket ID number at page of that document).

[27] The Joint Agreement available in the docket at *www.regulations.gov/comment/EERE-2014-BT-STD-0058-0055*.

longer proceeding with its prior 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.[28]

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 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.'' [29] 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,[30] 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 Joint Parties' letter, short-cycle products are not subject to the amended standards adopted by this direct final rule. 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 consumer clothes dryers: electric, standard; electric, compact; vented electric, compact; vented gas, standard; vented gas, compact; ventless electric, compact; and ventless electric, combination washer-dryer. Although these product classes were not further divided by cycle time, DOE understands them to exclude vented electric standard-size clothes dryers and vented gas standard-size clothes dryers with a cycle time of less than 30 minutes, when tested according to appendix D2. As previously noted, any such ''short-cycle'' consumer clothes dryers will be considered in the Remand Proceeding; the current standards applicable to such ''short-cycle'' consumer clothes dryers 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 vented electric standard-size clothes dryers and vented gas standard-size clothes dryers that is not distinguished by cycle time and is representative of all consumer clothes dryers currently on the market today. To the extent that any short cycle product classes 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 dryer.'' (*See* 42 U.S.C. 6291) DOE has defined an ''electric clothes dryer'' as a cabinet-like appliance designed to dry fabrics in a tumble-type drum with forced air circulation. The heat source is electricity and the drum and blower(s) are driven by an electric motor(s). 10 CFR 430.2. DOE has defined a ''gas clothes dryer'' as a cabinet-like appliance designed to dry fabrics in a tumble-type drum with forced air circulation. The heat source is gas and the drum and blower(s) are driven by an electric motor(s). *Id.* This direct final rule covers consumer clothes dryers, *i.e.,* those consumer products that meet the definitions of ''electric clothes dryer'' and ''gas clothes dryer,'' as codified at 10 CFR 430.2.

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

[28] The parenthetical reference provides a reference for information located in the docket of DOE's rulemaking to develop energy conservation standards for consumer clothes dryers. (Docket No. EERE–2014–BT–STD–0058, which is maintained at *www.regulations.gov*). The references are arranged as follows: (commenter name, comment docket ID number at page of that document).

[29] This document is available in the docket at: *www.regulations.gov/comment/EERE-2014-BT-STD-0058-0058.*

[30] See *https://www1.eere.energy.gov/buildings/appliance_standards/standards.aspx?productid=50.*

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, AHAM, which represents 11 manufacturers of consumer clothes dryers.[31] 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. 56). DOE also received a letter in support of the Joint Agreement from a gas and electric utility, SDG&E, and an electric utility, SCE (*See* comment No. 57). 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. In evaluating the recommended standards proposed in the Joint Agreement, DOE conducted the same analysis. 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 incorporated in commercially available products or in working prototypes to be technologically feasible. Sections 6(b)(3)(i) and 7(b)(1) of appendix A.

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. Sections 7(b)(2)–(5) of appendix A. Section IV.B of this document discusses the results of the screening analysis for consumer clothes dryers, 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 an 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 consumer clothes dryers 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 considered, DOE projected energy savings from application of the TSL to consumer clothes dryers 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 3) and 2028–2057 for TSL 3).[32] The savings are measured over the entire lifetime of consumer clothes dryers 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'') from potential amended standards for consumer clothes dryers. 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, petroleum fuels), and thus presents a more complete picture of the impacts of energy conservation standards.[33] 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 including through a direct final rule, 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.[34] For example, some covered products and equipment have most of their energy consumption occur during periods of peak energy demand. The impact 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 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 2.7 quads, the equivalent of the electricity

[31] These companies include: Alliance Laundry Systems, LLC; 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.

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

[33] 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).

[34] 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).

use of 18 million homes in one year. 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 direct final rulemaking.

a. Economic Impact on Manufacturers and Consumers

In determining the impacts of 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 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 the recommended 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 document.

f. Need for National Energy Conservation

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

DOE maintains that environmental and public health benefits associated with the more efficient use of energy are important to take into account when

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

g. Other Factors

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

2. Rebuttable Presumption

As set forth in 42 U.S.C. 6295(o)(2)(B)(iii), EPCA creates a rebuttable presumption that an energy conservation standard is economically justified if the additional cost to the consumer of a product that meets the standard is less than three times the value of the first year's energy savings resulting from the standard, as calculated under the applicable DOE test procedure. DOE's LCC and PBP analyses generate values used to calculate the effect potential amended energy conservation standards would have on the 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 regarding consumer clothes dryers. 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 consumer clothes dryers 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-2014-BT-STD-0058*. Additionally, DOE used output from the latest version of the Energy Information Administration's (''EIA's'') *Annual Energy Outlook 2023* (''*AEO2023*'') for the emissions and utility impact analyses.

A. Market and Technology Assessment

DOE develops information in the market and technology assessment that provides an overall picture of the market for the products concerned, including the purpose of the products, the industry structure, manufacturers, market characteristics, and technologies used in the products. This activity includes both quantitative and qualitative assessments, based primarily on publicly available information. The subjects addressed in the market and technology assessment for this rulemaking include (1) a determination of the scope of the rulemaking and product classes, (2) manufacturers and industry structure, (3) existing efficiency programs, (4) shipments information, (5) market and industry trends, and (6) technologies or design options that could improve the energy efficiency of consumer clothes dryers. 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 seven product classes for consumer clothes dryers. (Joint Agreement, No. 55 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 CONSUMER CLOTHES DRYER PRODUCT CLASSES

Product classes
1. Electric, Standard (4.4 ft3 or greater capacity)
2. Electric, Compact (120V) (less than 4.4 ft3 capacity)
3. Vented Electric, Compact (240V) (less than 4.4 ft3 capacity)
4. Vented Gas, Standard (4.4 ft3 or greater capacity)
5. Vented Gas, Compact (less than 4.4 ft3 capacity)
6. Ventless Electric, Compact (240V) (less than 4.4 ft3 capacity)
7. Ventless Electric, Combination Washer-Dryer

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. However, 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.[35] Additionally, DOE notes that 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 August 2022 NOPR. 87 FR 51734. Chapter 3 of the TSD for this direct final

[35] 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))

rule includes a detailed list and descriptions of all technology options identified for consumer clothes dryers. As discussed in chapter 3 of the TSD for this direct final rule, DOE has performed market research and evaluated available consumer clothes dryers to assess existing technology options to improve efficiency. The results of this research are discussed in chapter 3 of the TSD for this direct final rule. DOE notes that it did not receive any comments regarding the technology options analyzed in the August 2022 NOPR.

TABLE IV.2—DIRECT FINAL RULE ANALYSIS: TECHNOLOGY OPTIONS FOR CONSUMER CLOTHES DRYERS

Dryer control or drum upgrades:
Improved termination
Increased insulation
Modified operating conditions
Improved air circulation
Improved drum design
Methods of Exhaust Heat Recovery (Vented Models Only):
Recycle exhaust heat
Inlet air preheat
Inlet air preheat, condensing mode
Moisture Removal Options:
Heat pump, electric only
Thermoelectric heating, electric only
Microwave, electric only
Modulating heat
Indirect heating
RF drying, electric only
Ultrasonic drying, electric only
Component Improvements:
Improved motor efficiency
Improved fan efficiency
Standby Power Improvements:
Transformerless power supply with auto-powerdown

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

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

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

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

10 CFR part 430, subpart C, appendix A, sections 6(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 reasons for eliminating any technology are discussed in the following sections.

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

1. Screened Out Technologies

In conducting the screening analysis for this direct final rule, DOE considered comments it had received in response to the screening analysis conducted for the August 2022 NOPR.

a. Thermoelectric Heating, Electric Only

DOE notes that thermoelectric heating clothes dryers are still undergoing preliminary research, including at Oak Ridge National Laboratory (''ORNL''). While ORNL's test results of a preliminary prototype have shown the potential for improved efficiency, ORNL indicated that the initial prototype design produced longer-than-desired drying times due to direct-contact heat transfer limitations via the drum surface. ORNL subsequently developed another prototype that added pumped secondary water loops that transferred heat from the thermoelectric modules to the process air via air-to-water heat exchangers to further improve efficiency and minimize cycle length. ORNL's testing indicated efficiency and cycle times for this prototype that are approximately equivalent to those of vapor compression heat pump clothes dryers.[36] Because the research for such a thermoelectric heating clothes dryer that produces energy savings and meets consumer expectations for drying cycle time is still in the prototype stage, DOE determined that this technology option would not be practicable to manufacture, install, and service on a scale necessary to serve the relevant market at the time of the projected compliance date of any new or amended consumer clothes dryer standards, and did not consider it for further analysis.

[36] Patel, V., Boudreaux, P., and Gluesenkamp, K. Oak Ridge National Laboratory. Validated Model of a Thermoelectric Heat Pump Clothes Dryer Using Secondary Pumped Loops. Applied Thermal Engineering, Volume 184, February 5, 2021.

b. Microwave, Electric Only

Due to the large energy savings associated with microwave drying, this technology was the subject of a multiyear development effort at the Electric Power Research Institute (''EPRI'') in the mid-1990s.[37] At least one major manufacturer—Whirlpool—developed a countertop-scale version of such a product as recently as 2002,[38] but to date this technology has not been successfully commercialized.

Microwave drying introduces significant technical and safety issues with potential arcing from metallic objects in the fabric load, including zippers, buttons, or ''stray'' items such as coins. While efforts have been made to mitigate the conditions that are favorable to arcing or to detect incipient arcing and terminate the cycle, the possibility of fabric damage cannot be completely eliminated.[39] In addition to those consumer utility impacts, these conditions can also pose a safety hazard. For these reasons, microwave drying was not considered further for analysis.

c. Indirect Heating

Indirect heating would be viable only in residences that use a hydronic heating system. Also, in order to derive clothes dryer heat energy from a home's heating system, significant plumbing work would be required to circulate heated water through a heat exchanger in the clothes dryer. Therefore, this technology option does not meet the criterion of practicability to install on a scale necessary to serve the relevant market at the time of the effective date of any new standard and was not considered for further analysis.

d. RF Drying, Electric Only

CoolDry, LLC (''CoolDry'') developed an RF clothes dryer prototype, claiming an efficiency of 90 percent, compared to 50 percent for conventional clothes dryers.[40] CoolDry stated that its RF drying technology operates at lower temperatures than do conventional clothes dryers and, because the transfer of energy to clothes is not dependent on convective heat transfer, the RF clothes dryer requires less tumbling and subsequently consumes less energy for drum rotation than a conventional clothes dryer. Because this technology was in the prototype stage at the time it was initially considered and the company is no longer in business, research and development is unlikely to be ongoing. Therefore, DOE determined that this technology option would not be practicable to manufacture, install, and service on a scale necessary to serve the relevant market at the time of the projected compliance date of any new or amended consumer clothes dryer standards and did not consider it for further analysis.

e. Ultrasonic Drying, Electric Only

Researchers at ORNL have developed an ultrasonic drying prototype that uses piezoelectric transducers to separate water from clothes through water cavitation produced by ultrasonic vibrations. According to their research, the energy imparted to the water must overcome surface tension in order to break the water into droplets, but this energy is substantially less than the latent heat of vaporization of water, which is the primary thermodynamic barrier for conventional evaporation drying. The ORNL researchers anticipate that ultrasonic drying technology will result in an energy factor[41] of greater than 10 and a drying time of less than 20 minutes.[42] Because this technology is still in the prototype stage, however, DOE determined that this technology option would not be practicable to manufacture, install, and service on a scale necessary to serve the relevant market at the time of the projected compliance date of any new or amended consumer clothes dryer standards and did not consider it for further analysis.

DOE did not receive any comments in response to the August 2022 NOPR regarding these screened out technology options, and for the reasons discussed, screened out the same technologies for this direct final rule analysis.

2. Remaining Technologies

Through a review of each technology, DOE tentatively concludes that all of the other identified technologies listed in section IV.A.2 of this document met 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 CONSUMER CLOTHES DRYERS

Dryer Control or Drum Upgrades:
Improved termination
Modified operating conditions
Improved air circulation
Increased insulation
Improved drum design
Methods of Exhaust Heat Recovery (vented models only):
Recycle exhaust heat
Inlet air preheat
Inlet air preheat, condensing mode
Moisture Removal Options:
Heat pump, electric only
Modulating heat
Component Improvements:
Improved motor efficiency
Improved fan efficiency
Standby Power Improvements:
Transformerless Power Supply with Auto-Powerdown

[37] S. Ashley. 1998. ''Energy-Efficient Appliances,'' Mechanical Engineering Magazine, March 1998, pp. 94–97.

[38] E. Spagat. 2002. ''Whirlpool Goes Portable to Sell Dryers to Gen Y,'' Wall Street Journal, June 4, 2002.

[39] J.F. Gerling. 2003. ''Microwave Clothes Drying—Technical Solutions to Fundamental Challenges,'' Appliance Magazine, April 2003, p. 120.

[40] Cool Dry did not specify the metric or test method used to determine the efficiency of its prototype.

[41] This energy factor incorporates only active mode energy use and not standby mode and off mode energy use.

[42] Momen, A. *Ultrasonic Clothes Dryer: 2016 Building Technologies Office Peer Review.* 2016. Prepared for the U.S. Department of Energy at Oak Ridge National Laboratory, in partnership with the University of Florida and General Electric, p. 2.

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.

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.[43] In particular, the letter states that the joint stakeholders do not anticipate the recommended standards will negatively affect features or performance.

C. Engineering Analysis

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

1. 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 reverse engineering. This approach involved first testing and then physically disassembling a representative sample of commercially available products, reviewing publicly available cost information, and modeling equipment cost. From this information and through the reverse engineering process, DOE estimated the manufacturer production costs (''MPCs'') for a range of products currently available on the market, considering the design options and the steps manufacturers would likely take to reach a certain efficiency level. As part of this analysis, DOE included test units that represent baseline models, newly introduced units on the market, units with unique configurations, and units with technologies as observed in the technology assessment. The efficiency levels analyzed as part of this engineering analysis are attainable using commercially available clothes dryer technologies, or technologies that have been demonstrated in working prototypes.

a. Baseline Efficiency Levels

For each product/equipment 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/equipment class represents the characteristics of a product/equipment typical of that class (*e.g.,* capacity, physical size). Generally, a baseline model is one that just meets current energy conservation standards, or, if no standards are in place, the baseline is typically the most common or least efficient unit on the market.

The baseline clothes dryer efficiency levels for this direct final rule differ from the existing energy conservation standards that were established in the 2011 rulemaking analysis primarily due to the difference between the then-current appendix D1, which DOE used to evaluate products in the previous rulemaking, and the present version of appendix D2, established in the October 2021 TP Final Rule and which DOE used as the basis for this analysis. Appendix D2 includes test methods that more accurately measure the effects of automatic cycle termination and that may result in differences in the total measured energy consumption of the test cycle as compared to the test methods in appendix D1. Specifically, for automatic termination control dryers, appendix D2 requires a lower FMC of the test load and does not rely on a field use factor to account for the over-drying energy consumption, instead requiring that the automatic termination drying program run to the end of the cycle. Additionally, appendix D2 contains instructions for the testing of timer dryers, which include a lower FMC of the test load as compared to the version of appendix D1 used for the 2011 rulemaking analysis.

For the engineering analysis, DOE began by identifying the efficiency level corresponding to the Federal minimum energy conservation standards for each product class. Due to the test procedure changes adopted in the October 2021 Final Rule, DOE determined the baseline efficiency level representative of minimally compliant products when tested under appendix D2. To identify the appendix D2 baseline levels, DOE tested 22 models that were certified as minimally compliant with the current energy conservation standards, from across all product classes. Because certified performance data are not available for models on the market tested in accordance with both appendix D1 and appendix D2, DOE tested each basic model in its test sample in accordance with appendix D1 and appendix D2 and used the test values for appendix D2 to determine the baseline models in support of this engineering analysis. Due to the differences in the two test procedures previously described, the baseline CEF_{D2} measured using appendix D2 is numerically lower for each product class than the corresponding CEF_{D1} value in the current energy conservation standards, though that does not indicate a lower efficiency. The test procedure differences drive the lower baseline

[43] This document is available in the docket at: *www.regulations.gov/comment/EERE-2014-BT-STD-0058-0058.*

CEF_{D2} values and do not represent a lower efficiency or backsliding.

With regard to the vented gas compact product class, DOE is unaware of any currently available commercial products that fall within the vented gas compact product class. To determine the baseline level for this product class, DOE analyzed a vented gas compact-size model that was previously available on the market prior to the effective date of the current energy conservation. DOE's previous testing of that model—which utilized electromechanical controls—suggests that the model would not be compliant with the existing standards. DOE expects that manufacturers would implement electronic controls as a design option to produce vented gas compact clothes dryers that minimally comply with the existing standard. DOE determined the efficiency performance that would be achieved through the addition of electronic controls by applying the same relative efficiency improvement observed with the implementation of electronic controls for standard-size vented gas clothes dryers, as shown in Table IV.8 in section IV.C.1.b of this document. The resulting estimated level of baseline performance for the vented gas compact product class is consistent with the efficiency level recommended by the Joint Agreement for this product class.

The baseline efficiency levels considered for this analysis are presented along with the current standards in Table IV.4 and are discussed in more detail in chapter 5 of the direct final rule TSD. The baseline values are the same as those proposed in the August 2022 NOPR, except for the vented gas compact product class as discussed.

TABLE IV.4—DIRECT FINAL RULE CONSUMER CLOTHES DRYER BASELINE EFFICIENCY LEVELS

Product class	CEF_{D1} (lb/kWh)	CEF_{D2} (lb/kWh) *
(i) Electric, Standard (4.4 ft^3 or greater capacity)	3.73	2.20
(ii) Electric, Compact (120V) (less than 4.4 ft^3 capacity)	3.61	2.36
(iii) Vented Electric, Compact (240V) (less than 4.4 ft^3 capacity)	3.27	2.00
(iv) Vented Gas, Standard (4.4 cubic ft^3 or greater capacity)	3.30	2.00
(v) Vented Gas, Compact (less than 4.4 ft^3 capacity)	3.30	2.02
(vi) Ventless Electric, Compact (240V) (less than 4.4 ft^3 capacity)	2.55	2.03
(vii) Ventless Electric, Combination Washer-Dryer	2.08	2.27

* As discussed, the baseline CEF_{D2} values represent differences in test procedure between appendix D1 and appendix D2 and do not constitute backsliding. CEF_{D2} baseline efficiency levels as measured under appendix D2 account for differences in the effectiveness of automatic cycle termination. Manufacturers implement automatic termination in a variety of ways, which will impact the representations as measured under appendix D2 and result in a range of possible CEF_{D2} values, as compared to the CEF_{D1} values in the existing Federal standards.

b. Incremental Efficiency Levels

DOE developed incremental efficiency levels by reviewing products currently available on the market and by testing and reverse engineering products in the DOE test sample in support of the direct final rule. For each product class, DOE analyzed several efficiency levels and determined the incremental MPC at each of these levels. DOE initially reviewed data in DOE's Compliance Certification Database (''CCD'') to evaluate the range of efficiencies for consumer clothes dryers currently available on the market. As discussed in chapter 5 of the direct final rule TSD, non-ENERGY STAR-qualified products (*i.e.,* generally units with lower-rated efficiencies) are typically tested using appendix D1, while ENERGY STAR-qualified products are required to be tested using appendix D2. As a result, DOE conducted testing on a representative sample of non-ENERGY STAR-qualified products using appendix D2 to determine appropriate initial incremental efficiency levels for each product class. DOE observed that while electronic controls are typically implemented with other design options in this analysis, the improved automatic termination precision offered by switching to electronic controls contributed significantly to an increase in efficiency. This efficiency gain informed the first incremental efficiency levels for most product classes and was noted simply as electronic controls in the design options listed in the tables later in this section. The design options associated with higher efficiency levels were subsequently distinguished according to specific design options DOE found manufacturers used to meet these higher efficiencies. 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.

For the vented gas compact product class, no units were available on the market at the time of the analysis whose rated value exceeded the baseline level. Given recent market trends, DOE does not have reason to expect manufacturers to re-introduce compact-size vented gas clothes dryers to the market, regardless of amendments to energy conservation standards. Accordingly, DOE did not consider any higher efficiency levels for this product class.

In defining the incremental efficiency levels for the other product classes for this direct final rule, DOE considered comments it had received in response to the incremental efficiency levels proposed in the August 2022 NOPR, including several from commenters who support the Joint Agreement.

The CA IOUs supported DOE's decision to adopt the updated max-tech levels as indicative of the growth and maturity of heat pump technologies for vented and ventless products. The CA IOUs further commented that adopting the max-tech levels sets a key precedent for subsequent DOE energy efficiency and non-DOE rulemakings to represent the true potential of a product class. (California IOUs, No. 50 at pp. 4–5)

AHAM and Whirlpool disagreed with DOE's tentative determination that the proposed standards in the August 2022 NOPR would allow for electromechanical controls. AHAM and Whirlpool commented that electronic controls are required to enable the technology options for the proposed TSL. Whirlpool further commented that electromechanical control dryers are not sophisticated enough to enable the other technology options that DOE described in the August 2022 NOPR analysis and therefore could not be used effectively with the appendix D2 test procedure. Whirlpool stated that DOE's NOPR analysis missed several key aspects where utility and performance could be lessened in order to meet the proposed standard levels. Whirlpool noted that the average CEF score of the five tested units in the vented electric standard product class with electromechanical

controls in the August 2022 NOPR analysis is 2.64 lb/kWh, over 30-percent lower than the proposed standard. AHAM stated that electromechanical controls have consumer utility in that they are easy to use and reduce the overall costs associated with the product, and that requiring electronic controls would result in investment costs for manufacturers and increased purchase prices for consumers. AHAM requested that DOE retain electromechanical controls among a consumer's purchase options as, according to AHAM, they are a desirable feature for reliability, they provide reduced appliance cost among consumers, and their elimination from the market would likely cause consumers to postpone the purchase of new dryers, in turn increasing the total national energy consumption. Whirlpool stated concern regarding a forced regulatory phaseout of electromechanical controls because they are incorporated in a popular and affordable segment of consumer clothes dryers, and noted that although some electronic controls could be ''hidden'' from the consumer, there could be some lost utility from the easy and low-cost repairability of electromechanical control dryers. (AHAM, No. 46 at pp. 5, 10; Whirlpool, No. 53 at pp. 3–4)

DOE is not aware of reliability issues associated with the implementation of electronic controls relative to electromechanical controls. However, DOE acknowledges that a transition from electromechanical controls to electronic controls may require manufacturer investment costs to redesign products and would likely increase purchase price for consumers, as captured in the incremental costs estimated and presented in this direct final rule analysis. Based on its analysis for this direct final rule, DOE believes that component costs associated with the implementation of electronic controls are lower than those estimated in the August 2022 NOPR analysis, which is reflected in the updated MPCs for the efficiency levels that entail a shift to electronic controls. These costs are reflected in the MPCs, which are the basis for the LCC and PBP analyses, in which consumer impacts related to increased purchase price and repair and maintenance costs are considered. Additionally, DOE reevaluated repair costs and accordingly implemented higher repair costs associated with electronic controls in this direct final rule analysis, consistent with Whirlpool's comments. *See* section IV.F of this document and chapter 8 of the direct final rule TSD for additional details.

Regarding the concern that clothes dryers equipped with electromechanical controls could not be tested under appendix D2, DOE notes that its test sample shows that requiring the use of the appendix D2 test procedure will not preclude the use of electromechanical controls. As discussed in chapter 5 of the direct final rule TSD, DOE tested baseline models with electromechanical controls under appendix D2, where available. For the ventless electric compact (240V) product class and the ventless electric combination washer-dryer product class, there were no baseline models identified with electromechanical controls; however, the same efficiency-level approach was taken to establish the efficiency-level structures for these product classes. The baseline efficiency levels in this direct final rule represent a minimally compliant, basic-construction consumer clothes dryer on the market, such as a dryer with electromechanical controls, and were set according to the lowest tested values under appendix D2 in each product class. As Whirlpool noted, the average CEF score of the five tested units in the vented electric standard product class with electromechanical controls was significantly lower than the proposed standard, further indicating the efficiency savings associated with a transition to a combination of electronic controls and higher design options. Regarding the concern that the proposed amended standards would require the implementation of electronic controls, DOE reiterates that although it expects that electronic controls are most likely to be used to achieve higher efficiency levels, and a review of ENERGY STAR-qualified products suggests increased prevalent use of electronic controls, manufacturers are not required to implement these specific design options to meet amended standards. DOE therefore does not expect the amended standards to preclude electromechanical controls should manufacturers choose to implement them.

Regarding AHAM and Whirlpool's comments that the required implementation of electronic controls to reach efficiency levels above the existing standard may result in a loss of consumer utility associated with the traditional user interface utilizing electromechanical controls, DOE's testing and analysis of models currently on the market confirms Whirlpool's statement that electronic controls may be ''hidden'' from consumers who prefer a more traditional user interface. This may be accomplished by implementing physical dials for consumer use that in turn manipulate the electronic controls in order to achieve the efficiency savings associated with electronic controls while providing the user experience of electromechanical controls. Therefore, even if electronic controls are utilized, DOE does not expect a loss in consumer utility associated with the use of electromechanical controls. DOE notes that AHAM recommended the proposed efficiency levels in the Joint Agreement on behalf of its members, including Whirlpool, in the Joint Agreement, which includes efficiency levels that can be achieved with the implementation of electronic controls.

Whirlpool stated that there may be greater visibility and scrutiny of drying times associated with electronic control clothes dryers among consumers, as electromechanical control dryers do not display drying times. According to Whirlpool, consumers may believe they are losing control of their dryers in a way that results in additional energy consumption, and DOE should account for this possible behavioral shift and lost energy savings. (Whirlpool, No. 53 at p. 7)

DOE is not aware of any data suggesting that the behavior of consumers of with clothes dryers utilizing electronic controls results in greater energy use than for consumers with clothes dryers utilizing electromechanical controls and notes that electronic controls are typically more efficient than electromechanical controls. As previously noted, manufacturers currently provide electronic controls that provide the experience of electromechanical controls through the use of dials which would avoid any loss in consumer utility.

GEA stated that while the appendix D2 test procedure requires use of the ''normal'' or ''medium'' dryness setting for the clothes dryer test cycle, most labs, according to GEA, understand the ''optimum'' dryness setting to be the ''normal'' setting for appendix D2. GEA stated that it provides further clarity to consumers and test labs in the use and care manual for products with an ''optimum'' dryness setting by specifying that optimum is the dryness setting to use for most clothes when running the ''cottons'' cycle (the drying cycle recommended for certain consumer clothes dryers manufactured by GEA for drying cotton). Therefore, based on the cycle settings provided by the additional test information DOE published on October 13, 2022, and information provided by Guidehouse to GEA under a non-disclosure agreement,

GEA stated that DOE incorrectly tested two models in its test sample and urged DOE to either rerun its testing, exclude the models in question from its analysis, or accept the data provided by GEA and adjust its savings model. (GEA, No. 49 at pp. 2–3)

DOE notes that the baseline units GEA referenced are certified under appendix D1, and although these units were not originally intended to be tested under the appendix D2 test procedure, DOE tested them using the appropriate cycle settings under the appendix D2 test procedure to support the engineering analysis. These settings were different than the ''optimum'' dryness setting specified in the use and care manual for these particular units. Although GEA referred to specific cycle settings for consumer use, DOE notes that this instruction for cycle settings does not supersede the requirements of the appendix D2 test procedure. Additionally, DOE notes that the test cycle settings used were within the range anticipated and not expressly warned against by the owner's manual or use and care manual. Therefore, DOE maintains that the correct cycle settings were used to test the units in question.

Whirlpool stated that DOE should have presented the cycle times before and after wrinkle prevention mode was enabled for models in the test sample that had wrinkle prevention mode on by default. Whirlpool further stated that models reported in the data had extremely long cycle times, between 88 and 319 minutes, but that such times were distorted due to testing with wrinkle protection mode enabled. Additionally, Whirlpool stated that testing of consumer clothes dryers with wrinkle prevention mode enabled by default may have distorted some of the tested settings and the resulting CEF scores because wrinkle prevention results in additional cycle time of continuous tumbling after the heating element has been turned off. Whirlpool stated that, this results in an energy penalty as the additional cycle time potentially allows for moisture absorption in the test load to the point of failing to meet the required FMC of 2 percent, and therefore a retest is required using the highest dryness level setting associated with more energy consumption and thus a lower average measured CEF. Whirlpool further stated that wrinkle prevention mode does not produce an accurate comparison of average cycle times and CEF scores of these dryers compared to other dryers that do not have wrinkle prevention modes enabled by default, and DOE should have also recorded the CEF scores, FMC, and drying times of these models before they were allowed to enter wrinkle prevention mode. Whirlpool stated that this data should have been used to inform comparisons between dryers and the development of baseline efficiency levels. Whirlpool stated that if these dryers were designed to the appendix D2 test procedure, wrinkle prevention mode would likely not have been enabled by default. (Whirlpool, No. 53 at pp. 9–10)

In the August 2013 TP Final Rule, DOE clarified that if a clothes dryer is equipped with a wrinkle prevention mode that is activated by default in the as-shipped position, the cycle shall be considered complete after the end of the wrinkle prevention mode. 76 FR 49607, 49623–49624. Although wrinkle prevention mode may have been disabled had the test units been designed for appendix D2 testing, DOE stated previously that accurate testing of existing baseline units according to the appendix D2 test procedure was essential for the analysis, including the use of optional cycle settings that are enabled by default and that do not affect the program, temperature, or dryness settings. The test procedure in appendix D2 therefore requires that testing include wrinkle prevention mode if it is enabled by default. DOE maintains, as it was unable to predict or assume the cycle settings Whirlpool would have selected had the test units been designed for appendix D2 testing, that the test units in question were properly tested in accordance with appendix D2 using the correct cycle settings consistent with the DOE test procedure.

Chapter 5 of the direct final rule TSD discusses the incremental efficiency levels for each of the product classes in this analysis. The revised CEF_{D2} efficiency levels for each product class are shown below in Table IV.5 through Table IV.10, along with the current energy conservation standards in CEF_{D1} for comparison. As discussed in section IV.C.1.a of this document, the baseline CEF_{D2} values estimated for the preliminary analysis are lower than the current CEF_{D1} values in the energy conservation standards due to the differences in testing between appendix D1 and appendix D2.

TABLE IV.5—DIRECT FINAL RULE ANALYSIS: ELECTRIC STANDARD EFFICIENCY LEVELS

Efficiency level (''EL'')	Design option	Current standard CEF_{D1} (lb/kWh)	DFR CEF_{D2} (lb/kWh) *
Baseline	Baseline (Electromechanical Controls)	3.73	2.20
1	Baseline + Electronic Controls		2.68
2	EL1 + Optimized Heating System		3.04
3	EL2 + More Advanced Automatic Termination Control System		3.27
4	EL3 + Modulating (2-Stage) Heat		3.93
5	EL4 + Inlet Air Preheat		4.21
6	Hybrid Heat Pump Dryer (Additional Resistance Heater)		5.20
7	Heat Pump Dryer (Max-Tech)		[44] 7.39

* As discussed above, the baseline CEF_{D2} values represent differences in test procedure between appendix D1 and appendix D2 and do not constitute backsliding.

[44] DOE is aware of consumer clothes dryers in the electric standard product class that perform at higher efficiencies than the proposed max-tech level, but those models are not representative of the typical capacity in the electric standard product class. Therefore, based on the certified performance of those models and additional investigative testing, DOE determined a representative max-tech efficiency for the electric standard product class that reflects an appropriate, representative unit capacity. *See* chapter 5 of the final rule TSD for more information.

TABLE IV.6—DIRECT FINAL RULE ANALYSIS: ELECTRIC COMPACT (120V)—EFFICIENCY LEVELS

Efficiency level	Design option	Current standard CEF_{D1} (lb/kWh)	DFR CEF_{D2} (lb/kWh)
Baseline	Baseline (Electromechanical Controls)	3.61	2.36
1	Baseline + Electronic Controls		3.15
2	EL1 + Optimized Heating System		3.35
3	EL2 + More Advanced Automatic Termination Control System		4.28
4	EL3 + Modulating (2-Stage) Heat		4.33
5	EL4 + Inlet Air Preheat		4.63
6	Heat Pump Dryer (Max-Tech)		6.37

TABLE IV.7—DIRECT FINAL RULE ANALYSIS: VENTED ELECTRIC COMPACT (240V) EFFICIENCY LEVELS

Efficiency level	Design option	Current standard CEF_{D1} (lb/kWh)	DFR CEF_{D2} (lb/kWh)
Baseline	Baseline (Electromechanical Controls)	3.27	2.00
1	Baseline + Electronic Controls		2.44
2	EL1 + Optimized Heating System		2.76
3	EL2 + More Advanced Automatic Termination Control System		3.30
4	EL3 + Modulating (2-Stage) Heat		3.57
5	EL4 + Inlet Air Preheat		3.82
6	Heat Pump Dryer (Max-Tech)		3.91

TABLE IV.8—DIRECT FINAL RULE ANALYSIS: VENTED GAS STANDARD EFFICIENCY LEVELS

Efficiency level	Design option	Current standard CEF_{D1} (lb/kWh) [45]	DFR CEF_{D2} (lb/kWh)
Baseline	Baseline (Electromechanical Controls)	3.30	2.00
1	Baseline + Electronic Controls		2.44
2	EL1 + Optimized Heating System and More Advanced Automatic Termination Control System.		3.00
3	EL2 + Modulating (2-Stage) Heat		3.48
4	EL3 + Inlet Air Preheat (Max-Tech)		3.83

TABLE IV.9—DIRECT FINAL RULE ANALYSIS: VENTLESS ELECTRIC COMPACT (240V) EFFICIENCY LEVELS

Efficiency level	Design option	Current standard CEF_{D1} (lb/kWh)	DFR CEF_{D2} (lb/kWh)
Baseline	Baseline (Electronic Controls)	2.55	2.03
1	Baseline + More Advanced Automatic Termination Control System		2.68
2	Heat Pump Dryer (Max-Tech)		6.80

TABLE IV.10—DIRECT FINAL RULE ANALYSIS: VENTLESS ELECTRIC COMBINATION WASHER-DRYER EFFICIENCY LEVELS

Efficiency level	Design option	Current standard CEF_{D1} (lb/kWh)	DFR CEF_{D2} (lb/kWh)
Baseline	Baseline (Electronic Controls)	2.08	2.27
1	Baseline + High-Speed Spin		2.33
2	Heat Pump Dryer (Max-Tech)		4.01

[45] The current standard does not distinguish a separate product class for compact-size gas consumer clothes dryers. As such, the current standard may apply to all gas consumer clothes dryers.

2. 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 physical product teardowns to determine the baseline MPC for each product class as outlined in chapter 5 of the direct final rule TSD. DOE developed the cost-efficiency relationships for each product class as discussed in section IV.C.3 of this document. DOE developed incremental MPCs based on product teardowns and manufacturing cost modeling of the expected design changes at each efficiency level. DOE observed that the basic product designs of vented electric and vented gas clothes dryers are similar except for the heating system. DOE also observed that the technology designs of standard-size and compact-size consumer clothes dryers are similar as well, simply scaled in size. As a result, in the absence of models available on the market at certain efficiency levels for certain product classes, DOE estimated the incremental MPC for these based on the same design changes observed for the electric standard product class. DOE updated the cost-efficiency analysis from the preliminary analysis by updating the costs of raw materials and purchased components, as well as updating costs for manufacturing equipment, labor, and depreciation. DOE also used information from the teardown of units in the updated test sample to inform updates to the cost-efficiency analysis. Not all units in the updated test sample were torn down; DOE focused on units recently introduced in the market, units with unique configuration, and units with technologies that were not available at the time of the preliminary analysis to better inform the costs associated with particular product classes and design options.

The resulting bill of materials provides the basis for the MPC estimates in this direct final rule. The baseline MPCs for each consumer clothes dryer product class are listed in Table IV.11, with all costs presented in 2022 dollars.

TABLE IV.11—DIRECT FINAL RULE ANALYSIS: CONSUMER CLOTHES DRYER BASELINE MANUFACTURER PRODUCTION COSTS

Product class	Baseline MPC (2022$)
(i) Electric, Standard (4.4 cubic feet (ft^3) or greater capacity)	268.90
(ii) Electric, Compact (120 volts (V)) (less than 4.4 ft^3 capacity)	284.06
(iii) Vented Electric, Compact (240V) (less than 4.4 ft^3 capacity)	284.91
(iv) Vented Gas, Standard (4.4 cubic ft^3 or greater capacity)	303.39
(v) Vented Gas, Compact (less than 4.4 ft^3 capacity)	329.94
(vi) Ventless Electric, Compact (240V) (less than 4.4 ft^3 capacity)	453.09
(vii) Ventless Electric, Combination Washer-Dryer	611.19

To account for manufacturers' non-production costs and profit margin, DOE applies a multiplier (the manufacturer markup) to the MPC. The resulting manufacturer selling price (''MSP'') is the price at which the manufacturer distributes a unit into commerce. DOE developed an average manufacturer markup by examining the annual Securities and Exchange Commission (''SEC'') 10–K reports filed by publicly traded manufacturers primarily engaged in appliance manufacturing and whose combined product range includes consumer clothes dryers.[46] *See* section IV.J.2.d of this document and chapter 12 of the direct final rule TSD for additional information on the manufacturer markup.

3. Cost-Efficiency Results

The results of the engineering analysis are presented as cost-efficiency data for each of the efficiency levels for each of the product classes that were analyzed, as well as those extrapolated from a product class with similar features. DOE developed estimates of MPCs for each unit in the teardown sample to develop a comprehensive set of incremental MPCs (*i.e.,* the additional costs manufacturers would likely incur by producing consumer clothes dryers at each efficiency level compared to the baseline).

The resulting incremental MPCs from this analysis are provided in Table IV.12 through Table IV.17. *See* chapter 5 of the direct final rule TSD for additional detail on the engineering analysis.

[46] U.S. Securities and Exchange Commission, Electronic Data Gathering, Analysis, and Retrieval (''EDGAR'') system. Available at *www.sec.gov/edgar/search/* (last accessed April 21, 2023).

TABLE IV.12—DIRECT FINAL RULE ANALYSIS: ELECTRIC STANDARD INCREMENTAL MANUFACTURER PRODUCTION COSTS

Efficiency level	Design option	Incremental MPC (2022$)
Baseline	Baseline (Electromechanical Controls)	
1	Baseline + Electronic Controls	5.60
2	EL1 + Optimized Heating System	8.60
3	EL2 + More Advanced Automatic Termination Control System	9.15
4	EL3 + Modulating (2-Stage) Heat	15.19
5	EL4 + Inlet Air Preheat	60.11
6	Hybrid Heat Pump Dryer (Additional Resistive Heater)	231.01
7	Heat Pump Dryer (Max-Tech)	240.85

TABLE IV.13—DIRECT FINAL RULE ANALYSIS: ELECTRIC COMPACT (120V) INCREMENTAL MANUFACTURER PRODUCTION COSTS

Efficiency level	Design option	Incremental MPC (2022$)
Baseline	Baseline (Electromechanical Controls)	
1	Baseline + Electronic Controls	7.00
2	EL1 + Optimized Heating System	11.81
3	EL2 + More Advanced Automatic Termination Control System	12.63
4	EL3 + Modulating (2-Stage) Heat	19.43
5	EL4 + Inlet Air Preheat	70.28
6	Heat Pump Dryer (Max-Tech)	225.41

TABLE IV.14—DIRECT FINAL RULE ANALYSIS: VENTED ELECTRIC COMPACT (240V) INCREMENTAL MANUFACTURER PRODUCTION COSTS

Efficiency level	Design option	Incremental MPC (2022$)
Baseline	Baseline (Electromechanical Controls)	
1	Baseline + Electronic Controls	7.63
2	EL1 + Optimized Heating System	12.43
3	EL2 + More Advanced Automatic Termination Control System	13.26
4	EL3 + Modulating (2-Stage) Heat	20.06
5	EL4 + Inlet Air Preheat	70.90
6	Heat Pump Dryer (Max-Tech)	226.03

TABLE IV.15—DIRECT FINAL RULE ANALYSIS: VENTED GAS STANDARD INCREMENTAL MANUFACTURER PRODUCTION COSTS

Efficiency level	Design option	Incremental MPC (2022$)
Baseline	Baseline (Electromechanical Controls)	
1	Baseline + Electronic Controls	9.64
2	EL1 + Optimized Heating System and More Advanced Automatic Termination Control System	11.55
3	EL2 + Modulating (2-Stage) Heat	21.59
4	EL3 + Inlet Air Preheat (Max-Tech)	66.52

TABLE IV.16—DIRECT FINAL RULE ANALYSIS: VENTLESS ELECTRIC COMPACT (240V) INCREMENTAL MANUFACTURER PRODUCTION COSTS

Efficiency level	Design option	Incremental MPC (2022$)
Baseline	Baseline (Electronic Controls)	
1	Baseline + More Advanced Automatic Termination Control System	2.35
2	Heat Pump Dryer (Max-Tech)	196.51

TABLE IV.17—DIRECT FINAL RULE ANALYSIS: VENTLESS ELECTRIC COMBINATION WASHER-DRYER INCREMENTAL MANUFACTURER PRODUCTION COSTS

Efficiency level	Design option	Incremental MPC (2022$)
Baseline	Baseline (Electronic Controls)	
1	Baseline + High-Speed Spin	*0.00
2	Heat Pump Dryer (Max-Tech)	420.04

*Most ventless electric combination washer-dryers are already equipped with a spin-only mode option as a standard feature resulting in an incremental MPC of $0.00 for this design option.

D. Markups Analysis

The markups analysis develops appropriate markups (*e.g.,* manufacturer markups, 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.

DOE considered two distribution channels through which consumer clothes dryers move from manufacturers to consumers. The majority of consumer clothes dryer sales go through the direct retailer channel, in which manufacturers sell the products directly to retailers, who then sell to consumers. This direct retailer channel accounts for 90 percent of the consumer clothes dryer market. The rest of the market goes through a separate new construction distribution channel, in which manufacturers sell the products to wholesalers, who in turn sell the products to general contractors, then to consumers. The main parties in the post-manufacturer distribution channels are retailers, wholesalers, and contractors.

DOE developed baseline and incremental markups for each actor in the distribution channels. 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.[47]

DOE relied on economic data from the U.S. Census Bureau to estimate average baseline and incremental markups. Specifically, DOE used the 2017 Annual Retail Trade Survey for the ''electronics and appliance stores'' sector to develop retailer markups;[48] the 2017 Annual Wholesale Trade Survey for ''household appliances, and electrical and electronic goods merchant wholesalers'' to estimate wholesaler markups;[49] and the 2017 Economic Census for the residential construction sector to derive general contractor markups.[50]

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

E. Energy Use Analysis

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

In conducting the energy use analysis for this direct final rule, DOE considered comments it had received in response to the proposed analysis in the August 2022 NOPR. DOE received a comment from AHAM regarding the number of annual use cycles in the August 2022 NOPR energy use analysis. AHAM requested that DOE review the 2020 Residential Energy Consumption Survey (''2020 RECS'') data[51] and adjust the annual number of cycles accordingly. AHAM stated that it previously commented that RECS 2015 suggested an annual number of cycles of 236 as opposed to the 283 cycles in the current test procedure, which is consistent with the observation that clothes washer cycles have decreased in number to 234 cycles per year using the 2015 RECS. According to AHAM, it does not make sense for clothes washer cycles to decrease and clothes dryer cycles to increase or even stay the same. AHAM suggested that based on the 2020 RECS, the annual number of cycles should be 209. (AHAM, No. 46 at p. 12)

In the August 2022 NOPR analysis, DOE used data from the EIA's 2015 Residential Energy Consumption Survey (''2015 RECS'') to establish a reasonable range of energy consumption in the field for consumer clothes dryers. DOE noted that the microdata for the 2020 RECS was not available at the time the NOPR analysis was conducted but stated that it would update the underlying data to 2020 RECS if it was available prior to the final rule. 87 FR 51762. DOE is aware that the 2020 RECS has been published.[52] This survey collected data from 18,496 housing units and was designed by EIA to represent the household population in the United States. Therefore, DOE has integrated this data into its analysis for the direct final rule concerning households using clothes dryers.

DOE divided the sample of households into four subsamples for the product classes being analyzed:

[47] 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.

[48] U.S. Census Bureau, *Annual Retail Trade Survey.* 2017. Available at *www.census.gov/programs-surveys/arts.html* (last accessed Feb. 1, 2022).

[49] U.S. Census Bureau, Annual Wholesale Trade Survey. 2017. Available at *www.census.gov/wholesale/index.html* (last accessed Feb. 1, 2022).

[50] U.S. Census Bureau. 2017 Economic Census: Construction Industry Series: Detailed Statistics for Establishments: 2017. New Single-Family General Contractors, New Multifamily Housing Construction (Except Operative Builders), New Housing Operative Builders, and Residential Remodelers. Sector 23: 236115 through 236118. 2017. U.S. Census.

[51] The Residential Energy Consumption Survey 2020 data is available at *www.eia.gov/consumption/residential/data/2020/.*

[52] U.S. Department of Energy—Energy Information Administration, *Residential Energy Consumption Survey: 2020 Public Use Data Files.* Available at *www.eia.gov/consumption/residential/data/2020/index.php?view=microdata* (last accessed April 21, 2023).

standard or compact consumer clothes dryers using electricity or natural gas as the dryer fuel. For compact consumer clothes dryers, DOE developed a subsample consisting of households with an electric or gas clothes dryer in multifamily buildings, manufactured homes, and single-family homes with less than 1,000 square feet and no garage or basement, since these products are most likely to be found in these housing types.

The energy use analysis requires DOE to establish a range of total annual usage (number of cycles) in order to estimate annual energy consumption by a clothes dryer. DOE estimated the number of clothes dryer cycles per year for each sample household using data from the 2020 RECS on the number of laundry loads washed (clothes washer cycles) per week and the frequency of clothes dryer use. The average annual energy consumption was then calculated, reflecting an average annual sample-weighted usage of 213 cycles per year.

For each considered efficiency level, DOE derived the field energy use by separately estimating the active mode and standby mode energy use and then adding them together. The per-cycle active mode energy consumption was estimated using the DOE clothes dryer test procedure at appendix D2. It was then back calculated from the test procedure results by dividing the weight (lb) of clothes dried per-cycle (*i.e.,* 8.45 lb for standard and 3 lb for compact consumer clothes dryers) by the CEF_{D2} (lb/kWh) and subtracting standby power. DOE adjusted the test procedure energy use to reflect field conditions by making an adjustment for clothes dryer load weight and moisture removal factor. Chapter 7 of the direct final rule TSD provides more detail about these calculations.

DOE also considered the impact of clothes dryer operation on home heating and cooling loads, given that a clothes dryer releases heat to the surrounding environment. If the clothes dryer is located indoors, its use will tend to slightly reduce the heating load during the heating season and slightly increase the cooling load during the cooling season. To calculate this impact, DOE first estimated whether the clothes dryer in a RECS sample home is located in conditioned space (referred to as ''indoors'') or in unconditioned space (*e.g.,* garages, unconditioned basements, outdoor utility closets, or attics). Based on the 2020 RECS and the 2019 American Housing Survey (''AHS''),[53] DOE assumed that 50 percent of vented standard electric and gas consumer clothes dryers are located indoors, while 100 percent of compact and ventless consumer clothes dryers are located indoors. For these installations, DOE used the results from a European Union study about the impacts of consumer clothes dryers on home heating and cooling loads to determine the appropriate factor to apply to the total clothes dryer energy use.[54] This study reported that for vented consumer clothes dryers, there is a factor of negative 3 to 9 percent (average 3 percent), and for ventless consumer clothes dryers there is a factor of positive 7 to 15 percent (average 11 percent).[55] This effect is likely to be approximately the same for all of the considered efficiency levels because the amount of air passing through the clothes dryer does not vary.

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

F. Life-Cycle Cost and Payback Period Analysis

DOE conducted LCC and PBP analyses to evaluate the economic impacts on individual consumers of potential energy conservation standards for consumer clothes dryers. 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 use, maintenance, and repair). To compute the operating costs, DOE discounts future operating costs to the time of purchase and sums them over the lifetime of the product.
- The PBP is the estimated amount of time (in years) it takes consumers to recover the increased purchase cost (including installation) of a more efficient product through lower operating costs. DOE calculates the PBP by dividing the change in purchase cost at higher efficiency levels by the change in annual operating cost for the year that amended or new standards are assumed to take effect.

For any given efficiency level, DOE measures the change in LCC relative to the LCC in the no-new-standards case, which reflects the estimated efficiency distribution of consumer clothes dryers 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 housing units. As stated previously, DOE developed household samples from the 2020 RECS. For each sample household, DOE determined the energy consumption for the consumer clothes dryers and the appropriate energy price. By developing a representative sample of households, the analysis captured the variability in energy consumption and energy prices associated with the use of consumer clothes dryers.

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 consumption, energy 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 consumer clothes dryer user samples. For this rulemaking, the Monte Carlo approach is implemented in MS Excel together with the Crystal Ball™ add-on.[56] The model calculated the LCC for products

[53] U.S. Census Bureau: Housing and Household Economic Statistics Division, American Housing Survey National Data. 2019, HUD. Available at *www.census.gov/programs-surveys/ahs/data/2019/ahs-2019-public-use-file--puf-.html* (last accessed April 6, 2023).

[54] Rüdenauer, I. and C.-O. Gensch, *Energy demand of tumble driers with respect to differences in technology and ambient conditions,* January 13, 2004. European Committee of Domestic Equipment Manufacturers (CECED).

[55] For units that are located in conditioned space, a negative factor for vented consumer clothes dryers translates to a penalty in energy use, whereas a positive factor for ventless consumer clothes dryers translates to a credit in energy use. For details of the calculations, *see* the Rüdenauer and Gensch study referenced above.

[56] Crystal Ball™ is a 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 May 17, 2023).

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 consumer clothes dryers as if each were to purchase a new product in the first year of required compliance with new or amended standards. New and amended standards apply to consumer clothes dryers manufactured 3 years after the date on which any new or 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 amended standards for consumer clothes dryers for all the TSLs other than TSL 3. For TSL 3, DOE used 2028 as the first year of compliance for all product classes as specified for the Recommended TSL in the Joint Agreement.

Table IV.18 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.18—SUMMARY OF INPUTS AND METHODS FOR THE LCC AND PBP ANALYSIS *

Inputs	Source/method
Product Costs	Derived by multiplying MPCs by manufacturer and retailer markups and sales tax or by manufacturer, wholesaler, and general contractor 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 RSMeans Residential Cost Data 2022. Assumed no change with efficiency level.
Annual Energy Use	Total per-cycle energy use multiplied by the cycles per year. Average number of cycles based on field data. Variability: Based on the 2020 RECS (dryer usage), market data on remaining moisture content (RMC), and load weights.
Energy Prices	Electricity: Based on EIA's Form 861 data for 2022. Variability: Regional energy prices by Census Division.
Energy Price Trends	Based on *AEO2023* energy price projections.
Repair and Maintenance Costs	Repair costs vary between electromechanical and electronic control timers.
Product Lifetime	Average: 14 years.
Discount Rates	Approach involves identifying all possible debt or asset classes that might be used to purchase the considered appliances or that might be affected indirectly. Primary data source was the Federal Reserve Board's Survey of Consumer Finances.
Compliance Date	TSL 1, TSL 2, TSL 4, TSL 5, and TSL 6: 2027. TSL 3 (The Recommended TSL): 2028.

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

For this direct final rule, DOE considered comments it had received regarding the methodology for evaluating consumer economic impact that were submitted in response to the August 2022 NOPR. The approach used for this direct final rule is largely the same approach DOE had used for the August 2022 NOPR analysis.

In response to the August 2022 NOPR AHAM recommended that DOE modify the way consumer economic impact is analyzed and look at the probability that individual consumers will benefit from standards rather than whether the aggregate benefit is positive. (AHAM, No. 46 at p. 13)

In the LCC analysis, DOE notes that it does estimate the impact of potential standards on individual consumers in the household sample and considers the share of consumers that would benefit from a standard as part of its evaluation regarding whether particular standards are economically justified.

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. To derive the learning rate parameter for consumer clothes dryers, DOE obtained historical Producer Price Index (''PPI'') data from the Bureau of Labor Statistics (''BLS'') for ''household laundry equipment'' between 1947 and 2016 and ''major household appliance: primary products'' between 2016 and 2022 to form a time series price index representing household laundry equipment from 1947 to 2022.[57] Inflation-adjusted price indices were calculated by dividing the PPI series by the gross domestic product index from the Bureau of Economic Analysis for the same years. Using this data from 1947 to 2022, the estimated learning rate (defined as the fractional reduction in price from each doubling of cumulative production) is 17.2 percent.

For this direct final rule, DOE considered comments it had received regarding the methodology for calculating consumer product costs that were submitted in response to the August 2022 NOPR. The approach used

[57] ''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 Nov. 29, 2021).

for this direct final rule is largely the same approach DOE had used for the August 2022 NOPR analysis.

In response to the August 2022 NOPR, AHAM stated that DOE's pricing estimates are incorrect because currently, publicly available retail market prices for the lowest-priced units (many of which are equipped with electromechanical controls) are approximately $400, and DOE's estimate for a baseline standard electric unit is $607. (AHAM, No. 46 at pp. 5–6, 8)

Whirlpool stated that DOE does not consider retail prices for models actually being sold in the market today that meet varying efficiency levels and actually utilize technology options needed to meet TSL 3. Whirlpool commented that retail price differences between $200 and $300 may be a better reflection of the expected price premiums for consumers from amended standards than DOE's analysis and methodology. (Whirlpool, No. 53 at p. 7)

In response, DOE notes that the actual retail price differences between a baseline and higher efficiency level currently on the market may include the price for other premium features in addition to engineering designs relating to efficiency. Additionally, retail prices reflect economies of scale in production as well as marketing strategies and profit margins of manufacturers and retailers. DOE maintains that its traditional approach, which has been subject to peer review, is better able to identify the incremental costs that are only connected to higher efficiency. Furthermore, in this direct final rule analysis, DOE leveraged web scraping to gather data on clothes dryer models available on the market from January to March 2023. The data was collected from major retail outlets, including Best Buy, Lowe's, and AJ Madison. DOE found that the lowest-priced baseline model cost $630. DOE therefore concluded that its baseline estimate for a standard electric unit is reasonable for this direct final rule.

2. Installation Cost

Installation cost includes labor, overhead, and any miscellaneous materials and parts needed to install the product. DOE used data from RSMeans Residential Cost Data to estimate the baseline installation cost for consumer clothes dryers.[58] DOE estimated that for the new construction market, it takes, on average, 1 hour to install a clothes dryer, while for the replacement or new-owner market, it takes 2.5 hours (*i.e.,* 1 hour for the trip charge, 30 minutes to remove the old clothes dryer, and 1 hour to install). DOE found no evidence that increased efficiency levels would impact installation costs.

3. Annual Energy Consumption

For each sampled household, DOE determined the energy consumption for a consumer clothes dryer at different efficiency levels using the approach described previously in section IV.E of this document.

4. Energy Prices

Because marginal electricity and gas prices more accurately capture the incremental savings associated with a change in energy use from higher efficiency, they provide 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.

DOE derived electricity prices in 2022 using data from EEI Typical Bills and Average Rates reports. 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).[59]

DOE obtained data for calculating regional prices of natural gas from the EIA publication *Natural Gas*.[60] This publication presents monthly volumes of natural gas deliveries and average prices by state for residential, commercial, and industrial customers.

DOE's methodology allows electricity and gas prices to vary by sector, region, and season. In the analysis, variability in electricity and gas prices is chosen to be consistent with the way the consumer economic and energy use characteristics are defined in the LCC analysis. For consumer clothes dryers, DOE calculated weighted average values for average and marginal electricity and gas price for the 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.[61] To estimate price trends after 2050, the 2046–2050 average was used for all years.

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. Past rules indicate in general that small, incremental increases in product efficiency produce no, or only minor, changes in repair and maintenance costs compared to baseline efficiency products. 76 FR 22454.

For consumer clothes dryers, DOE derived an annualized repair rate based on Consumer Reports data on repair and maintenance issues for consumer clothes dryers. DOE estimated that the average repair rate (which measures the repair frequency) for electric and gas consumer clothes dryers is 12 percent and 14 percent, respectively. The most likely repairs concern the electromechanical control unit or the electronic control unit. The repair costs are annualized by dividing by the average equipment lifetime of 14 years.

For this direct final rule, DOE considered comments it had received regarding the maintenance and repair costs that were submitted in response to the August 2022 NOPR. Whirlpool stated that DOE's NOPR analysis failed to adequately account for the increased repair costs associated with more advanced and expensive electronic parts in electronic control dryers, which would be mandated through DOE's proposed standards. Whirlpool commented that a timer replacement on an electromechanical control dryer will be significantly cheaper than the replacement of an equivalent failed component on an electronic control dryer, with major component differences being the timer, push-to-start button, rotary switch, buzzer, appliance control unit, and user interface assembly. (Whirlpool, No. 53 at pp. 8–9)

[58] RSMeans Online Residential Data (2022 Release). Gordian: Greenville, SC. Available at *www.rsmeansonline.com* (last accessed April 6, 2023).

[59] Coughlin, K. and B. Beraki. 2018. Residential Electricity Prices: A Review of Data Sources and Estimation Methods. Lawrence Berkeley National Laboratory. Berkeley, CA. Report No. LBNL–2001169. Available at *ees.lbl.gov/publications/residential-electricity-prices-review* (last accessed April 6, 2023).

[60] U.S. Department of Energy—Energy Information Administration. *Natural Gas Navigator* 2022. Available at *www.eia.gov/naturalgas/data.php* (last accessed April 6, 2023).

[61] U.S. Department of Energy—Energy Information Administration. *Annual Energy Outlook 2023 with Projections to 2050.* Washington, DC. Available at *www.eia.gov/forecasts/aeo/* (last accessed May 7, 2023).

As previously stated, for this direct final rule, DOE has updated its methodology for estimating repair costs and included repair costs associated with timer replacement in both electromechanical control and electronic control dryers. Based on the information provided by Whirlpool and a literature review, DOE estimated the repair cost to be $75 for an electromechanical control unit and $225 for an electronic control unit.

6. Product Lifetime

For consumer clothes dryers, DOE developed a distribution of lifetimes from which specific values were assigned to the appliances in the test sample. DOE analyzed actual lifetime in the field using a combination of historical shipments data, the stock of the considered appliances in the *American Housing Survey,* and responses in a number of RECS on the age of the appliances in the homes. 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 6-percent increase in the number of consumer clothes dryers retiring before reaching 4 years of age, and an additional 1 percent lasting beyond 15 years. Therefore, for this direct final rule, DOE's estimated average lifetime for consumer clothes dryers remains 14 years, with a distribution that includes 1 percent more dryers retiring before reaching 4 years and 2 percent more dryers remaining after 15 years and up to 30 years, compared to the NOPR Weibull lifetime probability distribution. *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 consumer clothes dryers 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.[62] 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.

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[63] (''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 consumer clothes dryers for 2027 or 2028, DOE used 2021 model data from DOE's CCD and shipments data for consumer clothes dryers from the ENERGY STAR program.[64] [65] Based on the historical shipments trend of ENERGY STAR-qualified consumer clothes dryers, DOE estimated an annual 0.47-percent and 0.02-percent increase in shipment-weighted efficiency for electric standard and vented gas standard clothes dryers, respectively, beginning in 2021. Annual shipment-weighted efficiency for the other product classes (which in total have less than 2.5-percent market share) is held constant. The estimated market shares for the no-new-standards case for consumer clothes dryers are shown in Table IV.19 and Table IV.20. *See* chapter 8 of the direct final rule TSD for further information on the derivation of the efficiency distributions.

TABLE IV.19—NO-NEW-STANDARDS CASE EFFICIENCY DISTRIBUTION IN 2027 AND 2028: ELECTRIC STANDARD, ELECTRIC COMPACT (120V), ELECTRIC COMPACT (240V), AND VENTLESS ELECTRIC COMPACT (240V)

Electric standard		Electric compact (120V)		Vented electric compact (240V)		Ventless electric compact (240V)	
CEF_{D2} (lb/kWh)	Market share (%)	CEF_{D2} (lb/kWh)	Market share (%)	CEF_{D2} (lb/kWh)	Market share (%)	CEF_{D2} (lb/kWh)	Market share (%)
2.20	14	2.36	20	2.00	35	2.03	14

[62] 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.

[63] U.S. Board of Governors of the Federal Reserve System. Survey of Consumer Finances. 1995, 1998, 2001, 2004, 2007, 2010, 2013, 2016, and 2019. Available at *www.federalreserve.gov/econresdata/scf/scfindex.htm* (last accessed May 2023).

[64] U.S. Department of Energy's Compliance Certification Database. Available at *www.regulations.doe.gov/certification-data/#q=Product_Group_s%3A** (last accessed April 17, 2023).

[65] ENERGY STAR, ENERGY STAR® Unit Shipment and Market Penetration Report Calendar Year 2021 Summary. Available at *www.energystar.gov/partner_resources/products_partner_resources/brand_owner_resources/unit_shipment_data* (last accessed April 17, 2023).

TABLE IV.19—NO-NEW-STANDARDS CASE EFFICIENCY DISTRIBUTION IN 2027 AND 2028: ELECTRIC STANDARD, ELECTRIC COMPACT (120V), ELECTRIC COMPACT (240V), AND VENTLESS ELECTRIC COMPACT (240V)—Continued

Electric standard		Electric compact (120V)		Vented electric compact (240V)		Ventless electric compact (240V)	
CEF_{D2} (lb/kWh)	Market share (%)	CEF_{D2} (lb/kWh)	Market share (%)	CEF_{D2} (lb/kWh)	Market share (%)	CEF_{D2} (lb/kWh)	Market share (%)
2.68	13	3.15	15	2.44	25	2.68	59
3.04	13	3.35	25	2.76	30	6.80	28
3.27	9	4.28	0	3.30	10		
3.93	42	4.33	0	3.57	0		
4.21	*6 (7)	4.63	0	3.82	0		
5.20	2	6.37	40	3.91	0		
7.39	1						

*The value in the parentheses indicates 2028 market share.

TABLE IV.20 NO-NEW-STANDARDS CASE EFFICIENCY DISTRIBUTION IN 2027 AND 2028: VENTED GAS STANDARD, AND VENTLESS ELECTRIC COMBINATION WASHER-DRYER*

Vented gas standard		Ventless electric, combination washer-dryer	
CEF_{D2} (lb/kWh)	Market share (%)	CEF_{D2} (lb/kWh)	Market share (%)
2.00	15	2.27	39
2.44	19	2.33	58
3.00	18	4.01	3
3.48	48		
3.83	0		

*There are no models or shipments data for vented gas compact clothes dryers on the market.

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

In the August 2022 NOPR, DOE performed a random assignment of efficiency levels to consumers in its Monte Carlo sample. While DOE acknowledges that economic factors may play a role when consumers decide on what type of clothes dryers to install, assignment of clothes dryer 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, is a reasonable approach, because it simulates behavior in the clothes dryer market, where market failures result in purchasing decisions not being perfectly aligned with economic interests, more realistically than relying only on apparent cost-effectiveness criteria derived from the limited information in RECS. DOE further emphasizes that its approach does not assume that all purchasers of consumer clothes dryers make economically irrational decisions (*i.e.,* the lack of a correlation is not the same as a negative correlation). As part of the random assignment, some homes with more frequent dryer events will be assigned higher efficiency clothes dryers, and some homes with particularly lower dryer events will be assigned baseline units. 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 consumer clothes dryer purchases. First, consumers are motivated by more than simple financial trade-offs. There are several behavioral factors that can influence the purchasing decisions of complicated multi-attribute products, such as consumer clothes dryers. 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.[66] 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.[67] 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

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

[67] 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).

there is a high degree of information asymmetry.[68] These characteristics describe almost all purchasing situations of appliances and equipment, including consumer clothes dryers. The installation of a new or replacement consumer clothes dryers is done very infrequently, as evidenced by the mean lifetime of 14 years for consumer clothes dryers. Further, if the purchaser of the consumer clothes dryer 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 consumer clothes dryers. 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 consumer clothes dryers to install, whereas the renter is responsible for paying energy bills.

In addition to the split-incentive problem, there are other market failures that are likely to affect the choice of consumer clothes dryer efficiency made by consumers. For example, unplanned replacements due to unexpected failure of equipment such as a consumer clothes dryer are strongly biased toward like-for-like replacement (*i.e.,* replacing the non-functioning equipment with a similar or identical product). Time is a constraining factor during 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[69] 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. Consumer clothes dryers do not require EnergyGuide labels, therefore energy consumption information is more difficult to determine for a consumer, resulting in an even more inefficient allocation of energy efficiency across households with different usage levels.

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.*[70] show that consumers tend to underestimate the energy use of large energy-intensive appliances (such as air conditioners, dishwashers, and clothes dryers), but overestimate the energy use of small appliances (such as light bulbs). Therefore, it is possible that consumers systematically underestimate the energy use associated with consumer clothes dryers, resulting in less cost-effective purchases.

These market failures affect a sizeable share of the consumer population. A study by Houde[71] 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 consumer clothes dryer 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 consumer clothes dryer market. Further, even if a specific household is not subject to the market failures above, the purchasing decision of consumer clothes dryer 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 a consumer clothes dryer efficiency that deviates from the efficiency predicted using only energy use or economic considerations such as life-cycle cost or payback period (as calculated using the information from RECS 2020).

There is a complex set of behavioral factors, with sometimes opposing effects, affecting the consumer clothes dryer 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 consumer clothes dryers to households in the no-new-standards case where savings from the rule would be greatest, nor does it preferentially assign lower-efficiency consumer clothes dryers to households in the no-new-standards case where savings from the rule would be smallest. Some consumers were assigned the clothes dryers that they would have chosen if they had engaged in perfect economic considerations when purchasing the products. Others were assigned less-efficient clothes dryers even where a more-efficient product would eventually result in life-cycle savings, simulating scenarios where, for

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

[69] 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).

[70] 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).

[71] 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).

example, various market failures prevent consumers from realizing those savings. Still others were assigned clothes dryers 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.

Therefore, for this direct final rule, DOE performed a random assignment of efficiencies in the LCC analysis.

Additionally, for this direct final rule, DOE considered comments it received regarding the projected distribution of product efficiencies under the no-new-standards case that were submitted in response to the August 2022 NOPR. The CA IOUs requested that DOE clarify the changes in efficiency distributions from the 2021 preliminary analysis to the August 2022 NOPR analysis, specifically regarding the percentage of products that meet or exceed the ENERGY STAR level in the no-new-standards case. The CA IOUs stated that the preliminary analysis efficiency distributions resulted in a reasonably favorable consumer impact analysis for TSL 4. The CA IOUs recommended that DOE reconsider the analysis and conclusion regarding TSL 4 if the preliminary analysis efficiency distributions were more accurate. (CA IOUs, No. 50 at pp. 3–4).

In the 2021 preliminary analysis, DOE utilized a consumer-choice model to calculate market share of various efficiency options for consumer clothes dryers. This model considered factors such as the first cost for electric standard, vented gas standard, ventless electric compact (204V), and ventless electric washer-dryer units. The consumer-choice model relied on historical sales data from 2005 to 2011. To project the efficiency distribution for other product classes (electric compact (120V), vented electric compact (240V), DOE used inputs based on its own test samples and a review of models available in the market.

In the 2022 NOPR analysis, DOE evaluated concerns expressed by stakeholders regarding the adequacy and representativeness of the historical sales data from 2005 to 2011. DOE recognized that these data might not accurately reflect the correlations between shipments and sale prices in recent years. For this reason, as well as to maintain consistency in its methodology across product classes, DOE elected to use CCD model counts [72] instead of market shipments data to derive the no-new-standards case efficiency distributions for the NOPR.

The Joint Commenters commented that the ENERGY STAR shipment data is a better reflection of the consumer clothes dryer market than CCD model counts. The Joint Commenters stated that according to the ENERGY STAR shipment data, only about 40 percent of electric standard dryer models meet TSL 3 as opposed to DOE's estimate of 65 percent. (Joint Commenters, No. 51 at pp. 3–4).

For this direct final rule, DOE has considered the ENERGY STAR shipment data for standard consumer clothes dryers along with other pertinent market information. As a result, DOE has revised the market share estimate for electric and gas standard consumer clothes dryers meeting ENERGY STAR criteria in the compliance year. DOE reduced market share of electric standard consumer clothes dryers that meet TSL 3 from 61 percent to 42 percent and increased market share of gas standard consumer clothes dryers that meet TSL 3 from 38 percent to 48 percent. For the remaining product classes, which together account for less than 2.5 percent of the total shipments, DOE has continued to use the CCD model counts because it is not aware of other available information.

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.

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.[73] 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.

Total product shipments for consumer clothes dryers are developed by considering the demand from replacements for units in stock that fail and the demand from new installations in newly constructed homes. DOE calculated shipments due to replacements using the retirement function developed for the LCC analysis. DOE calculated shipments due to new installations using estimates for consumer clothes dryer saturation rates in newly constructed homes from 2015 to 2020 in the 2020 RECS and projections of new housing starts in *AEO2023*.

DOE disaggregated total product shipments into each product class using estimated market shares of each product class. To estimate these market shares, DOE first developed a linear time series regression model to estimate market share between the product fuel type (*i.e.,* gas or electric) by fitting the historical shipments of gas consumer clothes dryers. Historical shipments data showed a steady decline of market share of gas consumer clothes dryers, from 23 percent in 2000 to 17 percent in 2022. The linear regression model indicates that market share of gas

[72] The CCD database lists basic models of certified consumer clothes dryers that are subject to DOE's energy conservation standards, including their rated capacities and CEF. These clothes dryer models are submitted by manufacturers or their third-party representatives.

[73] 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.

consumer clothes dryers is strongly correlated with its historical time series.

After developing the market share estimation between electric and gas consumer clothes dryers, DOE then subtracted the estimated gas clothes dryer market share from total shipments and divided the electric clothes dryer market share into each electric consumer clothes dryer product class. DOE estimated that electric standard and vented gas standard consumer clothes dryers account for approximately 84 percent and 14 percent of the total shipments during the analysis period, respectively.

To estimate shipments under a standards case, DOE considers the impacts on shipments from changes in product purchase price and operating cost associated with higher energy efficiency levels using a price elasticity and an efficiency elasticity. As in the April 2021 preliminary analysis, DOE employed an efficiency elasticity rate of 0.2 percent and a price elasticity rate of −0.45 percent in its shipments model. These values are based on analysis of aggregated data for five residential appliances: consumer clothes washers, dishwashers, refrigerators, freezers, and room air conditioners.[74] The market impact is defined as the difference between the product of price elasticity of demand and the change in price due to a standard level, and the product of the efficiency elasticity and the change in operating costs due to a standard level.

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 clothes dryer 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 model assumes the remaining average lifetime for a used clothes dryer 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 dryer or a new one. *See* chapter 9 of the direct final rule TSD for details.

For this direct final rule, DOE considered comments it received regarding the shipments analysis that were submitted in response to the August 2022 NOPR. Whirlpool commented that consumers may continue replacing cheaper components well into the life of an electromechanical controlled dryer, extending its life, while they may not decide to make a more expensive electronic component repair, like a user interface assembly, after several years of ownership of an electronic control dryer. Whirlpool stated that DOE's proposed standards may effectively shorten the useful life of a consumer clothes dryer because of this repair-versus-replacement calculus, resulting in loss of time-saving benefits of dryer ownership. (Whirlpool, No. 53 at pp. 8–9)

As stated in section IV.C.1 of this document, the recommended standards would continue to allow for electromechanical controlled clothes dryers to be sold on the market. In addition, DOE is not aware of reliability issues associated with the implementation of electronic controls relative to electromechanical controls. Whirlpool's assertion that the adopted standards may shorten the useful life of consumer clothes dryers lacks quantitative data to support it. As stated in section IV.F.6 of this document, DOE's lifetime estimation is calibrated using shipments data, which include the adopted efficiency levels of ENERGY STAR-qualified consumer clothes dryers sold in the market. DOE's updated Weibull lifetime distribution in this direct final rule captures the trend of shorter lifetime and delayed replacement of consumer clothes dryers based on the recent field data. *See* chapter 9 of the direct final rule TSD for details.

H. National Impact Analysis

The NIA assesses the NES and the NPV from a national perspective of total consumer costs and savings that would be expected to result from new or amended standards at specific efficiency levels.[75] (''Consumer'' in this context refers to consumers of the product being regulated.) DOE calculates the NES and NPV for the potential standard levels considered based on projections of annual product shipments, along with the annual energy consumption and total installed cost data from the energy use and LCC analyses. For the present analysis, DOE projected the energy savings, operating cost savings, product costs, and NPV of consumer benefits over the lifetime of consumer clothes dryers sold from 2027 through 2056 for all TSLs other than 2028 through 2057 for TSL 3 (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 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	Methods
Shipments	Annual shipments from shipments model.
Compliance Date of Standard	TSL 1, TSL 2, TSL 4, TSL 5, and TSL 6: 2027. TSL 3 (the Recommended TSL): 2028.

[74] Fujita, K. (2015) Estimating Price Elasticity using Market-Level Appliance Data. Lawrence Berkeley National Laboratory, LBNL–188289.

[75] The NIA accounts for impacts in the 50 states and U.S. territories.

TABLE IV.21—SUMMARY OF INPUTS AND METHODS FOR THE NATIONAL IMPACT ANALYSIS—Continued

Inputs	Methods
Efficiency Trends	No-new-standards case: Annual efficiency improvement of 0.47% for electric standard and 0.02% for vented gas standard consumer clothes dryers. Standards cases: ''Roll-up'' equipment to meet potential efficiency level.
Annual Energy Consumption per Unit.	Annual weighted average values are a function of energy use at each TSL.
Total Installed Cost per Unit	Annual weighted average values are a function of cost at each TSL. Incorporates projection of future product prices based on historical data.
Annual Energy Cost per Unit	Annual weighted average values as a function of the annual energy consumption per-unit and energy prices.
Repair and Maintenance Cost per Unit.	Annual values change between electromechanical controls and electronic controls efficiency level.
Energy Price Trends	*AEO2023* projections (to 2050) and constant value based on the average between 2046 and 2050 thereafter.
Energy Site-to-Primary and FFC Conversion.	A time-series conversion factor based on *AEO2023.*
Discount Rate	3% and 7%.
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 or new standard. To project the trend in efficiency absent amended standards for consumer clothes dryers over the entire shipments projection period, DOE used an annual 0.47-percent and 0.02-percent increase in shipment-weighted efficiency beginning in 2021 for electric standard and vented gas standard consumer clothes dryers, respectively. The efficiency for the other product classes remains at their 2021 shipments-weighted efficiency levels. The approach is further described in chapter 10 of the direct final rule TSD.

For the standards cases, DOE used a ''roll-up'' scenario to establish the shipment-weighted efficiency for the year that standards are assumed to become effective. 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.

2. National Energy Savings

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

Use of higher efficiency products is sometimes associated with a direct rebound effect, which refers to an increase in utilization of the product due to the increase in efficiency. DOE did not find any data on the rebound effect specific to consumer clothes dryers, so it did not include a rebound effect in the analysis.

Separate from a direct rebound effect, DOE also assessed the potential implications of amended standards as it relates to clothes dryer energy use, namely whether amended standards could result in a decrease in drying performance that would require consumers to re-run their drying cycles to achieve satisfactory drying performance. As discussed in section II.B.2 of this document, DOE's appendix D2 test procedure includes a maximum FMC threshold (*i.e.,* a dryness level threshold that much be achieved in order to be considered a valid test cycle), which ensures that the rated energy consumption of clothes dryers is representative of consumer expectations for dryness. DOE testing confirmed that commercially available products achieve this FMC dryness threshold at each of the efficiency levels considered in this direct final rule analysis. Consequently, DOE has determined that clothes dryers that comply with the amended standards will provide consumer-acceptable levels of dryness corresponding to the rated energy consumption as measured by appendix D2. In the NES, therefore, DOE assumed that the amended standards would not result in any increase in clothes dryer usage, such as that arising from consumers re-running drying cycles.

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 [76] that EIA uses to prepare its *Annual Energy Outlook.* The FFC factors incorporate losses in production and delivery in the case of natural gas

[76] 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 April 20, 2023).

(including fugitive emissions) and additional energy used to produce and deliver the various fuels used by power plants. The approach used for deriving FFC measures of energy use and emissions is described in appendix 10B of the direct final rule TSD.

For this direct final rule, DOE considered comments it had received regarding the methodology for calculating the national energy savings that was presented in the August 2022 NOPR. The approach used for this direct final rule is largely the same approach DOE had used for the August 2022 NOPR analysis.

In response to the August 2022 NOPR, EEI stated that in the past, DOE stated potentially using a captured-energy approach when estimating upstream full-fuel-cycle energy savings; however, EEI noted that in recent notices and rulemakings, DOE is now overstating these estimates by using a fossil fuel equivalent for renewable energy, significantly overstating the upstream savings. (EEI, No. 37 at pp. 45–46)

As previously mentioned, DOE converts electricity consumption and savings to primary energy and FFC energy using annual conversion factors derived from the *AEO.* Traditionally, EIA has used the fossil fuel equivalency approach to report noncombustible renewables' contribution to total primary energy. The fossil fuel equivalency approach applies an annualized weighted average heat rate for fossil fuel power plants to the electricity generated (in kWh) from noncombustible renewables. EIA recognizes that using captured energy (*i.e.,* the net energy available for direct consumption after transformation of a noncombustible renewable energy into electricity) and using incident energy (*i.e.,* the mechanical, radiation, or thermal energy that is measurable as the ''input'' to the device) are possible approaches for converting renewable electricity to a common measure of primary energy, but it continues to use the fossil fuel equivalency approach in the *AEO* and other reporting of energy statistics. DOE has used this approach to accounting for primary energy savings from energy efficiency standards for the entirety of the appliance standards program.

Whirlpool commented that the lessening of utility and performance of dryers, including increases to drying cycle times and potentially increased fabric damage to clothes, may lead to corresponding compensatory behavioral changes from consumers that may result in lost energy savings. Whirlpool recommended that DOE's analysis account for possible negative rebound effects of changes, such that the expected energy savings from an amended standard may not be fully delivered over the analyzed period. Whirlpool commented that consumers associate longer drying times with more potential damage to their clothes and may choose cycles or options that reduce overall drying time at the expense of energy consumption. (Whirlpool, No. 53 at p. 6)

DOE has examined the potential impacts on different attributes of product performance while considering amended standards, as detailed in section IV.C.1 of this document. As discussed further in section V.B.4 of this document, DOE data indicate that the standards adopted by this direct final rule will not necessitate any substantive increase in cycle times compared to typical cycle times currently associated with baseline consumer clothes dryers and therefore are not expected to have any negative impacts on fabric care and product wear and tear that would lead consumers to use more energy consumptive drying cycles. Moreover, DOE notes that the appendix D2 test procedure, which will be required to demonstrate compliance with the amended standards established in this direct final rule, and is currently required for ENERGY STAR certification, ensures that clothes dryers provide a consumer-acceptable level of dryness.

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.[77] In particular, the letter states that the stakeholders do not anticipate the recommended standards will negatively affect features or performance, including cycle time. In particular, the signatories stated that because the test procedure that will be used to determine compliance with amended standards (*i.e.,* appendix D2) requires that dryers meet a threshold for ''final moisture content'' in order to be certified as compliant, this final moisture content requirement ensures that compliant clothes dryers will adequately dry clothes. The signatories further noted that there are more than 400 electric clothes dryer models and nearly 200 gas clothes dryer models that are certified to the current ENERGY STAR specification, which is equivalent to the recommended standard levels and is based on appendix D2, and that these models all meet the final moisture content threshold specified in appendix D2. For further discussion of consumer clothes dryer performance as it relates to amended standards, see section V.B.4 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 dryers through multiple cycles ''to adequately clean or dry their clothing.'' 85 FR 81365. In this rulemaking, DOE has found no evidence suggesting that consumers are running their dryers multiple times at TSL 3 (*i.e.,* the Recommended TSL), which corresponds to the current ENERGY STAR efficiency level for both electric and gas standard clothes dryers. As supported by data described in section IV.E of this document, average consumer usage of electric standard clothes has steadily declined from 301 cycles per year per dryer in the 2005 RECS to 213 cycles per year per dryer in the 2020 RECS, and vented gas standard clothes dryer usage has declined from 292 cycles in the 2005 RECS to 213 cycles in the 2020 RECS, while the average household size has remained essentially unchanged (average 3 household members) during the same period. This shows a significant downward trend in the average number of cycles run on each consumer clothes dryer over the past 15 years, even after the implementation of the current amended standard in 2015. These data indicate that amended energy conservation standards have not resulted in consumers increasing dryer usage due to amended standards for consumer clothes dryers.

Given that there is no evidence of any previous consumer clothes dryer standard increasing drying cycles per year, and in fact, instead cycles per year have decreased over time through multiple standards, DOE determines that a standard at the Recommended TSL would not be expected to lead consumers to increase their use of consumer clothes dryers.

3. Net Present Value Analysis

The inputs for determining the NPV of the total costs and benefits experienced by consumers are (1) total annual installed cost, (2) total annual operating costs (energy costs and repair and maintenance costs), and (3) a discount factor to calculate the present value of costs and savings. DOE

[77] This document is available in the docket at: *www.regulations.gov/comment/EERE-2014-BT-STD-0058-0058.*

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 consumer clothes dryer 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 2057, which is the end date of the projection period for the Recommended TSL detailed in Joint Agreement, the average consumer clothes dryer (real) price is projected to drop 18 percent relative to 2022. 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 consumer clothes dryers. In addition to the default price trend, DOE considered two product price sensitivity cases: (1) a high-price-decline case based on the combined price index from 1980 to 2022 [78] and (2) a constant price trend at the 2022 value. 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 cost savings are calculated using the estimated energy savings in each year and the projected price of the appropriate form of energy. To estimate energy prices in future years, DOE multiplied the average national energy prices by the projection of annual national-average residential energy price changes in the Reference case from *AEO2023,* which has an end year of 2050. To estimate price trends after 2050, the 2046–2050 average was used for all years. As part of the NIA, DOE also analyzed scenarios that used inputs from variants of the *AEO2023* Reference case that have lower and higher economic growth. Those cases have lower and higher energy price trends compared to the Reference case. NIA results based on these cases are presented in appendix 10D 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 OMB to Federal agencies on the development of regulatory analysis.[79] The discount rates for the determination of NPV are in contrast to the discount rates used in the LCC analysis, which are designed to reflect a consumer's perspective. The 7-percent real value is an estimate of the average before-tax rate of return to private capital in the U.S. economy. The 3-percent real value represents the ''social rate of time preference,'' which is the rate at which society discounts future consumption flows to their present value.

I. Consumer Subgroup Analysis

In analyzing the potential impact of new or amended energy conservation standards on consumers, DOE evaluates the impact on identifiable subgroups of consumers that may be disproportionately affected by a new or amended national 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 two subgroups: (1) low-income households and (2) senior-only 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.

For this direct final rule, DOE considered comments it received regarding the consumer subgroup analysis that were submitted in response to the August 2022 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.[80] In particular, the letter states that ''the recommended standards represent the maximum levels of efficiency that are technologically feasible and *economically justified*.'' (emphasis added).

In response to the August 2022 NOPR, AHAM stated that in a recent consumer study conducted by Bellomy Research for AHAM, low-income households were at a disadvantage when purchasing or replacing a laundry appliance, with many households indicating that they would have to make financial sacrifices in other areas of their lives to accommodate purchasing a dryer. AHAM stated that over 90 percent of low-income households cited cost as the most important factor when deciding to purchase a dryer, and nearly 75 percent of low-income households indicated they would not be willing to pay around $100 more for a more efficient appliance at the time of purchase to save approximately $50–$150 in energy costs over the lifetime of that appliance. AHAM stated that one in four low-income households indicated they would delay a replacement purchase if their laundry appliance stopped working, and in cases of replacement, they would replace it with another entry-level/value-tier model. Additionally, AHAM stated that over half of low-income households indicated they would turn to purchasing a used dryer or apply for assistance. (AHAM, No. 46 at pp. 6–7). AHAM stated that standards that result in increased prices for entry-level appliances or that price some consumers out of the clothes dryer market by eliminating technology options that allow manufacturers to produce entry-level models (*e.g.,* electromechanical controls) deepen inequity for underserved communities. According to AHAM, if low-income consumers do not have equitable access, they may forego dryer ownership and use a laundromat with lost time savings and additional operating costs, rely on expensive financing options, or buy an older and possibly less efficient used dryer, thus reducing overall savings potential. (AHAM, No. 46 at pp. 5–6, 8)

AGA and APGA supported AHAM's comments on the disproportionate effect more stringent standards could have on low-income consumers. (AGA et al., No. 47 at p. 4)

Whirlpool stated that low-income consumers may not be able to purchase more efficient dryers due to the

[78] DOE combined PPI data of ''household laundry equipment'' from 1948 to 2016 and PPI data of ''major household appliance: primary products'' from 2016 to 2022 into one time-series price index to project future price for consumer clothes dryers.

[79] U.S. Office of Management and Budget. *Circular A–4: Regulatory Analysis.* Available at *www.whitehouse.gov/omb/information-for-agencies/circulars/* (last accessed April 20, 2023). DOE used the prior version of Circular A–4 (2003) as a result of the effective date of the new version.

[80] This document is available in the docket at: *www.regulations.gov/comment/EERE-2014-BT-STD-0058-0058.*

significant cost increase and their inability to pay for very large emergency purchases over $500. Whirlpool stated that while there may be some level of life-cycle cost savings from proposed standards, consumers who can no longer afford an entry-level dryer may never realize these savings. Whirlpool stated that purchase price increases driven by DOE's proposed standards may drive undesirable consumer behavior, including repairing the old dryer or purchasing a used dryer, effectively keeping older and less efficient appliances on the grid. Whirlpool requested that DOE ensure new appliances remain as affordable to low-income consumers as possible. (Whirlpool, No. 53 at pp. 7–8)

NYSERDA stated that amended standards would significantly improve energy outcomes for low-income households and not create additional burdens. NYSERDA stated that in New York, there is a relatively even split between owner-occupied and rented homes, with a significant number of rental properties, especially in new construction, having in-unit consumer clothes dryers. NYSERDA commented that for individual renters who are not responsible for the purchase of their clothes dryer but who are responsible for paying their utility bills, amended standards will provide utility bill savings without incurring direct equipment costs. (NYSERDA, No. 48 at p. 2)

According to the 2020 RECS clothes dryer sample, approximately 47 percent of low-income households who have a dryer are renters. In most cases, the property owner would purchase a new dryer. While the owner might seek to collect some of this cost in rent, the ability to do so is constrained by lease agreements and larger market forces that influence rent levels in particular locations. Thus, it is reasonable to conclude that renters would see a significant net benefit from a higher efficiency dryer, and this is seen in the results of DOE's analysis (*see* section V.B.1.b of this document for results of the consumer subgroup analysis). Additionally, for this direct final rule, DOE implemented a scenario assuming that landlords would pass some of the incremental clothes dryer costs to renters in the LCC analysis. The results indicate that this scenario would not impact DOE's decision on adopting the amended standards. For details of the sensitivity results, *see* appendix 11A of the direct final rule TSD.

In DOE's analysis, approximately 53 percent of low-income households who have a dryer are homeowners, who would be responsible for purchasing a new dryer. Given that the average incremental increase in price for a dryer meeting the adopted standards (relative to the baseline model that reflects current entry-level products) is $27, DOE believes it is reasonable to conclude that most low-income homeowners who could afford to purchase a new dryer under the current standard could also afford to purchase a dryer that meets the new standard, particularly in the absence of data indicating otherwise. Furthermore, DOE's analysis found that for the largest product class (*i.e.,* electric standard), less than 1 percent of low-income households would experience a net cost under the adopted standard, but the majority would see a net benefit (*see* section V.B.1.b of this document for results of the consumer subgroup analysis).

In total, DOE's analysis estimated that 45 percent of low-income households who have a dryer would experience a net benefit and 54 percent of low-income households who have a dryer would have no impact under the adopted standard.

AHAM comment in response to the August 2022 NOPR that low-income consumers might lose equitable access to on-site dryer usage because of the amended standards did not include supporting data so DOE was unable to fully evaluate the assertion. Nevertheless, DOE's shipments analysis takes into account the market impact under a standards case. For this direct final rule, DOE has implemented scenarios in which affected consumers would either repair their clothes dryers or opt to purchase a used one instead of a new clothes dryer (*see* section IV.G of this document).

AHAM recommended that DOE review all available data sources regarding low-income households and appliances to incorporate into its low-income analysis, in particular the basis of only differential discount rates. AHAM commented that DOE's analysis is a very myopic view of the effects of standards on low-income households, and within this framework the approach of using average discount rates is fundamentally flawed in its understanding of the relationship between disposable income and balance sheet rebalancing. (AHAM, No. 46 at p. 8)

DOE's approach to the low-income consumer subgroup analysis includes households that do not have assets or debts included in the SCF. It is likely that a majority of these ''unbanked'' households primarily rely on cash to complete transactions and as a form of savings, which is included in the distribution of discount rates associated with low-income consumers. Consumers that rely entirely on cash are assigned a discount rate of 0 percent, as there is no lost opportunity cost from alternative noncash assets or debts. For households that utilize nontraditional, nonbank financing, DOE's methodology includes a distribution of high discount rates (*i.e.,* >10% percent), which are representative of the opportunity cost associated with nonbank lines of credit. Therefore, DOE determined that this comprehensive approach enables a fair assessment of discount rates for low-income consumers who have different financial situations.

J. Manufacturer Impact Analysis

1. Overview

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

The quantitative part of the MIA primarily relies on the GRIM, an industry cash flow model with inputs specific to this rulemaking. The key GRIM inputs include data on the industry cost structure, unit production costs, product shipments, manufacturer markups, and investments in R&D and manufacturing capital required to produce compliant products. The key GRIM outputs are the INPV, which is the sum of industry annual cash flows over the analysis period, discounted using the industry-weighted average cost of capital, and the impact on 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 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 consumer clothes dryer manufacturing industry based on the market and technology assessment, preliminary manufacturer interviews, and publicly available information. This included a top-down analysis of consumer clothes dryer 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 consumer clothes dryer manufacturing industry, including company filings of form 10–K from the SEC,[81] corporate annual reports, the U.S. Census Bureau's Quarterly Survey of Plant Capacity Utilization,[82] the U.S. Census Bureau's Annual Survey of Manufactures (''ASM''),[83] and reports from Dun & Bradstreet.[84]

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 consumer clothes dryers in order to develop other key GRIM inputs, including product and capital conversion costs, and to gather additional information on the anticipated effects of energy conservation standards on revenues, direct employment, capital assets, industry competitiveness, and subgroup impacts.

In Phase 3 of the MIA, DOE conducted structured, detailed interviews with representative manufacturers. During these interviews, DOE discussed engineering, manufacturing, procurement, and financial topics to validate assumptions used in the GRIM and to identify key issues or concerns. As part of Phase 3, DOE also evaluated subgroups of manufacturers that may be disproportionately impacted by amended standards or that may not be accurately represented by the average cost assumptions used to develop the industry cash flow analysis. Such manufacturer subgroups may include small business manufacturers, low-volume manufacturers, niche players, and/or manufacturers exhibiting a cost structure that largely differs from the industry average. DOE identified one subgroup for a separate impact analysis: small business manufacturers. The small business subgroup is discussed in 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 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 from the analyzed compliance year.[85] DOE calculated INPVs by summing the stream of annual discounted cash flows during this period. For manufacturers of consumer clothes dryers, DOE used a real discount rate of 7.5 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 amended energy conservation standard on manufacturers. As discussed previously, DOE developed the critical GRIM inputs using a number of sources, including publicly available data, results of the engineering analysis and 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 MPCs of covered products can affect the revenues, gross margins, and cash flow of the industry. DOE models the relationship between efficiency and MPCs as a part of its engineering analysis. 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 year of the analysis period (30 years from the analyzed compliance date [86]). *See* section IV.G of

[81] U.S. Securities and Exchange Commission. Company Filings. Available at *www.sec.gov/edgar/searchedgar/companysearch.html.* (Last accessed June 6, 2023).

[82] U.S. Census Bureau. Quarterly Survey of Plant Capacity Utilization. Available at *www.census.gov/programs-surveys/qpc/data/tables.html* (last accessed June 1, 2023).

[83] U.S. Census Bureau, Annual Survey of Manufactures. Available at *www.census.gov/programs-surveys/asm/data/tables.html* (last accessed June 1, 2023).

[84] The Dun & Bradstreet subscription login is available at *app.dnbhoovers.com* (last accessed June 8, 2023).

[85] For the no-new-standards case and all TSLs except the Recommended TSL (*i.e.,* TSL 3), the analysis period ranges from 2024–2056. For the Recommended TSL, the analysis period ranges from 2024–2057.

[86] *Id.*

this document and chapter 9 of the direct final rule TSD for additional details.

c. Capital and Product Conversion Costs

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 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 amended energy conservation standards.

DOE relied on manufacturer feedback to evaluate the level of capital and product conversion costs manufacturers would likely incur at the various TSLs. During confidential interviews, DOE asked manufacturers to estimate the capital conversion costs (*e.g.,* changes in production processes, equipment, and tooling) to meet the various efficiency levels. DOE also asked manufacturers to estimate the redesign effort and engineering resources required at various efficiency levels to quantify the product conversion costs. 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 reviewed the DOE CCD,[87] U.S. market share estimates, and company characteristics to scale the company-specific conversion cost estimates to levels that represent the overall industry. First, DOE used data from its CCD,[88] the ENERGY STAR-qualified product database,[89] and the California Energy Commission database [90] to identify original equipment manufacturers (''OEMs'') of the covered products. Next, DOE assessed each OEM's U.S. market share and product profile (*e.g.,* estimated sales by product class and efficiency) for consumer clothes dryers. Finally, DOE estimated industry-level conversion cost estimates by scaling feedback from OEMs based on a combination of product offerings and U.S. market share estimates.

DOE adjusted the conversion cost estimates developed in support of the August 2022 NOPR to 2022$ for this analysis. DOE also estimated industry costs associated with appendix D2, as finalized in the October 2021 TP Final Rule. 86 FR 56608.

In general, DOE assumes all conversion-related investments occur between the year of publication of the final rule and the year by which manufacturers must comply with the new standard. The conversion cost figures used in the GRIM can be found in section V.B.2.a of this document. For additional information on the estimated capital and product conversion costs, *see* chapter 12 of the 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 manufacturer markups to the MPCs estimated in the engineering analysis for each product class and efficiency level. Modifying these 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 approximately 21 percent for all product classes.[91] Manufacturers tend to believe it is optimistic to assume that they would be able to maintain the same gross margin percentage as their production costs increase, particularly for minimally efficient products. Therefore, this scenario represents a high bound to industry profitability under an amended energy conservation standard.

Under the preservation of operating profit scenario, DOE modeled a situation in which manufacturers are not able to increase per-unit operating profit in proportion to increases in manufacturer production costs. DOE implemented this scenario in the GRIM by lowering the manufacturer markups at each TSL to yield approximately the same earnings before interest and taxes in the standards case as in the no-new-standards case in the year after the compliance date of the amended standards. The implicit assumption behind this scenario is that the industry can only maintain its operating profit in absolute dollars after the standard.

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

3. Discussion of MIA Comments

For this direct final rule, DOE considered comments it had received regarding its manufacturer impact analysis presented in the August 2022 NOPR. The approach used for this direct final rule is largely the same as the approach DOE had used for the August 2022 NOPR analysis.

AHAM requested that DOE confirm it has fully included all costs that manufacturers would face in compliance to assure that the financial effects on manufacturers are not excessive. (AHAM, No. 46 at p. 11)

As discussed in section IV.J.2.c of this document, DOE primarily relied on manufacturer feedback to estimate the

[87] U.S. Department of Energy's Compliance Certification Database is available at *www.regulations.doe.gov/certification-data* (last accessed April 28, 2023).

[88] *Id.*

[89] ENERGY STAR Product Finder data set, available at *www.energystar.gov/productfinder* (last accessed April 28, 2023).

[90] California Energy Commission Modernized Appliance Efficiency Database System, available at *cacertappliances.energy.ca.gov/Pages/Search/AdvancedSearch.aspx* (last accessed April 28, 2023).

[91] The gross margin percentage of 21 percent is based on a manufacturer markup of 1.26.

capital and product conversion costs that manufacturers would likely incur at the various analyzed efficiency levels. DOE did not receive additional feedback about its conversion cost estimates published in the August 2022 NOPR. Therefore, DOE did not significantly alter its conversion cost methodology in evaluating this direct final rule. DOE adjusted the conversion cost estimates developed in support of the NOPR to 2022$ for this analysis. Additionally, for this direct final rule, DOE updated its product conversion cost estimates to incorporate the estimated industry costs associated with rerating basic models in accordance with appendix D2. 86 FR 56608.

AHAM stated that if DOE is to consider amending energy conservation standards, it must incorporate into its analysis the challenges manufacturers are facing regarding the COVID–19 pandemic and increased tariffs. AHAM commented that DOE cannot simply rely on its previous analysis regarding component costs. (AHAM, No. 46 at pp. 13–14)

For this direct final rule, DOE updated its engineering analysis to incorporate up-to-date cost estimates. Increased costs associated with recent supply chain challenges stemming from the COVID–19 pandemic have been incorporated into the cost analysis by way of 5-year moving averages for materials and the most up-to-date costs for purchased parts.

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. AHAM stated that the existing DOE analysis does not capture this situation, which creates a significant technical and financial burden on manufacturers. (AHAM, No. 46 at p. 11) AHAM stated its support for the ongoing Peer Review process regarding cumulative regulatory burden and stated that DOE should not discount the time and resources needed to evaluate and respond to all proposed test procedures and energy conservation standards for multiple products proposed over a short period. AHAM commented that when these rulemakings occur simultaneously, the cumulative burden increases dramatically. (AHAM, No. 46 at p. 13)

DOE notes that it is adopting the Recommended TSL in this direct final rule. The Joint Agreement included recommendations for other appliance standards rulemakings: residential clothes washers; 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. 55 at p. 3) The Joint Agreement specifies a compliance date of March 1, 2028 for both residential clothes washers and consumer clothes dryers. 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 residential clothes washers and consumer clothes dryers would align.

AHAM urged DOE to incorporate the financial results of the current cumulative regulatory burden analysis directly into the MIA and stated that this is achievable by adding the combined costs of complying with multiple regulations into the Product Conversion Costs in the GRIM model and including the costs to manufacturers of responding to and monitoring regulations. (AHAM, No. 46 at p. 11) AHAM requested that DOE explicitly recognize the industry effects of multiple regulations issued within a short period of time on the same product. AHAM stated that the MIA inherently assumes the regulation analyzed in the INPV analysis is a single event (investment) and that all other cash flows are unaffected by this regulation. In addition, AHAM stated that when there are multiple regulations on the same product within the 6-year lock-in period, the second regulation violates the recoupment assumption inherent in the first one, which is not considered by the GRIM model. AHAM stated that DOE could resolve this by conducting a consolidated analysis for multiple regulations starting from the time of the first regulation or by incorporating a value reduction factor in the first post-regulation year of the analysis that subtracts the value lost from the remaining years of the previous regulation. (*Id.* at pp. 11–12)

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. 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. Conversion costs would be spread over a larger revenue base and result in less severe INPV impacts when evaluated on a percent change basis. Furthermore, DOE is not aware of other Federal, product-specific regulations on consumer clothes dryers that would go into effect 3 years before or after the 2028 compliance date. DOE understands that if the effective dates of the consumer clothes dryer and residential clothes washer amended standards were misaligned, there could be additional development and marketing costs associated with aligning the design cycles of these products, as clothes dryers and clothes washers are typically designed and sold in pairs. However, DOE did not account for any additional development cost associated with this potential regulatory burden, as DOE modeled the recommended March 1, 2028 compliance date from the Joint Agreement for both rulemakings.

AHAM urged DOE to weigh in against regulatory misalignment with Natural Resources Canada (''NRCan'') through the United States-Canada Regulatory Cooperation Council work plan on energy efficiency and under the Memorandum of Understanding (''MOU'') on energy cooperation. AHAM also urged DOE to account for the burden of any misalignment in its analysis. According to AHAM, it is critical that amended standards are coordinated with NRCan, in both substance and timing, to maintain a consistent United States-Canadian market for home appliances. (AHAM, No. 46 at p. 13)

As part of the analysis underlying the energy conservation standards for consumer clothes dryers, DOE considers and reviews standards programs from other regions. As part of this effort, DOE considers regulatory actions undertaken by NRCan and notes that per a notice published on April 2, 2022 in the Canada Gazette, Part I,[92] NRCan is currently proceeding with pre-consultations to align the energy efficiency and testing standard for five home appliance categories including consumer clothes dryer with the outcomes of the current DOE regulatory efforts. Further detail regarding DOE's review of the NRCan regulatory actions and those in other regions are discussed in chapter 3 of the direct final rule TSD.

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

[92] The notice published in the Canada Gazette, Part I can be found at: *gazette.gc.ca/rp-pr/p1/2022/2022-04-02/html/notice-avis-eng.html#ne4.*

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).[93]

The on-site operation of consumer clothes dryers 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.[94]

FFC upstream emissions, which include emissions from fuel combustion during extraction, processing, and transportation of fuels, and ''fugitive'' emissions (direct leakage to the atmosphere) of CH_4 and CO_2, are estimated based on the methodology described in chapter 15 of the 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.

[93] Available at *www.epa.gov/sites/production/files/2021-04/documents/emission-factors_apr2021.pdf* (last accessed April 6, 2023).

[94] 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 May 26, 2023).

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* generally represents current legislation and environmental regulations, including recent government actions, that were in place at the time of preparation of *AEO2023,* including the emissions control programs discussed in the following paragraphs.[95]

SO_2 emissions from affected electric generating units (''EGUs'') are subject to nationwide and regional emissions cap-and-trade programs. Title IV of the Clean Air Act sets an annual emissions cap on SO_2 for affected EGUs in the 48 contiguous States and the District of Columbia (''DC''). (42 U.S.C. 7651 *et seq.*) SO_2 emissions from numerous States in the eastern half of the United States are also limited under the Cross-State Air Pollution Rule (''CSAPR''). 76 FR 48208 (Aug. 8, 2011). CSAPR requires these States to reduce certain emissions, including annual SO_2 emissions, and went into effect as of January 1, 2015.[96] *AEO2023* 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.

[95] 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 May 26, 2023).

[96] 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).

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

CSAPR also established limits on NO_X emissions for numerous States in the eastern half of the United States. Energy conservation standards would have little effect on NO_X emissions in those States covered by CSAPR emissions limits if excess NO_X emissions allowances resulting from the lower electricity demand could be used to permit offsetting increases in NO_X emissions from other EGUs. In such case, 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.

EEI stated that the emissions estimates are significantly overstated

with the passage of the Inflation Reduction Act (''IRA''). EEI recommended that DOE update the analysis to account for the IRA and all the impacts in terms of the significantly increased use of renewable electricity as well as the increase in the number of utilities that have stated zero carbon electricity can be attained within the next 15 to 25 years. (EEI, No. 37 at pp. 54–55)

As previously stated, for the direct final rule DOE used the *AEO2023* Reference case, which includes the IRA, to represent the electric power sector over the coming decades. The *AEO2023* Reference case reflects EIA's view of the most likely uptake of IRA tax credits, and it assumes qualified technologies receive the base tax credit and some bonus credits. The IRA provisions, in combination with other policies and market forces, push wind and solar to 56 percent of electricity generation by 2050. DOE estimated emissions reductions from the adopted standards relative to this case.

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.,* social costs of greenhouse gases ''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 recommended by applicable Executive orders, and DOE would reach the same conclusion presented in this rulemaking in the absence of the social cost of greenhouse gases. That is, the SC–CO_2, 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, did not affect the rule ultimately proposed 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. 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 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 SC–GHG estimates published by the EPA in December 2023 within their rulemaking on oil and natural gas sector sources.[97] For this rulemaking, DOE used these updated SC–GHG values to conduct a sensitivity analysis of the value of GHG emissions reductions associated with alternative standards for clothes dryers (see section IV.L.1.c of this document).

The SC–GHG estimates presented here were developed over many years, using peer-reviewed methodologies, a transparent process, the best science available at the time of that process, and 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 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 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.[98] and underwent a standard double-blind peer review process prior to journal publication. In 2015, as part of the response to public comments received following 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*

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

[98] 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 U.S. Government's SC–CO_2 estimates. *Climate Policy.* 2015. 15(2): pp. 272–298.

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 (National Academies, 2017).[99] Shortly thereafter, in March 2017, President Trump issued Executive Order (''E.O.'') 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,[100] ''including with respect to the consideration of domestic versus international impacts and the consideration of appropriate discount rates'' (E.O. 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 of the National Academies (2017). The IWG was tasked with first reviewing the SC–GHG estimates currently used in Federal analyses and publishing interim estimates within 30 days of E.O. 13990 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 rulemaking. E.O. 13990 instructs the IWG to undertake a fuller update of the SC–GHG estimates by January 2022 that takes into consideration the advice of the National Academies (2017) 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 United States 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 United States citizens and residents by mitigating climate impacts that affect United States 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 United States 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 direct final 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 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 previously discussed, 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 (2017) 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 [101] and recommended that discount rate uncertainty and relevant 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

[99] 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.

[100] U.S. Office of Management and Budget. *Circular A–4: Regulatory Analysis.* Available at *www.whitehouse.gov/omb/information-for-agencies/circulars/* (last accessed April 20, 2023). DOE used the prior version of Circular A–4 (2003) as a result of the effective date of the new version.

[101] Interagency Working Group on Social Cost of Carbon, United States Government. Technical Support Document: Social Cost of Carbon for Regulatory Impact Analysis Under Executive Order 12866. 2010. 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, United States Government. Technical Support Document: 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 Jan. 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 Jan. 18, 2022).

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 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 document.

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 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, with which 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 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.[102] 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 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 interregional 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 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 IWG's February 2021 TSD, which are shown in Table IV.22 in 5-year increments from 2020 to 2050. The set of annual values that DOE used, which was adapted from estimates published by EPA,[103] is presented in appendix 14A of the direct final rule TSD. These estimates are based on methods, assumptions, and parameters identical with the 2020–2050 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 any longer-life consumer clothes dryers after 2070, but a lack of available SC–CO_2 estimates for

[102] Interagency Working Group on Social Cost of Greenhouse Gases (IWG), United States Government. Technical Support Document: Social Cost of Carbon, Methane, and Nitrous Oxide Interim Estimates Under Executive Order 13990. February 2021. 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/* (last accessed May 23, 2023).

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

emissions years beyond 2070 prevents DOE from monetizing these potential benefits in this analysis.

For purposes of capturing the uncertainties involved in regulatory impact analysis, DOE has determined it is appropriate to include all four sets of $SC–CO_2$ values, as recommended by the IWG.[104]

TABLE IV.22—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 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.

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 TSD. Table IV.23 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.23.—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 gross domestic product (''GDP'') from the Bureau of Economic Analysis. To calculate a present value of the stream of monetary values, DOE discounted the values in 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 estimates (2023 SC–GHG) in connection with a final rulemaking under the Clean Air Act.[105] 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 consumer clothes dryers. This sensitivity analysis provides an expanded range of potential climate benefits associated with amended standards. The final year of EPA's new 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 using 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

[104] For example, the February 2021 TSD discusses how the understanding of discounting approaches suggests that discount rates appropriate for intergenerational analysis in the context of climate change may be lower than 3 percent.

[105] *See www.epa.gov/environmental-economics/scghg.*

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.

2. Monetization of Other Emissions Impacts

For the 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.[106] DOE used EPA's values for $PM_{2.5}$-related benefits associated with NO_X and SO_2 and for ozone-related benefits associated with NO_X for 2025 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 benefit-per-ton estimates with regional information on electricity consumption and emissions to define weighted average national values for NO_X and SO_2 as a function of sector (*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 consumer clothes dryers 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.[107] The EPA document provides high and low estimates for 2025 and 2030 at 3- and 7-percent discount rates.[108] 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.

For this direct final rule, DOE considered comments it had received regarding its monetization emission impact analysis presented in the August 2022 NOPR. The approach used for this direct final rule is largely the same as the approach DOE had used for the August 2022 NOPR analysis.

In response to the August 2022 NOPR, AHAM disagreed with DOE's use of both the social cost of carbon (''SCC'') and other monetization of emissions reductions benefits in its analysis of the factors that EPCA requires DOE to balance in determining the appropriate standard, as these values are highly subjective and ever-changing. (AHAM, No. 46 at p. 14)

As stated in section III.E.1.f of this document, DOE maintains that environmental and public health benefits associated with more efficient use of energy, including those connected to global climate change, are important to take into account when considering the need for national energy conservation, which is one of the factors that EPCA requires DOE to evaluate in determining whether a potential energy conservation standard is economically justified. In addition, Executive Order 13563, which was reaffirmed 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 monetized emissions reductions in its evaluation of potential standard levels. As previously stated, however, DOE would reach the same conclusion presented in this rulemaking in the absence of the SC–GHG. 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 64 times higher than the maximum estimated manufacturers' loss in INPV.

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

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

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 Labor Department's Bureau of Labor Statistics (''BLS''). BLS regularly publishes its estimates of the number of

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

[107] ''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.

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

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.[109] 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'').[110] ImSET is a special-purpose version of the ''U.S. Benchmark National Input-Output'' (''I–O'') model, which was designed to estimate the national employment and income effects of energy-saving technologies. The ImSET software includes a computer-based I–O model having structural coefficients that characterize economic flows among 187 sectors most relevant to industrial, commercial, and residential building energy use.

DOE notes that ImSET is not a general equilibrium forecasting model, and that 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 overestimate actual job impacts over the long run for this rule. Therefore, DOE used ImSET only to generate results for near-term timeframes (2027–2033) where these uncertainties are reduced.[111] 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 VI.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.

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.

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 meetings in 2020, and NAS issued the report [112] 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 recommended that DOE adopt the recommendations of the NAS report and incorporate the Regulatory Impact Analysis methodology of Office of Management and Budget (''OMB'') Circular A–4 and start with a more robust assessment of private market failures and alternatives to minimum standards that includes a robust identification and assessment of market failures by market segment. (AHAM, No. 46 at pp. 12–13)

AGA and APGA also commented that DOE should implement recommendations in the NAS report, specifically: appliance standards should be economically justified or based on significant failures of private markets or irrational consumer behavior (Recommendation 2–2); the Cost Analysis segment of the Engineering Analysis should be expanded to include ranges of costs, patterns of consumption, diversity factors, energy peak demand, and variance regarding environmental factors (Recommendation 3–5); DOE should put greater weight on ex post and market-based evidence of markups to project a more realistic range of effects of a standard on prices (Recommendation 4–1); DOE should place greater emphasis on providing an argument for

[109] *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 *www.osti.gov/biblio/7281092* (last accessed July 1, 2021).

[110] 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. Available at *www.pnnl.gov/main/publications/external/technical_reports/PNNL-24563.pdf* (last accessed April 26, 2023).

[111] The near-term timeframes for the Recommended TSL are 2028–2034.

[112] Review of Methods Used by the U.S. Department of Energy in Setting Appliance and Equipment Standards (2021), available at *nap.nationalacademies.org/25992.*

the plausibility and magnitude of any market failure related to the energy efficiency gap in its analyses (Recommendation 4–13); and DOE should give greater attention to a broader set of potential market failures on the supply side, including how standards might reduce the number of competing firms, and also how standards might impact price discrimination, technological diffusion, and collusion (Recommendation 4–14). (APGA *et al.,* No. 47 at pp. 2–3)

The rulemaking process for standards of covered products and equipment are outlined 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 cited by commenters on the August 2022 NOPR, which pertain to the processes by which DOE analyzes energy conservation standards, will be considered in a separate rulemaking considering all product categories.

V. Analytical Results and Conclusions

The following section addresses the results from DOE's analyses with respect to the considered energy conservation standards for consumer clothes dryers. It addresses the TSLs examined by DOE, the projected impacts of each of these levels if adopted as energy conservation standards for consumer clothes dryers, 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 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 market cross elasticity from 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 six TSLs for consumer clothes dryers. DOE developed TSLs that combine efficiency levels for each analyzed product class/category using similar technologies and/or efficiencies and having roughly comparable equipment availability. 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. 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 presents the TSLs and the corresponding efficiency levels that DOE has identified for potential amended energy conservation standards for consumer clothes dryers. For the vented gas compact product class, all TSLs represent the baseline efficiency level because there are no higher efficiency levels, and this level corresponds to the efficiency level for vented gas compact clothes dryers in the Recommended TSL in the Joint Agreement. For all remaining product classes, the TSLs are defined as follows. TSL 6 represents the maximum technologically feasible (''max-tech'') energy efficiency. TSL 5 represents the maximum national energy savings with maximum positive NPV. TSL 4 represents the maximum national energy savings with simple PBP less than 4 years. TSL 3—which corresponds to the Recommended TSL in the Joint Agreement—represents the intermediate efficiency level between TSL 2 and TSL 4. TSL 2 corresponds to the efficiency level with high-speed spin for ventless electric combination washer-dryer and automatic termination control system for all other product classes. TSL 1 corresponds to the efficiency level with electronic controls.

TABLE V.1—TRIAL STANDARD LEVELS FOR CONSUMER CLOTHES DRYERS

Product class	TSL 1	TSL 2	TSL 3	TSL 4	TSL 5	TSL 6
Efficiency level and representative CEF_{D2} (*lb/kWh*)						
Electric, Standard	1 (2.68)	3 (3.27)	4 (3.93)	5 (4.21)	7 (7.39)	7 (7.39)
Electric, Compact (120V)	1 (3.15)	3 (4.28)	4 (4.33)	4 (4.33)	4 (4.33)	6 (6.37)
Vented Electric, Compact (240V)	1 (2.44)	3 (3.30)	4 (3.57)	4 (3.57)	5 (3.82)	6 (3.91)
Vented Gas, Standard	1 (2.44)	2 (3.00)	3 (3.48)	3 (3.48)	4 (3.83)	4 (3.83)
Vented Gas, Compact	Baseline (2.02)	Baseline (2.02)	Baseline (2.02)	Baseline (2.02)	Baseline (2.02)	Baseline (2.02)
Ventless Electric, Compact (240V).	Baseline (2.03)	1 (2.68)	1 (2.68)	1 (2.68)	1 (2.68)	2 (6.80)
Ventless Electric, Combination Washer-Dryer.	Baseline (2.27)	1 (2.33)	1 (2.33)	1 (2.33)	1 (2.33)	2 (4.01)

DOE constructed the TSLs for this direct final rule to include efficiency levels (''ELs'') representative of ELs with similar characteristics (*i.e.,* using similar technologies and/or efficiencies, and having roughly comparable equipment availability). The use of representative ELs provided for greater distinction between the TSLs. While representative ELs were included in the TSLs, DOE considered all ELs as part of its analysis but did not include all ELs in the TSLs.[113]

B. Economic Justification and Energy Savings

1. Economic Impacts on Individual Consumers

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

a. Life-Cycle Cost and Payback Period

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

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

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

Table V.2 through Table V.13 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 in the no-new-standards case in the compliance year (*see* section IV.F.8 of this document). Because some consumers purchase products with higher efficiency in the no-new-standards case, the average savings are less than the difference between the average LCC of the baseline product and the average LCC at each TSL. The savings refer only to consumers who are affected by a standard at a given TSL. Those who already purchase a product with efficiency at or above a given TSL are not affected. Consumers for whom the LCC increases at a given TSL experience a net cost.

TABLE V.2—AVERAGE LCC AND PBP RESULTS FOR ELECTRIC STANDARD CONSUMER CLOTHES DRYERS

TSL	CEF_{D2} (lb/kWh)	Efficiency level	Average costs (2022$)				Simple payback period (years)	Average lifetime (years)
			Installed cost	First year's operating cost	Lifetime operating cost	LCC		
.....	2.20	Baseline	$656	$111	$1,251	$1,907	.....	14
1	2.68	1	666	94	1,082	1,748	0.5	14
2	3.27	3	672	79	922	1,594	0.5	14
3*	3.93	4	678	67	802	1,480	0.6	14
4	4.21	5	756	64	759	1,515	2.1	14
5, 6	7.39	7	1,055	42	514	1,569	5.8	14

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 TSLs except TSL 3 (the Recommended TSL) have a compliance year of 2027. TSL 3 has a compliance year of 2028.

TABLE V.3—AVERAGE LCC SAVINGS RELATIVE TO THE NO-NEW-STANDARDS CASE FOR ELECTRIC STANDARD CONSUMER CLOTHES DRYERS

TSL	CEF_{D2} (lb/kWh)	Efficiency level	Life-cycle cost savings	
			Average LCC savings* (2022$)	Percentage of consumers that experience net cost (%)
1	2.68	1	$150	1.2
2	3.27	3	170	0.9
3**	3.93	4	252	0.9
4	4.21	5	100	48.0
5, 6	7.39	7	41	63.1

* The savings represent the average LCC for affected consumers.

** All TSLs except TSL 3 (the Recommended TSL) have a compliance year of 2027. TSL 3 has a compliance year of 2028.

TABLE V.4—AVERAGE LCC AND PBP RESULTS FOR ELECTRIC COMPACT (120V) CONSUMER CLOTHES DRYERS

TSL	CEF_{D2} (lb/kWh)	Efficiency level	Average costs (2022$)				Simple payback period (years)	Average lifetime (years)
			Installed cost	First year's operating cost	Lifetime operating cost	LCC		
.....	2.36	Baseline	$683	$40	$325	$1,136	.....	14
1	3.15	1	695	32	257	1,082	1.5	14
2	4.28	3	704	25	199	1,017	1.5	14
3*	4.33	4	712	25	198	1,023	2.2	14
4, 5	4.33	4	715	25	198	1,026	2.2	14
6	6.37	6	1,057	19	146	1,301	18.1	14

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 TSLs except TSL 3 (the Recommended TSL) have a compliance year of 2027. TSL 3 has a compliance year of 2028.

TABLE V.5—AVERAGE LCC SAVINGS RELATIVE TO THE NO-NEW-STANDARDS CASE FOR ELECTRIC COMPACT (120V) CONSUMER CLOTHES DRYERS

TSL	CEF_{D2} (lb/kWh)	Efficiency level	Life-cycle cost savings	
			Average LCC savings* (2022$)	Percentage of consumers that experience net cost (%)
1	3.15	1	$53	4.8
2	4.28	3	83	5.1
**3	4.33	4	66	21.4
4, 5	4.33	4	66	21.7

TABLE V.5—AVERAGE LCC SAVINGS RELATIVE TO THE NO-NEW-STANDARDS CASE FOR ELECTRIC COMPACT (120V) CONSUMER CLOTHES DRYERS—Continued

TSL	CEF_{D2} (lb/kWh)	Efficiency level	Life-cycle cost savings	
			Average LCC savings * (2022$)	Percentage of consumers that experience net cost (%)
6	6.37	6	(209)	90.9

* The savings represent the average LCC for affected consumers. Negative values are denoted in parentheses.
** All TSLs except TSL 3 (the Recommended TSL) have a compliance year of 2027. TSL 3 has a compliance year of 2028.

TABLE V.6—AVERAGE LCC AND PBP RESULTS FOR ELECTRIC COMPACT (240V) CONSUMER CLOTHES DRYERS

TSL	CEF_{D2} (lb/kWh)	Efficiency level	Average costs (2022$)				Simple payback period (years)	Average lifetime (years)
			Installed cost	First year's operating cost	Lifetime operating cost	LCC		
	2.00	Baseline	$685	$47	$541	$1,226		14
1	2.44	1	698	41	490	1,187	2.1	14
2	3.30	3	707	32	394	1,101	1.5	14
3 *	3.57	4	714	30	375	1,090	2.0	14
4	3.57	4	718	30	374	1,092	2.0	14
5	3.82	5	802	29	357	1,160	6.6	14
6	3.91	6	1,059	29	352	1,412	20.4	14

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 TSLs except TSL 3 (the Recommended TSL) have a compliance year of 2027. TSL 3 has a compliance year of 2028.

TABLE V.7—AVERAGE LCC SAVINGS RELATIVE TO THE NO-NEW-STANDARDS CASE FOR VENTED ELECTRIC COMPACT (240V) CONSUMER CLOTHES DRYERS

TSL	CEF_{D2} (lb/kWh)	Efficiency level	Life-Cycle cost savings	
			Average LCC savings * (2022$)	Percentage of consumers that experience net cost (%)
1	2.44	1	$38	5.7
2	3.30	3	89	4.6
3 **	3.57	4	90	12.4
4	3.57	4	90	12.6
5	3.82	5	22	60.7
6	3.91	6	(230)	92.8

* The savings represent the average LCC for affected consumers. Negative values are denoted in parentheses.
** All TSLs except TSL 3 (the Recommended TSL) have a compliance year of 2027. TSL 3 has a compliance year of 2028.

TABLE V.8—AVERAGE LCC AND PBP RESULTS FOR VENTED GAS STANDARD CONSUMER CLOTHES DRYERS

TSL	CEF_{D2} (lb/kWh)	Efficiency level	Average costs (2022$)				Simple payback period (years)	Average lifetime (years)
			Installed cost	First year's operating cost	Lifetime operating cost	LCC		
	2.00	Baseline	$794	$56	$668	$1,461		14
1	2.44	1	810	50	607	1,417	2.5	14
2	3.00	2	813	41	511	1,324	1.3	14
3 *	3.48	3	825	36	465	1,291	1.9	14
4	3.48	3	830	37	464	1,293	1.9	14
5, 6	3.83	4	904	34	429	1,333	5.0	14

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 TSLs except TSL 3 (the Recommended TSL) have a compliance year of 2027. TSL 3 has a compliance year of 2028.

TABLE V.9—AVERAGE LCC SAVINGS RELATIVE TO THE NO-NEW-STANDARDS CASE FOR VENTED GAS STANDARD CONSUMER CLOTHES DRYERS

TSL	CEF_{D2} (lb/kWh)	Efficiency level	Life-cycle cost savings	
			Average LCC savings * (2022$)	Percentage of consumers that experience net cost (%)
1	2.44	1	$48	2.7%
2	3.00	2	112	1.7
3 **	3.48	3	102	7.1
4	3.48	3	102	7.0
5, 6	3.83	4	13	68.7

* The savings represent the average LCC for affected consumers.
** All TSLs except TSL 3 (the Recommended TSL) have a compliance year of 2027. TSL 3 has a compliance year of 2028.

TABLE V.10—AVERAGE LCC AND PBP RESULTS FOR VENTLESS ELECTRIC COMPACT (240V) CONSUMER CLOTHES DRYERS

TSL	CEF_{D2} (lb/kWh)	Efficiency level	Average costs (2022$)				Simple payback period (years)	Average lifetime (years)
			Installed cost	First year's operating cost	Lifetime operating cost	LCC		
	2.03	Baseline	$1,020	$41	$475	$1,495		14
1	2.03	Baseline	1,020	41	475	1,495		14
2, 4, 5	2.68	1	1,024	31	368	1,392	0.4	14
3 *	2.68	1	1,018	30	370	1,387	0.4	14
6	6.80	2	1,346	12	167	1,513	11.4	14

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 TSLs except TSL 3 (the Recommended TSL) have a compliance year of 2027. TSL 3 has a compliance year of 2028.

TABLE V.11—AVERAGE LCC SAVINGS RELATIVE TO THE NO-NEW-STANDARDS CASE FOR VENTLESS ELECTRIC COMPACT (240V) CONSUMER CLOTHES DRYERS

TSL	CEF_{D2} (lb/kWh)	Efficiency level	Life-cycle cost savings	
			Average LCC savings * (2022$)	Percentage of consumers that experience net cost (%)
1	2.03	Baseline		
2, 4, 5	2.68	1	99	0.0
3 **	2.68	1	99	0.0
6	6.80	2	(102)	58.6

* The savings represent the average LCC for affected consumers. Negative values are denoted in parentheses.
** All TSLs except TSL 3 (the Recommended TSL) have a compliance year of 2027. TSL 3 has a compliance year of 2028.

TABLE V.12—AVERAGE LCC AND PBP RESULTS FOR VENTLESS ELECTRIC COMBINATION WASHER-DRYER CONSUMER CLOTHES DRYERS

TSL	CEF_{D2} (lb/kWh)	Efficiency level	Average costs (2022$)				Simple payback period (years)	Average lifetime (years)
			Installed cost	First year's operating cost	Lifetime operating cost	LCC		
1	2.27	Baseline	$1,335	$37	$445	$1,780		14
2, 4, 5	2.33	1	1,335	36	435	1,769	0.0	14
3 *	2.33	1	1,327	36	436	1,763	0.0	14
6	4.01	2	2,031	22	275	2,305	46.3	14

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 TSLs except TSL 3 (the Recommended TSL) have a compliance year of 2027. TSL 3 has a compliance year of 2028.

TABLE V.13—AVERAGE LCC SAVINGS RELATIVE TO THE NO-NEW-STANDARDS CASE FOR VENTLESS ELECTRIC COMBINATION WASHER-DRYER CONSUMER CLOTHES DRYERS

TSL	CEF_{D2} (lb/kWh)	Efficiency level	Life-cycle cost savings	
			Average LCC savings* (2022$)	Percentage of consumers that experience net cost (%)
1	2.27	Baseline	.....	.....
2, 4, 5	2.33	1	$10	0.0
3**	2.33	1	11	0.0
6	4.01	2	(531)	95.0

*The savings represent the average LCC for affected consumers. Negative values are denoted in parentheses.
** All TSLs except TSL 3 (the Recommended TSL) have a compliance year of 2027. TSL 3 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.14 through Table V.25 compare the average LCC savings, PBP, percent of consumers negatively impacted, and percent of consumers positively impacted at each EL for the consumer subgroups, along with corresponding values for the entire residential consumer sample for product classes with a sufficient sample size. In most cases, the average LCC savings and PBP for low-income households and senior-only households at the considered ELs are not substantially different from the average for all households. Chapter 11 of the direct final rule TSD presents the complete LCC and PBP results for the subgroups.

TABLE V.14—COMPARISON OF LCC SAVINGS AND PBP FOR CONSUMER SUBGROUPS AND ALL HOUSEHOLDS: ELECTRIC STANDARD CONSUMER CLOTHES DRYERS

EL	TSL	Average life-cycle cost savings* (2022$)			Simple payback period (years)		
		Low-income households	Senior-only households	All households	Low-income households	Senior-only households	All households
1	1	$148	$110	$150	0.3	0.7	0.5
3	2	166	128	170	0.3	0.6	0.5
4	**3	245	190	252	0.3	0.8	0.6
5	4	127	58	100	1.1	2.8	2.1
7	5, 6	180	(56)	41	3.2	7.6	5.8

*The savings represent the average LCC for affected consumers. Negative values are denoted in parentheses.
** All TSLs except TSL 3 (the Recommended TSL) have a compliance year of 2027. TSL 3 has a compliance year of 2028.

TABLE V.15—COMPARISON OF PERCENTAGES OF IMPACTED CONSUMERS* FOR CONSUMER SUBGROUPS AND ALL HOUSEHOLDS: ELECTRIC STANDARD CONSUMER CLOTHES DRYERS

EL	TSL	Low-income households (%)	Senior-only households (%)	All households (%)
1	1	1.3	1.4	1.2
3	2	1.0	1.1	0.9
4	**3	0.8	1.1	0.9
5	4	26.6	53.6	48.0
7	5, 6	34.9	71.6	63.1

*Percentage of impacted consumers indicates households with net cost.
** All TSLs except TSL 3 (the Recommended TSL) have a compliance year of 2027. TSL 3 has a compliance year of 2028.

TABLE V.16—COMPARISON OF LCC SAVINGS AND PBP FOR CONSUMER SUBGROUPS AND ALL HOUSEHOLDS: ELECTRIC COMPACT (120V) CONSUMER CLOTHES DRYERS

EL	TSL	Average life-cycle cost savings* (2022$)			Simple payback period (years)		
		Low-income households	Senior-only households	All households	Low-income households	Senior-only households	All households
1	1	$67	$34	$53	0.7	2.1	1.5
3	2	96	61	83	0.7	1.9	1.5
4	**3	84	46	66	1.0	2.9	2.2
4	4, 5	83	46	66	1.0	2.9	2.2
6	6	(23)	(243)	(209)	8.5	23.4	18.1

*The savings represent the average LCC for affected consumers. Negative values are denoted in parentheses.
** All TSLs except TSL 3 (the Recommended TSL) have a compliance year of 2027. TSL 3 has a compliance year of 2028.

TABLE V.17—COMPARISON OF PERCENTAGES OF IMPACTED CONSUMERS * FOR CONSUMER SUBGROUPS AND ALL HOUSEHOLDS: ELECTRIC COMPACT (120V) CONSUMER CLOTHES DRYERS

EL	TSL	Low-income households (%)	Senior-only households (%)	All households (%)
1	1	4.0	5.0	4.8
3	2	3.8	5.6	5.1
4	** 3	12.2	24.8	21.4
4	4, 5	12.2	25.0	21.7
6	6	43.9	94.9	90.9

* Percentage of impacted consumers indicates households with net cost.
** All TSLs except TSL 3 (the Recommended TSL) have a compliance year of 2027. TSL 3 has a compliance year of 2028.

TABLE V.18—COMPARISON OF LCC SAVINGS AND PBP FOR CONSUMER SUBGROUPS AND ALL HOUSEHOLDS: VENTED ELECTRIC COMPACT (240V) CONSUMER CLOTHES DRYERS

EL	TSL	Average life-cycle cost savings * (2022$)			Simple payback period (years)		
		Low-income households	Senior-only households	All households	Low-income households	Senior-only households	All households
1	1	$51	$22	$38	1.0	2.8	2.1
3	2	102	66	89	0.7	2.0	1.5
4	** 3	109	65	90	1.0	2.6	2.0
4	4	109	64	90	1.0	2.6	2.0
5	5	83	(7)	22	3.1	8.5	6.6
6	6	(45)	(260)	(230)	9.6	26.5	20.4

* The savings represent the average LCC for affected consumers. Negative values are denoted in parentheses.
** All TSLs except TSL 3 (the Recommended TSL) have a compliance year of 2027. TSL 3 has a compliance year of 2028.

TABLE V.19—COMPARISON OF PERCENT OF IMPACTED CONSUMERS * FOR CONSUMER SUBGROUPS AND ALL HOUSEHOLDS: VENTED ELECTRIC COMPACT (240V) CONSUMER CLOTHES DRYERS

EL	TSL	Low-income households (%)	Senior-only households (%)	All households (%)
1	1	4.5	6.0	5.7
3	2	3.7	5.0	4.6
4	** 3	7.4	15.1	12.4
4	4	7.5	15.3	12.6
5	5	30.0	68.5	60.7
6	6	44.9	96.1	92.8

* Percent of impacted consumers indicates households with net cost.
** All TSLs except TSL 3 (the Recommended TSL) have a compliance year of 2027. TSL 3 has a compliance year of 2028.

TABLE V.20—COMPARISON OF LCC SAVINGS AND PBP FOR CONSUMER SUBGROUPS AND ALL HOUSEHOLDS: VENTED GAS STANDARD CONSUMER CLOTHES DRYERS

EL	TSL	Average life-cycle cost savings * (2022$)			Simple payback period (years)		
		Low-income households	Senior-only households	All households	Low-income households	Senior-only households	All households
1	1	$57	$33	$48	1.3	3.3	2.5
2	2	117	91	112	0.7	1.6	1.3
3	** 3	113	81	102	1.0	2.4	1.9
3	4	113	81	102	1.0	2.4	1.9
4	5, 6	54	(5)	13	2.7	6.3	5.0

* The savings represent the average LCC for affected consumers. Negative values are denoted in parentheses.
** All TSLs except TSL 3 (the Recommended TSL) have a compliance year of 2027. TSL 3 has a compliance year of 2028.

TABLE V.21—COMPARISON OF PERCENTAGES OF IMPACTED CONSUMERS * FOR CONSUMER SUBGROUPS AND ALL HOUSEHOLDS: VENTED GAS STANDARD CONSUMER CLOTHES DRYERS

EL	TSL	Low-income households (%)	Senior-only households (%)	All households (%)
1	1	2.4	3.0	2.7
2	2	1.6	1.7	1.7
3	** 3	4.8	8.9	7.1
3	3, 4	4.8	8.8	7.0

TABLE V.21—COMPARISON OF PERCENTAGES OF IMPACTED CONSUMERS * FOR CONSUMER SUBGROUPS AND ALL HOUSEHOLDS: VENTED GAS STANDARD CONSUMER CLOTHES DRYERS—Continued

EL	TSL	Low-income households (%)	Senior-only households (%)	All households (%)
4	5, 6	35.9	74.5	68.7

* Percentage of impacted consumers indicates households with net cost.
** All TSLs except TSL 3 (the Recommended TSL) have a compliance year of 2027. TSL 3 has a compliance year of 2028.

TABLE V.22—COMPARISON OF LCC SAVINGS AND PBP FOR CONSUMER SUBGROUPS AND ALL HOUSEHOLDS: VENTLESS ELECTRIC COMPACT (240V) CONSUMER CLOTHES DRYERS

EL	TSL	Average life-cycle cost savings * (2022$)			Simple payback period (years)		
		Low-income households	Senior-only households	All households	Low-income households	Senior-only households	All households
0	1	.....	.....	.....	.....	.....	.....
1	2, 4, 5	$108	$80	$99	0.2	0.5	0.4
1	**3	108	80	99	0.2	0.5	0.4
2	6	64	(147)	(102)	5.4	14.5	11.4

* The savings represent the average LCC for affected consumers. Negative values are denoted in parentheses.
** All TSLs except TSL 3 (the Recommended TSL) have a compliance year of 2027. TSL 3 has a compliance year of 2028.

TABLE V.23—COMPARISON OF PERCENT OF IMPACTED CONSUMERS * FOR CONSUMER SUBGROUPS AND ALL HOUSEHOLDS: VENTLESS ELECTRIC COMPACT (240V) CONSUMER CLOTHES DRYERS

EL	TSL	Low-income households (%)	Senior-only households (%)	All households (%)
0	1	.....	.....	.....
1	2, 4, 5	0.0	0.0	0.0
2	**3	0.0	0.0	0.0
2	6	27.8	63.4	58.6

* Percentage of impacted consumers indicates households with net cost.
** All TSLs except TSL 3 (the Recommended TSL) have a compliance year of 2027. TSL 3 has a compliance year of 2028.

TABLE V.24—COMPARISON OF LCC SAVINGS AND PBP FOR CONSUMER SUBGROUPS AND ALL HOUSEHOLDS: VENTLESS ELECTRIC COMBINATION WASHER-DRYER CONSUMER CLOTHES DRYERS

EL	TSL	Average life-cycle cost savings * (2022$)			Simple payback period (years)		
		Low-income households	Senior-only households	All households	Low-income households	Senior-only households	All households
0	1	.....	.....	.....	.....	.....	.....
1	2, 4, 5	$11	$8	$10	0.0	0.0	0.0
1	**3	11	8	11	0.0	0.0	0.0
2	6	(186)	(565)	(531)	22.0	58.6	46.3

* The savings represent the average LCC for affected consumers. Negative values are denoted in parentheses.
** All TSLs except TSL 3 (the Recommended TSL) have a compliance year of 2027. TSL 3 has a compliance year of 2028.

TABLE V.25—COMPARISON OF PERCENTAGES OF IMPACTED CONSUMERS * FOR CONSUMER SUBGROUPS AND ALL HOUSEHOLDS: VENTLESS ELECTRIC COMBINATION WASHER-DRYER CONSUMER CLOTHES DRYERS

EL	TSL	Low-income households (%)	Senior-only households (%)	All households (%)
0	1	.....	.....	.....
1	2, 4, 5	0.0	0.0	0.0
1	**3	0.0	0.0	0.0
2	6	44.8	96.2	95.0

* Percentage of impacted consumers indicates households with net cost.
** All TSLs except TSL 3 (the Recommended TSL) have a compliance year of 2027. TSL 3 has a compliance year of 2028.

c. Rebuttable Presumption Payback

As discussed in section II.A 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 consumer clothes dryers. In contrast, the PBPs presented in section V.B.1.a of this document were calculated using distributions that reflect the range of energy use in the field.

Table V.26 presents the rebuttable presumption payback periods for the considered TSLs for consumer clothes dryers. 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.26—REBUTTABLE PRESUMPTION PAYBACK PERIODS

Product class	Trial standard level					
	1	2	3*	4	5	6
	(years)					
Electric, Standard	0.4	0.3	0.4	1.5	4.1	4.1
Electric, Compact (120 V)	1.0	1.0	1.6	1.6	1.6	13.0
Vented Electric, Compact (240 V)	3.2	1.0	1.4	1.4	4.6	14.2
Vented Gas, Standard	3.1	2.0	2.9	2.8	7.8	7.8
Ventless Electric, Compact (240 V)	.....	0.3	0.3	0.3	0.3	8.8
Ventless Electric, Combination Washer-Dryer	.....	0.0	0.0	0.0	0.0	33.8

* All TSLs except TSL 3 (the Recommended TSL) have a compliance year of 2027. TSL 3 has a compliance year of 2028.

2. Economic Impacts on Manufacturers

DOE performed an MIA to estimate the impact of amended energy conservation standards on manufacturers of consumer clothes dryers. 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 consumer clothes dryers, as well as the conversion costs that DOE estimates manufacturers of consumer clothes dryers would incur at each TSL.

The impacts 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. In the preservation-of-gross-margin-percentage scenario, DOE applied a gross margin percentage of 21 percent for all product classes and all efficiency levels in the standards case.[114] This scenario assumes that a manufacturer's per-unit dollar profit would increase as MPCs increase in the standards cases. DOE models this scenario as an upper bound to industry profitability under an energy conservation standard.

In the preservation-of-operating-profit scenario, manufacturers do not earn additional operating profit when compared to the no-new-standards case scenario. While manufacturers make the necessary upfront investments required to produce compliant products, per-unit operating profit does not change in absolute dollars. DOE models this scenario as the lower bound to industry profitability under an energy conservation standard.

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).[115] 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 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 new standard. The conversion costs can have a significant impact on short-term cash flow within the industry and generally result in lower free cash flow in the period between 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.

[114] The gross margin percentage of 21 percent is based on a manufacturer markup of 1.26.

[115] The analysis period ranges from 2024–2056 for the no-new-standards case and all TSLs, except for TSL 3 (the Recommended TSL). The analysis period for TSL 3 ranges from 2024–2057 due to the 2028 compliance year.

TABLE V.27—MANUFACTURER IMPACT ANALYSIS RESULTS FOR CONSUMER CLOTHES DRYERS

	Units	No-new-standards case	TSL 1	TSL 2	TSL 3	TSL 4	TSL 5	TSL 6
INPV	*2022$ millions.*	2,115.4	2,080.3 to 2,084.3.	2,061.1 to 2,069.5.	1,971.2 to 1,995.8.	1,501.9 to 1,724.8.	679.9 to 1,800.8.	604.3 to 1,753.5
Change in INPV *	%		(1.7) to (1.5)	(2.6) to (2.2)	(6.8) to (5.7)	(29.0) to (18.5)	(67.9) to (14.9).	(71.4) to (17.1)
Free Cash Flow (2026) **	*2022$ millions.*	*** 136.7	119.2	109.7	61.2	(153.7)	(496.0)	(531.4)
Change in Free Cash Flow (2026) **.	%		(12.8)	(19.8)	(55.2)	(212.5)	(462.9)	(488.8)
Product Conversion Costs	*2022$ millions.*		27.3	37.6	51.7	87.7	122.6	128.2
Capital Conversion Costs	*2022$ millions.*		18.6	31.9	128.9	579.7	1,314.3	1,388.8
Total Conversion Costs	*2022$ millions.*		45.8	69.5	180.7	667.5	1,436.9	1,516.9

* Parentheses denote negative values.
** TSL 3 (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 $136.6 million.

The cash flow results discussion below refers to product classes as defined in Table IV.1 in section IV.A.1 of this document. It also refers to the efficiency levels and associated design options designated in Table IV.5 through Table IV.10 in section IV.C.1.b of this document.

At TSL 1, the standard reflects efficiency levels with electronic controls for all product classes. The change in INPV is expected to range from −1.7 to −1.5 percent. At this level, free cash flow is estimated to decrease by 12.8 percent compared to the no-new-standards case value of $136.7 million in the year 2026, the year before the 2027 standards year. DOE's shipments analysis estimates approximately 85 percent of current shipments meet this level.[116]

The design options DOE analyzed include implementing electronic controls. For electric standard, electric compact (120V), vented electric compact (240V), and vented gas standard, TSL 1 corresponds to EL 1. For ventless electric compact (240V) and ventless electric combination washer-dryer, TSL 1 corresponds to the baseline CEF_{D2}. Capital conversion costs may be necessary for additional tooling for timers and electronics. Product conversion costs may be necessary for developing, sourcing, and testing electronics (*e.g.,* safety, performance, and durability tests). DOE does not expect industry to incur re-flooring costs at this level since the necessary enhancements could be done ''behind the hinge,'' incorporating the design changes in a manner that does not impact product appearance. DOE does not expect industry to incur conversion costs related to the ventless electric compact (240V) or ventless electric combination washer-dryer as the efficiency levels would remain at baseline. DOE estimates capital conversion costs of $18.6 million and product conversion costs of $27.3 million. Conversion costs total $45.8 million.

At TSL 1, the shipment-weighted average MPC for all consumer clothes dryers is expected to increase by 0.3 percent relative to the no-new-standards case shipment-weighted average MPC for all consumer clothes dryers in 2027. Given this relatively small increase in production costs, DOE does not project a notable drop in shipments in the year the standard takes effect. In the preservation-of-gross-margin-percentage scenario, the slight increase in cash flow from the higher MSP is outweighed by the $45.8 million in conversion costs, causing a slightly negative change in INPV at TSL 1 under this scenario. Under the preservation-of-operating-profit scenario, manufacturers earn the same per-unit operating profit as would be earned in the no-new-standards case, but manufacturers do not earn additional profit from their investments. In this scenario, the manufacturer markup decreases in 2028, the year after the analyzed 2027 compliance year. This reduction in the manufacturer markup and the $45.8 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, the standard reflects efficiency levels with more advanced automatic termination controls for electric standard, electric compact (120V), vented electric compact (240V), vented gas standard, and ventless electric compact (240V), and high-speed spin for ventless electric combination washer-dryer. The change in INPV is expected to range from −2.6 to −2.2 percent. At this level, free cash flow is estimated to decrease 19.8 percent compared to the no-new-standards case value of $136.7 million in the year 2026, the year before the 2027 standards year. DOE's shipments analysis estimates approximately 58 percent of current shipments meet this level.

The design options for electric standard, electric compact (120V), vented electric compact (240V), vented gas standard, and ventless electric compact (240V) include implementing electronic controls, optimized heating systems, and more advanced automatic termination controls. For ventless electric combination washer-dryer, the design option analyzed includes high-speed spin cycles. For the electric standard, electric compact (120V), and vented electric compact (240V), TSL 2 corresponds to EL 3. For vented gas standard, TSL 2 corresponds to EL 2. For ventless electric compact (240V) and ventless electric combination washer-dryer, TSL 2 corresponds to EL 1. Capital conversion costs may be necessary for incremental updates in tooling. Product conversion costs may be necessary for software optimization, prototyping, and testing. DOE expects industry to incur some re-flooring costs as manufacturers redesign product lines to meet the efficiency levels required by TSL 2. DOE estimates capital conversion costs of $31.9 million and product conversion costs of $37.6 million. Conversion costs total $69.5 million.

At TSL 2, the shipment-weighted average MPC for all consumer clothes dryers is expected to increase by 0.6 percent relative to the no-new-standards case shipment-weighted average MPC for all consumer clothes dryers in 2027. Given the relatively small increase in production costs, DOE does not project a notable drop in shipments in the year

[116] Current shipments calculations relied on shipments in 2024 (the reference year).

the standard takes effect. In the preservation-of-gross-margin-percentage scenario, the slight increase cash flow from the higher MSP is outweighed by the $69.5 million in conversion costs, causing a slightly negative change in INPV at TSL 2 under this scenario. Under the preservation-of-operating-profit scenario, the manufacturer markup decreases in 2028, the year after the analyzed 2027 compliance year. This reduction in the manufacturer markup and the $69.5 million in conversion costs incurred by manufacturers cause a negative change in INPV at TSL 2 under the preservation-of-operating-profit scenario.

At TSL 3 (*i.e.,* the Recommended TSL), the standard reflects a set of efficiency levels between the levels designated in TSL 2 and TSL 4. The change in INPV is expected to range from −6.8 to −5.7 percent. At this level, free cash flow is estimated to decrease 55.2 percent compared to the no-new-standards case value of $136.6 million in the year 2027, the year before the 2028 standards year. DOE's shipments analysis estimates approximately 48 percent of current shipments meet this level.

The design options analyzed for electric standard, electric compact (120V), vented electric compact (240V), and vented gas standard include implementing electronic controls, optimized heating systems, more advanced automatic termination controls, and modulating heat. For ventless electric compact (240V) and ventless electric combination washer-dryer, the design options analyzed are the same as TSL 2. For electric standard, electric compact (120V), and vented electric compact (240V), TSL 3 corresponds to EL 4. For vented gas standard, TSL 3 corresponds to EL 3. For ventless electric compact (240V) and ventless electric combination washer-dryer, TSL 3 corresponds to EL 1. The incremental increase in industry conversion costs from the prior TSL are due to the higher efficiency level requirements for electric standard, electric compact (120V), vented electric compact (240V), and vented gas standard. Capital conversion costs may be necessary as manufacturers increase tooling for two-stage heating systems. Product conversion costs may be necessary for prototyping and testing. DOE expects industry to incur similar re-flooring costs as with TSL 2. DOE estimates capital conversion costs of $128.9 million and product conversion costs of $51.7 million. Conversion costs total $180.7 million.

At TSL 3, the shipment-weighted average MPC for all consumer clothes dryers is expected to increase by 1.7 percent relative to the no-new-standards case shipment-weighted average MPC for all consumer clothes dryers in 2028. Given the relatively small increase in production costs, DOE does not project a notable drop in shipments in the year the standard takes effect. In the preservation-of-gross-margin-percentage scenario, the increase in cash flow from the higher MSP is outweighed by the $180.7 million in conversion costs, causing a negative change in INPV at TSL 3 under this scenario. Under the preservation-of-operating-profit scenario, the manufacturer markup decreases in 2029, the year after the analyzed 2028 compliance year. This reduction in the manufacturer markup and the $180.7 million in conversion costs incurred by manufacturers cause a negative change in INPV at TSL 3 under the preservation-of-operating-profit scenario.

At TSL 4, the standard reflects the maximum national energy savings with a simple PBP of less than 4 years. The change in INPV is expected to range from −29.0 to −18.5 percent. At this level, free cash flow is estimated to decrease by 212.5 percent compared to the no-new-standards case value of $136.7 million in the year 2026, the year before the 2027 standards year. DOE's shipments analysis estimates approximately 15 percent of current shipments meet this level.

The design options analyzed for electric standard include implementing electronic controls, optimized heating systems, more advanced automatic termination controls, modulating heat, and inlet air preheat. For the remaining product classes, the efficiency levels and analyzed design options for TSL 4 are the same as TSL 3. The incremental increase in industry conversion costs from the prior TSL is due to the efficiency level requirements for electric standard. There is very little industry experience with inlet air preheat designs. Currently, DOE is not aware of any consumer clothes dryers on the market utilizing this design option. Electric standard dryers account for an estimated 81 percent of domestic consumer clothes dryer shipments. Of these standard electric dryer shipments, DOE estimates only 7 percent meet or exceed the efficiency level required by TSL 4. Implementing inlet air preheat represents a major overhaul of existing product lines and manufacturing facilities. For capital conversion costs, this change might necessitate significant new equipment and tooling. Product conversion costs may be necessary for designing, prototyping, and testing new or updated platforms. DOE expects industry to incur more re-flooring costs compared to prior TSLs as more display units would need to be replaced with high-efficiency models. DOE estimates capital conversion costs of $579.7 million and product conversion costs of $87.7 million. Conversion costs total $667.5 million.

At TSL 4, the large conversion costs result in 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 this level, the shipment-weighted average MPC for all consumer clothes dryers is expected to increase by 13 percent relative to the no-new-standards case shipment-weighted average MPC for all consumer clothes dryers in 2027. Given the projected increase in production costs, DOE estimates a less than 1-percent drop in shipments in the year the standard takes effect compared to the no-new-standards case. In the preservation-of-gross-margin-percentage scenario, the increase in cash flow from the higher MSP is outweighed by the $667.5 million in conversion costs, causing a 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 2027 compliance year. This reduction in the manufacturer markup and the $667.5 million in conversion costs incurred by manufacturers cause a negative change in INPV at TSL 4 under the preservation-of-operating-profit scenario.

At TSL 5, the standard reflects the maximum national energy savings with maximum positive NPV. The change in INPV is expected to range from −67.9 to −14.9 percent. At this level, free cash flow is estimated to decrease by 462.9 percent compared to the no-new-standards case value of $136.7 million in the year 2026, the year before the 2027 standards year. DOE's shipments analysis estimates approximately 2 percent of current shipments meet this level.

The design option analyzed for electric standard includes implementing heat pump technology. The design options analyzed for the vented electric compact (240V) and vented gas standard include implementing electronic controls, optimized heating systems, more advanced automatic termination controls, modulating heat, and inlet air preheat. For electric compact (120V), ventless electric compact (240V), and ventless electric combination washer-

dryer, the design options analyzed are the same as the prior TSL. For electric standard, TSL 5 corresponds to EL 7. For electric compact (120V) and vented gas standard, TSL 5 corresponds to EL 4. For vented electric compact (240V), TSL 5 corresponds to EL 5. For ventless electric compact (240V) and ventless electric combination washer-dryer, TSL 5 corresponds to EL 1.

At TSL 5, conversion costs are largely driven by the max-tech efficiency level required for electric standard and vented gas standard. As previously discussed, electric standard dryers account for 81 percent of domestic consumer clothes dryer shipments. Currently, there are few electric standard models on the U.S. market that meet the max-tech efficiency level required by TSL 5. Of the 13 OEMs identified that offer electric standard dryers, only five OEMs manufacture electric standard dryers that utilize heat pump technology. Of these five OEMs, four OEMs offer approximately six models (accounting for less than 1 percent of electric standard model listings) that meet the max-tech level required at TSL 5. Nearly all manufacturers would need to significantly update facilities to meet a heat pump efficiency level for electric standard dryers. Mandating a heat pump efficiency level for this product class would require many manufacturers to design completely new clothes dryer platforms or adapt heat pump designs from other markets (*i.e.,* redesign European heat pump models to adhere to U.S. safety standards and consumer preferences).

Vented gas standard dryers account for approximately 17 percent of domestic consumer clothes dryer shipments. Manufacturers would need to implement inlet air preheat technology along with other design options to meet the efficiency levels required by TSL 5. Thus far, dryers with this technology and performance have not been observed in clothes dryers available on the consumer market. Clothes dryers with inlet air preheat designs have been observed only in laboratory settings. In interviews, some manufacturers raised concerns about implementing a relatively untested technology for the consumer market. There is very little industry experience with inlet air preheat designs. Several manufacturers speculated that implementing inlet air preheat technology would require a major overhaul of existing production facilities and a significant amount of engineering time.

DOE expects industry to incur more re-flooring costs compared to prior TSLs, as nearly all display units would need to be replaced with high-efficiency models. DOE estimates capital conversion costs of $1,314.3 million and product conversion costs of $122.6 million. Conversion costs total $1,436.9 million.

As with TSL 4, the large conversion costs result in free cash flow dropping below zero in the years before the standard year. The negative free cash-flow calculation indicates manufacturers may need to access cash reserves or outside capital to finance conversion efforts.

At this level, the shipment-weighted average MPC for all consumer clothes dryers is expected to increase by 63.2 percent relative to the no-new-standards case shipment-weighted average MPC for all consumer clothes dryers in 2027. Given the projected increase in production costs, DOE expects an estimated 11-percent drop in shipments in the year the standard takes effect compared to the no-new-standards case. In the preservation-of-gross-margin-percentage scenario, the increase in MSP is outweighed by the $1,436.9 million in conversion costs and the drop in annual shipments, causing a negative change in INPV at TSL 5 under this scenario. Under the preservation-of-operating-profit scenario, the manufacturer markup decreases in 2028, the year after the analyzed 2027 compliance year. This large reduction in manufacturer markup, the $1,436.9 million in conversion costs incurred by manufacturers, and the drop in annual shipments cause a significantly negative change in INPV at TSL 5 under the preservation-of-operating-profit scenario.

At TSL 6, the standard reflects max-tech efficiency for all product classes. The change in INPV is expected to range from −71.4 to −17.1 percent. At this level, free cash flow is estimated to decrease by 488.8 percent compared to the no-new-standards case value of $136.7 million in the year 2026, the year before the 2027 standards year. DOE's shipments analysis estimates approximately 1 percent of current shipments meet this level.

The design option analyzed for TSL 6 incorporates heat pump technology for electric standard, electric compact (120V), vented electric compact (240V), ventless electric compact (240V), and ventless electric combination washer-dryer. For vented gas standard, the design options analyzed include implementing electronic controls, optimized heating systems, more advanced automatic termination controls, modulating heat, and inlet air preheat.

Of the 19 OEMs that manufacture electric consumer clothes dryers (*i.e.,* electric standard, electric compact (120V), vented electric compact (240V), ventless electric compact (240V), ventless electric combination washer-dryer), 10 OEMs do not currently offer any consumer clothes dryer models for the U.S. market that utilize heat pump technology. Of the 13 OEMs that offer electric standard clothes dryers, four OEMs currently offer some models that meet the max-tech heat pump level. Of the 10 OEMs that offer electric compact (120V) clothes dryers, one OEM offers a model that meets the max-tech level. Of the five OEMs that offer vented electric compact (240V) clothes dryers, one OEM offers models that meet the max-tech level. Of the 13 OEMs that offer ventless electric compact (240V) clothes dryers, one OEM offers a model that meets the max-tech level. Of the five OEMs that offer ventless electric combination washer-dryer, two OEMs offer models that meet the max-tech level.

A standard that could only be met using heat pump technology could require a total renovation of existing facilities and completely new clothes dryer platforms for manufacturers that do not offer heat pump clothes dryers today. In interviews, two OEMs with significant market shares stated that they would require additional facilities to handle dryer manufacturing under a standard that could only be met using heat pump technology. As previously discussed, implementing inlet air preheat also represents a major overhaul of existing vented gas product lines. DOE expects industry to incur slightly more re-flooring costs compared to TSL 5, as all display models below max-tech efficiency would need to be replaced due to the higher standard. At TSL 6, reaching max-tech efficiency levels is a billion-dollar investment for industry. DOE estimates capital conversion costs of $1,388.8 million and product conversion costs of $128.2 million. Conversion costs total $1,516.9 million.

As with TSL 4 and TSL 5, the large conversion costs result in free cash flow dropping below zero in the years before the standard year. The negative free cash-flow calculation indicates manufacturers may need to access cash reserves or outside capital to finance conversion efforts.

At this level, the shipment-weighted average MPC for all consumer clothes dryers is expected to increase by 64.7 percent relative to the no-new-standards case shipment-weighted average MPC for all consumer clothes dryers in 2027. Given the projected increase in production costs, DOE expects an

estimated 11-percent drop in shipments in the year the standard takes effect compared to the no-new-standards case. In the preservation-of-gross-margin-percentage scenario, the large increase in MSP is still outweighed by the $1,516.9 million in conversion costs and drop in annual shipments, causing a moderately negative change in INPV at TSL 6 under this scenario. Under the preservation-of-operating-profit scenario, the manufacturer markup decreases in 2028, the year after the analyzed 2027 compliance year. This large reduction in manufacturer markup, the $1,516.9 million in conversion costs incurred by manufacturers, and the drop in annual shipments cause a significantly negative change in INPV at TSL 6 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 consumer clothes dryer 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 U.S. Census Bureau's 2021 ASM,[117] the U.S. Bureau of Labor Statistics' employee compensation data,[118] results of the engineering analysis, and manufacturer interviews.

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 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 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. For the August 2022 NOPR, DOE estimated that approximately 58 percent of consumer clothes dryers were produced domestically. In support of this direct final rule analysis, DOE conducted further research to ensure this estimate was still accurate. Based on a review of publicly available data, DOE estimates that 60 percent of consumer clothes dryers 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 amended rulemaking.

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. Using the amount of domestic production workers calculated above, non-production domestic employees are extrapolated by multiplying the ratio of non-production workers in the industry compared to production employees. DOE assumes that this employee distribution ratio remains constant between the no-new-standards case and standards cases.

Using the GRIM, DOE estimates that in the absence of new energy conservation standards, there would be 2,725 domestic production and non-production workers for consumer clothes dryers in 2027. Table V.28 shows the range of the impacts of energy conservation standards on U.S. manufacturing employment in the consumer clothes dryer industry. The following discussion provides a qualitative evaluation of the range of potential impacts presented in Table V.28.

TABLE V.28—DOMESTIC DIRECT EMPLOYMENT IMPACTS FOR CONSUMER CLOTHES DRYER MANUFACTURERS IN THE ANALYZED COMPLIANCE YEAR

	No-new-standards case	TSL 1	TSL 2	TSL 3	TSL 4	TSL 5	TSL 6
Direct Employment in 2027* (Production Workers + Non-Production Workers).	**2,725	2,729	2,752	2,778	3,106	5,687	5,737
Potential Changes in Direct Employment Workers***.		(2,433) to 4	(2,433) to 27	(2,433) to 34	(2,433) to 381	(2,433) to 2,962	(2,433) to 3,012

*TSL 3 (the Recommended TSL) represents the direct employment in 2028.
**In 2028, the no-new-standards case direct employment estimate is 2,744.
***DOE presents a range of potential employment impacts. Parentheses denote negative values.

The direct employment impacts shown in Table V.29 represent the potential domestic employment changes that could result following the compliance date for the consumer clothes dryer product classes in this amended rule. The upper-bound estimate corresponds to an increase in the number of domestic workers that would result from amended energy conservation standards if manufacturers continue to produce the same scope of

[117] U.S. Census Bureau, Annual Survey of Manufactures: Summary Statistics for Industry Groups and Industries in the U.S.: 2018–2021. Available at *www.census.gov/programs-surveys/asm/data/tables.html* (last accessed May 23, 2023).

[118] U.S. Bureau of Labor Statistics. *Employer Costs for Employee Compensation*. March 17, 2023. Available at *www.bls.gov/news.release/pdf/ecec.pdf* (last accessed June 8, 2023).

covered products within the United States after compliance takes effect. The lower-bound estimate represents the maximum decrease in production workers if manufacturing moved to lower labor-cost countries. Most manufacturers currently produce at least a portion of their consumer clothes dryers in countries with lower labor costs, and an amended standard that necessitates large increases in labor content or large expenditures to retool facilities could cause manufacturers to reevaluate domestic production siting options. However, the Recommended TSL (*i.e.,* TSL 3) would likely not require significant increases in labor content or significant capital investments. As such, DOE expects that the likelihood of changes in production location as a direct result of amended standards are relatively low.

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, implementing the different design options analyzed for this direct final rule would require varying levels of resources and investment. A standard level that would require the use of heat pump technology for electric dryers and combination washer-dryers would represent the biggest shift in technology for clothes dryer manufacturing among all the design options considered for this analysis. Adopting efficiency levels that require heat pump technology would necessitate very large investments to both redesign products and update production facilities. Currently, DOE estimates that approximately 1 percent of consumer clothes dryer shipments meet the analyzed max-tech heat pump efficiency levels. In interviews, several manufacturers expressed concern that the 3-year EPCA-specified time period between the announcement of a final rule and the compliance date of the amended energy conservation standard might be insufficient to design, test, and manufacture the necessary number of products to meet demand.

In interviews, some manufacturers raised concerns about implementing inlet air preheat designs. Unlike the discussions about heat pump technology, there is very little industry experience with inlet air preheat designs. Currently, no models on the U.S. market incorporate this design option. Several manufacturers speculated that implementing inlet air preheat would require a major overhaul of existing production facilities and a significant amount of engineering time.

However, because TSL 3 (*i.e.,* the Recommended TSL) would not require heat pump technology or inlet air preheat designs, DOE does not expect manufacturers to face long-term capacity constraints due to the standard levels detailed in this direct final rule. 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 to redesign products to meet the adopted standard levels.

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. 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 consumer clothes dryer manufacturers that take effect approximately 3 years before or after the 2028 compliance date. This information is presented in Table V.29.

TABLE V.29—COMPLIANCE DATES AND EXPECTED CONVERSION EXPENSES OF FEDERAL ENERGY CONSERVATION STANDARDS AFFECTING CONSUMER CLOTHES DRYER ORIGINAL EQUIPMENT MANUFACTURERS

Federal energy conservation standard	Number of OEMs *	Number of OEMs affected by today's rule **	Approx. standards compliance year	Industry conversion costs (Millions)	Industry conversion costs/equipment revenue ***(%)
Portable Air Conditioners 85 FR 1378 (January 10, 2020)	9	2	2025	$320.9 (2015$)	6.7
Residential Clothes Washers †88 FR 13520 (March 3, 2023)	19	14	2027	$690.8 (2021$)	5.2
Miscellaneous Refrigeration Products †88 FR 19382 (March 31, 2023)	38	5	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

TABLE V.29—COMPLIANCE DATES AND EXPECTED CONVERSION EXPENSES OF FEDERAL ENERGY CONSERVATION STANDARDS AFFECTING CONSUMER CLOTHES DRYER ORIGINAL EQUIPMENT MANUFACTURERS—Continued

Federal energy conservation standard	Number of OEMs *	Number of OEMs affected by today's rule **	Approx. standards compliance year	Industry conversion costs (Millions)	Industry conversion costs/equipment revenue ***(%)
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	11	2026	$46.1 (2021$)	0.7
Consumer Water Heaters †88 FR 49058 (July 28, 2023)	22	3	2030	$228.1 (2022$)	1.3
Commercial Water Heating Equipment 88 FR 69686 (October 6, 2023)	15	1	2026	$42.7 (2022$)	5.3
Commercial Refrigerators, Refrigerator-Freezers, and Freezers †88 FR 70196 (October 10, 2023)	83	4	2028	$226.4 (2022$)	1.6
Dehumidifiers †88 FR 76510 (November 6, 2023)	20	3	2028	$6.9 (2022$)	0.4
Consumer Furnaces 88 FR 87502 (December 18, 2023)	15	1	2029	$162.0 (2022$)	1.8
Refrigerators, Freezers, and Refrigerator-Freezers 89 FR 3026 (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 consumer clothes dryers that are also listed as OEMs in the identified energy conservation standard that is contributing to cumulative regulatory burden.

*** This column presents industry conversion costs as a percentage of equipment revenue during the conversion period. Industry conversion costs are the upfront investments manufacturers must make to sell compliant products/equipment. The revenue used for this calculation is the revenue from just the covered product/equipment associated with each row. The conversion period is the time frame over which conversion costs are made and lasts from the publication year of a final rule to the compliance year of the energy conservation standard. The conversion period typically ranges from 3 to 5 years, depending on the rulemaking.

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

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

As shown in Table V.29, the rulemakings with the largest overlap of consumer clothes dryer OEMs include residential clothes washers, 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.[119] 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. 55, 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. 55 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 residential clothes washers and consumer clothes dryers). *See* section IV.J.3 of this document for stakeholder comments about cumulative regulatory burden. *See* Table V.30 for a comparison of the estimated compliance dates based on EPCA-specified timelines and the compliance dates detailed in the Joint Agreement.

TABLE V.30—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
Residential Clothes Washers	2027	2028
Consumer Conventional Cooking Products	2027	2028

[119] The microwave ovens energy conservation standards final rule (88 FR 39912), which has 11 overlapping OEMs, was published prior to the joint submission of the multi-product Joint Agreement.

TABLE V.30—EXPECTED COMPLIANCE DATES FOR MULTI-PRODUCT JOINT AGREEMENT—Continued

Rulemaking	Estimated compliance year based on EPCA requirements	Compliance year in the joint agreement
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. 55 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 Savings

To estimate the energy savings attributable to potential amended standards for consumer clothes dryers, DOE compared clothes dryer energy consumption under the no-new-standards case to their anticipated energy consumption under each TSL. The savings are measured over the entire lifetime of products purchased in the 30-year period that begins in the year of anticipated compliance with amended standards (2027–2056).[120] Table V.31 presents DOE's projections of the national energy savings for each TSL considered for consumer clothes dryers. The savings were calculated using the approach described in section IV.H.2 of this document.

TABLE V.31—CUMULATIVE NATIONAL ENERGY SAVINGS FOR CONSUMER CLOTHES DRYERS; 30 YEARS OF SHIPMENTS (2027–2056) *

	Trial Standard Level					
	1	2	3	4	5	6
	quads					
Primary energy	0.55	1.53	2.57	3.41	9.42	9.47
FFC energy	0.57	1.58	2.66	3.52	9.70	9.76

* The analysis period for TSL 3 (the Recommended TSL) is 2028–2057.

OMB Circular A–4 requires agencies to present analytical results including separate schedules of the monetized benefits and costs that show the type and timing of benefits and costs. Circular A–4 also directs agencies to consider the variability of key elements underlying the estimates of benefits and costs. For this rulemaking, DOE undertook a sensitivity analysis using 9 years, rather than 30 years, of product shipments. The choice of a 9-year period is a proxy for the timeline in EPCA for the review of certain energy conservation standards and potential revision of and compliance with such revised standards.[121] The review timeframe established in EPCA is generally not synchronized with the product lifetime, product manufacturing cycles, or other factors specific to consumer clothes dryers. Thus, such results are presented for informational purposes only and are not indicative of any change in DOE's analytical methodology. The NES sensitivity analysis results based on a 9-year analytical period are presented in Table V.32. The impacts are counted over the lifetime of consumer clothes dryers purchased during the period 2027–2035.[122]

TABLE V.32—CUMULATIVE NATIONAL ENERGY SAVINGS FOR CONSUMER CLOTHES DRYERS; 9 YEARS OF SHIPMENTS (2027–2035) *

	Trial Standard Level					
	1	2	3	4	5	6
	quads					
Primary energy	0.19	0.54	0.92	1.17	2.80	2.81

[120] The analysis period for TSL 3 (the Recommended TSL) is 2028–2057.

[121] 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. 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.

[122] The analysis period for TSL 3 (the Recommended TSL) is 2028–2036.

TABLE V.32—CUMULATIVE NATIONAL ENERGY SAVINGS FOR CONSUMER CLOTHES DRYERS; 9 YEARS OF SHIPMENTS (2027–2035) *—Continued

	Trial Standard Level					
	1	2	3	4	5	6
	quads					
FFC energy	0.20	0.56	0.96	1.21	2.89	2.90

* The analysis period for TSL 3 (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 consumer clothes dryers. In accordance with OMB's guidelines on regulatory analysis, DOE calculated NPV using both a 7-percent and a 3-percent real discount rate. Table V.33 shows the consumer NPV results with impacts counted over the lifetime of products purchased during the period 2027–2056.

TABLE V.33—CUMULATIVE NET PRESENT VALUE OF CONSUMER BENEFITS FOR CONSUMER CLOTHES DRYERS; 30 YEARS OF SHIPMENTS (2027–2056) *

	Trial Standard Level					
	1	2	3	4	5	6
	billion 2022$					
3 percent	4.07	12.33	20.08	19.85	31.21	30.50
7 percent	1.92	5.88	9.23	8.42	9.03	8.58

* The analysis period for TSL 3 (the Recommended TSL) is 2028–2057.

The NPV results based on the aforementioned 9-year analytical period are presented in Table V.34. The impacts are counted over the lifetime of products purchased during the period 2027–2035. As mentioned previously, such results are presented for informational purposes only and are not indicative of any change in DOE's analytical methodology or decision criteria.

TABLE V.34 CUMULATIVE NET PRESENT VALUE OF CONSUMER BENEFITS FOR CONSUMER CLOTHES DRYERS; 9 YEARS OF SHIPMENTS (2027–2035) *

	Trial Standard Level					
	1	2	3	4	5	6
	billion 2022$					
3 percent	1.78	5.46	9.08	8.80	13.64	13.41
7 percent	1.07	3.31	5.28	4.77	5.69	5.49

* The analysis period for TSL 3 (the Recommended TSL) is 2028–2036.

The previous results reflect the use of a default trend to estimate the change in price for consumer clothes dryers over the analysis period (*see* section IV.F.1 of this document). DOE also conducted a sensitivity analysis that considered one scenario with a lower rate of price decline than the reference case and one scenario with a higher rate of price decline than the reference case. The results of these alternative cases are presented in appendix 10C of the direct final rule TSD. In the high-price-decline case, the NPV of consumer benefits is higher than in the default case. In the lower-price-decline case, the NPV of consumer benefits is lower than in the default case.

c. Indirect Impacts on Employment

DOE estimates that amended energy conservation standards for consumer clothes dryers will reduce energy expenditures for consumers of those products, with the resulting net savings being redirected to other forms of economic activity. These expected shifts in spending and economic activity could affect the demand for labor. As described in section IV.N of this document, DOE used an input/output model of the U.S. economy to estimate indirect employment impacts of the TSLs that DOE considered. There are uncertainties involved in projecting employment impacts, especially changes in the later years of the analysis. Therefore, DOE generated results for near-term timeframes (2027–2033),[123] 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.

[123] The analysis period for TSL 3 (the Recommended TSL) is 2028–2034.

4. Impact on Utility or Performance of Products

As discussed in section III.E.1.d of this document, DOE has concluded that the standards adopted in this direct final rule will not lessen the utility or performance of the consumer clothes dryers under consideration in this rulemaking. Manufacturers of these products currently offer units that meet or exceed the adopted standards.

In response to the August 2022 NOPR, AHAM stated that DOE must ensure that amended standards do not lengthen cycle times, and AHAM believes that in order to achieve the test procedure's current FMC requirement and meet the standards proposed in the August 2022 NOPR, cycle lengths will get longer. Whirlpool commented that the strategies used in consumer clothes dryers certified under appendix D2 often lower the overall average drying temperature and extend the drying time to increase the CEF, while minimally compliant consumer clothes dryers certified under appendix D1 typically achieve a higher overall temperature and shorten the drying process. Citing DOE's test sample, Whirlpool stated that models certified using appendix D1 without wrinkle prevention mode activated had an average drying time of 56 minutes when tested to appendix D2, while models certified using appendix D2 had an average drying time of 66 minutes, and ENERGY STAR-qualified products had an average drying time of 71 minutes, the additional time needed to meet the 2-percent FMC requirement. Whirlpool stated that DOE's statutory criteria are not met to proceed with the standards proposed in the August 2022 NOPR due to a clear lessening of performance and utility of the product associated with longer drying times. (AHAM, No. 46 at pp. 8–10; Whirlpool, No. 53 at p. 4)

DOE's test data do not support the assertion by AHAM and Whirlpool that amended standards would necessitate longer drying times. In DOE's test sample, the consumer clothes dryers certified under appendix D1 have an average cycle time of 61 minutes when tested in accordance with appendix D2. In comparison, among the units in DOE's test sample that are certified under appendix D2 at or above the amended standard, multiple units have a cycle time less than 60 minutes. This indicates that the standards adopted by this direct final rule will not necessitate any increase in cycle time compared to typical cycle times currently associated with baseline consumer clothes dryers. DOE notes that a 60-minute cycle time is notably less than the 80-minute cycle time required for ENERGY STAR qualification.[124] DOE further notes that cycle time is one of many product attributes that consumers consider when purchasing a clothes dryer, such as drying performance and fabric care. As further examples, Consumer Reports—which DOE recognizes is one popular resource for consumers seeking independent reviews of consumer products—highlights the following product attributes for consumer clothes dryers in addition to cycle time: drying performance, ergonomics, noise level, capacity, drum material, compatibility with a drying rack, availability of custom programs, availability of a steam option, moisture sensing capability, Wifi connectivity, and stackability with an accompanying clothes washer.[125]

As noted in section IV.H.2 of this document, DOE has observed a steady decline in annual consumer clothes dryer cycles over the past 15 years, despite the implementation of more stringent consumer clothes dryer energy conservation standards, which is an indication that consumers are not rerunning their clothes dryers. Additionally, the amended standards correspond to the current ENERGY STAR efficiency level for both electric and gas standard clothes dryers, which requires testing in accordance with appendix D2 and which ensures consumer-accepted dryness levels as discussed in section II.B.2 of this document. As noted above, DOE does not expect increased cycle times compared to typical cycle times currently associated with baseline consumer clothes dryers as a result of adopted standards. In addition, DOE does not expect consumers to re-run the consumer clothes dryer upon completion of the initial run as a result of the amended standards being adopted in this direct final rule. DOE therefore does not expect a lessening in performance or utility as a result of the standards adopted by this direct final rule. 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.[126] In particular, the letter states that DOE's test data show, and industry experience agrees, that the recommended standard levels for consumer clothes dryers will not result in significant differences in cycle time and will adequately dry clothes.

Whirlpool stated that due to the core technological differences in energy-saving heat pump clothes dryers (such as lower air temperatures, heat retention, and water condensing systems) compared to conventional resistive heater clothes dryers, harder-to-dry fabrics need additional time in a heat pump clothes dryer to remove their embedded moisture and some heat pump clothes dryers may not get down to the required FMC. (Whirlpool, No. 53 at pp. 12–13)

With regard to Whirlpool's concerns about the performance of heat pump clothes dryers for certain hard-to-dry fabrics, DOE notes that the standards adopted by this direct final rule do not require the use of heat pump technology. AHAM stated that longer consumer clothes dryer cycle times may create different cycle times between clothes washers and clothes dryers, which may result in different consumer behaviors. According to AHAM, different operating times in laundry products may result in the increased use of wrinkle control cycles or redrying loads to avoid wrinkled clothes resulting from the clothes sitting in the clothes dryer for more extended periods of time, or in consumers re-washing clothes that were not transferred to the clothes dryer due to a previous load still being dried, ultimately resulting in increased water and energy use. AHAM also stated that consumers could turn to using other cycles, thus undercutting savings designed to be achieved through use of the normal cycle. AHAM and Whirlpool therefore stated that DOE should evaluate the impact of amended standards on drying times as cycle length is a performance feature associated with consumer preferences that consumers are unlikely to accept if cycles are too long and do not match washing times. AHAM also disagreed with DOE's use of the maximum drying time of 80 minutes in the current ENERGY STAR specification as a benchmark for its analysis, asserting that the specification was not based on sufficient supporting or consumer-relevant data. (AHAM, No. 46 at pp. 8–10)

As previously stated, DOE does not expect a shift in consumer drying times associated with amended standards beyond what is typically experienced by consumers of baseline consumer clothes dryers. Additionally, DOE does not expect that the amended standards

[124] ENERGY STAR criteria for consumer clothes dryers can be found at: *www.energystar.gov/products/appliances/clothes_dryers/key_product_criteria.*

[125] Consumer Reports ratings of consumer clothes dryers available at *www.consumerreports.org/appliances/clothes-dryers* (last accessed February 5, 2024).

[126] This document is available in the docket at: *www.regulations.gov/comment/EERE–2014-BT-STD-0058-0058.*

would result in longer drying cycles given the prevalence on the market of consumer clothes dryers that meet the amended standard with cycle times comparable to those of current baseline models, regardless of the longer cycle time of 80 minutes allowed in the ENERGY STAR specification. Therefore, DOE has no basis to conclude that the amended standards would alter the existing relative cycle times between consumer clothes dryers and clothes washers.

The test data presented in the August 2022 NOPR contradict certain conclusions and presumptions made by DOE in previous rulemakings with regard 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 certain manufacturers have prioritized cycle time while maintaining adequate drying performance and other performance aspects of consumer clothes dryers; and that based on this presumption, the current energy conservation standards may have discouraged manufacturers from bringing models to the market with cycle times of 30 minutes or less. 85 FR 49297, 49305 reiterated at 85 FR 81359, 81361. DOE further asserted that offering products with shorter cycle times would require more per-cycle energy use than would be permitted under the current standards in order to maintain the same level of performance in other areas. 85 FR 49297, 49299.

DOE has determined, contrary to the August 2020 NOPR's assumptions, that current energy conservation standards have not prevented the sale of consumer clothes dryers with shorter cycle times. DOE's test data presented in the August 2022 NOPR indicate no discernable correlation between efficiency level and cycle time for vented electric standard dryers or vented gas clothes dryers (*i.e.,* the consumer clothes dryer product classes subject to the December 2020 Final Rule) Indeed, for vented electric standard clothes dryers, the most efficient model in DOE's test sample has a shorter cycle time (80 minutes) than the least efficient minimally-compliant model in DOE's test sample (98 minutes). The models with the lowest cycle times of 36 and 39 minutes both achieve higher efficiency level EL 3. Similarly, for vented gas clothes dryers, the most efficient model in DOE's test sample has a cycle time of 66 minutes, substantially similar to the baseline unit with a cycle time of 65 minutes. The models with the lowest cycle times of 35 and 36 minutes both achieve higher efficiency level EL 2. 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 show no discernable correlation between efficiency and cycle time, this data does not support DOE's prior assertion that the current consumer clothes dryer 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 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 there is no significant difference in cycle time between consumer clothes dryers in DOE's data set that are less efficient than the recommended standards and those that just meet the recommended standard levels. The signatories noted, for example, that the difference in average cycle time is only about 2 minutes between electric standard clothes dryers in DOE's data set that are less efficient than the recommended standard and those that just meet the recommended standard (with CEFs of 3.93 and 3.94). Moreover, the signatories stated that the electric standard clothes dryers in DOE's data set that are less efficient than the recommended standards include models with longer cycle times than those that meet the recommended standards, suggesting that cycle time is tied to more than efficiency alone.

Finally, for the reasons previously discussed, DOE has also determined that the standards adopted in this direct final rule will not result in any significant differences in drying cycle times.

AHAM and Whirlpool commented that longer cycle times also cause more wear and tear on clothing as well as on the product itself and can decrease the lifetime of the product and increase the need for repair. Whirlpool stated that longer cycles lead to consumer perception that their clothes are being damaged and potentially lead consumers to interrupt consumer clothes dryer cycles to prevent garment damage, depending on different fabric types/thicknesses. Whirlpool commented that when presented with the concept of a lower-heat and slower-drying cycle that would save energy, consumers were not enthusiastic and did not trust that such a drying strategy would prevent garment damage or match clothes washer cycle times. Whirlpool stated that, according to its provided research focused on thread removal counts on test cloth, there is the possibility of increased fabric damage with longer drying times when the test cloth is in a semi-saturated state. Whirlpool commented that every 30 minutes of drying time for semi-saturated fabric is equivalent to 2.4 times the amount of fabric damage that would have been seen with one complete wash cycle in a front-load clothes washer. Whirlpool commented that this research showed 17-percent thread removal from 7 minutes of drying under appendix D1 testing and 40-percent thread removal from 30 minutes of drying under appendix D2 testing. Whirlpool stated that according to these results, appendix D2 testing resulted in a longer drying time in which the test cloth was in a semi-saturated state, as well as 2.4 times the fabric damage as a consumer clothes dryer cycle under appendix D1 testing. According to Whirlpool, the longer the drying cycle is drawn out at lower temperatures, the more total friction and thread removal occurs as the semi-saturated clothes rub together when tumbling in the drum. Whirlpool asserted that fabric care is partially a story of cycle temperature and mechanical damage from extended drying times, and although there may be some benefit from lower temperatures, the potentially increased mechanical damage from longer cycles cannot be ignored, nor the additional cost burden associated with consumers replacing damaged or worn clothing that was not factored into DOE's analysis. AHAM stated that manufacturers would also have to plan for increased wear and tear on the product itself with more robust components; therefore, AHAM disagreed with DOE's conclusion that repair and maintenance costs would not change with the proposed standard. Both AHAM and Whirlpool stated that DOE should account for the impacts of energy conservation standards associated with increased drying times on fabric care and the additional cost burden in its analysis. (AHAM, No. 46 at pp. 9–10; Whirlpool, No. 53 at p. 5)

The fabric care data Whirlpool shared shows increased thread removal from drying under appendix D2 testing compared to testing under appendix D1 for the same unit, which according to Whirlpool is due to longer drying times when the test cloth is in a semi-saturated state. However, DOE notes that amended standards would not require any specific drying strategy (*e.g.,* longer cycle times, longer drying time at

the semi-saturated state, lower drying temperatures) to ensure the FMC requirement or amended standards are met nor preclude shorter drying times at the semi-saturated state. Additionally, DOE notes that this testing did not compare the thread removal from drying for units with different efficiencies, but rather the same unit tested under two different tests, so DOE is not aware of any data substantiating a correlation between increased efficiency and thread removal. As previously noted, appendix D2 accounts for all consumer clothes dryers with and without automatic termination control and is therefore more representative of consumer use than appendix D1, and depending on the automatic termination control system, the appendix D2 cycle time may be longer or shorter than that when testing in accordance with appendix D1. Furthermore, DOE is not aware of any information indicating that the higher efficiency levels associated with amended standards would increase cycle time beyond what is typically experienced by consumers of baseline consumer clothes dryers, and has determined that existing cycle times can be met with consumer clothes dryers capable of meeting the amended standards. Therefore, DOE has concluded the recommend standards that are the subject of this direct final rule would not result in increased impacts on fabric care and product wear and tear as AHAM and Whirlpool suggested. Additionally, DOE notes that AHAM recommended the efficiency levels proposed in the August 2022 NOPR for adoption in this direct final rule. DOE, however, will continue to review relevant data on potential impacts on fabric care and product wear and tear and may consider it in future rulemakings.

For the reasons discussed throughout this section 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 consumer clothes dryers 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 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 is providing 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 consumer clothes dryers is expected to yield environmental benefits in the form of reduced emissions of certain air pollutants and greenhouse gases. Table V.35 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.35—CUMULATIVE EMISSIONS REDUCTION FOR CONSUMER CLOTHES DRYERS SHIPPED IN 2027–2056 *

	Trial Standard Level					
	1	2	3	4	5	6
Power Sector Emissions						
CO_2 (*million metric tons*)	11.2	30.8	51.5	66.5	170.9	171.7
CH_4 (*thousand tons*)	0.7	2.0	3.3	4.4	12.0	12.1
N_2O (*thousand tons*)	0.1	0.3	0.4	0.6	1.7	1.7
NO_X (*thousand tons*)	6.4	17.4	29.3	36.6	87.6	88.0
SO_2 (*thousand tons*)	2.9	8.3	13.6	18.7	52.4	52.7
Hg (*tons*)	0.02	0.06	0.09	0.13	0.36	0.36
Upstream Emissions						
CO_2 (million metric tons)	1.2	3.3	5.6	7.0	17.7	17.8
CH_4 (thousand tons)	114.0	309.4	524.3	657.1	1,633	1,642
N_2O (thousand tons)	0.005	0.001	0.021	0.003	0.1	0.1
NO_X (thousand tons)	18.9	51.6	87.3	110.0	276.5	277.9
SO_2 (thousand tons)	0.1	0.2	0.3	0.3	1.0	1.0
Hg (tons)	0.0001	0.0002	0.0003	0.0005	0.0013	0.0013
Total FFC Emissions						
CO_2 (*million metric tons*)	12.4	34.1	57.1	73.5	188.6	189.5
CH_4 (*thousand tons*)	114.7	311.4	527.6	661.5	1,645	1,654
N_2O (*thousand tons*)	0.1	0.3	0.5	0.6	1.7	1.7
NO_X (*thousand tons*)	25.4	69.0	116.5	146.6	364.1	365.9
SO_2 (*thousand tons*)	3.0	8.4	13.9	19.0	53.3	53.6
Hg (*tons*)	0.02	0.06	0.10	0.13	0.36	0.37

* The analysis period for TSL 3 (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 consumer clothes dryers. Section IV.L of this document discusses the estimated SC–CO_2 values that DOE used. Table V.36 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.36—PRESENT VALUE OF CO_2 EMISSIONS REDUCTION FOR CONSUMER CLOTHES DRYERS SHIPPED IN 2027–2056 *

TSL	SC–CO_2 case discount rate and statistics			
	5% Average	3% Average	2.5% Average	3% 95th percentile
	(*million 2022$*)			
1	136	565	876	1,718
2	376	1,559	2,415	4,739
3	613	2,566	3,985	7,800
4	808	3,353	5,197	10,192
5	2,012	8,435	13,115	25,622
6	2,022	8,479	13,183	25,753

* The analysis period for TSL 3 (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 consumer clothes dryers. Table V.37 presents the value of the CH_4 emissions reduction at each TSL, and Table V.38 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.37—PRESENT VALUE OF METHANE EMISSIONS REDUCTION FOR CONSUMER CLOTHES DRYERS SHIPPED IN 2027–2056 *

TSL	SC–CH_4 case discount rate and statistics			
	5% Average	3% Average	2.5% Average	3% 95th percentile
	(*million 2022$*)			
1	57	165	229	438
2	156	450	623	1,193
3	259	754	1,046	1,996
4	331	954	1,321	2,527
5	801	2,342	3,252	6,200
6	805	2,354	3,268	6,230

* The analysis period for TSL 3 (the Recommended TSL) is 2028–2057.

TABLE V.38—PRESENT VALUE OF NITROUS OXIDE EMISSIONS REDUCTION FOR CONSUMER CLOTHES DRYERS SHIPPED IN 2027–2056 *

TSL	SC–N_2O case discount rate and statistics			
	5% Average	3% Average	2.5% Average	3% 95th percentile
	(*million 2022$*)			
1	0.4	1.6	2.5	4.4
2	1.2	4.6	7.1	12.3
3	1.9	7.5	11.6	20.0
4	2.7	10.3	15.8	27.4
5	7.1	27.6	42.5	73.6
6	7.1	27.8	42.7	74.0

* The analysis period for TSL 3 (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 consumer clothes dryers. The dollar-per-ton values that DOE used are discussed in section IV.L.2 of this document. Table V.39 presents the present value for NO_X emissions reductions for each TSL calculated using 7-percent and 3-percent discount rates, and Table V.40 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.39—PRESENT VALUE OF NO_X EMISSIONS REDUCTION FOR CONSUMER CLOTHES DRYERS SHIPPED IN 2027–2056 *

TSL	7% Discount rate	3% Discount rate
	million 2022$	
1	502	1,167
2	1,391	3,216
3	2,217	5,305
4	2,962	6,887
5	7,133	17,135
6	7,168	17,222

Note: Results are based on the low benefit-per-ton values.

*The analysis period for TSL 3 (the Recommended TSL) is 2028–2057.

TABLE V.40—PRESENT VALUE OF SO_2 EMISSIONS REDUCTION FOR CONSUMER CLOTHES DRYERS SHIPPED IN 2027–2056 *

TSL	7% Discount rate	3% Discount rate
	million 2022$	
1	93	209
2	265	594
3	415	963
4	590	1,333
5	1,541	3,630
6	1,550	3,651

*The analysis period for TSL 3 (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 particulate matter (''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.41 presents the NPV values that result from adding the estimates of the economic benefits resulting from reduced GHG and NO_X and SO_2 emissions to the NPV of consumer benefits calculated for each TSL considered in this rulemaking. The consumer benefits are domestic U.S. monetary savings that occur as a result of purchasing the covered products and are measured for the lifetime of products shipped during the period 2027–2056.[127] 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 consumer clothes dryers shipped during the period 2027–2056.[128]

TABLE V.41—CONSUMER NPV COMBINED WITH PRESENT VALUE OF CLIMATE BENEFITS AND HEALTH BENEFITS

Category	TSL 1	TSL 2	TSL 3	TSL 4	TSL 5	TSL 6
Using 3% discount rate for Consumer NPV and Health Benefits (billion 2022$)						
5% Average SC–GHG case	5.6	16.7	27.2	29.2	54.8	54.2
3% Average SC–GHG case	6.2	18.2	29.7	32.4	62.8	62.2
2.5% Average SC–GHG case	6.6	19.2	31.4	34.6	68.4	67.9
3% 95th percentile SC–GHG case	7.6	22.1	36.2	40.8	83.9	83.4
Using 7% discount rate for Consumer NPV and Health Benefits (billion 2022$)						
5% Average SC–GHG case	2.7	8.1	12.7	13.1	20.5	20.1
3% Average SC–GHG case	3.3	9.6	15.2	16.3	28.5	28.2
2.5% Average SC–GHG case	3.6	10.6	16.9	18.5	34.1	33.8
3% 95th percentile SC–GHG case	4.7	13.5	21.7	24.7	49.6	49.4

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

[127] The analysis period for TSL 3 (the Recommended TSL) is 2028–2057.

[128] *Id.*

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 consumer clothes dryers 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 residential clothes washers and consumer 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 consumer clothes dryers. 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 clothes washer standards could result in less total moisture needing to be removed from the clothing in a dryer, whereas amended clothes dryer standards could result in a less energy-intensive process for removing that moisture. As explained on page 99, 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 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.[129]

While DOE is not prepared at present to provide a fuller quantifiable framework for estimating the benefits and costs of changes in consumer purchase decisions due to an energy conservation standard, DOE is committed to developing a framework that can support empirical quantitative tools for improved assessment of the consumer welfare impacts of appliance standards. DOE has posted a paper that discusses the issue of consumer welfare impacts of appliance energy conservation standards, and potential enhancements to the methodology by which these impacts are defined and estimated in the regulatory process.[130]

1. Benefits and Burdens of TSLs Considered for Consumer Clothes Dryer Standards

Table V.42 and Table V.43 summarize the quantitative impacts estimated for each TSL for consumer clothes dryers. The national impacts are measured over the lifetime of consumer clothes dryers purchased in the 30-year period that begins in the anticipated year of

[129] 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.*

[130] Sanstad, A. H. *Notes on the Economics of Household Energy Consumption and Technology Choice.* 2010. Lawrence Berkeley National Laboratory. Available at *www1.eere.energy.gov/buildings/appliance_standards/pdfs/consumer_ee_theory.pdf* (last accessed July 1, 2021).

compliance with amended standards (2027–2056).[131] 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.

TABLE V.42—SUMMARY OF ANALYTICAL RESULTS FOR CONSUMER CLOTHES DRYERS TSLS: NATIONAL IMPACTS

Category	TSL 1	TSL 2	TSL 3	TSL 4	TSL 5	TSL 6
Cumulative FFC National Energy Savings (*quads*)						
Quads	0.57	1.58	2.66	3.52	9.70	9.76
Cumulative FFC Emissions Reduction (Total FFC Emissions)						
CO_2 (*million metric tons*)	12.4	34.1	57.1	73.5	188.6	189.6
CH_4 (*thousand tons*)	114.8	311.4	527.6	661.6	1,646	1,654
N_2O (*thousand tons*)	0.1	0.3	0.5	0.6	1.7	1.7
NO_X (*thousand tons*)	25.4	69.0	116.5	146.7	364.1	366.0
SO_2 (*thousand tons*)	3.0	8.4	13.9	19.0	53.3	53.6
Hg (*tons*)	0.02	0.1	0.1	0.1	0.4	0.4
Present Value of Monetized Benefits and Costs (*3% discount rate, billion 2022$*)						
Consumer Operating Cost Savings	4.3	12.7	21.1	28.8	77.4	77.8
Climate Benefits *	0.7	2.0	3.3	4.3	10.8	10.9
Health Benefits **	1.4	3.8	6.3	8.2	20.8	20.9
Total Benefits †	6.4	18.5	30.7	41.3	108.9	109.5
Consumer Incremental Product Costs ‡	0.2	0.4	1.0	8.9	46.2	47.3
Consumer Net Benefits	4.1	12.3	20.1	19.9	31.2	30.5
Total Net Benefits	6.2	18.2	29.7	32.4	62.8	62.2
Present Value of Monetized Benefits and Costs (*7% discount rate, billions 2022$*)						
Consumer Operating Cost Savings	2.0	6.1	9.8	13.7	35.2	35.4
Climate Benefits *	0.7	2.0	3.3	4.3	10.8	10.9
Health Benefits **	0.6	1.7	2.6	3.6	8.7	8.7
Total Benefits †	3.4	9.8	15.8	21.6	54.7	55.0
Consumer Incremental Product Costs ‡	0.1	0.2	0.6	5.3	26.2	26.8
Consumer Net Benefits	1.9	5.9	9.2	8.4	9.0	8.6
Total Net Benefits	3.3	9.6	15.2	16.3	28.5	28.2

Note: This table presents the costs and benefits associated with consumer clothes dryers shipped during the period 2027–2056 for all TSLs except TSL 3 (the Recommended TSL) and 2028–2057 for TSL 3. These results include benefits to consumers which accrue after 2056 from the products shipped during the period 2027–2056 for all TSLs except for TSL 3 and 2057 from the products 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.

TABLE V.43—SUMMARY OF ANALYTICAL RESULTS FOR CONSUMER CLOTHES DRYERS TSLS: MANUFACTURER AND CONSUMER IMPACTS

Category	TSL 1 *	TSL 2 *	TSL 3 *	TSL 4 *	TSL 5 *	TSL 6 *
Manufacturer Impacts						
Industry NPV (million 2022$) (No-new-standards case INPV = 2,115.4).	2,080.3–2,084.3.	2,061.1–2,069.5	1,971.2–1,995.8	1,501.9–1,724.8	679.9–1,800.8	604.3–1,753.5
Industry NPV (*% change*).	(1.7)–(1.5) ..	(2.6)–(2.2)	(6.8)–(5.7)	(29.0)–(18.5)	(67.9)–(14.9)	(71.4)–(17.1)

[131] The analysis period for TSL 3 (the Recommended TSL) is 2028–2057.

TABLE V.43—SUMMARY OF ANALYTICAL RESULTS FOR CONSUMER CLOTHES DRYERS TSLS: MANUFACTURER AND CONSUMER IMPACTS—Continued

Category	TSL 1 *	TSL 2 *	TSL 3 *	TSL 4 *	TSL 5 *	TSL 6 *
Consumer Average LCC Savings (2022$)						
Electric, Standard	150	170	252	101	41	41
Electric, Compact (120 V).	53	83	66	66	66	(209)
Vented Electric, Compact (240 V).	38	89	90	90	22	(230)
Vented Gas, Standard	48	112	102	102	13	13
Ventless Electric, Compact (240 V).	0	99	99	99	99	(102)
Ventless Electric, Combination Washer-Dryer.	0	10	11	10	10	(531)
Shipment-Weighted Average *.	131	159	224	100	36	29
Consumer Simple PBP (years)						
Electric, Standard	0.5	0.5	0.6	2.1	5.8	5.8
Electric, Compact (120 V).	1.5	1.5	2.2	2.2	2.2	18.1
Vented Electric, Compact (240 V).	2.1	1.5	2.0	2.0	6.6	20.4
Vented Gas, Standard	2.5	1.3	1.9	1.9	5.0	5.0
Ventless Electric, Compact (240 V).	0.0	0.4	0.4	0.4	0.4	11.4
Ventless Electric, Combination Washer-Dryer.	0.0	0.0	0.0	0.0	0.0	46.3
Shipment-Weighted Average *.	0.9	0.6	0.8	2.1	5.6	6.1
Percent of Consumers that Experience a Net Cost						
Electric, Standard	1.2	0.9	0.9	48.0	63.1	63.1
Electric, Compact (120 V).	4.8	5.1	21.4	21.7	21.7	90.9
Vented Electric, Compact (240 V).	5.7	4.6	12.4	12.6	60.7	92.8
Vented Gas, Standard	2.7	1.7	7.1	7.0	68.7	68.7
Ventless Electric, Compact (240 V).	0.0	0.0	0.0	0.0	0.0	58.6
Ventless Electric, Combination Washer-Dryer.	0.0	0.0	0.0	0.0	0.0	95.0
Shipment-Weighted Average *.	1.5	1.0	2.0	40.4	63.3	64.5

Parentheses indicate negative (−) values.
* Weighted by shares of each product class in total projected shipments in 2027 for all TSLs except TSL 3 and in 2028 for TSL 3.

DOE first considered TSL 6, which represents the max-tech efficiency level and includes the design parameters of the most efficient products available on the market or in working prototypes for all product classes. The max-tech design options include heat pump technology for electric consumer clothes dryers and inlet air preheat technology for gas consumer clothes dryers. DOE's shipments analysis estimates approximately 1 percent of annual consumer clothes dryer shipments currently meet this level. TSL 6 would save an estimated 9.76 quads of energy, an amount DOE considers significant. Under TSL 6, the NPV of consumer benefit would be $8.6 billion using a discount rate of 7 percent, and $30.5 billion using a discount rate of 3 percent.

The cumulative emissions reductions at TSL 6 are 189.6 Mt of CO_2, 53.6 thousand tons of SO_2, 366.0 thousand tons of NO_X, 0.4 ton of Hg, 1,654 thousand tons of CH_4, and 1.7 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 6 is $10.9 billion. The estimated monetary value of the health benefits from reduced SO_2 and NO_X emissions at TSL 6 is $8.7 billion using a 7-percent discount rate and $20.9 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 6 is $28.2 billion. Using a 3-percent discount rate for all benefits and costs, the estimated total NPV at TSL 6 is $62.2 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 6, the average LCC impact on affected consumers is a savings of $41 for electric standard, −$209 for electric compact (120V), −$230 for vented electric compact (240V), $13 for vented gas standard, −$102 for ventless

electric compact (240V), and −$531 for ventless electric combination washer-dryer. The simple PBP is 6 years for electric standard, 18 years for electric compact (120V), 20 years for vented electric compact (240V), 5 years for vented gas standard, 11 years for ventless electric compact (240V), and 46 years for ventless electric combination washer-dryer. The fraction of consumers experiencing a net LCC cost is 63 percent for electric standard, 91 percent for electric compact (120V), 93 percent for vented electric compact (240V), 69 percent for vented gas standard, 59 percent for ventless electric compact (240V), and 95 percent for ventless electric combination washer-dryer. Overall, across the product classes, the majority of consumers will experience a net LCC cost, especially for senior households. DOE estimated that more 72 percent of senior-only households will experience a net LCC cost at TSL 6.

At TSL 6, the projected change in INPV ranges from a decrease of $1,511.1 million to a decrease of $361.9 million, corresponding to decreases of 71.4 percent and 17.1 percent, respectively. The loss in INPV is largely driven by industry conversion costs as manufacturers work to redesign their portfolios of model offerings and retool entire factories to comply with amended standards at this level. Industry conversion costs could reach $1,516.9 million at this TSL.

Conversion costs at TSL 6 are significant, as nearly all existing consumer clothes dryer models would need to be redesigned to meet the max-tech efficiencies. Approximately 1 percent of industry shipments currently meet TSL 6. For the electric clothes dryer product classes, manufacturers would need to implement heat pump technology to meet max-tech levels. Out of the 19 OEMs that manufacture electric consumer clothes dryers, nine OEMs offer heat pump models for the U.S. market. The remaining 10 OEMs do not offer any models for the domestic market that utilize heat pump technology. A standard that could only be met using heat pump technology would require a total renovation of existing production facilities and would require most manufacturers to design completely new clothes dryer platforms, as they would not be able to maintain the resistive heating designs that currently dominate the U.S. electric clothes dryer market. In interviews, several manufacturers expressed concern about a potential shortage of products given the required scale of investment, redesign efforts, and 3-year compliance timeline.

For gas consumer clothes dryers, manufacturers would need to implement inlet air preheat technology along with other design options to meet the efficiency levels required by TSL 6. Thus far, consumer clothes dryers with this technology and performance have not been observed in consumer clothes dryers available on the consumer market. Consumer clothes dryers with inlet air preheat designs have been observed only in laboratory settings. In interviews, some manufacturers raised concerns about implementing a relatively untested technology for the consumer market. There is very little industry experience with inlet air preheat designs. Several manufacturers speculated that implementing inlet air preheat technology would require a major overhaul of existing production facilities and a significant amount of engineering time.

At this level, DOE estimates an 11-percent drop in shipments in the year the standard takes effect compared to the no-new-standards case, as price-sensitive consumers may forgo purchasing a new clothes dryer or rely on alternatives such as repair or purchasing a used dryer due to the increased upfront cost of baseline models.

The Secretary concludes that at TSL 6 for consumer clothes dryers, the benefits of energy savings, positive NPV of consumer benefits, emission reductions, and the estimated monetary value of the emissions reductions would be outweighed by the economic burden on many consumers, especially senior-only households, as well as the impacts on manufacturers, including the potential for large conversion costs and reduction in INPV.

TSL 6, representing the most efficient heat pump technology on the market, would provide significant energy savings potential, as discussed. Despite the current and potential future benefits of heat pump technology, the analysis at TSL 6 indicates that a significant fraction of consumers, including low-income and senior-only households, would experience a net cost given the current relatively high incremental cost of certain consumer clothes dryers at the max-tech efficiency level. This is particularly pronounced for electric standard clothes dryers, where the incremental production cost at the max-tech efficiency level is comparable to the manufacturer production cost for the baseline efficiency level. Consumers with existing electric standard clothes dryers below EL 4 (about 55 percent) and consumers with existing vented gas standard clothes dryers below EL 3 (about 50 percent) are more likely to experience a net cost at TSL 6, given the relatively modest decrease in operating costs compared to the high incremental installed costs as represented by the weighted average LCC savings of $30. Few products currently meet the efficiency levels required by TSL 6. DOE estimates that approximately 1 percent of current shipments meet the max-tech efficiencies. At max-tech, limited industry experience by certain manufacturers with the high-efficiency design options, the large conversion costs to update facilities and product designs, and expected drop in industry shipments would result in a reduction of INPV and a potential shortage of products given the required scale of investment, redesign efforts, and time constraints. Consequently, the Secretary has concluded that TSL 6 is not economically justified.

DOE then considered TSL 5, which represents the maximum energy savings with maximum positive NPV. TSL 5 corresponds to the max-tech level (EL 7), which represents heat pump technology, for the electric standard product class, and the efficiency levels corresponding to modulating (2-stage) heating technology in the electric compact (120V) and inlet air preheat technology in the vented electric compact (240V) product classes considered in this analysis. For the vented gas standard product class, TSL 5 corresponds to the max-tech level (EL 4), which represents inlet air preheat technology. TSL 5 would save an estimated 9.70 quads of energy, an amount DOE considers significant. Under TSL 5, the NPV of consumer benefit would be $9.0 billion using a discount rate of 7 percent, and $31.2 billion using a discount rate of 3 percent.

The cumulative emissions reductions at TSL 5 are 188.6 Mt of CO_2, 53.3 thousand tons of SO_2, 364.1 thousand tons of NO_X, 0.4 ton of Hg, 1,646 thousand tons of CH_4, and 1.7 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 5 is $10.8 billion. The estimated monetary value of the health benefits from reduced SO_2 and NO_X emissions at TSL 5 is $ 8.7 billion using a 7-percent discount rate and $20.8 billion using a 3-percent discount rate.

Using a 7-percent discount rate for consumer benefits and costs, health benefits from reduced SO_2 and NO_X emissions, and the 3-percent discount rate case for climate benefits from reduced GHG emissions, the estimated total NPV at TSL 5 is $28.5 billion.

Using a 3-percent discount rate for all benefits and costs, the estimated total NPV at TSL 5 is $62.8 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 5, the average LCC impact on affected consumers is a savings of $41 for electric standard, $66 for electric compact (120V), $22 for vented electric compact (240V), $13 for vented gas standard, $99 for ventless electric compact (240V), and $10 for ventless electric combination washer-dryer. The simple PBP is 6 years for electric standard, 2 years for electric compact (120V), 7 years for vented electric compact (240V), 5 years for vented gas standard, 0.4 years for ventless electric compact (240V), and zero years for ventless electric combination washer-dryer. The fraction of consumers experiencing a net LCC cost is 63 percent for electric standard, 22 percent for electric compact (120V), 61 percent for vented electric compact (240V), 69 percent for vented gas standard, and zero percent for ventless electric compact (240V) and ventless electric combination washer-dryer. Overall, across the product classes, approximately 63 percent of consumers will experience a net LCC cost, especially for senior-only households. DOE estimated that more than 71 percent of senior-only households will experience a net LCC cost at TSL 5.

At TSL 5, the projected change in INPV ranges from a decrease of $1,435.5 million to a decrease of $314.6 million, corresponding to decreases of 67.9 percent and 14.9 percent, respectively. Industry conversion costs could reach $1,436.9 million at this TSL.

DOE's shipments analysis estimates approximately 2 percent of annual shipments currently meet this level. At TSL 5, the efficiency levels and analyzed design options for electric standard and vented gas standard dryers (which together account for approximately 98 percent of industry shipments) are the same as at max-tech. Thus, requiring heat pump technology for electric standard dryers and inlet air preheat for vented gas standard dryers would result in similar conversion costs, reduction in INPV, and drop in shipments as TSL 6.

At this level, DOE estimates a 11-percent drop in shipments in the year the standard takes effect compared to the no-new-standards case, as price-sensitive consumers may forgo purchasing a new clothes dryer or rely on alternatives such as repair or purchasing a used dryer due to the increased upfront cost of baseline models.

The Secretary concludes that at TSL 5 for consumer clothes dryers, the benefits of energy savings, positive NPV of consumer benefits, emission reductions, and the estimated monetary value of the emissions reductions would be outweighed by the economic burden on many consumers, especially senior-only households, as well as the impacts on manufacturers, including the significant conversion costs and large potential reduction in INPV. A significant fraction of electric standard clothes dryer consumers, including low-income and senior-only households, would experience a net cost. This is due to the high incremental cost of electric standard clothes dryers at the max-tech efficiency level. Consumers with existing electric standard clothes dryers below EL 4 are more likely to experience a net cost at TSL 5, given the relatively modest decrease in operating costs compared to the high incremental installed costs. DOE estimates that approximately 2 percent of shipments currently meet the efficiencies required by this TSL. At TSL 5, the limited industry experience by certain manufacturers with the high-efficiency design options, the large conversion costs to update facilities and product designs, and expected drop in industry shipments would result in a reduction of INPV and a potential shortage of products given the required scale of investment, redesign efforts, and time constraints. Consequently, the Secretary has concluded that TSL 5 is not economically justified.

DOE then considered TSL 4, which represents the maximum national energy savings with simple PBP less than 4 years for each product class. TSL 4 corresponds to the EL that represents inlet air preheat technology for the electric standard product class considered in this analysis. For the electric compact (120V) and vented electric compact (240V) product classes, TSL 4 corresponds to EL 4, which represents modulating (2-stage) heating technology. For the vented gas standard product class, TSL 4 corresponds to EL 3, which also represents modulating (2-stage) heating technology. TSL 4 would save an estimated 3.52 quads of energy, an amount DOE considers significant. Under TSL 4, the NPV of consumer benefit would be $8.4 billion using a discount rate of 7 percent, and $19.9 billion using a discount rate of 3 percent.

The cumulative emissions reductions at TSL 4 are 73.5 Mt of CO_2, 19.0 thousand tons of SO_2, 146.7 thousand tons of NO_X, 0.1 ton of Hg, 661.6 thousand tons of CH_4, and 0.6 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 $4.3 billion. The estimated monetary value of the health benefits from reduced SO_2 and NO_X emissions at TSL 4 is $3.6 billion using a 7-percent discount rate and $8.2 million 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 $16.3 billion. Using a 3-percent discount rate for all benefits and costs, the estimated total NPV at TSL 4 is $32.4 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 on affected consumers is a savings of $101 for electric standard, $66 for electric compact (120V), $90 for vented electric compact (240V), $102 for vented gas standard, $99 for ventless electric compact, and $10 for ventless electric combination washer-dryer. The simple PBP is 2 years for electric standard, 2 years for electric compact (120V), 2 years for vented electric compact (240V), 2 years for vented gas standard, 0.4 years for ventless electric compact (240V), and 0 years for ventless electric combination washer-dryer. The fraction of consumers experiencing a net LCC cost is 48 percent for electric standard, 22 percent for electric compact (120V), 13 percent for vented electric compact (240V), 7 percent for vented gas standard, and zero percent for ventless electric compact (240V) and ventless electric combination washer-dryer. Overall, across the product classes, approximately 40 percent of consumers will experience a net LCC cost, especially for senior households. DOE estimated that about 45 percent of senior-only households will experience a net LCC cost at TSL 4.

At TSL 4, the projected change in INPV ranges from a decrease of $613.5 million to a decrease of $390.6 million, corresponding to decreases of 29.0 percent and 18.5 percent, respectively. Industry conversion costs could reach $667.5 million at this TSL.

At TSL 4, the majority of consumer clothes dryer models would need to be redesigned to meet the efficiency levels required. DOE's shipments analysis

estimates approximately 15 percent of current shipments meet this level. For electric standard dryers, the design options include implementing inlet air preheat and other features. As previously noted, electric standard dryers account for approximately 81 percent of total shipments. At the current time, there is very little industry experience with inlet air preheat designs. Currently, DOE is not aware of any consumer clothes dryers on the market utilizing this design option. DOE's shipments analysis estimates that approximately 7 percent of electric standard shipments currently meet the efficiency required by TSL 4. Implementing inlet air preheat for electric standard dryers would represent a major overhaul of existing product lines and manufacturing facilities. This change would necessitate significant investments in new equipment and tooling. Product conversion costs would be necessary for designing, prototyping, and testing new or updated platforms.

For vented gas standard clothes dryers, the analyzed design option at TSL 4 includes modulating (2-stage) heat technology, among other design options. Out of the nine OEMs that manufacture vented gas standard clothes dryers, eight offer products that meet the efficiencies required at TSL 4. DOE does not believe that there are any substantive barriers to modulating (2-stage) heating technology. Capital conversion costs would be necessary as manufacturers increase tooling for 2-stage heating systems. Product conversion costs would be necessary for cost-optimizing and testing new designs for a market with amended standards.

At this level, DOE does not expect a notable drop in shipments in the year the standard takes effect.

The Secretary concludes that at TSL 4 for consumer clothes dryers, the benefits of energy savings, positive NPV of consumer benefits, emission reductions, and the estimated monetary value of the emissions reductions would be outweighed by the economic burden on many consumers, especially senior-only households, as well as the impacts on manufacturers, including the conversion costs and profit margin impacts that could result in a large reduction in INPV. A significant fraction of electric standard clothes dryer consumers, including senior-only households, would experience a net cost. This is due to the high incremental cost of electric standard clothes dryers at the inlet air preheat technology efficiency level. Consumers with existing electric standard clothes dryers below EL 4 are more likely to experience a net cost at TSL 4, given the relatively modest decrease in operating costs compared to the high incremental installed costs. For electric standard dryers, DOE estimates that approximately 7 percent of shipments currently meet the efficiency level required by this TSL. At TSL 4, the limited industry experience of electric standard dryer manufacturers with inlet air preheat technology and the large conversion costs to update facilities and product designs, would result in a large reduction of INPV. Consequently, the Secretary has concluded that TSL 4 is not economically justified.

DOE then considered the Recommended TSL, which represents a set of intermediate efficiency levels between those designated in TSL 2 and TSL 4 and corresponds to the current ENERGY STAR efficiency levels for the electric standard and vented gas standard product classes, which represent approximately 98 percent of the market. The Recommended TSL corresponds to the EL that represents modulating (2-stage) heating technology for the electric standard and electric compact (120V) product classes. For the vented gas standard product class, the Recommended TSL corresponds to EL 3, which also represents modulating (2-stage) heating technology. For the vented gas compact product class, the Recommended TSL corresponds to baseline CEF_{D2}. For the electric compact (240V) product classes, the Recommended TSL corresponds to EL 2 for vented consumer clothes dryers, which represents a model with an optimized heating system and EL 1 for ventless consumer clothes dryers, which represents a baseline model with a more advanced automatic termination control system. For the ventless electric combination washer-dryer product class, the Recommended TSL corresponds to EL 1, which represents a baseline model with high-speed spin technology. The Recommended TSL would save an estimated 2.66 quads of energy, an amount DOE considers significant. Under the Recommended TSL, the NPV of consumer benefit would be $9.23 billion using a discount rate of 7 percent, and $20.08 billion using a discount rate of 3 percent.

The cumulative emissions reductions at the Recommended TSL are 57.1 Mt of CO_2, 13.9 thousand tons of SO_2, 116.5 thousand tons of NO_X, 0.1 ton of Hg, 527.6 thousand tons of CH_4, and 0.5 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 $3.3 billion. The estimated monetary value of the health benefits from reduced SO_2 and NO_X emissions at TSL 3 is $2.6 billion using a 7-percent discount rate and $6.3 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 $15.2 billion. Using a 3-percent discount rate for all benefits and costs, the estimated total NPV at the Recommended TSL is $29.7 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 on affected consumers is a savings of $252 for electric standard, $66 for electric compact (120V), $90 for vented electric compact (240V), $102 for vented gas standard, $99 for ventless electric compact, and $11 for ventless electric combination washer-dryer. The simple PBP is 1 year for the largest product class (electric standard), 2 years for electric compact (120V), 2 years for vented electric compact (240V), 2 years for vented gas standard, 0.4 years for ventless electric compact (240V), and 0 years for ventless electric combination washer-dryer. The fraction of consumers experiencing a net LCC cost is 1 percent for electric standard, 21 percent for PC 2, 12 percent for vented electric compact (240V), 7 percent for vented gas standard, and zero percent for ventless electric compact (240V) and ventless electric combination washer-dryer. Overall, across the product classes, approximately 2 percent of consumers, including low-income and senior-only households, will experience a net LCC cost.

At the Recommended TSL, the projected change in INPV ranges from a decrease of $144.2 million to a decrease of $119.7 million, corresponding to decreases of 6.8 percent and 5.7 percent, respectively. Industry conversion costs could reach $180.7 million at this TSL.

DOE expects that some existing consumer clothes dryer models would need to be redesigned to meet the Recommended TSL efficiencies, but there are a wide range of available models for vented electric standard dryers due to participation in the ENERGY STAR program. DOE's shipments analysis estimates approximately 48 percent of annual shipments currently meet this level. For electric standard, electric compact

(120V), vented electric compact (240V), and vented gas standard clothes dryers, which account for approximately 99 percent of total annual shipments, the design options include implementing electronic controls, optimized heating systems, more advanced automatic termination controls, and modulating (2-stage) heat. Of the 19 electric dryer OEMs, 14 offer products at or above the efficiencies required for the electric dryer product classes at the Recommended TSL. Out of the nine OEMs that manufacture vented gas standard clothes dryers, eight offer products that meet the efficiencies required at the Recommended TSL. Capital conversion costs may be necessary as manufacturers increase tooling for 2-stage heating systems. Manufacturers may choose to further cost-optimize and test new designs as a result of the standards, but DOE believes some of this has already occurred in response to ENERGY STAR. DOE does not expect any drop in shipments in the year the standard takes effect.

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.

At the Recommended TSL, DOE's data demonstrate no negative impact on consumer utility for consumer clothes dryers. In addition, the second joint statement from the same group of stakeholders that submitted the Joint Agreement states that DOE's test data show, and industry experience agrees, that the recommended standard level for consumer clothes dryers will not result in significant differences in cycle time and will adequately dry clothes.[132] Based on the information available, DOE concludes that no lessening of product utility or performance would occur at the Recommended TSL.

After considering the analysis and weighing the benefits and burdens, the Secretary has concluded that a standard set at the Recommended TSL for consumer clothes dryers would result in the maximum improvement in energy efficiency that is technologically feasible and economically justified and also result in the significant conservation of energy. At this TSL, the average LCC savings for all consumer clothes dryer product classes are positive. An estimated weighted average of 2 percent of consumer clothes dryer consumers would experience a net cost. The FFC national energy savings are significant and the NPV of consumer benefits is positive using both a 3-percent and 7-percent discount rate. Notably, the benefits to consumers vastly outweigh the cost to manufacturers. At the Recommended TSL, the NPV of consumer benefits, even measured at the more conservative discount rate of 7 percent, is over 64 times higher than the maximum estimated manufacturers' loss in INPV. The positive LCC savings—a different way of quantifying consumer benefits—reinforces this conclusion. 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 $3.3 billion in climate benefits (associated with the average SC–GHG at a 3-percent discount rate), and $6.3 billion (using a 3-percent discount rate) or $2.6 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 6, TSL 5, and TSL 4, the Recommended TSL has higher average LCC savings, smaller percentages of consumers experiencing a net cost, a lower maximum decrease in INPV, and lower manufacturer conversion costs.

Although DOE considered amended standard levels for consumer clothes dryers by grouping the efficiency levels for each product class into TSLs, DOE evaluates all analyzed efficiency levels in its analysis. 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. For electric standard and vented gas standard consumer clothes dryers, which account for approximately 98 percent of U.S. shipments, requiring efficiency levels above the levels required by the Recommended TSL result in a large percentage of consumers experiencing a net LCC cost, in addition to significant manufacturer impacts and reductions in INPV. Additionally, for consumer clothes dryers, most manufacturers offer products that can meet the Recommended TSL across both electric and gas consumer clothes dryers. In addition, the Recommended TSL corresponds to the current ENERGY STAR levels for electric standard and vented gas standard clothes dryers, which have significant market share and manufacturer support due to their promotion over the past couple of years as a voluntary energy efficiency program. The adoption of standards, if finalized, at this TSL may encourage ENERGY STAR to further consider more efficient levels for dryers in the year leadings up to the compliance of date of the standard, which would in turn likely spur additional market introductions of consumer clothes dryers with heat pump technology, foster maturation of the technology and downward price trends, and further support differentiation within the dryer market for energy efficient products. For electric and vented gas standard consumer clothes dryers, the Recommended TSL is comprised of EL 4 and EL 3, respectively, resulting in higher LCC savings, a significant reduction in the number of consumers experiencing a net cost, a lower maximum decrease in INPV, and lower conversion costs to the point where DOE has concluded they are economically justified, as discussed for the Recommended TSL in the preceding paragraphs.

Therefore, based on the previous considerations, DOE adopts the energy conservation standards for consumer clothes dryers 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 consumer clothes dryers adopted in this direct final rule is part of a multi-product Joint Agreement covering six rulemakings (residential clothes washers; consumer clothes dryers;

[132] This document is available in the docket at: *www.regulations.gov/comment/EERE–2014–BT–STD–0058–0058.*

consumer conventional cooking products; dishwashers; refrigerators, refrigerator-freezers, and freezers; and miscellaneous refrigeration products). The signatories indicated that the Joint Agreement for the six rulemakings should be considered as a joint statement of recommended standards, to be adopted in its entirety. As discussed in section V.B.2.e of this document, many consumer clothes dryer OEMs also manufacture residential 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),[133] 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 August 2022 NOPR, AHAM expressed concerns about the timing of ongoing home appliance rulemakings. Specifically, AHAM commented that there are a number of ongoing regulations that impact consumer clothes dryer manufacturers. (AHAM, No. 46 at p. 13) AHAM has submitted similar comments to other ongoing home appliance rulemakings.[134] 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 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 residential clothes washers and consumer clothes dryers specifically, aligned compliance dates would help reduce cumulative regulatory burden for the 13 OEMs that manufacture both residential clothes washers and consumer clothes dryers. In response to the August 2022 NOPR, AHAM commented that laundry products (RCWs and consumer clothes dryers) are designed and used in pairs. (AHAM, No. 46 at p. 10) 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. AHAM further stated that coordinated compliance dates would greatly reduce burden on manufacturers and retailers. (*Id.*)

The amended energy conservation standards for consumer clothes dryers, which are expressed as CEF_{D2}, are shown in Table V.44.

TABLE V.44—AMENDED ENERGY CONSERVATION STANDARDS FOR CONSUMER CLOTHES DRYERS

Product class	CEF_{D2} (lb/kWh)
(i) Electric, Standard (4.4 ft^3 or greater capacity)	*3.93*
(ii) Electric, Compact (120V) (less than 4.4 ft^3 capacity)	*4.33*
(iii) Vented Electric, Compact (240V) (less than 4.4 ft^3 capacity)	*3.57*
(iv) Ventless Electric, Combination Washer-Dryer	*2.33*
(v) Vented Gas, Standard (4.4 ft^3 or greater capacity)	*3.48*
(vi) Ventless Electric, Compact (240V) (less than 4.4 ft^3 capacity)	*2.68*
(vii) Vented Gas, Compact (less than 4.4 ft^3 capacity)	*2.02*

NEEA, the Joint Commenters, and Samsung supported DOE's proposed TSL 3, which aligns with the Recommended TSL in this direct final rule, given the national energy savings, life-cycle cost savings, and reasonable manufacturer impacts. According to the Joint Commenters, TSL 3 provides large cost savings for all consumer groups, including low-income households. Samsung supported DOE's proposed TSL 3 and believes the test sample adequately represents the current marketplace. (NEEA, No. 45 at p. 2; Joint Commenters, No. 51 at p. 2; Samsung, No. 54 at p. 2)

NYSERDA also supported DOE's proposal in the August 2022 NOPR and urged expedient adoption of the amended standards given significant LCC savings, reasonable payback periods, significant GHG emissions reductions, energy savings, and monetary benefits for consumers in New York and beyond, and the aging out of a significant portion of the installed dryer stock in New York. According to the 2019 New York Residential Building Stock Assessment, 49 percent of New York consumer clothes dryers are over 10 years old, and another 81 percent are 5 years or older. NYSERDA stated that based on DOE's assumption of a product lifetime average of 14 years, a significant number of dryers in New York will be due for replacement around the time of the new standard, but only if DOE finalizes this standard promptly. (NYSERDA, No. 48 at pp. 1–2)

While the California IOUs supported DOE's conclusion that TSL 3 represented an economically justified and technologically feasible efficiency level achieving significant energy savings, the California IOUs requested that DOE clarify the supporting data that led to the conclusion that TSL 4 was not economically justified. The California IOUs urged DOE to adopt TSL 3 at the earliest opportunity so that consumers may obtain the significant savings provided from this level. (California IOUs, No. 50 at pp. 1–2)

As previously stated, TSL 4 is not economically justified. Nearly 50 percent of electric standard clothes dryer users, including over 53 percent of senior-only households, would experience a net cost. This can be

[133] 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.

[134] 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-2017-BT-STD-0014-0464* (pp. 41–44) for residential clothes washers; *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.

attributed to the high incremental cost of electric standard dryers with the inlet air preheat technology efficiency level. Moreover, the industry conversion costs for implementing TSL 4 could amount to $668 million, resulting in a substantial decrease in the manufacturer's INPV. In addition, there is very little industry experience with inlet air preheat designs. Currently, DOE is not aware of any consumer clothes dryers on the market utilizing this design option. DOE's shipments analysis estimates that approximately 7 percent of electric standard shipments currently meet the efficiency required by TSL 4. Implementing inlet air preheat for electric standard dryers would represent a major overhaul of existing product lines and manufacturing facilities.

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.45 shows the annualized values for consumer clothes dryers 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 NO_X and SO_2 reductions, and the 3-percent discount rate case for GHG social costs, the estimated cost of the adopted standards for consumer clothes dryers is $60.0 million per year in increased equipment installed costs, while the estimated annual benefits are $971.4 million from reduced equipment operating costs, $185.5 million in GHG reductions, and $259.9 million from reduced NO_X and SO_2 emissions. In this case, the net benefit amounts to $1,357 million per year.

Using a 3-percent discount rate for all benefits and costs, the estimated cost of the adopted standards for consumer clothes dryers is $57.2 million per year in increased equipment costs, while the estimated annual benefits are $1,177 million in reduced operating costs, $185.5 million from GHG reductions, and $349.4 million from reduced NO_X and SO_2 emissions. In this case, the net benefit amounts to $1,654 million per year.

TABLE—V.45 ANNUALIZED MONETIZED BENEFITS AND COSTS OF ENERGY CONSERVATION STANDARDS FOR CONSUMER CLOTHES DRYERS (THE RECOMMENDED TSL)

	Million 2022$/year		
	Primary Estimate	Low-net-benefits estimate	High-net-benefits estimate
3% discount rate			
Consumer Operating Cost Savings	1,177	1,103	1,230
Climate Benefits*	185.5	178.9	187.8
Health Benefits**	349.4	337.2	353.7
Total Benefits†	1,712	1,619	1,771
Consumer Incremental Product Costs‡	57.2	58.9	54.4
Net Benefits	1,654	1,560	1,717
Change in Producer Cashflow (INPV‡‡)	(12)–(10)	(12)–(10)	(12)–(10)
7% discount rate			
Consumer Operating Cost Savings	971.4	915.5	1,014
Climate Benefits*	185.5	178.9	187.8
Health Benefits**	259.9	251.5	262.8
Total Benefits†	1,417	1,346	1,464
Consumer Incremental Product Costs‡	60.0	61.2	57.7
Net Benefits	1,357	1,285	1,407
Change in Producer Cashflow (INPV‡‡)	(12)–(10)	(12)–(10)	(12)–(10)

Note: This table presents the costs and benefits associated with consumer clothes dryers shipped in 2028–2057. These results include benefits to consumers which 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 constant 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 NIA 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 (the MIA). *See* section IV.J of this document and chapter 12 of the direct final rule TSD. 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 7.5 percent that is estimated in the manufacturer impact analysis (*see* chapter 12 of the direct final rule TSD for a complete description of the industry weighted average cost of capital). For consumer clothes dryers, those values are −$12 million to −$10 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 chapter 12 of the direct final rule TSD, 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 INPV into the annualized net benefit calculation for this direct final rule, the annualized net benefits, using the primary estimate, would range from $1,642 million to $,1644 million at 3-percent discount rate and would range from $1,345 million to $1,347 million at 7-percent discount rate. Parentheses ( ) indicate negative values.

VI. Procedural Issues and Regulatory Review

A. Review Under Executive Orders 12866, 13563 and 14094

Executive Order (''E.O.'') 12866, ''Regulatory Planning and Review,'' as supplemented and reaffirmed by E.O. 13563, ''Improving Regulation and Regulatory Review,'' 76 FR 3821 (Jan. 21, 2011) and amended by E.O. 14094, ''Modernizing Regulatory Review,'' 88 FR 21879 (April 11, 2023), requires agencies, to the extent permitted by law, to (1) propose or adopt a regulation only upon a reasoned determination that its benefits justify its costs (recognizing that some benefits and costs are difficult to quantify); (2) tailor regulations to impose the least burden on society, consistent with obtaining regulatory objectives, taking into account, among other things, and to the extent practicable, the costs of cumulative regulations; (3) select, in choosing among alternative regulatory approaches, those approaches that maximize net benefits (including potential economic, environmental, public health and safety, and other advantages; distributive impacts; and equity); (4) to the extent feasible, specify performance objectives, rather than specifying the behavior or manner of compliance that regulated entities must adopt; and (5) identify and assess available alternatives to direct regulation, including providing economic incentives to encourage the desired behavior, such as user fees or marketable permits, or providing information upon which choices can be made by the public. DOE emphasizes as well that E.O. 13563 requires agencies to use the best available techniques to quantify anticipated present and future benefits and costs as accurately as possible. In its guidance, the Office of Information and Regulatory Affairs (''OIRA'') in the Office of Management and Budget (''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 consumer clothes dryers under the procedures in 42 U.S.C. 6295(p)(4). DOE notes that the NOPR for energy conservation standards for consumer clothes dryers published elsewhere in this issue of the **Federal Register** contains a regulatory flexibility analysis.

C. Review Under the Paperwork Reduction Act

Manufacturers of consumer clothes dryers must certify to DOE that their products comply with any applicable energy conservation standards. In certifying compliance, manufacturers must test their products according to the DOE test procedures for consumer clothes dryers, including any amendments adopted for those test procedures. DOE has established regulations for the certification and recordkeeping requirements for all covered consumer products and commercial equipment, including consumer clothes dryers. (*See generally* 10 CFR part 429.) The collection-of-information requirement for the certification and recordkeeping is subject to review and approval by OMB under the Paperwork Reduction Act (''PRA''). This requirement has been

approved by OMB under OMB control number 1910–1400. Public reporting burden for the certification is estimated to average 35 hours per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information.

Notwithstanding any other provision of the law, no person is required to respond to, nor shall any person be subject to a penalty for failure to comply with, a collection of information subject to the requirements of the PRA, unless that collection of information displays a currently valid OMB Control Number.

D. Review Under the National Environmental Policy Act of 1969

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

E. Review Under Executive Order 13132

E.O. 13132, ''Federalism,'' 64 FR 43255 (Aug. 10, 1999), imposes certain requirements on Federal agencies formulating and implementing policies or regulations that preempt State law or that have federalism implications. The Executive order requires agencies to examine the constitutional and statutory authority supporting any action that would limit the policymaking discretion of the States and to carefully assess the necessity for such actions. The Executive order also requires agencies to have an accountable process to ensure meaningful and timely input by State and local officials in the development of regulatory policies that have federalism implications. On March 14, 2000, DOE published a statement of policy describing the intergovernmental consultation process it will follow in the development of such regulations. 65 FR 13735. DOE has examined this rule and has determined that it would not have a substantial direct effect on the States, on the relationship between the national government and the States, or on the distribution of power and responsibilities among the various levels of government. EPCA governs and prescribes Federal preemption of State regulations as to energy conservation for the products that are the subject of this 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 13132.

F. Review Under Executive Order 12988

With respect to the review of existing regulations and the promulgation of new regulations, section 3(a) of E.O. 12988, ''Civil Justice Reform,'' imposes on Federal agencies the general duty to adhere to the following requirements: (1) eliminate drafting errors and ambiguity, (2) write regulations to minimize litigation, (3) provide a clear legal standard for affected conduct rather than a general standard, and (4) promote simplification and burden reduction. 61 FR 4729 (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 consumer clothes dryer 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 consumer clothes dryers 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. This **SUPPLEMENTARY INFORMATION** section and the TSD for this direct final rule respond to those requirements.

Under section 205 of UMRA, the Department 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 consumer clothes dryers 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 IV.I of this document, DOE's analysis estimated that 45 percent of low-income households who have a consumer clothes dryer would experience a net benefit and 54 percent of low-income households who have a consumer clothes dryer would have no impact under the adopted standards. 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 consumer clothes dryers, 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.[135] Generation of this report involved a rigorous, formal, and documented evaluation using objective criteria and qualified and independent reviewers to make a judgment as to the technical/scientific/business merit, the actual or anticipated results, and the productivity

[135] 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 November 2021).

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.[136]

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 action meets the criteria set forth in 5 U.S.C. 804(2).

VII. Approval of the Office of the Secretary

The Secretary of Energy has approved publication of this 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.

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 March 1, 2024.

Treena V. Garrett,

Federal Register Liaison Officer, 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 adding paragraph (h)(4) to read as follows:

§ 430.32 Energy and water conservation standards and their compliance dates.

* * * * *

(h) * * *

(4) Clothes dryers manufactured on or after March 1, 2028, shall have a combined energy factor, determined in accordance with appendix D2 of this subpart, no less than:

Product class	CEF_{D2} (lb/kWh)
(i) Electric, Standard (4.4 ft^3 or greater capacity) *	3.93
(ii) Electric, Compact (120V) (less than 4.4 ft^3 capacity)	4.33
(iii) Vented Electric, Compact (240V) (less than 4.4 ft^3 capacity)	3.57
(iv) Vented Gas, Standard (4.4 ft^3 or greater capacity) **	3.48
(v) Vented Gas, Compact (less than 4.4 ft^3 capacity)	2.02
(vi) Ventless Electric, Compact (240V) (less than 4.4 ft^3 capacity)	2.68
(vii) Ventless Electric, Combination Washer-Dryer	2.33

* The energy conservation standards in this product class do not apply to Vented Electric, Standard clothes dryers with a cycle time of less than 30 minutes, when tested according to appendix D2 in subpart B of this part.

** The energy conservation standards in this product class do not apply to Vented Gas, Standard clothes dryers with a cycle time of less than 30 minutes, when tested according to appendix D2 in subpart B of this part.

* * * * *

[FR Doc. 2024–04765 Filed 3–11–24; 8:45 am]

BILLING CODE 6450–01–P

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