DEPARTMENT OF ENERGY

10 CFR Parts 429 and 430

[EERE–2021–BT–STD–0020]

RIN 1904–AD49

Energy Conservation Program: Energy Conservation Standards for Consumer Pool Heaters

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

ACTION: Final rule.

SUMMARY: The Energy Policy and Conservation Act, as amended (''EPCA''), prescribes energy conservation standards for various consumer products and certain commercial and industrial equipment, including consumer pool heaters. EPCA also requires the U.S. Department of Energy (''DOE'' or ''the Department'') to periodically determine whether more-stringent, standards would be technologically feasible and economically justified, and would result in significant energy savings. In this final rule, DOE is adopting new and amended energy conservation standards for consumer pool heaters. It has determined that the new and 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 31, 2023. Compliance with the new and amended standards established for consumer pool heaters in this final rule is required on and after May 30, 2028.

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-2021-BT-STD-0020.* The docket web page contains instructions on how to access all documents, including public comments, in the docket.

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

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SUPPLEMENTARY INFORMATION:

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I. Synopsis of the Final Rule

The Energy Policy and Conservation Act,[1] as amended, Public Law 94–163, (42 U.S.C. 6291–6317, as codified) (''EPCA''), authorizes DOE to regulate the energy efficiency of a number of consumer products and certain industrial equipment. 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 pool heaters, the subject of this rulemaking.

Pursuant to EPCA, any new or amended energy conservation standard must be designed to achieve the maximum improvement in energy efficiency that DOE determines is technologically feasible and economically justified. (42 U.S.C. 6295(o)(2)(A)) Furthermore, the new or amended standard must result in significant conservation of energy. (42 U.S.C. 6295(o)(3)(B)) EPCA also provides that not later than 6 years after 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 notice of proposed rulemaking including new proposed energy conservation standards (proceeding to a final rule, as appropriate). (42 U.S.C. 6295(m))

In accordance with these and other statutory provisions discussed in this document, DOE is adopting amended energy conservation standards for gas-fired pool heaters and new energy conservation standards for electric pool heaters. The adopted new and amended standards are expressed in terms of the integrated thermal efficiency (''TE_I'') metric, which replaces the thermal efficiency (''TE'') metric for gas-fired pool heaters, and are shown in Table I.1. The TE_I standards are expressed as a function of the active mode electrical input power (''PE'') in British thermal units per hour (''Btu/h'') for electric pool heaters and the gas input rating (''Q_{IN}'') in Btu/h for gas-fired pool heaters. These standards apply to all products listed in Table I.1 and manufactured in, or imported into, the United States starting on May 30, 2028.

Table I.1 Energy Conservation Standards for Consumer Pool Heaters (Compliance Starting May 30, 2028**)**

Product Class	Integrated Thermal Efficiency TE_I* *(percent)*
Electric Pool Heater	$\frac{600(PE)}{PE + 1,619}$
Gas-Fired Pool Heater	$\frac{84(Q_{IN} + 491)}{Q_{IN} + 2,536}$

* PE is the active electrical power for electric pool heaters, in Btu/h, and Q_{IN} is the input capacity for gas-fired pool heaters, in Btu/h, as determined in accordance with the DOE test procedure at title 10 of the Code of Federal Regulations part 430, subpart B, appendix P.

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 pool heaters, as measured by the average life-cycle cost (''LCC'') savings and the simple payback period (''PBP'').[3] The average LCC savings are positive for electric pool heaters and

[1] All references to EPCA in this document refer to the statute as amended through the Energy Act of 2020, Public Law 116–260 (Dec. 27, 2020), which reflect the last statutory amendments that impact Parts A and A–1 of EPCA.

[2] For editorial reasons, upon codification in the U.S. Code, Part B was redesignated Part A.

[3] The average LCC savings refer to consumers that are affected by a standard and are measured relative to the efficiency distribution in the no-new-standards case, which depicts the market in the compliance year in the absence of new or amended standards (see section IV.F.8 of this document). The simple PBP, which is designed to compare specific efficiency levels, is measured relative to the baseline product (see section IV.F.9 of this document).

gas-fired pool heaters, and the PBP is less than the average lifetime of electric pool heaters and gas-fired pool heaters, which is estimated to be 11.1 years (see section IV.F of this document).

TABLE I.2—IMPACTS OF ADOPTED ENERGY CONSERVATION STANDARDS ON CONSUMERS OF CONSUMER POOL HEATERS

Product class	Average LCC savings (2021$)	Simple payback period (years)
Electric Pool Heaters	1,130	0.5
Gas-fired Pool Heaters	80	2.3

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

B. Impact on Manufacturers

The industry net present value (''INPV'') is the sum of the discounted cash flows to the industry from the base year through the end of the analysis period (2023–2057). Using a real discount rate of 7.4 percent,[4] DOE estimates that the INPV for manufacturers of consumer pool heaters in the case without new and amended standards is $585.7 million in 2021 dollars. Under the adopted standards, DOE estimates the change in INPV to range from −6.4 percent to 0.3 percent, which is approximately −$37.3 million to $2.0 million. In order to bring products into compliance with the new and amended standards, it is estimated that industry will incur total conversion costs of $48.4 million.

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

C. National Benefits and Costs[5]

DOE's analyses indicate that the adopted energy conservation standards for consumer pool heaters will save a significant amount of energy. Relative to the case without new or amended standards, the lifetime energy savings for consumer pool heaters purchased in the 30-year period that begins in the anticipated year of compliance with the new or amended standards (2028–2057), amount to 0.70 quadrillion British thermal units (''Btu''), or quads.[6] This represents a savings of 2.9 percent relative to the energy use of these products in the case without new or 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 pool heaters ranges from $1.18 billion (at a 7-percent discount rate) to $3.00 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 pool heaters purchased in 2028–2057.

In addition, the adopted standards for consumer pool heaters are projected to yield significant environmental benefits. DOE estimates that the standards will result in cumulative emission reductions (over the same period as for energy savings) of 29 million metric tons (''Mt'')[7] of carbon dioxide (''CO_2''), 6.0 thousand tons of sulfur dioxide (''SO_2''), 241 thousand tons of nitrogen oxides (''NO_X''), 284 thousand tons of methane (''CH_4''), 0.17 thousand tons of nitrous oxide (''N_2O''), and 0.04 tons of mercury (''Hg'').[8] The estimated cumulative reduction in CO_2 emissions through 2030 amounts to 0.57 Mt, which is equivalent to the emissions resulting from the annual electricity use of more than 0.1 million 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'').[9] DOE used interim SC–GHG values developed by an Interagency Working Group on the Social Cost of Greenhouse Gases (''IWG'').[10] 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 $1.5 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 scientific literature, as discussed in section IV.L of this document. DOE estimated the present value of the health benefits will be $0.9 billion using a 7-percent discount rate, and $2.3 billion using a 3-percent discount rate.[11] DOE is currently only monetizing (for SO_2 and NO_X) $PM_{2.5}$ precursor health benefits and (for NO_X) ozone precursor health benefits but will continue to assess the ability to monetize other effects such as health benefits from reductions in direct $PM_{2.5}$ emissions.

Table I.3 summarizes the economic benefits and costs expected to result from the new and amended standards for consumer pool heaters. There are

[4] The discount rate was derived from industry financials from publicly traded companies and then modified according to feedback received during manufacturer interviews.

[5] All monetary values in this document are expressed in 2021 dollars.

[6] 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.1 of this document.

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

[8] DOE calculated emissions reductions relative to the no-new-standards-case, which reflects key assumptions in the *Annual Energy Outlook 2022* (''*AEO2022*''). *AEO2022* 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 *AEO2022* assumptions that affect air pollutant emissions.

[9] 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 Interagency Working Group on the Social Cost of Greenhouse Gases (IWG).

[10] *See* Interagency Working Group on Social Cost of Greenhouse Gases, Technical Support Document: Social Cost of Carbon, Methane, and Nitrous Oxide. Interim Estimates Under Executive Order 13990, Washington, DC, February 2021 (''February 2021 SC–GHG TSD''). *www.whitehouse.gov/wp-content/uploads/2021/02/TechnicalSupportDocument_SocialCostofCarbonMethaneNitrousOxide.pdf.*

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

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 POOL HEATERS

	Billion 2021$
3% discount rate	
Consumer Operating Cost Savings	4.3
Climate Benefits *	1.5
Health Benefits **	2.3
Total Monetized Benefits †	8.0
Consumer Incremental Product Costs ‡	1.3
Net Monetized Benefits	6.7
7% discount rate	
Consumer Operating Cost Savings	1.8
Climate Benefits * (3% discount rate)	1.5
Health Benefits **	0.9
Total Monetized Benefits †	4.2
Consumer Incremental Product Costs ‡	0.7
Net Monetized Benefits	3.5

Note: This table presents the costs and benefits associated with consumer pool heaters shipped in 2028–2057. These results include benefits to consumers which accrue after 2057 from the products shipped in 2028–2057.

* Climate benefits are calculated using four different estimates of the social cost of carbon (SC–CO_2), methane (SC–CH_4), and nitrous oxide (SC–N_2O) (model average at 2.5-percent, 3-percent, and 5-percent discount rates; 95th percentile at a 3-percent discount rate) (see section IV.L of this document). 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, but DOE does not have a single central SC–GHG point estimate. 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 Interagency Working Group on the Social Cost of Greenhouse Gases (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, but DOE does not have a single central SC–GHG point estimate. DOE emphasizes the importance and value of considering the benefits calculated using all four sets of SC–GHG estimates.

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

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 monetized value of climate and health benefits of emission reductions, all annualized.[12]

The national operating cost savings are domestic private U.S. consumer monetary savings that occur as a result of purchasing the covered products and are measured for the lifetime of consumer pool heaters 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 pool heaters shipped in 2028–2057. Total benefits for both the 3-percent and 7-percent cases are presented using the average GHG social costs with 3-percent discount rate. Estimates of SC–GHG values are presented for all four discount rates in section IV.L.1 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 $74.1 per year in increased equipment costs, while the estimated annual benefits are $208.0 million in reduced equipment operating costs, $88.3 million in monetized climate benefits, and $97.7 million in monetized health benefits. In this case, the net monetized benefit will amount to $319.8 million per year.

Using a 3-percent discount rate for all benefits and costs, the estimated cost of the standards is $75.3 million per year in increased equipment costs, while the estimated annual benefits are $252.7 million in reduced operating costs, $88.3 million in monetized climate benefits, and $133.1 million in monetized health benefits. In this case, the net monetized benefit will amount to $398.8 million per year.

[12] To convert the time-series of costs and benefits into annualized values, DOE calculated a present value in 2022, 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 2022. 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 POOL HEATERS

	Million 2021$/year		
	Primary estimate	Low-net-benefits estimate	High-net-benefits estimate
3% discount rate			
Consumer Operating Cost Savings	252.7	238.5	270.0
Climate Benefits *	88.3	85.3	91.2
Health Benefits **	133.1	128.8	137.6
Total Monetized Benefits †	474.1	452.6	498.7
Consumer Incremental Product Costs ‡	75.3	76.5	73.4
Net Monetized Benefits	398.8	376.1	425.4
7% discount rate			
Consumer Operating Cost Savings	208.0	197.5	220.3
Climate Benefits * (3% discount rate)	88.3	85.3	91.2
Health Benefits **	97.7	94.8	100.7
Total Monetized Benefits †	393.9	377.6	412.2
Consumer Incremental Product Costs ‡	74.1	74.6	73.2
Net Monetized Benefits	319.8	303.0	339.1

Note: This table presents the costs and benefits associated with products 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 *AEO2022* Reference case, Low Economic Growth case, and High Economic Growth case, respectively. In addition, incremental equipment costs reflect a constant price in the Primary Estimate, an increasing rate in the Low Net Benefits Estimate, and a declining rate in the High Net Benefits Estimate. The methods used to derive projected price trends are explained in sections IV.F.1 and IV.F.4 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 the Department 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 Interagency Working Group on the Social Cost of Greenhouse Gases (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 the Department does not have a single central SC–GHG point estimate.

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

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

D. Conclusion

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

Using a 7-percent discount rate for consumer benefits and costs and 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 pool heaters is $74.1 million per year in increased product costs, while the estimated annual benefits are $208.0 million in reduced product operating costs, $88.3 million in monetized climate benefits, and $97.7 million in monetized health benefits. The net monetized benefit amounts to $319.8 million per year.

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.[13] For example, some covered products and equipment have most of their energy consumption occur during periods of peak energy demand. The impacts of these products on the energy infrastructure can be more pronounced than products with relatively constant demand. Accordingly, DOE evaluates the significance of energy savings on a case-by-case basis.

As previously mentioned, the standards are projected to result in estimated national energy savings of 0.70 quads FFC, the equivalent of the primary annual energy use of 7.5 million homes. In addition, they are projected to reduce CO_2 emissions by 29 Mt. Based on these findings, DOE has determined the energy savings from the standard levels adopted in this final rule are ''significant'' within the meaning of 42 U.S.C. 6295(o)(3)(B). A more detailed discussion of the basis for these conclusions is contained in the remainder of this document and the accompanying technical support document (''TSD'').

II. Introduction

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

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

[13] 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).

EPCA established the Energy Conservation Program for Consumer Products Other Than Automobiles. These products include consumer pool heaters, the subject of this document. (42 U.S.C. 6292(a)(11)) EPCA prescribed energy conservation standards for these products (42 U.S.C. 6295(e)(2)), and directs DOE to conduct two cycles of rulemakings to determine whether to amend these standards. (42 U.S.C. 6295(e)(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 notice of proposed rulemaking (''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 the EPCA specifically include definitions (42 U.S.C. 6291), test procedures (42 U.S.C. 6293), labeling provisions (42 U.S.C. 6294), energy conservation standards (42 U.S.C. 6295), and the authority to require information and reports from manufacturers (42 U.S.C. 6296).

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

Subject to certain criteria and conditions, DOE is required to develop test procedures to measure the energy efficiency, energy use, or estimated annual operating cost of each covered product. (42 U.S.C. 6295(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 procedure for consumer pool heaters appears at title 10 of the Code of Federal Regulations (''CFR'') part 430, subpart B, appendix P (''appendix P'').

DOE must follow specific statutory criteria for prescribing new or amended standards for covered products, including consumer pool heaters. Any new or amended standard for a covered product must be designed to achieve the maximum improvement in energy efficiency that the Secretary of Energy 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 (1) for certain products, including consumer pool heaters, if no test procedure has been established for the product, or (2) if DOE determines by rule that the standard is not technologically feasible or economically justified. (42 U.S.C. 6295(o)(3)(A)–(B)) In deciding whether a proposed standard is economically justified, DOE must determine whether the benefits of the standard exceed its burdens. (42 U.S.C. 6295(o)(2)(B)(i)) DOE must make this determination after receiving comments on the proposed standard, and by considering, to the greatest extent practicable, the following seven statutory factors:

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

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

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

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

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

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

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

Additionally, EPCA specifies requirements when promulgating an energy conservation standard for a covered product that has two or more subcategories. DOE 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 must 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))

Finally, pursuant to the amendments contained in the Energy Independence and Security Act of 2007 (''EISA 2007''), Public Law 110–140, any final rule for new or amended energy conservation standards promulgated after July 1, 2010, is required to address standby mode and off mode energy use. (42 U.S.C. 6295(gg)(3)) Specifically, when DOE adopts a standard for a covered product after that date, it must, if justified by the criteria for adoption of standards under EPCA (42 U.S.C. 6295(o)), incorporate standby mode and off mode energy use into a single standard, or, if that is not feasible, adopt a separate standard for such energy use for that product. (42 U.S.C. 6295(gg)(3)(A)–(B)) DOE's current test procedure for consumer pool heaters addresses standby mode and off mode energy use by use of the integrated thermal efficiency metric, as do the new and amended standards adopted in this final rule.

B. Background

1. Current Standards

The current energy conservation standard for gas-fired pool heaters is set forth in DOE's regulations at 10 CFR 430.32(k) and is repeated in Table II.1 of this document. The current energy conservation standard for gas-fired pool heaters is in terms of thermal efficiency (E_t), which measures only active mode efficiency. Electric pool heaters are a covered product under EPCA, but prior to this rulemaking there was no Federal energy conservation standard for this product class.

TABLE II.1—FEDERAL ENERGY CONSERVATION STANDARDS FOR CONSUMER POOL HEATERS

Product class	Minimum thermal efficiency (percent)
Gas-Fired Pool Heaters	82

2. History of Standards Rulemaking for Consumer Pool Heaters

On April 16, 2010, DOE published a final rule in which it concluded the first round of rulemaking required under EPCA and established an amended energy conservation standard for consumer pool heaters. 75 FR 20112 (''April 2010 Final Rule'').[14] In relevant part, the April 2010 Final Rule amended the statutorily prescribed standards for gas-fired pool heaters with a compliance date of April 16, 2013, on and after which gas-fired pool heaters were required to achieve an E_t of 82 percent.

On December 17, 2012, DOE published a final rule in the **Federal Register** that established a new efficiency metric, integrated thermal efficiency (TE_I), for gas-fired pool heaters. 77 FR 74559, 74565 (''December 2012 TP Final Rule''). The TE_I metric built on the existing E_t metric for measuring active mode energy efficiency, and accounts for the energy consumption during standby mode and off mode operation. DOE stated in the December 2012 TP Final Rule that for purposes of compliance with the energy conservation standard, the test procedure amendments related to standby mode and off mode (*i.e.,* integrated thermal efficiency) are not required until the compliance date of the next standards final rule, which addresses standby and off mode. 77 FR 74559, 74559.

On January 6, 2015, DOE published a final rule pertaining to its test procedures for direct heating equipment (''DHE'') and consumer pool heaters. 80 FR 792 (''January 2015 TP Final Rule''). In that final rule, DOE established test methods for measuring the integrated thermal efficiency of electric resistance and electric heat pump pool heaters. *Id.*

To evaluate whether to propose amendments to the energy conservation standard for consumer pool heaters, DOE issued a request for information (''RFI'') in the **Federal Register** on March 26, 2015. 80 FR 15922 (''March 2015 RFI''). Through the March 2015 RFI, DOE requested data and information pertaining to its planned technical and economic analyses for DHE and consumer pool heaters. Among other topics, the March 2015 RFI sought data and information pertaining to electric pool heaters. 80 FR 15922, 15924–15925. Although the March 2015 RFI and the previous energy conservation standards rulemaking (concluding with the April 2010 Final Rule) included both DHE and consumer pool heaters, DOE has elected to review its energy conservation standards for each of these products separately.[15]

DOE subsequently published a notice of data availability (''NODA'') in the **Federal Register** on October 26, 2015, which announced the availability of its analyses for electric pool heaters. 80 FR 65169 (''October 2015 NODA''). The purpose of the October 2015 NODA was to make publicly available the initial technical and economic analyses conducted for electric pool heaters, and present initial results of those analyses to seek further input from stakeholders. DOE did not propose new or amended standards for consumer pool heaters at that time. The initial TSD and accompanying analytical spreadsheets for the October 2015 NODA provided the analyses DOE undertook to examine the potential for establishing energy conservation standards for electric pool heaters and provided preliminary discussions in response to several issues raised by comments to the March 2015 RFI. The October 2015 NODA described the analytical methodology that DOE used, and each analysis DOE had performed.

Most recently, on April 15, 2022, DOE published a NOPR (''April 2022 NOPR'') for consumer pool heaters, in which DOE proposed new energy conservation standards for electric pool heaters and amended energy conservation standards for gas-fired pool heaters. 87 FR 22640. The new and amended standards proposed in the April 2022 NOPR were defined in terms of the TE_I metric, adopted in the December 2012 TP Final Rule (for gas-fired pool heaters) and January 2015 TP Final Rule (for electric pool heaters). DOE received 11 comments in response to the April 2022 NOPR from interested parties which are listed in Table II.2.

TABLE II.2—INTERESTED PARTIES PROVIDING WRITTEN COMMENT IN RESPONSE TO THE APRIL 2022 NOPR

Commenter(s)	Abbreviation	Comment No. in the docket	Commenter type
Air-Conditioning, Heating, and Refrigeration Institute; Pool & Hot Tub Alliance.	AHRI and PHTA	20	Trade Association.
American Gas Association; American Public Gas Association	Gas Associations	15	Utility Association.
Appliance Standards Awareness Project; American Council for an Energy-Efficient Economy; Natural Resources Defense Council; Northwest Energy Efficiency Alliance; National Consumer Law Center.	Joint Advocates	13	Efficiency Organization.
Aqua Cal AutoPilot, Inc	AquaCal	11	Manufacturer.
Bradford White Corporation	BWC	12	Manufacturer.
Fluidra	Fluidra	18	Manufacturer.

[14] A correction notice was published on April 27, 2010, correcting a reference to the compliance date for the energy conservation standard. 75 FR 21981.

[15] The rulemaking docket for DHE can be found at: *www.regulations.gov/#!docketDetail;D=EERE-2016-BT-STD-0007.*

TABLE II.2—INTERESTED PARTIES PROVIDING WRITTEN COMMENT IN RESPONSE TO THE APRIL 2022 NOPR—Continued

Commenter(s)	Abbreviation	Comment No. in the docket	Commenter type
Hayward Holdings, Inc	Hayward	17	Manufacturer.
New York State Energy Research and Development Authority	NYSERDA	10	State Agency.
Pacific Gas and Electric Company; Southern California Edison; San Diego Gas & Electric Company.	CA IOUs	16	Utility Association.
Rheem Manufacturing Company	Rheem	19	Manufacturer.
Union of Concerned Scientists; Center for Climate and Energy Solutions; Montana Environmental Information Center; Institute for Policy Integrity, NYU School of Law; Sierra Club; Natural Resources Defense Council.	Environmental Advocates	14	Efficiency Organization.

A parenthetical reference at the end of a comment quotation or paraphrase provides the location of the item in the public record.[16] To the extent that interested parties have provided written comments that are substantively consistent with any oral comments provided during the May 4, 2022, public meeting, DOE cites the written comments throughout this final rule. Any oral comments provided during the webinar that are not substantively addressed by written comments are summarized and cited separately throughout this final rule.

III. General Discussion

DOE developed this final rule after considering oral and written comments, data, and information from interested parties that represent a variety of interests. The following discussion addresses issues raised by these commenters.

A. General Comments

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

The Gas Associations commented that DOE should adopt changes to its rulemaking process as outlined in a report by National Academies of Sciences, Engineering, and Medicine (''NASEM'')[17] for both test procedures and standards. (Gas Associations, No. 15 at p. 3) In response, the Department notes that the rulemaking process for standards of covered products and equipment are outlined at appendix A to subpart C of 10 CFR part 430 (''appendix A''), and DOE periodically examines and revises these provisions in separate rulemaking proceedings.

AHRI and PHTA suggested that the Department perform another round of manufacturer interviews to determine if the data sources and methodology used are still accurate to ensure DOE's analyses capture products and conditions that best represent the current state of the market. (AHRI and PHTA, No. 20 at p. 6) BWC urged DOE to utilize the most recently available data when conducting its analysis for this rulemaking, stating that many sources cited throughout the April 2022 NOPR are outdated and may provide an inaccurate picture of current market impacts for manufacturers of consumer pool heaters. BWC specifically noted that the Department cited information that was gathered during manufacturer interviews conducted in 2015. BWC asserted that several major events have transpired since that time, which have had significant consequences for pool heater manufacturers (including significant pricing increases for components and materials that are utilized in manufacturing). Thus, BWC also recommended that DOE re-interview product manufacturers and conduct additional research to obtain updated costing information before issuing a final rule. (BWC, No. 12 at pp. 1–2)

Throughout the rulemaking process, DOE seeks feedback and insight from interested parties to improve the information used in the analyses. During Phase III of the manufacturer impact analysis (''MIA'') (see section IV.J of this document and chapter 12 of the final rule TSD), DOE interviews manufacturers to gather information on the effects of new and amended energy conservation standards on revenues and finances, direct employment, capital assets, and industry competitiveness. DOE also verifies findings from its other analyses with manufacturers. The Phase III analysis for the April 2022 NOPR occurred several years prior to this final rule, and given this unique circumstance, the Department conducted additional interviews after the publication of the April 2022 NOPR in order to collect the most recent information, as stakeholders suggested. The analysis conducted for this final rule takes into account the most recent feedback from manufacturers and other interested parties.

B. Scope of Coverage

This final rule covers those consumer products that meet the statutory and regulatory definition of ''pool heater,'' as codified at 10 CFR 430.2. (*see also* 42 U.S.C. 6291(25)) Consumer ''pool heaters'' are defined as an appliance designed for heating nonpotable water contained at atmospheric pressure, including heating water in swimming pools, spas, hot tubs and similar applications. 10 CFR 430.2. In this rulemaking, DOE has addressed comments requesting the Department to limit the scope of consumer pool heater regulations to products with capacities that are below a certain limit in order to distinguish these products from pool heaters that are commercial equipment. However, EPCA places no capacity limit on the pool heaters it covers under its definition of ''pool heater.'' (42 U.S.C. 6291(25)) Furthermore, EPCA covers pool heaters as a ''consumer product,'' (42 U.S.C. 6291(2), 42 U.S.C. 6292(a)(11)) and defines ''consumer product,'' in part, as an article that ''to any significant extent, is distributed in commerce for personal use or consumption by individuals.'' (42 U.S.C. 6291(1)) Standards established for pool heaters as a consumer product under EPCA therefore apply to any pool heater distributed to any significant extent as a consumer product for personal use or consumption by individuals, regardless of input capacity

[16] The parenthetical reference provides a reference for information located in the docket of DOE's rulemaking to develop energy conservation standards for consumer pool heaters. (Docket No. EERE–2021–BT–STD–0020, which is maintained at *www.regulations.gov*). The references are arranged as follows: (commenter name, comment docket ID number, page of that document).

[17] Although not specified, DOE interprets this comment to refer to the National Academies of Science, Engineering, and Medicine 2021 report entitled ''Review of Methods Used by the U.S. Department of Energy in Setting Appliance and Equipment Standards.'' Copies of the report are available at *nap.nationalacademies.org/catalog/25992/review-of-methods-used-by-the-us-department-of-energy-in-setting-appliance-and-equipment-standards* (last accessed on October 15, 2022).

and including consumer pool heater models that may also be installed in commercial applications.

In the April 2022 NOPR, DOE initially concluded that further delineation by adding an input capacity limit is not necessary. 87 FR 22640, 22653. DOE maintained its position initially stated in the April 2010 Final Rule that pool heaters marketed as commercial equipment contain additional design modifications related to safety requirements for installation in commercial buildings, including being designed to meet a high volume flow and are matched with a pump from the point of manufacture to accommodate the needs of commercial facilities, which allows manufacturers to distinguish those units from pool heaters distributed to any significant extent for residential use, regardless of input capacity. *Id.;* (*see also* 75 FR 20112, 20127–20128). Moreover, standards for gas-fired pool heaters regardless of size have been in place since 1990, and to place a capacity limit on standards now would result in backsliding for products over the capacity limit, which would be contrary to the anti-backsliding provision in EPCA. (42 U.S.C. 6295(o)(1))

In response to the April 2022 NOPR, several commenters requested that DOE further clarify the distinction between consumer pool heaters and pool heaters which do not meet the definition of a consumer product (*i.e.,* ''commercial pool heaters''). Hayward requested that DOE utilize a physical parameter to distinguish consumer pool heaters from commercial pool heaters because the proposals in the April 2022 NOPR may allow manufacturers to use marketing or branding in order to exclude products from the scope of the rule. (Hayward, No. 17 at p. 3) AHRI and PHTA suggested the following physical criteria could be used to determine whether a pool heater is not a consumer pool heater: uses a voltage above 277 volts, uses 3-phase current, is rated to Section IV of the American Society of Mechanical Engineers (''ASME'') Boiler and Pressure Vessel Code, is rated for 400,000 Btu/h or greater, and is designed and marketed as commercial equipment. (AHRI and PHTA, No. 20 at p. 3)

Rheem supported the product classes DOE analyzed for this consumer pool heater rulemaking and agreed with DOE's interpretation on coverage of standards for consumer products. Specifically, Rheem indicated that it differentiates consumer and commercial pool heaters through marketing materials as well as unique design aspects such as: high-volume flow, matching with a pump, ASME standards certification, and voltage/phase. (Rheem, No. 19 at p. 3)

Comments from Hayward, Rheem, AHRI, and PHTA state that there are certain physical characteristics of pool heaters which indicate they are not distributed in commerce for personal use or consumption by individuals. This is not inconsistent with DOE's position that consumer pool heaters as products can presently be sufficiently distinguished from ''commercial pool heaters.'' DOE notes, however, that EPCA places no limitation on the physical characteristics for a pool heater to qualify as a consumer product, (42 U.S.C. 6291(25)), and has concluded that explicitly specifying design criteria to define consumer pool heaters is unnecessary at this time.

When evaluating and establishing energy conservation standards, DOE divides covered products into product classes by the type of energy used or by capacity or other performance-related features that justify differing standards. In determining whether a performance-related feature justifies a different standard, DOE must consider such factors as the utility of the feature to the consumer and other factors DOE determines are appropriate. (42 U.S.C. 6295(q)(1))

As discussed in section IV.A.1 of this document, this final rule considered consumer gas-fired pool heaters, oil-fired pool heaters, electric pool heaters, and electric spa heaters. However, DOE is establishing standards for only two product classes in this rulemaking: gas-fired pool heaters and electric pool heaters. DOE may, in a future rulemaking addressing energy conservation standards for consumer pool heaters, analyze standards for oil-fired pool heaters and/or electric spa heaters, or consider setting differential standards for new product classes that may be considered.

NYSERDA supported DOE's effort to set standards for electric pool heaters for the first time and concurred that the proposed standards are cost effective and technologically feasible. (NYSERDA, No. 10 at p. 1) Hayward stated that electric resistance heaters should be included in the scope of the rule to achieve the power usage and efficiency goals for all pool heating systems. (Hayward, No. 17 at p. 2)

As discussed in section IV.C.1.a of this document, the baseline efficiency level that DOE selected for electric pool heaters is based on use of electric resistance elements. See section IV.A.1 of this document for discussion of the product classes analyzed in this final rule.

C. Test Procedure

EPCA sets forth generally applicable criteria and procedures for DOE's adoption and amendment of test procedures. (42 U.S.C. 6293) Manufacturers of covered products must use these test procedures to certify to DOE that their product complies with energy conservation standards and to quantify the efficiency of their product. DOE's current energy conservation standards for consumer pool heaters are expressed in terms of E_t. (*See* 10 CFR 430.32(k)(2).) DOE's test procedure for consumer pool heaters is found at appendix P.

As discussed in section II.A of this document, EISA 2007 amended EPCA to require DOE to amend its test procedures for covered consumer products generally to include measurement of standby mode and off mode energy consumption. (42 U.S.C. 6295(gg)(2)(A)) The current test procedure established for fossil fuel-fired pool heaters determines an integrated thermal efficiency metric (TE_I), which accounts for energy consumption during active mode operation (sections 2.1.1, 3.1.1, and 4.1.1 of appendix P) and standby mode (sections 2.2, 3.2, and 4.2 of appendix P) and off mode operation (sections 2.3, 3.2, and 4.3 of appendix P), as required by EISA 2007. 77 FR 74559, 74572. *See also* 77 FR 74559, 74564–74565. The DOE test procedure for electric resistance and electric heat pump pool heaters determines the active mode energy use for electric resistance (sections 2.1.2, 3.1.2, and 4.1.2 of appendix P) and electric heat pump pool heaters (sections 2.1.3, 3.1.3, and 4.1.3 of appendix P). Standby mode and off mode energy use are also recorded using the same procedures used for fossil-fuel fired pool heaters (sections 2.2, 3.2, and 4.2 and 2.3, 3.2, and 4.3 of appendix P, respectively). The active mode, standby mode, and off mode energy use are then combined into the TE_I metric (section 5 of appendix P).

In this document, DOE is establishing new and amended energy conservation standards for consumer pool heaters in terms of TE_I to align with the metric in the current test procedure.

To the extent DOE is also making amendments to the test procedure, such amendments are limited to those necessary to accommodate the proposed definitions and the proposed product classes. As discussed further in sections III.G.1 and IV.A.1 of this document, DOE is amending appendix P to add definitions for ''active electrical power,'' ''input capacity,'' and ''output capacity;'' to add a calculation to determine the output capacity for electric pool heaters; and to clarify the calculation of input capacity for fossil fuel-fired pool heaters. These amendments to appendix P would not impact test procedure conduct nor the measurements taken, but rather the new provisions use existing measurements to calculate the values necessary for comparing product efficiency to the proposed standards.

In response to the April 2022 NOPR, DOE received comments from stakeholders relating to the method of testing in the consumer pool heater test procedure. Specifically, AHRI and PHTA suggested that the Department use mass flow rate as an alternative calculation to using the mass of water in the test procedure, as the use of a mass flow meter would provide a significantly more accurate and repeatable data collection that would also allow for automation of the test procedure. AHRI and PHTA also encouraged DOE to update its references to the latest edition of ANSI Z21.56.[18] AHRI and PHTA noted that there are measurable increases in efficiency due to part-load operation when operating at colder ambient conditions that are not captured in the current rating test. (AHRI and PHTA, No. 20 at pp. 3–4) Similarly, Rheem suggested that DOE investigate part-load efficiency in the next test procedure rulemaking. (Rheem, No. 19 at p. 4)

DOE will consider these comments further in the next revision of its consumer pool heater test procedure.

D. Technological Feasibility

1. General

In each energy conservation standards rulemaking, DOE conducts a screening analysis based on information gathered on all current technology options and prototype designs that could improve the efficiency of the products or equipment that are the subject of the rulemaking. As the first step in such an analysis, DOE develops a list of technology options for consideration in consultation with manufacturers, design engineers, and other interested parties. DOE then determines which of those means for improving efficiency are technologically feasible. DOE considers technologies 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 to 10 CFR part 430 subpart C (''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. Section 7(b)(2)–(5) of appendix A. Section IV.B of this document discusses the results of the screening analysis for consumer pool heaters, particularly the designs DOE considered, those it screened out, and those that are the basis for the standards adopted in this rulemaking. For further details on the screening analysis for this rulemaking, see chapter 4 of the final rule TSD.

2. Maximum Technologically Feasible Levels

When DOE adopts a new or amended standard for a type or class of covered product, it must determine the maximum improvement in energy efficiency or maximum reduction in energy use that is technologically feasible for such product. (42 U.S.C. 6295(p)(1)) Accordingly, in the engineering analysis, DOE determined the maximum technologically feasible (''max-tech'') improvements in energy efficiency for consumer pool heaters, 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 final rule TSD.

E. Energy Savings

1. Determination of Savings

For each trial standard level (''TSL''), DOE projected energy savings from application of the TSL to consumer pool heaters purchased in the 30-year period that begins in the first full year of compliance with the new and amended standards (2028–2057).[19] The savings are measured over the entire lifetime of products purchased in the 30-year analysis period. DOE quantified the energy savings attributable to each TSL as the difference in energy consumption between each standards case and the no-new-standards case. The no-new-standards case represents a projection of energy consumption that reflects how the market for a product would likely evolve in the absence of new and amended energy conservation standards.

DOE used its national impact analysis (''NIA'') spreadsheet models to estimate national energy savings (''NES'') from potential new and amended standards for consumer pool heaters. The NIA spreadsheet model (described in section IV.H of this document) calculates energy savings in terms of site energy, which is the energy directly consumed by products at the locations where they are used. For electricity, DOE reports 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.[20] DOE's approach is based on the calculation of an FFC multiplier for each of the energy types used by covered products or equipment. For more information on FFC energy savings, see section IV.H.2 of this document.

2. Significance of Savings

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

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

The standard levels adopted in this final rule are projected to result in

[18] The most recent version of ANSI Z21.56 is ANSI Z21.56/CSA 4.7–2017, *Gas-Fired Pool Heaters.* Copies of the standard are available for purchase at: *webstore.ansi.org/Standards/CSA/ansiz21562017csa* (last accessed on October 15, 2022).

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

[20] 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).

national energy savings of 0.70 quads, the equivalent of the electricity use of 7.5 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 final rule are ''significant'' within the meaning of 42 U.S.C. 6295(o)(3)(B).

F. Economic Justification

1. Specific Criteria

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

a. Economic Impact on Manufacturers and Consumers

EPCA requires DOE to consider the economic impact of the standard on manufacturers and consumers of the product that would be subject to the standard. (42 U.S.C. 6295(o)(2)(B)(i)(I). In determining the impacts of potential 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 full 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 establishing product classes, and in evaluating design options and the impact of potential standard levels, DOE evaluates potential standards that would not lessen the utility or performance of the considered products. (42 U.S.C. 6295(o)(2)(B)(i)(IV)) Based on data available to DOE, the standards adopted in this document will 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)) To assist the Department of Justice (''DOJ'') in making such a determination, DOE transmitted copies of its proposed rule and the NOPR TSD to the Attorney General for review, with a request that the DOJ provide its determination on this issue. In its assessment letter responding to DOE, DOJ concluded that the proposed energy conservation standards for consumer pool heaters are unlikely to have a significant adverse impact on competition. DOE is publishing the Attorney General's assessment at the end of this final rule.

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 full 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.

G. Other Topics

1. Test Procedure Updates

This final rule establishes amended standards for gas-fired pool heaters and new standards for electric pool heaters in terms of TE_I. These standards are functions of the input capacity (''Q_{IN}'') for gas-fired pool heaters and the active electrical power (''PE'') for electric pool heaters. To provide clarity on how values would be determined for certification, DOE is adopting definitions for ''input capacity,'' ''active electrical power,'' and ''output capacity'' (''Q_{OUT}'') and identifying which measured variables in the test procedure represent these characteristics.

Given the dependency of TE_I on Q_{IN} and PE, in the April 2022 NOPR DOE proposed updates to the test procedure and product-specific enforcement provisions to ensure clarity in determination of these parameters. Specifically, DOE proposed to amend appendix P to:

• Use values measured during the active mode test described in Section 2.10.1 of ANSI.Z21.56–2006 (*i.e.,* heating value times correction factor times the quantity of fossil fuel used divided by the length of the test) to determine the input capacity of a fossil fuel-fired pool heater, as this calculation was not stated clearly within appendix P;

• Clarify that active electrical power is represented by the variable PE; and

• Provide a calculation for output capacity so that the product class for an electric pool heater can be appropriately determined.

87 FR 22640, 22651.

In response, Rheem suggested DOE add provisions to appendix P to describe how to appropriately calculate input capacity for gas-fired pool heaters at standard temperature and pressure conditions. (Rheem, No. 19 at p. 2) AHRI and PHTA provided similar feedback, requesting that DOE specify values for barometric pressure, as this value can vary depending on numerous factors including test location and environmental conditions. (AHRI and PHTA, No. 20 at p. 3)

Section 2.10.1 of ANSI Z21.56–2006, the industry test standard that is incorporated by reference into appendix P for gas-fired pool heaters, includes the use of a correction factor (''CF'') ''to correct observed gas volume to the conditions of pressure and temperature at which the heating value of the gas is specified [normally 30 inches mercury column (101.6 kPa) and 60 °F (15.5 °C)]''. As such, the standard temperature and pressure is already specified as 60 degrees Fahrenheit (''°F'') and 30 inches of mercury (''in. Hg'') for the calculation of Q_{IN}. If the laboratory barometric conditions do not match the standard pressure, as AHRI and PHTA suggested, section 2.10.1 of ANSI Z21.56–2006 requires the gas measurement to be mathematically corrected.

Rheem also requested that DOE clarify whether coefficient of performance (''COP'') representations in manufacturer literature may continue to be made at ambient conditions other than the ''High Air Temperature—Mid Humidity'' condition in AHRI Standard 1160. (Rheem, No. 19 at p. 10)

Section 3.1.3 of appendix P states that the test conditions for electric heat pump pool heaters shall be at the ''High Air Temperature—Mid Humidity (63% RH)'' level specified in section 6 of AHRI 1160–2009, the industry test standard that is incorporated by reference into appendix P for heat pump pool heaters. EPCA mandates that no manufacturer, distributor, retailer, and or private labeler may make any representation with respect to the energy use or efficiency of a covered product to which a test procedure is applicable unless such product has been tested in accordance with such test procedure and such representation fairly discloses the results of such testing. (42 U.S.C. 6293(c)(1)(A)–(B)) Therefore, although manufacturers may make representations of COP according to the test conditions in appendix P, manufacturers may not make representations for heat pump pool heaters at test conditions which are not included in appendix P.

Taking into consideration the feedback received on the necessary updates to the test procedure to accommodate the transition to TE_I-based standards, DOE is amending appendix P as proposed in the April 2022 NOPR to include new definitions and methods for determining for input capacity, active electrical power, and output capacity.

2. Enforcement Provisions

The Department codifies product-specific enforcement provisions at 10 CFR 429.134 to indicate how DOE would conduct certain aspects of assessment or enforcement testing on covered products and equipment.

In the April 2022 NOPR, DOE proposed that the input capacity or active electrical power (as applicable) for enforcement testing would be measured pursuant to appendix P and compared against the rated value certified by the manufacturer. If the measured input capacity or active electrical power (as applicable) is within ±2 percent of the certified value, then DOE would use the certified value when determining the applicable standard. The ±2 percent threshold was chosen because it is already used for commercial water heating equipment (*see* 10 CFR 429.134(n)) and it represents a reasonable range to account for manufacturing variations that may affect the input capacity. DOE proposed that, during enforcement testing for a gas-fired pool heater, if the measured input capacity is not within ±2 percent of the certified value, then DOE would follow these steps to attempt to bring the fuel input rate to within ±2 percent of the certified value. First, DOE would attempt to adjust the gas pressure in order to increase or decrease the input capacity as necessary. If the input capacity is still not within ±2 percent of the certified value, DOE would then attempt to modify the gas inlet orifice (*i.e.,* drill) if the unit is equipped with one. Finally, if these measures do not bring the input capacity to within ±2 percent of the certified value, DOE would use the mean measured input capacity (either for a single unit sample or the average for a multiple-unit sample) when determining the applicable standard for the basic model. 87 FR 22640, 22651.

In the April 2022 NOPR, DOE proposed that, for an electric pool heater, it would not take any steps to modify the unit to bring the active electrical power of the unit within the ±2 percent threshold. Rather, if the active electrical power is not within ±2 percent of the certified value, DOE would use the measured active electrical power (either for a single unit sample or the average for a multiple unit sample) when determining the applicable standard for the basic model. *Id.* at 87 FR 22652.

AHRI and PHTI commented that the Department's suggested ±2 percent threshold is appropriate for the certified value of input capacity or active electrical power for gas-fired pool heaters because adjustment of the valve should be allowed to achieve input rate. However, AHRI and PHTA recommended that DOE should apply the ±5 percent threshold that is specified in section 6.3 [21] of AHRI 1160 on the certified value of input capacity or active electrical power for electric pool heaters, and requested that the Department offer additional clarification for the proposed definition of ''certified.'' (AHRI and PHTA, No. 20 at pp. 2–3) Hayward similarly supported a ±2 percent threshold for gas-fired pool heaters, but believed that a ± 5 percent threshold would be appropriate for heat pump pool heaters due to variances in compressor performance. (Hayward, No. 17 at p. 3) Rheem supported the DOE proposal to add a ±2 percent threshold to its enforcement provisions at 10 CFR 429.134 regarding input capacity, which is required for gas-fired pool heaters. For electric products, Rheem stated there are no methods to easily adjust power, so while a threshold should be placed on active electrical power in the enforcement provisions, due to the inherent variability in active electrical power for electric pool heaters this threshold should be ±5 percent. (Rheem, No. 19 at p. 2)

DOE agrees with Rheem that electrical power cannot be readily adjusted on a pool heater the way gas input is designed to be adjusted for a field-installed unit, and thus, for electric pool heaters, inherent product variability is not able to be compensated for with in-field adjustments to energy input, as is possible for gas-fired pool heaters. For this reason, DOE concludes that a higher threshold for electrical power in the enforcement testing provisions for electrical pool heaters as compared to the input capacity threshold for gas-fired pool heaters is warranted. Section 6.3 of AHRI 1160–2006 states that measured test results for heating capacity and COP shall not be less than 95 percent of published ratings. Based on these considerations, DOE agrees that the ±5 percent threshold recommended by stakeholders is appropriate for enforcement testing of electric pool heaters. In this final rule, DOE is establishing product-specific enforcement provisions for consumer pool heaters which allow a ±2 percent threshold for gas-fired pool heaters and a ±5 percent threshold for electric pool heaters.

Rheem also recommended changing the title to 10 CFR 429.134(s)(2) to ''Verification of active electrical power for electric pool heaters.'' (Rheem, No. 19 at p. 2) DOE understands this to be a typographical correction to the title proposed in the April 2022 NOPR, which read, ''Verification of active electrical power for pool heaters.'' 87 FR 22640, 22716. Due to the additions of several product-specific enforcement provisions since the April 2022 NOPR, the enforcement provisions for pool heaters have been relocated to 10 CFR 429.134(dd). Because the title suggested by Rheem clarifies that the provision applies only to electric pool heaters and not all pool heaters, DOE is adopting the suggested title for 10 CFR 429.134(cc)(2).

3. Certification Requirements

In the April 2022 NOPR, DOE stated that if new and amended energy conservation standards were adopted in this rulemaking, the Department would review and revise the certification provisions accordingly to establish certification provisions for electric pool heaters and to allow for appropriate reporting of TE_I values. DOE stated that it would consider such amendments in a separate rulemaking. 87 FR 22640, 22651.

In response, Rheem generally recommended DOE update the certification provisions at 10 CFR 429.24 to require certification of integrated thermal efficiency and either input capacity or active electrical power as necessary. (Rheem, No. 19 at p. 2) Rheem also requested that DOE add certification provisions which allow for the propane gas version of a basic model to be rated using the natural gas version if the propane gas input rate is within 10 percent of the natural gas input rate. (Rheem, No. 19 at p. 10)

DOE is considering these comments in a separate rulemaking addressing certification requirements for consumer pool heaters and other products and equipment. Interested parties may find this rulemaking at Docket No. EERE–2023–BT–CE–0001. Compliance with the energy conservation standards promulgated by this final rule must be demonstrated on and after May 30, 2028.

IV. Methodology and Discussion of Related Comments

This section addresses the analyses DOE has performed for this final rule with regard to consumer pool heaters. Separate subsections address each component of DOE's analyses.

DOE used several analytical tools to estimate the impact of the standards considered in this document. The first tool is a spreadsheet that calculates the LCC savings and PBP of potential amended or new energy conservation standards. The national impacts analysis uses a second spreadsheet set that provides shipments projections and

[21] The commenters referenced section 6.2 of AHRI 1160, which specifies application ratings. DOE interprets this comment as intending to reference section 6.3 of AHRI 1160–2006, which specifies tolerances on heating capacity and COP.

calculates NES and NPV of total consumer costs and savings expected to result from potential energy conservation standards. DOE uses the third spreadsheet tool, the Government Regulatory Impact Model (''GRIM''), to assess manufacturer impacts of potential standards. These three spreadsheet tools are available on the DOE website for this rulemaking: *www.regulations.gov/docket/EERE-2021-BT-STD-0020.* Additionally, DOE used output from the latest version of the Energy Information Administration's (''EIA's'') *Annual Energy Outlook* (''*AEO*'') for the emissions and utility impact analyses.

A. Market and Technology Assessment

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

1. Product Classes

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

Under EPCA, pool heaters are covered products. (42 U.S.C. 6292(a)(11)) EPCA defines ''pool heater'' as an appliance designed for heating nonpotable water contained at atmospheric pressure, including heating water in swimming pools, spas, hot tubs and similar applications. (42 U.S.C. 6291(25)) This includes electric pool heaters, gas-fired pool heaters, and oil-fired pool heaters. However, energy conservation standards have been previously established only for gas-fired pool heaters.[22] In this final rule, DOE establishes definitions for gas-fired pool heaters, electric pool heaters, electric spa heaters, and oil-fired pool heaters; establishes new energy conservation standards for electric pool heaters; and for gas-fired pool heaters, translates the existing standard from the E_t metric to an equivalent level in terms of the TE_I metric and amends the energy conservation standards. DOE has not analyzed potential standards for oil-fired pool heaters because they comprise a very small market share and such standards would result in very little energy savings. DOE also did not perform energy conservation standards analysis for electric spa heaters, as DOE was unable to identify technology options available to improve the efficiency of such products. Accordingly, DOE is not establishing standards for these products in this final rule.

As discussed in the April 2022 NOPR, some commenters responding to the March 2015 RFI suggested DOE consider atmospherically vented gas-fired pool heaters separately from fan-assisted gas-fired pool heaters or to consider condensing and non-condensing products separately. 87 FR 22640, 22653. As previously noted by DOE, the standard for gas-fired pool heaters proposed in the April 2022 NOPR, and adopted in this final rule, can be achieved by atmospherically vented and/or non-condensing gas-fired pool heaters.

In the March 2015 RFI, DOE sought comment on whether capacity or other performance related features that may affect efficiency would justify the establishment of consumer pool heater product classes that would be subject to different energy conservation standards. Specifically, DOE sought comment on whether heat pump technology was a viable design for applications which typically utilize electric resistance pool heaters. 80 FR 15922, 15925. As discussed in the April 2022 NOPR, some commenters recommended DOE create separate product classes for electric resistance and electric heat pump pool heaters, and others urged DOE to regulate both under one product class covering all electric pool heaters. 87 FR 22640, 22654. In the April 2022 NOPR, DOE noted that although heat pump pool heaters perform best when operating within an environment with high air temperature and high air humidity, they are nonetheless capable of operating effectively in cooler climates during the swimming season. Additionally, rare cases in which the ambient temperature is too low for the heat pump pool heater to work effectively could be accommodated through the incorporation of electric resistance backup elements. Therefore, DOE proposed to maintain a single product class for electric pool heaters. *Id.*

In response to the April 2022 NOPR, the Joint Advocates stated their support of a single product class for all electric pool heaters because electric resistance heaters provide no unique utility. (Joint Advocates, No. 13 at p. 1–2) The CA IOUs also agreed with DOE that separate product classes for electric resistance and electric heat pump pool heaters are not justified. (CA IOUs, No. 16 at p. 6) DOE received no other comments in response to the April 2022 NOPR on this issue and, for the reasons discussed, maintains a single product class for electric pool heaters in this final rule.

In the April 2022 NOPR, DOE proposed definitions for electric pool heaters (note that ''electric spa heater'' is defined later in this section), gas-fired pool heaters, and oil-fired pool heaters. 87 FR 22640, 22656. The proposed definitions were as follows:

Electric pool heater means a pool heater other than an electric spa heater that uses electricity as its primary energy source.

Gas-fired pool heater means a pool heater that uses gas as its primary energy source.

Oil-fired pool heater means a pool heater that uses oil as its primary energy source.

In response to the April 2022 NOPR, BWC agreed with DOE's proposal to clarify regulations by adding a definition for ''gas-fired pool heater'' at 10 CFR 430.2. (BWC, No. 12 at p. 2) AHRI and PHTA stated their general agreement with DOE's proposed definitions, but urged the Department to create separate definitions for electric heat pump and electric resistance pool heaters, and provided a recommended definition for electric heat pump pool heaters. (AHRI and PHTA, No. 20 at p. 4)

DOE acknowledges that there are differences in the components and operation of electric resistance pool heaters and electric heat pump pool heaters. However, because DOE is

[22] EPCA prescribed a minimum thermal efficiency of pool heaters and initially defined thermal efficiency of pool heaters only in the context of test conditions for gas-fired pool heaters. (*See* 42 U.S.C. 6295(e)(2) and 42 U.S.C. 6291(26))

maintaining one product class for all electric pool heaters, there is no need to distinguish between these two types of electric pool heaters. As such, DOE adopts the definitions above as proposed in the April 2022 NOPR.

The definition of an electric pool heater adopted by this final rule specifically excludes pool heaters meeting the definition of an ''electric spa heater''. In the April 2022 NOPR, DOE explained that lower capacity [23] electric heaters used to heat water in spas are a covered product by virtue of being within EPCA's definition of pool heater. 87 FR 22640, 22654–22656; (*see* 42 U.S.C. 6291(25).) In addition, DOE noted in the April 2022 NOPR that electric spa heaters are often incorporated into the construction of a self-contained spa or hot tub, resulting in the heater performing its major function (heating spa water) in an environment that would preclude the use of higher efficiency technologies (heat pump) and manufacturers instead rely on electric resistance heating elements. Therefore, DOE determined that heat pump technology is not a viable option for electric spa heaters designed for use within a self-contained portable electric spa because a heat pump cannot be readily incorporated into the construction of a spa or hot tub. However, DOE also determined that heat pump technology is a viable option for heating a spa or hot tub if the heater is separate from the construction of the hot tub or spa (*i.e.,* non-self-contained as defined in section 1 of ANSI/APSP/International Code Council Standard 6–2013, ''American National Standard for Residential Portable Spas and Swim Spas''). Therefore, in the April 2022 NOPR, DOE proposed to define ''electric spa heater'' as follows:

Electric spa heater means a pool heater that (1) uses electricity as its primary energy source; (2) has an output capacity (as measured according to appendix P to subpart B of part 430) of 11 kW or less; and (3) is designed to be installed within a portable electric spa.

87 FR 22640, 22656.

In the April 2022 NOPR, DOE also proposed a definition for ''portable electric spa,'' because at that time, DOE had not codified such a definition.

Portable electric spa means a self-contained, factory-built spa or hot tub in which all control, water heating and water circulating equipment is an integral part of the product. Self-contained spas may be permanently wired, or cord connected.

87 FR 22640, 22656.

Commenting in response to the April 2022 NOPR, the CA IOUs stated their agreement with DOE's decision to exclude electric spa heaters from this rulemaking due to differences in consumer utility, but suggested DOE modify the definition for electric spa heater by replacing the phrase ''to be installed'' with ''and marketed for use as an electric pool heater.'' The CA IOUs explained that ''designed and marketed'' means that the equipment is designed to fulfill the indicated application and, when distributed in commerce, is marketed for that application, with the designation on the packaging and any publicly available documents, citing a definition from 10 CFR 431.462 (related to DOE's regulations for commercial pumps). (CA IOUs, No. 16 at pp. 5–6)

Rheem recommended aligning the definitions for portable electric spas from the coverage determination for portable electric spas (Docket No. EERE–2022–BT–DET–0006) and the NOPR prior to the publication of either the final portable electric spa determination or consumer pool heaters standards final rule. (Rheem, No. 19 at p. 3) AHRI and PHTA sought clarification on whether swim spas are captured within the definition of portable electric spas. (AHRI and PHTA, No. 20 at p. 4)

On September 2, 2022, DOE published a final determination (''September 2022 Final Determination'') that established portable electric spas as a covered consumer product and included the following definition to be codified in 10 CFR 430.2:

Portable electric spa means a factory-built electric spa or hot tub, supplied with equipment for heating and circulating water at the time of sale or sold separately for subsequent attachment.

87 FR 54123, 54129.

This newly established definition is substantively the same as the one DOE proposed in the April 2022 NOPR and thus, DOE is not adopting any amendments to that definition in this final rule.

In response to the comment from AHRI and PHTA, DOE notes that swim spas are captured by the newly established definition for portable electric spa to the extent that they meet the description included in the definition. DOE also notes that portable electric spas are not within the scope of this rulemaking and will not be subject to the energy conservation standards adopted in this final rule. DOE appreciates the suggested definitional change for electric spa heaters from the CA IOUs but notes that the cited definition for commercial pumps is not relevant to consumer products, including electric spa heaters, a type of consumer pool heater. EPCA defines a consumer product, in relevant part, as any article of a type which, to any significant extent, is distributed in commerce for personal use or consumption by individuals; without regard to whether such article of such type is in fact distributed in commerce for personal use or consumption by an individual. (42 U.S.C. 6291(1)) As such, the design of an electric spa heater is sufficient to determine whether the product is a covered consumer product; coverage does not hinge on how the product is marketed. For this reason, DOE is not incorporating the language suggested by the CA IOUs in the definition of ''electric spa heater'' in this final rule.

Hayward suggested that DOE define pool heaters by technology (*e.g.,* gas-fired, air vapor compression heating/cooling, ground-source vapor compression heating/cooling, absorption heating/cooling, electric resistance) because different technology types correspond to different applications. (Hayward, No. 17 at pp. 3–4)

In response the suggestion from Hayward, DOE notes that EPCA provides that product classes shall be defined if the Secretary determines that covered products with the class consume a different kind of energy from that consumed by other covered products within such type (or class); or 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 from that which applies (or will apply) to other products within such type (or class). (42 U.S.C. 6295(q)(1)) Accordingly, DOE is adopting separate definitions and analyzed different energy conservation standards for gas-fired and electric pool heaters, which consume different kinds of energy. However, among the technologies listed by Hayward that consume electricity, DOE was unable to identify, nor did Hayward suggest, a correlation between technology type and capacity or other performance-related feature that would constitute a ''feature'' under 42 U.S.C. 6295(q)(1). Therefore, DOE is declining to additionally define consumer pool heater products by technology type.

[23] In this case, ''lower-capacity'' means an input rating of less than 11 kW. DOE identified 11 kW as being a typical output capacity below which electric resistance heaters are integrated in spas based on its assessment of the market performed for the October 2015 NODA. 80 FR 65169. This threshold was also suggested by a commenter responding to the March 2015 RFI. 87 FR 22640, 22655.

In the April 2022 NOPR, DOE proposed a definition for output capacity along with equations for its calculation for electric pool and spa heaters to be incorporated in the consumer pool heaters test procedure at appendix P. The proposed calculation for output capacity for an electric pool or spa heater utilizes measurements already taken for other calculations in appendix P and therefore DOE would not consider the provision to result in any additional test procedure burden. 87 FR 22640, 22656. DOE proposed to define output capacity for electric pool and spa heaters as follows:

Output capacity for an electric pool or spa heater means the maximum rate at which energy is transferred to the water.

DOE proposed separate equations for the calculation of output capacity of an electric resistance pool heater and electric heat pump pool heater. 87 FR 22640, 22656. For electric pool heaters that rely on electric resistance heating elements, DOE proposed that the output capacity be calculated as:

$$Q_{OUT,ER} = k * W * (T_{mo} - T_{mi}) * (60/30)$$

where k is the specific heat of water, W is the mass of water collected during the test, T_{mo} is the average outlet water temperature recorded during the primary test, T_{mi} is the average inlet water temperature record during the primary test, all as defined in section 11.1 of ASHRAE 146, and (60/30) is the conversion factor to convert the output capacity measured during the 30-minute test to output capacity per hour.

DOE proposed that the output capacity of an electric pool heater that uses heat pump technology be calculated as:

$$Q_{OUT,HP} = k * W * (T_{ohp} - T_{ihp}) * (60/t_{HP})$$

where k is the specific heat of water, W is the mass of water collected during the test, T_{ohp} is the average outlet water temperature during the standard rating test, T_{ihp} is the average inlet water temperature during the standard rating test, all as defined in section 11.2 of ASHRAE 146, and t_{HP} is the elapsed time of data recording during the thermal efficiency test on electric heat pump pool heater, as defined in section 9.1 of ASHRAE 146, in minutes. 87 FR 22640, 22656.

DOE did not receive any comments pertaining to the definition and calculations for output capacity proposed in the April 2022 NOPR and therefore will adopt them, as proposed, in this final rule.

In the April 2022 NOPR, DOE tentatively determined that the creation of a separate product class for heat pump pool heaters with cooling capability was not necessary, and requested comment on its assumption that electric pool heaters with cooling capabilities do not suffer diminished efficiency performance in heating mode. 87 FR 22640, 22655–22656.

Responding to the April 2022 NOPR, Hayward commented that heat pump pool heaters with heating and cooling need to have some efficiency offset to accommodate additional system components that affect efficiency in heating mode; the alternatives to heat pumps with cooling include evaporative coolers, which consume both energy and water, and are not currently regulated by DOE. (Hayward, No. 17 at p. 1) AHRI and PHTA stated that the efficiency and performance for a heat pump with cooling capabilities should be evaluated independently, as the pressure drop from the reversing valve could have negative impacts on overall performance compared to a similar model without cooling capabilities. (AHRI and PHTA, No. 20 at p. 3) Hayward commented that heat pump pool heaters that have both heating and cooling capabilities suffer diminished efficiency performance in heating mode due to pressure drops from the reversing valve and heat exchanger designs. Therefore, Hayward argued that the standards for heat pumps with heating and cooling should be lower than those for heating-only heat pumps. (Hayward, No. 17 at p. 3) Rheem stated that its heat pump pool heaters with cooling capability experience minimal effect on efficiency performance when in heating mode, but any difference is captured in performance ratings. (Rheem, No. 19 at p. 3)

DOE's market assessment performed for this rulemaking included both heating-only and heating- and cooling-capable consumer pool heaters. Of the models DOE identified, differences in COP are negligible between the heating- and cooling-capable pool heaters and the heating-only pool heaters. As such, DOE maintains that the creation of a separate product class for heat pump pool heaters with cooling capability is not warranted and does not establish one in this final rule.

2. Technology Options

In the April 2022 NOPR, DOE identified nine technology options for electric pool heaters and eight technology options for gas-fired pool heaters that would be expected to improve the efficiency as measured by DOE test procedure. 87 FR 22640, 22656–22657. Table IV.1 below lists all technology options identified.

TABLE IV.1—TECHNOLOGY OPTIONS IDENTIFIED FOR THE APRIL 2022 NOPR

Technology option	Electric pool heater	Gas-fired pool heater
Insulation improvements	X	X
Control improvements	X	X
Heat pump technology	X	
Heat exchanger improvements	X	X
Compressor improvements	X	
Expansion valve improvements	X	
Fan improvements	X	
Condensing heat exchanger		X
Electronic ignition systems		X
Switch mode power supply	X	X
Seasonal off switch	X	X
Condensing pulse combination		X

In the April 2022 NOPR, DOE discussed comments it received from interested parties requesting the Department consider fan motor improvements as a technology option to improve efficiency at multiple load conditions. DOE noted that these improvements are unlikely to yield improvements because heat pump pool heaters operate at full capacity to satisfy the call for heat. Heat pump pool heaters on the market use permanent split capacitor (''PSC'') motors and do not currently utilize brushless permanent magnet (''BPM'') fan motors.[24] Therefore, DOE has not been able to test products in order to determine the magnitude of efficiency improvement, if any, that could be expected due to the incorporation of BPM motors. The Department requested more information on this topic to determine whether there would be an efficiency improvement from replacing PSC motors with BPM motors. 87 FR 22640, 22660–22661.

Responding to the April 2022 NOPR, Fluidra stated it generally agreed with the technology options analyzed. (Fluidra, No. 18 at p. 2) Hayward suggested consideration of modulating heaters, as they can provide both improved efficiency and a better user experience, and recommended further analysis on average energy or part load energy consumption to provide credit for variable-capacity (modulating) pool heaters. (Hayward, No. 17 at pp. 4–5) Hayward added that variable-capacity heat pump pool heaters and gas-fired pool heaters, which would allow for efficiency calculations at part loads, should be considered for additional efficiency levels. Hayward also suggested that a variable-capacity heat pump pool heater would constitute a new max-tech electric pool heater efficiency level, and a variable-capacity gas-fired pool heater would fall between 84-percent and 95-percent thermal efficiency. (Hayward, No. 17 at p. 2) Conversely, AHRI and PHTA stated that their testing shows variable-speed fans have minimal impact on heat pump efficiency, and that the current efficiency metric does not benefit from variable-capacity equipment. In addition, these commenters noted that variable-capacity equipment will have higher standby mode and off mode losses. (AHRI and PHTA, No. 20 at p. 4)

Rheem stated that fan motor efficiency improvements will affect only the active mode testing in the current DOE test procedure. Rheem noted that the current DOE test procedure does not address part-load efficiency, which could be improved with fan motor efficiency (*e.g.,* switching from a PSC to a BPM fan motor). (Rheem, No. 19 at p. 4) Hayward claimed that while BPM fan motors may offer improved efficiency at reduced speed, the energy consumed by the fan motor is small compared to the energy consumed by the compressor motor. (Hayward, No. 17 at p. 4)

In order for a given technology to be considered a technology option by DOE for the purposes of evaluating potential new or amended energy conservation standards, the technology must be expected to improve the efficiency or energy consumption as measured by DOE test procedure. Appendix P does not capture part-load performance; therefore, DOE is unable to determine the efficiency impacts of modulating heaters or variable-capacity heat pumps for consumer pool heaters. Thus, DOE did not evaluate either of these technologies as a technology option for this final rule.

In response to the comment from Hayward, DOE acknowledges that the energy consumed by the fan motor is generally smaller than that of the compressor in an electric heat pump water heater. However, DOE agrees with Rheem that improvements in fan motor efficiency will improve the efficiency of a consumer pool heater as measured by appendix P and, therefore, continued to consider fan motor improvements as part of the general fan improvements technology option for this final rule. As discussed in section III.C of this document, DOE may consider comments related to part-load efficiency provisions in appendix P in its next test procedure rulemaking for consumer pool heaters.

In summary, DOE retains the same list of technology options from the April 2022 NOPR in this final rule. After considering all identified potential technology options for improving the efficiency of consumer pool heaters, DOE performed the screening analysis (see section IV.B of this document and chapter 4 of the final rule TSD) on these technologies to determine which were considered further in the final rule analysis.

B. Screening Analysis

DOE uses the following four 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. Sections 6(b)(3) and 7(b) of appendix A.

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

1. Screened-Out Technologies

In the April 2022 NOPR, DOE proposed eliminating condensing pulse combustion from its analysis, having tentatively determined that this technology option is not technologically feasible and not practicable to manufacture, install, and service. DOE stated that, although condensing pulse combustion technology shows promising results in increasing efficiency, it has not yet penetrated the consumer pool heater market, and similar efficiencies are achievable with other technologies that have already been introduced on the market. 87 FR 22640, 22657. BWC agreed with screening out condensing pulse combustion technology. (BWC, No. 12 at p. 2) For the reasons stated, DOE screened out the condensing pulse combustion technology option in the final rule analysis. Although condensing pulse combustion technology shows promising results in increasing efficiency, it has not yet penetrated the consumer pool heater market, and similar efficiencies are achievable with

[24] The efficiency of PSC motors is highest at a single speed, with significant diminishing operation efficiency at other speeds, whereas BPM motors are capable of maintaining a high operating efficiency at multiple speeds.

other technologies that have already been introduced on the market.

2. Remaining Technologies

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

TABLE IV.2—TECHNOLOGY OPTIONS THAT PASSED SCREENING CRITERIA

Technology option	Electric pool heater	Gas-fired pool heater
Insulation improvements	✓	✓
Control improvements	✓	✓
Heat pump technology	✓	
Heat exchanger improvements	✓	✓
Expansion valve improvements	✓	
Fan improvements	✓	
Condensing heat exchanger		✓
Electronic ignition systems		✓
Switch mode power supply	✓	✓
Seasonal off switch	✓	✓

BWC agreed that the technology options identified by DOE in Table IV.2 of the April 2022 NOPR (which are the same as those retained for this final rule) are comprehensive and appropriate in assessing gas-fired pool heaters, although many of the retained technologies are unlikely to lead to significant overall energy efficiency improvements for these consumer pool heaters. (BWC, No. 12 at 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 found 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 final rule TSD. DOE notes that the technology options which passed screening criteria do not in their entirety constitute the list of technologies which were analyzed as representative of the major design pathways to improving TE_I values for consumer pool heaters; those ''design options'' are described in further detail in the engineering analysis (see section IV.C.1.b of this document).

C. Engineering Analysis

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

1. 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).

In this final rule, DOE relied on the efficiency-level approach. Efficiency levels for electric pool heaters were initially identified in the October 2015 NODA based on a review of products on the market and then revised in the April 2022 NOPR. DOE applied the same analytical approach for the efficiency analysis of gas-fired pool heaters in the April 2022 NOPR. 87 FR 22640, 22658.

As discussed in the April 2022 NOPR, the efficiency-level approach enabled DOE to identify incremental improvements in efficiency resulting from design options that consumer pool heater manufacturers already incorporate in commercially available models. 87 FR 22640, 22658. However, as of this final rule, manufacturers have not yet begun publishing ratings in terms of TE_I because there are no standards or certification requirements for electric pool heaters, and requirements for gas-fired pool heaters are limited only to E_t representations. Due to this lack of certified or otherwise publicly available TE_I ratings, the Department's efficiency analysis included a process to convert existing E_t ratings for gas-fired pool heaters and COP ratings for heat pump pool heaters to representative TE_I values based on the calculation procedures found in section 5.1 of the appendix P test procedure. Typical values for active mode, standby mode, and off mode energy consumption were estimated based on test data and feedback from manufacturers during confidential interviews. *Id.*

The TE_I metric improves upon the E_t metric by taking into account standby mode and off mode energy consumption, as discussed in section III.C of this document. The current standard for gas-fired pool heaters requires an E_t of 82 percent for products of all capacities. Figure 3.2.24 of the April 2010 Final Rule TSD (''Distribution of Pool Heater Models by Input Capacity and Thermal Efficiency'') demonstrated that E_t is not strongly dependent upon capacity. However, the transition to a regulated TE_I metric has required additional consideration for how standby and off mode energy consumption may affect ratings for products of different capacities. From information collected throughout this rulemaking process, DOE has determined that standby and off mode energy consumption is not directly correlated to input capacity, Q_{IN}, for a gas-fired pool heater or active mode electrical energy consumption, PE, for an electric pool heater. As a result, consumer pool heaters with lower capacities cannot achieve the same TE_I levels as products with higher capacities because the standby and off mode energy consumption is a more significant contribution to the overall energy consumption of lower-capacity products.

To account for this, in the April 2022 NOPR, DOE developed efficiency levels in which the TE_I requirement is a function of the capacity of the unit. 87 FR 22640, 22659. In the engineering analysis for the April 2022 NOPR, the Department used several performance parameters measured in the appendix P test procedure as inputs to determining TE_I efficiency levels for consumer pool heaters as a function of capacity. *Id.* at 87 FR 22658–22659.

In response to the April 2022 NOPR, Hayward argued that standards for heat pump and gas-fired pool heaters should be strictly focused on thermal efficiency and not include standby power. Hayward suggested that standby mode power could be considered in a future revision when these other requirements are more mature and understood. (Hayward, No. 17 at p. 2) Rheem stated the methodology used to estimate standby energy use was appropriate. Rheem also supported the use of the integrated thermal efficiency metric as it would allow manufacturers to make tradeoffs between active mode, standby mode, and off mode energy use regarding the overall efficiency and other features. (Rheem, No. 19 at p. 6) BWC agreed with the Department's estimates for standby mode and off mode power consumption for gas-fired pool heaters, as well as the assertion that this energy consumption accounts for a very small amount of the total overall annual energy use for such products, and will not increase with higher input products. (BWC, No. 12 at p. 3)

DOE notes first that EPCA requires that any final rule for new or amended energy conservation standards promulgated after July 1, 2010, must address standby mode and off mode energy use, (42 U.S.C. 6295(gg)(3)), in that 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)). The TE_I metric, which incorporates energy consumption in active mode, standby mode, and off mode and upon which potential new and amended energy conservation standards for consumer pool heaters were evaluated, has been established in the appendix P test procedure since July 6, 2015, as discussed in section III.C of this document, allowing ample time for manufacturers to assess products per this metric.

For this final rule, DOE revisited market energy efficiency distributions (see chapter 3 of the final rule TSD) and performed another round of manufacturer interviews (see section IV.J.3 of this document) to determine that the same efficiency levels from the April 2022 NOPR remain representative of the current consumer pool heater market. The following subsections detail the baseline, intermediate, and max-tech efficiency levels addressed in this final rule. Further discussion can be found in chapter 5 of the final rule TSD.

a. Baseline Efficiency

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

DOE uses the baseline model for comparison in several analyses, including the engineering analysis, LCC analysis, PBP analysis, and NIA. To determine energy savings that will results from a new or amended energy conservation standard, DOE compared energy use at each of the higher energy efficiency levels to the energy consumption of the baseline unit. Similarly, to determine the change sin price to the consumer that will result from an amended energy conservation standard, DOE compares the price of a baseline unit to the price of a unit at each higher efficiency level.

For gas-fired pool heaters, DOE analyzed a baseline efficiency level corresponding to a product which is minimally compliant with the current standard (82-percent E_t) and uses a standing pilot light. As discussed in the April 2022 NOPR, standing pilot lights operate when the product is not in use and contribute to fossil fuel energy use in standby mode, thereby resulting in lower TE_I values than products with electronic ignition. 87 FR 22640, 22659. Table IV.3 depicts the baseline efficiency level for gas-fired pool heaters analyzed for the April 2022 NOPR (and, as discussed later, also analyzed in this final rule).

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Table IV.3 Baseline Efficiency Level for Gas-Fired Pool Heaters

Efficiency Level	E_t (percent)	Q_{PR} (Btu/h)	$Q_{off,R}$ (Btu/h)	PE (W)	$P_{W,SB}$* (W)	$P_{W,OFF}$* (W)	TE_I** (percent)
EL 0	82	1,000	1,000	20	7.2	7.2	$\frac{82(Q_{IN}+68)}{Q_{IN}+85{,}344}$

* Presented in terms of Btu/h in appendix P.
** Equation comprises input capacity Q_{IN} and E_t and values for $P_{W,SB}$, and $P_{W,OFF}$ at left and uses equation 5.4.3 in appendix P.

For electric pool heaters, DOE analyzed a baseline efficiency level corresponding to electric resistance heating, which was found to be the least efficient electric pool heater design on the market. Table IV.4 depicts the baseline efficiency level for electric pool heaters analyzed for the April 2022 NOPR and this final rule.

Table IV.4 Baseline Efficiency Level for Electric Pool Heaters

Efficiency Level	E_t (percent)	$P_{W,SB}$ (W)*	$P_{W,OFF}$ (W)*	TE_I** (percent)
EL 0	99	1.2	1.2	$\frac{99\ PE}{PE+341}$

* Presented in terms of Btu/h in appendix P.
** Equation comprises active electrical power PE and values for E_t, $P_{W,SB}$, and $P_{W,OFF}$ at left and uses equation 5.4.3 in appendix P.

BWC believed that the baseline efficiency levels established in the April 2022 NOPR were appropriate based on the DOE test procedure for these products. (BWC, No. 12 at p. 2)

DOE did not receive any other comments specifically on the baseline efficiency levels proposed in the April 2022 NOPR. Comments relating to energy use in standby mode and off mode power, which factor into the baseline TE_I equations, have been discussed previously in section IV.C.1 of this document. For the reasons described, DOE maintained these baseline efficiency levels for the final rule analysis.

Additional details on the selection of baseline models and the development of the baseline efficiency equations may be found in chapter 5 of the final rule TSD.

b. Higher Efficiency Levels

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 consumer pool heaters, the max-tech efficiency levels are achieved by gas-fired pool heaters that utilize condensing technology and by electric pool heaters that utilize heat pump technology.

As discussed in section IV.C.1 of this document, efficiency levels for electric pool heaters were initially analyzed in the October 2015 NODA. DOE requested comment on these efficiency levels and reviewed stakeholder feedback in the April 2022 NOPR. In response to that feedback, DOE incorporated additional design options in the April 2022 NOPR to decrease the standby mode and off mode energy consumption at the max-tech levels and to further improve TE_I values: transformer improvements, switch mode power supply, and a seasonal off switch. 87 FR 22640, 22660.

Between the baseline efficiency level and the max-tech efficiency level, DOE analyzed several intermediate higher efficiency levels for gas-fired pool heaters and electric pool heaters in the April 2022 NOPR. 87 FR 22640, 22659–22660. These efficiency levels, and corresponding major design options to achieve these efficiency levels, are shown in Table IV.5 through Table IV.8. As discussed in this section, the Department is using these efficiency levels and design options for this final rule analysis.

Table IV.5 Efficiency Levels for Gas-Fired Pool Heaters

Efficiency Level	E_t (percent)	Q_{PR} (Btu/h)	$Q_{off,R}$ (Btu/h)	PE (W)	$P_{W,SB}$* (W)	$P_{W,OFF}$* (W)	TE_I† (percent)
EL 0	82	1,000	1,000	20	7.2	7.2	$\frac{82(Q_{IN}+68)}{Q_{IN}+85{,}344}$
EL 1	82	0	0	20	7.2	7.2	$\frac{82(Q_{IN}+68)}{Q_{IN}+2{,}113}$
EL 2	84	0	0	144	7.2	7.2	$\frac{84(Q_{IN}+491)}{Q_{IN}+2{,}536}$
EL 3**	95	0	0	220	4.6**	0**	$\frac{95(Q_{IN}+751)}{Q_{IN}+1{,}409}$

* Presented in terms of Btu/h in appendix P.
** The max-tech efficiency level includes standby mode and off mode technology options.
† Equation comprises values for E_t, $P_{W,SB}$, and $P_{W,OFF}$ at left and uses equation 5.4.3 in appendix P.

TABLE IV.6—DESIGN OPTIONS FOR GAS-FIRED POOL HEATERS

Efficiency level	Technology
EL 0	Standing Pilot + Cu or CuNi Finned Tube + Atmospheric.
EL 1	Electronic Ignition + Cu or CuNi Finned Tube + Atmospheric.
EL 2	Electronic Ignition + Cu or CuNi Finned Tube + Blower Driven Gas/Air Mix.
EL 3	Condensing + CuNi and Cu Finned Tube + seasonal off switch + switch mode power supply.

Table IV.7 Efficiency Levels for Electric Pool Heaters

Efficiency Level	E_t (percent)	$P_{W,SB}$* (W)	$P_{W,OFF}$* (W)	TE_I‡ (percent)
EL 0	99	1.2	1.2	$\frac{99\ PE}{PE+341}$
EL 1	410	5.7	5.7	$\frac{410\ PE}{PE+1{,}619}$
EL 2	520	5.7	5.7	$\frac{520\ PE}{PE+1{,}619}$
EL 3	580	5.7	5.7	$\frac{580\ PE}{PE+1{,}619}$
EL 4	600	5.7	5.7	$\frac{600\ PE}{PE+1{,}619}$
EL 5†	610	3.1	0	$\frac{610\ PE}{PE+443}$

* Presented in terms of Btu/h in appendix P.
† The max-tech efficiency level includes standby mode and off mode technology options.
‡ Equation comprises values for E_t, $P_{W,SB}$, and $P_{W,OFF}$ at left and uses equation 5.4.3 in appendix P.

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TABLE IV.8—DESIGN OPTIONS FOR ELECTRIC POOL HEATERS

Efficiency level	Technology
EL 0	Electric Resistance.
EL 1	Heat Pump, twisted Titanium tube coil in concentric/counter flow PVC Pipe.
EL 2	EL 1 + increased evaporator surface area.
EL 3	EL 2 + increased evaporator surface area.
EL 4	EL 3 + increased evaporator surface area.
EL 5	EL4 + condenser coil length + seasonal off switch + switch mode power supply.

The April 2022 NOPR requested comment on the proposed efficiency levels above the baseline and the typical technological changes associated with each efficiency level. 87 FR 22640, 22663.

In response, the Joint Advocates encouraged DOE to consider additional efficiency levels for both electric and gas-fired pool heaters that include designs employing seasonal off switches and switch mode power supplies. The Joint Advocates suggested that adding seasonal off switches would increase energy savings with minimal cost, and cited State regulations for heat pump pool heaters in California, Connecticut, and Florida which already require an off switch mounted on the pool heater that permits shutoff without adjusting the thermostat. The Joint Advocates commented that the proposed standard levels should be adjusted to include seasonal off switches and/or a switch mode power supply and that the analysis include the reduced standby mode and off mode energy consumption associated with the use of these technology options. (Joint Advocates, No. 13 at pp. 2–3) Similarly, the CA IOUs recommended that DOE consider incorporating the assumption that all consumer pool heaters are equipped with a seasonal off switch and updating the efficiency levels as appropriate. The CA IOUs indicated that heat pump pool heaters certified in the California Energy Commission's Modernized Appliance Efficiency Database System (''MAEDbS'') all have an on/off switch as California's Appliance Efficiency Regulations (Title 20) adopted this as a prescriptive design requirement for all consumer pool heaters sold in the state. CA IOUs suggested that the seasonal off switch would be a cost effective means for many models to reach the EL 4 level without needing to redesign for a higher COP. (CA IOUs, No. 16 at pp. 3–5)

AquaCal suggested that the proposed efficiency level for electric pool heaters was more stringent, in terms of relative level of technological advancement required, than that for gas-fired pool heaters. AquaCal recommended DOE should consider proposing efficiency levels that are more comparable, in terms of the relative level of technological advancement required, for electric and gas-fired pool heaters. (AquaCal, No. 11 at p. 1) However, as results have shown, the benefits and burdens for higher efficiency levels of gas-fired pool heaters are not equivalent to the benefits and burdens for higher efficiency levels of electric pool heaters, and DOE accounts for this when constructing TSLs.

Rheem generally supported the technology changes associated with each efficiency level. However, Rheem stated that the off-mode energy use may not actually be zero when there is a seasonal off switch, and the commenter recommended DOE either amend appendix P to require that any non-zero off mode energy use be measured or provide clarification on whether seasonal off switches with non-zero off mode energy use meet the definition of a seasonal off switch within appendix P. (Rheem, No. 19 at pp. 4–5)

Section 1.7 of appendix P defines ''off mode'' as the condition during the pool non-heating season in which the consumer pool heater is connected to the power source, and neither the main burner, nor the electric resistance elements, nor the heat pump is activated, and the seasonal off switch, if present, is in the ''off'' position. Section 1.8 defines ''seasonal off switch'' as a switch that results in different energy consumption in off mode as compared to standby mode. Thus, there is no requirement for a seasonal off switch to result in a measured energy consumption of zero in off mode in order to meet the definition in section 1.8 of appendix P. However, feedback from manufacturers and DOE's own testing has led the Department to conclude that 0 watts is a representative value for $P_{W,OFF}$ at max-tech because some seasonal off switches, including those analyzed for the max-tech level, are capable of reducing the electrical power consumption to 0 watts when in off mode.

DOE reviewed the regulations and building codes in California,[25] Connecticut,[26] Texas,[27] and Florida [28] to consider the requirements for seasonal off switches in these jurisdictions. From its research, the Department recognizes that these States do not have the same definition or usage for off switches as DOE provides in appendix P; the States and DOE are not defining the same type of switch despite similar terminology. Specifically, these States require the use of a ''readily accessible on-off switch'' which allows the unit to shut off the heater operation without adjusting the thermostat setting. These requirements do not specify that all power-consuming components of the pool heater are off—only the heater operation. Therefore, it is uncertain whether these State-required on-off switches would put the pool heater in a state where it would consume 0 watts of power. As noted, DOE defines ''seasonal off switch'' as a switch that results in different energy consumption in off mode as compared to standby mode, and this would typically cause the pool heater to consume 0 watts in the off mode. Additionally, DOE notes that California's regulations require such a switch only for heat pump pool heaters.

AHRI and PHTA stated that a unit disconnect is required in these installations, and this typically functions as the off switch. AHRI and PHTA opposed using seasonal off switches at lower efficiency levels in DOE's analysis. (AHRI and PHTA, No. 20 at p. 3)

[25] *See* California Code of Regulations at 20 CCR § 1605.3(g)(2), found online at: *govt.westlaw.com/calregs/Index?transitionType=Default&contextData=%28sc.Default%29* (last accessed on October 15, 2022).

[26] In the current, 2022 version of Connecticut building code, an emergency off switch is no longer required for pool heaters. Item 313.7, which used to address the emergency shutoff switch, has been deleted. *See* 2022 Connecticut State Building code at *portal.ct.gov/-/media/DAS/Office-of-State-Building-Inspector/2022-State-Codes/2022-CSBC-Final.pdf* (last accessed on October 15, 2022).

[27] See Texas Administrative Code § 265.197 at *texreg.sos.state.tx.us/public/readtac$ext.TacPage?sl=T&app=9&p_dir=N&p_rloc=202557&p_tloc=&p_ploc=1&pg=3&p_tac=&ti=25&pt=1&ch=265&rl=197* (last accessed on October 15, 2022).

[28] *See* 2020 Florida Building Code, Energy Conservation at C404.9.1, *codes.iccsafe.org/content/FLEC2020P1/chapter-4-ce-commercial-energy-efficiency* (last accessed on October 15, 2022).

As such, it is unclear whether manufacturers are responding to State mandates for ''readily accessible on-off switches'' by introducing seasonal off switches which meet DOE's definition in appendix P.

DOE agrees that seasonal off switches and switch mode power supplies can improve the TE_I values of each efficiency level. However, DOE notes that the engineering analysis identifies the major design pathway manufacturers are expected to use to improve efficiency From discussions with manufacturers, DOE understands that improvements to heat exchangers and fans would likely be implemented first to achieve efficiencies above the baseline, before equipping consumer pool heaters with technologies to reduce standby mode and off mode energy consumption, because active mode energy consumption is significantly larger and would be prioritized when considering which design option to implement to achieve a target standard level. For this reason, DOE maintains its analysis from the April 2022 NOPR, which attributes the incorporation of seasonal off switches, switch mode power supply, and transformer improvements only at the max-tech efficiency level, after manufacturers have exhausted options to improve efficiency via heat exchanger upgrades.

Furthermore, the CA IOUs suggested increasing the max-tech efficiency level for electric pool heaters, given the presence of such products with AHRI-certified COP values that exceed the max-tech COP level analyzed in the April 2022 NOPR. (CA IOUs, No. 16 at pp. 4–5) In response to this, DOE notes that it evaluated the efficiencies of electric pool heaters on the basis of the TE_I metric, and found that, based on expected values of standby and off mode power consumption, the max-tech efficiency level assessed in the NOPR is still representative of the maximum efficiency that has been demonstrated across a full range of capacities.

The Department also received comments regarding the efficiency levels chosen for analysis of gas-fired pool heaters. The Joint Advocates urged DOE to evaluate an efficiency level for gas pool heaters with an active mode thermal efficiency of 85 percent. The Joint Advocates claimed that there exist non-condensing gas-fired products from multiple manufacturers with 85-percent thermal efficiency at capacities ranging from 150,000 to 750,000 Btu/h, which can be found in DOE's Compliance Certification Database (''CCD'') and MAEDbS. (Joint Advocates, No. 13 at p. 2) AHRI and PHTA, by contrast, claimed that the current Efficiency Level 2 (''EL 2'') (corresponding to an active mode E_t of 84 percent) for gas-fired pool heaters has the potential to condense, and that the Department should set the thermal efficiency at 83 percent.

AHRI and PHTA, along with the Gas Associations, encouraged DOE to adopt a standard based on a thermal efficiency of 83 percent to avoid venting re-configurations due to this potential condensing operation that could occur at the proposed standard that corresponds to 84-percent thermal efficiency. (AHRI and PHTA, No. 20 at pp. 2 and 5; Gas Associations, No. 15 at p. 2) Fluidra provided similar comments, indicating that 84-percent thermal efficiency is too close to the functional limit for non-condensing gas-fired pool heaters, and suggesting that the standard should be set at a level which corresponds to a thermal efficiency of 83 percent in order to ensure a margin of efficiency is used to prevent new products from operating in condensing mode when installed as a non-condensing product. They noted this approach would minimize disruption to consumers and industry by increasing the minimum thermal efficiency, while allowing adequate transition time for gas-fired pool heaters to reach EL 3 in the future. (Fluidra, No. 18 at pp. 1–2) At the NOPR public meeting, DOE also received comments that 84 percent is the threshold of condensing operation, and any thermal efficiency higher than 84 percent would inevitably result in condensation. (Pentair, Public Meeting Transcript, No. 9 at pp. 5–6)

In manufacturer interviews since the April 2022 NOPR, stakeholders have elaborated that at an 84-percent E_t rating, in certain installation conditions condensate forms in venting as the flue gases exiting the heat exchanger are close to the dew point. Thus, while such a gas-fired pool heater would be considered ''non-condensing'' because the condensation does not occur in the heat exchanger, installation considerations would still include using the appropriate venting materials to handle possible condensation. Additionally, stakeholders indicated that, when a gas-fired pool heater is operating at an efficiency that is close to the condensing threshold, variations in ambient temperature and water inlet temperature can cause condensation to actually occur in the heat exchanger. While these fluctuations would improve the efficiency of the gas-fired pool heater as compared to its rating, the result may be corrosive damage to the heat exchanger, according to these manufacturers.

Given these considerations, DOE did not consider an efficiency level of 85-percent E_t for gas-fired pool heaters, which was suggested by the Joint Advocates, because safety or installation concerns about near-condensing operation (brought up by manufacturers in response to the April 2022 NOPR) would potentially be exacerbated at 85-percent E_t. Additionally, upon its review of the CCD, DOE has found that only one model line from one manufacturer is available at 85-percent E_t, indicating that manufacturers do not generally produce gas-fired pool heaters at that efficiency. This would indicate that near-condensing operation concerns may hinder the production of 85-percent E_t pool heaters.

Although several parties indicated that near-condensing operation is also an issue at 84-percent E_t, DOE's market assessment demonstrates that there are a large number of unique basic models of gas-fired pool heaters from six manufacturers available at 84-percent E_t. This shows that a significant portion of the market uses products at this efficiency level, and that the potential for condensation to disrupt system performance has apparently been adequately mitigated through appropriate product design and installation instructions for these products to maintain market share in the United States. For example, DOE observed that gas-fired pool heaters at 84-percent E_t can be equipped with blowers that ensure positive vent pressure (for indoor installations) and may need to be installed with adequate means to discharge potential condensate. Most importantly, far more products exist at 84-percent E_t than do at 83-percent E_t [29]—hence, it would appear that the 84-percent E_t efficiency level is feasible and generally more desirable to consumers than 83-percent E_t since the market has already largely moved to 84-percent. For these reasons, DOE maintains a TE_I level based on 84-percent E_t in its efficiency analysis for gas-fired pool heaters.

Rheem and AHRI and PHTA stated that copper and cupronickel heat exchangers are not suitable for condensing operation because they are not resistant to the corrosion from condensate and thus should not be considered for EL 3. (Rheem, No. 19 at pp. 4–5; AHRI and PHTA, No. 20 at p. 5) In response, DOE notes that it observed condensing cupronickel-based pool heaters in its teardown analysis.

[29] As of October 2022, 51 unique basic models of gas-fired pool heaters were certified to DOE at 84% E_t, whereas only 10 unique basic models were rated at 83% E_t. See chapter 3 of the TSD for further details on the market assessment.

Therefore, DOE has determined that cupronickel is suitable for condensing operation, and the manufacturer production cost (''MPC'') for EL 3, as discussed in section IV.C.2.a of this document, reflects the use of this material.

Fluidra also commented that gas-fired pool heaters at EL 0 and EL 1, which were based on a model with 82-percent E_t with and without a standing pilot light, respectively, have become less prevalent in the marketplace and that these efficiency levels would have minimal meaningful impact. (Fluidra, No. 18 at p. 2) However, DOE's market assessment reveals that, contrary to Fluidra's comment, 82-percent E_t (the active mode thermal efficiency at EL 0 and EL 1) is the most commonly found thermal efficiency on the market for gas-fired pool heaters. Hence DOE analyzed gas-fired pool heaters with 82-percent E_t (with and without standing pilot lights) for this final rule analysis.

Hayward suggested that DOE analyze additional efficiency levels for both gas-fired pool heaters and electric pool heaters with variable-capacity technologies (*i.e.,* modulating burners or inverter drives). Hayward stated that it believed that manufacturers will be deterred from developing modulating consumer pool heaters because the standby power consumption for inverter-driven heat pump pool heaters will be higher than that for single-capacity heat pump pool heaters. Hayward also indicated that standby power requirements could also deter development of demand-response technologies. Hayward claimed that variable-capacity heat pump pool heaters have significant efficiency improvements over single-capacity products. (Hayward, No. 17 at p. 4) However, as discussed in section IV.A.2 of this document, DOE has determined that modulating burners and inverter-driven (*i.e.,* variable-speed fan) heat pump designs would not provide substantial improvements to TE_I as measured by the current appendix P test procedure, because the test conditions require consumer pool heaters to operate at full-load capacity. Thus, DOE did not analyze additional efficiency levels for these technologies.

AquaCal claimed that the EL 4 level chosen by DOE for electric pool heaters, while possible to achieve, only represents 10 percent of the existing market because of the price increase for products at that level of efficiency. (AquaCal, No. 11 at p. 1) EL 4 for electric pool heaters corresponds to a COP of 6.0 or an E_t of 600 percent. This level was originally selected in the October 2015 NODA because many heat pump pool heaters are rated at COPs of 6.0. An efficiency level which approximately reflects the top 10 percent of the market is a useful point to have in the analysis, because it represents a market-available stringency which would result in significant energy savings. In this final rule analysis, DOE has determined that several manufacturers produce heat pump pool heaters which meet or exceed EL 4; therefore, DOE is maintaining this efficiency level in its analysis of electric pool heaters.

With respect to the description of technologies implemented at higher efficiency levels for electric pool heaters, AHRI and PHTA stated that the description for EL 1 is too specific for the heat exchanger and does not account for a wide variety of heat exchanger technologies on the market at this level. (AHRI and PHTA, No. 20 at p. 5)

In the initial October 2015 NODA engineering analysis, DOE associated straight titanium tube coils in submerged water tanks as the main heat exchanger type for achieving a TE_I of 344 percent at EL 1. In response to this analysis, AHRI suggested that the design features assumed for EL 1 were mischaracterized, and DOE re-evaluated this efficiency level in the April 2022 NOPR. In the April 2022 NOPR, DOE had tentatively determined that electric pool heaters at EL 1 would have more similar designs to electric pool heaters at EL 2, and, as a result, DOE revised this efficiency level to reflect a twisted titanium tube concentric/counterflow heat exchanger. The TE_I rating of this efficiency level was increased to 387 percent to correlate with the improvement in heat exchanger type from submerged coils. 87 FR 22640, 22664. See chapter 5 of the April 2022 NOPR TSD for additional information. As such, DOE is aware that products that perform at or near EL 1 may use either submerged coil or twisted tube concentric/counterflow heat exchangers. AHRI's previous comments, however, had indicated that a submerged coil design misrepresented this efficiency level.

DOE reiterates its assertion in the April 2022 NOPR that its association of specific technology options with efficiency levels is based on observed designs in commercially available products, and that the Department does not assume *a priori* that certain heat exchanger designs would result in specific efficiency levels. 87 FR 22640, 22664. DOE discussed technology options in manufacturer interviews conducted after the April 2022 NOPR and did not receive further feedback indicating that a twisted tube concentric/counterflow heat exchanger would not be representative of EL 1. Given that the majority of heat pump pool heaters utilize this style of heat exchanger (based on DOE's market review and teardowns of other efficiency levels), DOE is maintaining this technology option for EL 1 in this final rule analysis.

AHRI and PHTA stated that the descriptions for electric pool heaters at EL 2 to EL 4 are too simple, and that other designs must be implemented beyond increased evaporator surface area, such as increased condenser surface area. AHRI and PHTA requested more information from DOE regarding how the measured efficiency increases articulated in the different ELs were derived via the increased evaporator surface area and urged DOE to consider the impacts of reduced standby mode and off mode energy consumption. AHRI and PHTA also encouraged DOE to investigate the impact on efficiency levels due to the required change in refrigerants. (AHRI and PHTA, No. 20 at p. 5)

To clarify, efficiency increases for heat pump pool heaters were not numerically derived: DOE conducted teardown analyses on products which were rated at these efficiency levels and observed that the designs differed by evaporator surface area. This trend was verified through teardowns of multiple samples spanning a range of efficiencies. DOE did not observe condenser coil increases to contribute to intermediate efficiency levels across all manufacturers' designs. Specifically, several condenser coil lengths were observed for products meeting similar efficiencies, and vice-versa: similar condenser coil lengths were observed for products meeting different intermediate efficiencies. This would indicate that manufacturers did not rely on this design option to improve efficiency. The only case where DOE observed significant increases in condenser length and coil diameter was in the model representing the max-tech efficiency level. Thus, DOE determined that condenser coil improvements are necessary to achieve EL 5.

In response to AHRI and PHTA's request for DOE to consider the impact of standby mode and off mode energy consumption, DOE notes that its estimated typical standby mode and off mode energy consumption values for the engineering analysis do not mandate that manufacturers must meet these values in order to comply with potential standards. Because TE_I is an integrated metric that combines active mode, standby mode, and off mode energy consumption, manufacturers may design products to meet potential standards by implementing improvements to any combination of the three energy-consuming modes. The technology options in this efficiency analysis assess the most cost-effective design pathways to improvement efficiency based on market evidence.

With respect to changes in refrigerant, products torn down by DOE utilized R–410A refrigerant. While several low-GWP replacements for R–410A, such as R–441A, R–290, and R–32, are currently being developed and implemented in other refrigeration-based consumer products, that refrigerant changeover is being driven in part by regulations such as those in California. Consumer pool heaters are not subject to those regulations at this time and thus the consumer pool heater market has not yet experienced a similar shift to other refrigerants. Moreover, commenters did not provide any specifics for replacement refrigerants that DOE should consider during manufacturer interviews. As such, DOE assumes that manufacturers will opt to continue to use R–410A refrigerant as long as possible, and thereafter use drop-in replacements using an alternative refrigerant wherever feasible to limit product and capital conversion costs. Because these drop-in replacements have not been taken up by the consumer pool heater market at this time, it is uncertain what the MPC of an alternative refrigerant system would be, nor whether there would be efficiency impacts. Therefore, DOE maintained R–410A as the basis for heat pump pool heater efficiency levels and MPCs in this final rule.

Further details of the efficiency analysis are found in chapter 5 of the final rule TSD.

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, 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.

At the start of the engineering analysis, DOE identified the energy efficiency levels associated with consumer pool heaters on the market using data gathered in the market assessment. DOE also identified potential technologies and features that are typically incorporated into products at the baseline level and at the various efficiency levels analyzed above the baseline. Next, DOE selected products for a physical teardown analysis having characteristics of typical products on the market at the representative capacity and used these teardowns to verify technology options implemented at each efficiency level. DOE chose a representative size of 250,000 Btu/h input capacity for gas-fired pool heaters and 110,000 Btu/h output capacity for electric pool heaters. As explained in the April 2022 NOPR, DOE selected these representative capacities based on the number of available models on the market and by referencing a number of sources, including information collected for the market and technology assessment, as well as information obtained from product literature. DOE then sought feedback on the representative capacities during confidential manufacturer interviews. 87 FR 22640, 22664. DOE gathered information from performing a physical teardown to create detailed bills of materials (''BOMs''), which included all components and processes used to manufacture the products. The resulting BOMs provide the basis for the MPC estimates. MPCs are estimated spanning the full range of efficiencies from the baseline to the maximum technology available. For this rulemaking, DOE held interviews with manufacturers to gain insight into the consumer pool heater industry and to request feedback on the engineering analysis presented in the April 2022 NOPR. DOE used the information gathered from these interviews, along with the data obtained through teardown analysis and insights from public stakeholder comments, to refine its MPC estimates.

a. Manufacturer Production Costs

To assemble BOMs and to calculate the manufacturing costs for the different components in consumer pool heaters, DOE primarily relied upon physical teardowns. Using the data gathered from the physical teardowns, DOE characterized each component according to its weight, dimensions, material, quantity, and the manufacturing processes used to fabricate and assemble it. DOE also used catalog teardowns to supplement physical teardown data. For the catalog teardowns DOE examined published manufacturer catalogs and supplementary component data to estimate the major physical differences (such as dimensions, weight, design features) between a product that was physically disassembled and a similar product that was not.

The teardown analysis allowed DOE to identify the technologies that manufacturers typically incorporate into their products, along with the efficiency levels associated with each technology or combination of technologies. The BOMs from the teardown analysis were then used as inputs to calculate the MPC for each product that was torn down. These individual model MPCs take into account the cost of materials, fabrication, labor, overhead, depreciation, and all other aspects that make up a production facility.

Fluidra claimed that product pricing has gone up year over year since the initial 2015 analysis, and component shortages over the last few years have had a significant cost impact to both manufacturers and consumers due to decrease of supply and increase of demand. Fluidra stated that due to the smaller economy of scale for the consumer pool heater market, price breaks for volume are not as large as other heating, ventilation, and air-conditioning equipment. (Fluidra, No. 18 at p. 3)

DOE collected information on labor rates, tooling costs, raw material prices, and other factors as inputs to the cost estimates. For fabricated parts, the prices of raw metal materials [30] (*i.e.,* tube or sheet metal) are estimated using the average of the most recent 5-year period. The 5-year period for this final rule analysis captures metal prices from 2017–2022, and, therefore, the updated resulting MPCs in this final rule analysis reflect much of the material price increases that manufacturers have experienced in recent years (smoothed over this 5-year period). For purchased

[30] Prices are sourced from the American Metals Market, available online at *www.amm.com* (last accessed on October 15, 2022).

parts, DOE estimated the purchase price based on volume-variable price quotations and detailed discussions with manufacturers and component suppliers. The cost of transforming the intermediate materials into finished parts was estimated based on current industry pricing at the time of this final rule analysis.

The MPCs resulting from the teardowns were used to develop an industry average MPC for each efficiency level of each product class analyzed.

For gas-fired pool heaters, DOE's industry average MPCs reflect a weighted average of costs for gas-fired pool heaters which use different heat exchanger materials (*e.g.,* copper versus cupronickel). As discussed in the April 2022 NOPR, DOE surveyed the market and found the percentage of models at each efficiency level that currently utilize copper or cupronickel heat exchangers and assumed that, under an amended standard, the percentage would remain unchanged. DOE requested comment on this assumption. 87 FR 22640, 22664.

In response to the April 2022 NOPR, Hayward claimed that the fraction of cupronickel heat exchangers in the market would likely be reduced as a result of amended standards, but not to zero. (Hayward, No. 17 at p. 4) AHRI and PHTA, stated that amended standards would greatly reduce the number of products available on the market, and this would in turn drive a large number of redesigns requiring cupronickel heat exchangers. (AHRI and PHTA, No. 20 at p. 6)

Given the uncertainty in the outlook for copper versus cupronickel heat exchangers in an amended standards case scenario, DOE maintained its approach to assume that these fractions would remain the same as they are currently.

b. Manufacturer Selling Prices

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. To meet new or amended energy conservation standards, manufacturers typically redesign their baseline products. These design changes typically increase MPCs relative to those of previous baseline MPCs. Depending on the competitive environment for these particular products, some or all of the increased production costs may be passed from manufacturers to retailers and eventually to customers in the form of higher purchase prices. As production costs increase, manufacturers may also incur additional overhead (*e.g.,* warranty costs).

The manufacturer markup has an important bearing on profitability. A high markup under a standards scenario suggests manufacturers can readily pass along the increased variable costs and some of the capital and product conversion costs (the one-time expenditures) to consumers. A low markup suggests that manufacturers will have greater difficulty recovering their investments, product conversion costs, and/or incremental MPCs.

In the April 2022 NOPR analysis, DOE used a manufacturer markup of 1.33 for gas-fired pool heaters and a manufacturer markup of 1.28 for electric pool heaters. DOE conducted interviews with manufacturers after the publication of the April 2022 NOPR, during which several manufacturers stated the estimated manufacturer markup for each product class of consumer pool heaters used in the NOPR analysis were lower than their manufacturer markup for those products. Based on these additional inputs, DOE revised its markup calculations for this final rule, increasing the gas-fired pool heater manufacturer markup from 1.33 used in the April 2022 NOPR analysis to 1.44 and increasing the electric pool heater manufacturer markup from 1.28 used in the April 2022 NOPR analysis to 1.39.

See chapter 12 of the final rule TSD for more details about the manufacturer markup calculation.

3. Cost-Efficiency Results

The results of the engineering analysis are reported as cost-efficiency data (or ''curves'') in the form of TE_I (in percent) versus MPC (in 2021 dollars), which form the basis for subsequent analyses. DOE developed one curve for gas-fired pool heaters and one curve for electric pool heaters, and these curves reflect the MPCs developed for the representative capacities discussed in the previous section. See chapter 5 of the final rule TSD for additional detail on the engineering analysis.

TABLE IV.9—MANUFACTURER PRODUCTION COST FOR GAS-FIRED POOL HEATERS AT REPRESENTATIVE INPUT CAPACITY OF 250,000 Btu/h

Efficiency level	TE_I (percent)	MPC (2021$)	MSP (2021$)
EL 0	61.1	$782	$1,186
EL 1	81.3	788	1,195
EL 2	83.3	969	1,444
EL 3	94.8	1,349	2,016

TABLE IV.10—MANUFACTURER PRODUCTION COST FOR ELECTRIC POOL HEATERS AT REPRESENTATIVE OUTPUT CAPACITY OF 110,000 Btu/h

Efficiency level	TE_I (percent)	MPC (2021$)	MSP (2021$)
EL 0	99	$1,028	$1,441
EL 1	387	1,248	1,845
EL 2	483	1,305	1,924
EL 3	534	1,355	1,993
EL 4	551	1,427	2,094
EL 5	595	1,523	2,228

D. Markups Analysis

The markups analysis develops appropriate markups (*e.g.,* wholesaler and distributors, pool contractors, pool retailers, pool builders) 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 and in the manufacturer impact analysis. At each step in the distribution channel, companies mark up the price of the product to cover business costs and profit margin.

For consumer pool heaters, the main parties in the distribution chain are: (1) manufacturers; (2) wholesalers or distributors; (3) pool contractors; (4) pool retailers; (5) buying groups; [31] and (6) pool builders. For each actor in the distribution chain except for manufacturers, DOE developed baseline and incremental markups. 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.[32]

For the NOPR, DOE characterized how pool products pass from the manufacturer to residential and commercial consumers [33] by gathering data from several sources including 2020 Pkdata report,[34] POOLCORP's 2020 Form 10–K,[35] PRNewswire,[36] PoolPro Magazine,[37] Aqua Magazine,[38] and Pool and Spa News [39] to determine the distribution channels and fraction of shipments going through each distribution channel. The distribution channels for replacement or new installation of a consumer pool heater for existing swimming pool or spa are characterized as follows: [40]

Manufacturer → Wholesaler → Pool Contractor → Consumer
Manufacturer → Wholesaler → Pool Retailer → Consumer
Manufacturer → Pool Retailer → Consumer
Manufacturer → Buying Group → Pool Contractor → Consumer

The distribution channels for installation of consumer pool heaters in a new swimming pool or spa are characterized as follows: [41]

Manufacturer → Wholesaler → Pool Builder → Consumer
Manufacturer → Buying Group → Pool Builder → Consumer

Lochinvar stated that the distribution channels for pool heaters sold for commercial applications are similar to those used in commercial packaged boiler and commercial water heater rulemakings. (Lochinvar, No. 2 at p. 2) Lochinvar did not provide specific fractions of shipments for each distribution channel. For the final rule analysis, DOE estimated that half of consumer pool heaters installed in commercial applications would use similar distribution channels to commercial packaged boilers and commercial water heaters (Manufacturer → Wholesaler → Mechanical Contractor → Consumer for replacements and new owners; and Manufacturer → Wholesaler → Mechanical Contractor → General Contractor → Consumer for new swimming pool construction),[42] while the remaining consumer pool heaters would have the distribution channels described previously.

Rheem and BWC stated that the distribution channels appear appropriate. Rheem also noted that the market share through each distribution channel may change from manufacturer to manufacturer. BWC noted that, however, in the residential distribution channel there are circumstances where a product passes from a retailer to a contractor before the consumer takes possession of the product and that, in the commercial distribution channel, there are scenarios where a wholesaler never takes ownership of the pool heater prior to it being installed. (Rheem, No. 19 at p. 5; BWC, No. 12 at p. 3) Additionally, AHRI and PHTA stated that the share of products moving through each channel is a constantly moving target. (AHRI and PHTA, No. 20 at p. 6)

In response to Rheem's and AHRI and PHTA comment, DOE uses PKdata to estimate the distribution channel market shares, which account for variability of the market shares for each manufacturer. In response to BWC comments, for this final rule DOE added a distribution channel to account for the cases when the product passes from a retailer to a contractor to customer, without involving a wholesaler. For commercial pool heater applications, DOE already takes into account ''national accounts'', where the wholesaler never takes ownership of the pool heater prior to it being installed. For the final rule, DOE updated its distribution channel market shares by using the latest PKdata available.[43] The latest data shows a growing market share for direct dealers and online retailers.

AHRI and PHTA noted that there would be a slight difference between the distribution channels for gas fired pool

[31] Buying groups are intermediaries between the pool heater manufacturers and contractors. A buying group is a coalition of companies within a shared category who leverage their collective purchasing power to negotiate price reductions from manufacturers.

[32] 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.

[33] DOE estimates that 6 percent of electric pool heaters and 13 percent of gas pool heaters will be shipped to commercial applications in 2028. *See* section IV.E.1 for further discussion.

[34] Pkdata, 2020 Residential and Commercial Swimming Pool, Hot Tub, and Pool Heater Customized Report for LBNL, October 15, 2020, available at: *www.pkdata.com/datapointstrade.html#/* (last accessed October 15, 2022).

[35] POOLCORP, 2020 Form 10–K, available at: *dd7pmep5szm19.cloudfront.net/603/0000945841-1-000022.pdf* (last accessed October 15, 2022).

[36] PRNewswire, United Aqua Group, one of the nation's largest organizations dedicated to the professional pool construction, service and retail industry, announces that POOLCORP® is no longer the preferred distributor for its swimming pool products or building materials, May 15, 2018, available at: *www.prnewswire.com/news-releases/united-aqua-group-one-of-the-nations-largest-organizations-dedicated-to-the-professional-pool-construction-service-and-retail-industry-announces-that-poolcorp-is-no-longer-the-preferred-distributor-for-its-swimming-pool-produ-300648220.html* (last accessed October 15, 2022).

[37] PoolPro, *Channel Choices,* PoolPro Magazine, March 5, 2018, available at: *poolpromag.com/channel-choices/* (last accessed October 15, 2022).

[38] Herman, E., *Distributors: The Middleman's Role,* Aqua Magazine, December 2017, available at: *aquamagazine.com/features/the-middleman-s-role.html* (last accessed October 15, 2022).

[39] Green, L., Forward Thinking: A Look at Distributor Sector in Pool, Spa Industry Distributors adapt with the times, Pool and Spa News, March 27, 2015, available at: *www.poolspanews.com/business/retail-management/forward-thinking-a-look-at-distributor-sector-in-pool-spa-industry_o* (last accessed October 15, 2022).

[40] Based on 2020 Pkdata, in residential pools and spas, DOE assumed that the consumer pool heater goes through the wholesaler 45 percent of the time, 10 percent of the time wholesaler to retailer, 40 percent of the time directly through the pool retailer, and 5 percent of the time through the buying group.

[41] Based on 2020 Pkdata, DOE estimated that about 40 percent of consumer pool heater installations in new pools are distributed through a wholesaler and about 60 percent are distributed through a buying group.

[42] Based on 2020 Pkdata, which showed a much larger fraction of pool heaters being sold through distributors (about 70 percent) and directly to end users (about 20 percent) in commercial applications compared to pool heaters in residential applications.

[43] Pkdata, 2022 Residential and Commercial Swimming Pool, Hot Tub, and Pool Heater Customized Report for LBNL, October 15, 2020, available at: *www.pkdata.com/datapointstrade.html#/* (last accessed October 15, 2022).

heaters and heat pump pool heaters, which is that heat pump heaters may not need to go through a buying group as they can be sold directly from manufacturer to a dealer. Given that AHRI and PHTA cannot provide data to support this, they stated they would support the sources that DOE utilized in the NOPR. (AHRI and PHTA, No. 20 at p. 6)

As stated previously, DOE uses the latest PKData data available to estimate the distribution channel market shares which is not disaggregated by gas-fired pool heaters and heat pump pool heaters. At this time, DOE does not have data to account for slight differences between the distribution channels for gas fired pool heaters and heat pump pool heaters.

DOE developed baseline and incremental markups for each actor in the distribution chain. Baseline markups are applied to the price of products with baseline efficiency, while incremental markups are applied to the difference in price between baseline and higher-efficiency models (the incremental cost increase). The incremental markup is typically less than the baseline markup and is designed to maintain similar per-unit operating profit before and after new or amended standards.[44]

To estimate average baseline and incremental markups, DOE relied on several sources, including: (1) form 10–K from U.S. Securities and Exchange Commission (''SEC'') for Pool Corp (pool wholesaler)[45] and for the Leslie's, Home Depot, Lowe's, Wal-Mart, and Costco (for pool retailers); (2) U.S. Census Bureau 2017 Annual Retail Trade Report for miscellaneous store retailers (NAICS 453) (for pool retailers),[46] (3) U.S. Census Bureau 2017 Economic Census data[47] on the residential and commercial building construction industry (for pool builder, pool contractor, and general and plumbing/mechanical contractors for commercial applications); and (4) the Heating, Air Conditioning & Refrigeration Distributors International (''HARDI'') 2013 Profit Report[48] (for wholesalers for commercial applications). DOE assumes that the markups for buying group is half of the value of pool wholesaler markups derived from Pool Corp's form 10–K. In addition, DOE used the 2005 Air Conditioning Contractors of America's (''ACCA'') Financial Analysis on the Heating, Ventilation, Air-Conditioning, and Refrigeration (''HVACR'') contracting industry[49] to disaggregate the mechanical contractor markups into replacement and new construction markets for consumer pool heaters used in commercial applications.

In addition to the markups, DOE obtained state and local taxes from data provided by the Sales Tax Clearinghouse.[50] These data represent weighted average taxes that include county and city rates. DOE derived shipment-weighted average tax values for each region considered in the analysis.

Chapter 6 of the final rule TSD provides details on DOE's development of markups for consumer pool heaters.

E. Energy Use Analysis

The purpose of the energy use analysis is to determine the annual energy consumption of consumer pool heaters at different efficiencies in representative U.S. single-family homes, multi-family residences, and commercial buildings, and to assess the energy savings potential of increased consumer pool heaters efficiency. The energy use analysis estimates the range of energy use of consumer pool heaters 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.

1. Pool Heater Consumer Samples

DOE created individual consumer samples for seven pool heater market types: (1) pool heaters in single family homes that serve a swimming pool only (pool type 1); (2) pool heaters in single family homes that serve both a swimming pool and spa (pool type 2); (3) pool heaters in single family homes that serve a spa only (pool type 3);[51] (4) pool heaters in single-family community swimming pools or spas (pool type 4); (5) pool heaters in multi-family community swimming pools or spas (pool type 5); (6) pool heaters in indoor commercial swimming pools or spas (pool type 6); (7) pool heaters in outdoor commercial swimming pools or spas (pool type 7). DOE used the samples not only to determine pool heater annual energy consumption, but also as the basis for conducting the LCC and PBP analysis.

For the NOPR, DOE used the EIA's 2015 Residential Energy Consumption Survey (''RECS 2015'') to establish a sample of single family homes that use an electric or gas-fired pool heater in a swimming pool or spa or both.[52] RECS 2015 includes information such as the household or building owner demographics, fuel types used, months swimming pool used in the last year, energy consumption and expenditures, and other relevant data. For consumer pool heaters used in indoor swimming pools in commercial applications, DOE developed a sample using the 2012 Commercial Building Energy Consumption Survey (''CBECS 2012'').[53] CBECS 2012 does not provide data on community pools or outdoor swimming pools in commercial applications. To develop samples for consumer pool heaters in single or multi-family

[44] 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.

[45] U.S. Securities and Exchange Commission, *SEC 10–K Reports* (2017–2021), available at *www.sec.gov/* (last accessed October 15, 2022). Leslie's data was only available from 2018–2021.

[46] U.S. Census Bureau, *2017 Annual Retail Trade Report,* available at *www.census.gov/programs-surveys/arts.html* (last accessed October 15, 2022). Note that the 2017 Annual Retail Trade Report is the latest version of the report that includes detailed operating expenses data.

[47] U.S. Census Bureau, *2017 Economic Census Data.* available at *www.census.gov/programs-surveys/economic-census.html* (last accessed October 15, 2022). Note that the 2017 Economic Census Data is the latest version of this data.

[48] Heating, Air Conditioning & Refrigeration Distributors International (''HARDI''), *2013 HARDI Profit Report,* available at *hardinet.org/* (last accessed October 15, 2022). Note that the 2013 HARDI Profit Report is the latest version of the report.

[49] Air Conditioning Contractors of America (''ACCA''), *Financial Analysis for the HVACR Contracting Industry* (2005), available at *www.acca.org/store#/storefront* (last accessed October 15, 2022). Note that the 2005 Financial Analysis for the HVACR Contracting Industry is the latest version of the report and is only used to disaggregate the mechanical contractor markups into replacement and new construction markets.

[50] Sales Tax Clearinghouse Inc., *State Sales Tax Rates Along with Combined Average City and County Rates* (June 8, 2022), available at *thestc.com/STrates.stm* (last accessed October 15, 2022).

[51] For electric pool heater sample, DOE only considered a small fraction of large spas that require a pool heater large than 11 kW. For this final rule, the fraction of spas with an electric pool heater larger than 11 kW was determined based on 2022 Pkdata and DOE's shipments analysis.

[52] U.S. Department of Energy—Energy Information Administration. *2015 RECS Survey Data,* available at *www.eia.gov/consumption/residential/data/2015/* (last accessed October 15, 2022). RECS 2015 uses the term hot tub instead of spa. When a household has a pool heater and spa heater of the same fuel, RECS 2015 does not provide information about whether the pool heater is used for both. For the NOPR and Final Rule, DOE assumed that in this case, a single pool heater is used to heat both the pool and spa.

[53] U.S. Department of Energy—Energy Information Administration. *2012 CBECS Survey Data,* available at *www.eia.gov/consumption/commercial/data/2012/* (last accessed October 15, 2022).

community pools and/or spas, DOE used a combination of RECS 2015, U.S. Census 2017 American Home Survey Data, and the 2020 Pkdata.[54] To develop a sample for pool heaters in outdoor swimming pools in commercial applications, DOE used a combination of CBECS 2012 and the 2020 Pkdata.

BWC suggested that DOE utilize the CBECS 2018 and RECS 2020 to update its analysis for gas-fired pool heaters. (BWC, No. 12 at p. 2) AHRI and PHTA requested that DOE review and incorporate the latest RECS data as data from 2009 is not a valid basis for today's market. (AHRI and PHTA, No. 20 at pp. 8–9)

The energy consumption and expenditures data for RECS 2020 and CBECS 2018 were not yet available at the time the final rule analysis was performed. Only the housing characteristics data were available. As a result, DOE continued to rely on the RECS 2015 and CBECS 2012 energy consumption and expenditures data to develop its energy use analysis. For this final rule, DOE did use the RECS 2020 and CBECS 2018 stock and housing characteristics by state to update the sample weighting and shipments analysis. It also updated the sample weighting factors using the latest swimming pool and spa data from PKdata.

AHRI and PHTA also noted that the analysis does not consider second or vacation rental homes with pools and spas that utilize pool heaters that will operate only when the home is occupied. (AHRI and PHTA, No. 20 at pp. 6–7)

DOE notes that such homes are not part of RECS, which only considers occupied housing units. U.S. Census American Housing Survey (AHS) does include second or vacation rental homes. The 2015 AHS shows that there are about half a million such units which have swimming pools or spas. A fraction of these likely include a pool heater. DOE notes that a fairly large fraction of these units are rented out and likely have significant pool and spa usage, since this is seen as a valuable feature for these rentals.[55] DOE also believes that by using RECS data the LCC analysis does include homes with varying levels of pool and spa usage that on average likely covers similar usage patterns of many second or vacation rental homes.

Table IV.11 shows the estimated weights for the samples of electric pool heaters and gas-fired pool heaters by the seven pool heater market types. See chapter 7 of the final rule TSD for more details about the creation of the samples and the regional breakdowns.

TABLE IV.11—FRACTION OF ELECTRIC POOL HEATERS AND GAS-FIRED POOL HEATERS BY POOL HEATER MARKET

Pool type ID	Description	Electric pool heaters (%)	Gas-fired pool heaters (%)
1	Single Family with Pool Heater Serving Swimming Pool Only	65.9	40.3
2	Single Family with Pool Heater Serving Swimming Pool + Spa	19.0	26.4
3	Single Family with Pool Heater Serving Spa Only	8.8	20.4
4	Community Pools or Spas (Single-Family)	0.8	1.5
5	Community Pools or Spas (Multi-Family)	2.8	5.1
6	Commercial Indoor Pools and Spas	1.4	3.8
7	Commercial Outdoor Pools and Spas	1.3	2.5

2. Energy Use Estimation

For the NOPR, DOE's energy use analysis was based on all available data including RECS 2015,[56] CBECS 2012, a Consortium for Energy Efficiency (''CEE'') report,[57] a Brookhaven National Laboratory report,[58] and 2020 Pkdata. In particular, for consumer pool heaters in single family homes, DOE was able to use the energy use estimates provided in RECS 2015 to estimate the pool heater load for each sampled pool or spa. For consumer pool heaters in commercial buildings, DOE first calculated the pool heater load for each sampled consumer based on assumptions regarding the size of a typical pool, ambient conditions for different locations, length of the swimming pool season, and whether the pool has a cover.[59]

For each household or building with a consumer pool heater, DOE matched the pool heating load to the sampled swimming pool based on household or building geographical location and an assumption of whether the pool is covered or not. DOE then used the pool heating load together with the consumer pool heater output[60] to determine the burner operating hours. The electricity or fuel consumption in active mode was calculated by multiplying the burner operating hours by the input capacity.

For heat pump pool heaters, DOE accounted for the potential increase in pump electricity use due to longer operating hours of these products (see discussion). For heat pump pool heaters, to account for variations of output capacity, input capacity, and COPs observed in the field, DOE

[54] Pkdata. 2020 Residential and Commercial Swimming Pool, Hot tub, and Pool Heater Customized Report for LBNL, available at *www.pkdata.net/datapointstrade.html* (last accessed October 15, 2022).

[55] Li *et al.,* Market Shifts in the Sharing Economy: The Impact of Airbnb on Housing Rentals, available at *pubsonline.informs.org/doi/abs/10.1287/mnsc.2021.4288* (last accessed October 15, 2022); Money, This Summer's Hottest Moneymaker? Renting out Your Swimming Pool, available at *money.com/swimming-pool-rental-trend-tips/* (last accessed October 15, 2022); Bay Property Management Group, Pros and Cons of Renting a Property with a Pool: Is It Worth It?, available at *www.baymgmtgroup.com/blog/renting-a-property-with-a-pool/* (last accessed October 15, 2022); ALAGLAS Swimming Pools, Will a Swimming Pool Increase the Value of Your Rental Property?, available at *alaglaspools.com/will-a-swimming-pool-increase-the-value-of-rental-property/* (last accessed October 15, 2022).

[56] RECS 2015 provides separate estimates for electric spa heaters, natural gas pool heaters, and natural gas spa heaters in single family homes. However, RECS 2015 does not provide separate estimates for electric pool heater energy use and propane pool and spa heaters. Instead, RECS 2015 groups these pool heaters in the ''other devices and purposes not elsewhere classified.''

[57] Consortium for Energy Efficiency (CEE), CEESM High Efficiency Residential Swimming Pool Initiative, January 2013, available at *library.cee1.org/system/files/library/9986/CEE_Res_SwimmingPoolInitiative_01Jan2013_Corrected.pdf* (last accessed October 15, 2022).

[58] Brookhaven National Laboratory (BNL), *Performance Study of Swimming Pool Heaters,* January 2009, available at *www.bnl.gov/isd/documents/73878.pdf* (last accessed October 15, 2022).

[59] RECS 2015 estimates of the annual energy consumption from the household's energy bills using conditional demand analysis. RECS 2015 does not provide any energy use data for community pools with pool heaters and CBECS 2012 does not provide separate energy use estimates for pool heaters in other commercial applications.

[60] For heat pump pool heaters, pool heater output capacity is adjusted based on average outdoor conditions, since the rated output is measured at outdoor ambient conditions that are often different from actual field conditions. The adjustment is done based on coefficient of performance (COP) from heat pump pool heater data at different ambient conditions.

determined these values based on the geographical location of the sampled household. DOE assumed that 32 percent of pools with consumer pool heaters in commercial applications use a cover and 68 percent of pools with consumer pool heaters do not use a cover based on comments from NRDC in a CEC pool pumps rulemaking.[61] DOE assumes that a pool cover can save up to 50–70 percent of overall energy use.[62]

a. Consumer Pool Heater Operating Hours

Rheem stated that they appreciated DOE's efforts to adjust pool operating hours by geographical location using RECS data. Rheem recommended expanding this information by using heating degree days or a similar approach to more finely predict pool operating hours throughout the United States. (Rheem, No. 19 at p. 6) BWC expressed concerns about DOE conducting its analysis with the assumption that (gas-fired) pool heaters run approximately 190 hours per year. BWC stated that the figure is reliant on a number of installation-specific factors, including the size of the pool being heated, whether the pool is located indoors or outdoors, and the type of application the pool heater is installed in. BWC recommended that DOE utilize the most recently available data to learn more about where these products are often installed and to recalculate an average run time for each common installation for the purposes of this rulemaking. (BWC, No. 12 at p. 3) AHRI and PHTA stated that there are many factors that can cause a large variance in operating hours including geographic location and use preference. (AHRI and PHTA, No. 20 at p. 7) Hayward stated that there are many factors that come into play when determining pool heater hours of operation that can cause a large variance in hours including geographic location and use preference. (Hayward, No. 17 at p. 5)

DOE notes that the operating hours vary significantly based on several factors including geographic location (which accounts for ambient temperature conditions), consumer preference in terms of pool or spa usage (limited usage to year-round usage), installation location (indoor vs. outdoor pools), application (swimming pool only, spa only, swimming pool and spa using the pool heater), market segment (residential and commercial applications), and whether a pool cover is used, etc. Also, operating hours are driven by the output capacity of the pool heater. For this final rule analysis, DOE improved its sizing methodology to match PKdata swimming pool sizing data and assigned appropriate pool heater output capacity sizes for each assumed swimming pool and/or spa size. The NOPR analysis assigned only two sizes, one for residential (250 kBtu/h input capacity for gas-fired pool heaters and 110 kBtu/h output capacity for electric pool heaters) and one for commercial applications (500 kBtu/h input capacity for gas-fired pool heaters and 220 kBtu/h output capacity for electric pool heaters). The final rule analysis, expanded to all available model input capacities up to 2 MMBtu/hr for gas-fired pool heaters and 800 kBtu/h output capacity for heat pump pool heaters.

For residential applications, DOE's pool heating load calculations are based directly on the RECS 2015 energy use estimates, which show a significant variation between different household installations (see chapter 7 of the final rule TSD). To improve the energy usage by month DOE used typical pool heating load calculators for multiple locations around the country.[63] For commercial applications, DOE's energy use pool heating load calculations are based primarily on pool/spa usage (length of operating season), weather conditions, pool/spa installation location (indoor vs. outdoor pools), application type (swimming pool only, spa only, swimming pool and spa using the pool heater), and whether a pool/spa cover is used. For the final rule, DOE expanded the pool heating load model to include more locations with weather data. For heat pump pool heaters, DOE also considered that the output capacity varies by ambient air temperature conditions around the heat pump pool heater. In contrast, for electric resistance and gas-fired pool heaters, output is assumed to not vary with ambient temperature.

Rheem agreed with DOE's statement in section 7.3.3.3 of the TSD that burner operating hours in the field are much higher than assumed in the DOE test procedure which states (section 7.3.3.3) that electric pool heaters operate an estimated 353 hours per year but also stated that electric resistance and heat pump pool heaters have different annual operating hours. Rheem requested that electric resistance and heat pump pool heater hours of operation be separately provided. (Rheem, No. 19 at p. 6) Rheem and AHRI and PHTA both agreed that the heat pump pool heaters will have higher hours of operation than gas-fired pool heaters. (Rheem, No. 19 at p. 6, AHRI and PHTA, No. 20 at p. 7) Fluidra stated that the operating times for both electric and gas pool heaters vary widely based on geographical location, user preferences, and the difference in heating time between gas heaters and electric heaters and that, in general, heat pump pool heater run time hours are significantly higher than those of gas-fired pool heaters. (Fluidra, No. 18, p. 2)

For the final rule, DOE accounted for differences in operating hours for electric resistance, heat pump, and gas-fired pool heaters. As noted by stakeholders these differences account for geographical location, user preferences, and the difference in output capacity between electric and gas-fired pool heaters. In addition, DOE took into account differences between electric resistance vs. heat pump heaters. On average electric resistance pool heaters are used in installations with lower pool heating load compared to heat pump pool heaters (on average 9 MMBtu/yr for electric resistance vs. 15 MMBtu/yr for heat pump pool heaters). For heat pump pool heaters, DOE also considered that the output capacity varies by ambient air temperature conditions around the heat pump pool heater. In contrast, for electric resistance and gas-fired pool heaters, output is assumed to not vary with ambient temperature. See chapter 7 of the final rule TSD for more information and for disaggregated operating hours by pool heater type and application.

b. Heat Pump Pool Heater Energy Use

Rheem noted that many heat pump pool heaters can operate at various input rates depending on the ambient conditions and desired pool temperature. Rheem stated that DOE appears to have accounted for this somewhat in section 7.3.3.2 of the TSD by assigning an ambient condition to different geographical locations, however heating load can change between the various ambient conditions in the same geographical location within the same pool heating season. (Rheem, No. 19 at p. 6) AHRI and PHTA specifically requested information from the Department on how the outdoor air effects on heat pumps have been

[61] NRDC's Response to CEC's Invitation to Participate in the Development of Appliance Energy Efficiency Measures 2013 Appliance Efficiency Pre-Rulemaking on Appliance Efficiency Regulations: Docket Number 12–AAER–2F—Residential Pool Pumps and Motors (May 2013), available at *efiling.energy.ca.gov/GetDocument.aspx?tn=70721&DocumentContentId=8266* (last accessed October 15, 2022).

[62] U.S. Department of Energy, Energy Saver: Swimming Pool Covers, available at *www.energy.gov/energysaver/swimming-pool-covers* (last accessed October 15, 2022).

[63] Raypak, Residential Gas Heater Sizing, available at *apps.raypak.com/gas_sizing/Raypak_gas.php* (last accessed October 15, 2022).

represented in their EL calculations. (AHRI and PHTA, No. 20 at p. 6)

For the NOPR, DOE accounted for heat pump pool heater differences in performance due to ambient temperatures by using the ambient temperature data to determine heat pump pool heater COP field values based on the geographical location of the sampled household. 87 FR 22640, 22670 For example, for EL 2 the weighted COPs by region are 5.44 for the Hot Humid region, 5.20 for the Warm region, and 3.76 for the Cold region. For this final rule, DOE improved its methodology by adding additional weather location data by assigned weather stations to refine its approach by estimating monthly field adjusted average COP values using ambient temperatures (see chapter 7 of the final rule TSD for more details).

c. Modulating Equipment

Hayward stated that modulating heaters run considerably more hours (at lower capacity and higher efficiency) than their single speed counterparts. (Hayward, No. 17 at p. 5) Rheem added that conditions change throughout the pool heating season and part load or variable speed operation provides more control and allows the heat pump pool heater to adjust its output based on demand. (Rheem, No. 19 at p.4) Hayward recommended further analysis on average energy use or part load energy consumption to provide credit for dual or variable capacity products because at part load conditions, the efficiency of these units is improved significantly relative to single speed units (especially for heat pumps). Hayward stated that for modulating capacity appliances, the standby power should be reduced and the methodology should be reassessed to consider this new technology where the heater can be run longer at lower capacity (and higher efficiency). (Hayward, No. 17 at p. 5) AHRI and PHTA noted that operating hours can change for modulating units compared to single speed units. (AHRI and PHTA, No. 20 at p. 7)

DOE agrees that for certain applications modulating pool heaters could operate at increased operating hours, which would impact the electricity use and might increase the overall efficiency if the part load efficiency is greater than the full load efficiency. In contrast, longer operating hours could also lead to more electrical consumption if the pump and auxiliary equipment does not operate at a reduced wattage in the part-load or variable speed operation. DOE does not currently have test data and has not found any references to assess the part-load efficiency of modulating units (either heat pump or gas-fired equipment). DOE also notes that the current test procedure does not account for part-load efficiency. Overall, DOE at this time did not assess the energy use impact of modulating units compared to single speed units due to lack of data and uncertainty related to decreased or increased field fuel and electricity usage.

d. Consumer Pool Heater Standby and Off Mode Energy Use

Rheem stated that the methodology used to measure standby energy use is appropriate. Rheem also noted that there are currently ‘‘seasonal off switches’’ which reduce power consumption as compared to standby mode, but that do not reduce the electrical power consumption to zero. (Rheem, No. 19 at p. 6) BWC also stated that it agrees with the Department's estimate of off mode and standby mode power consumption for gas-fired pool heaters and that off mode and standby mode power consumption for these products will not increase in products with higher inputs. (BWC, No. 12 at p. 3) AHRI and PHTA stated that for heat pump pool heaters and gas-fired pool heaters the overall standby hours will be different and that the off mode hours are essentially identical. (AHRI and PHTA, No. 20 at p. 7)

DOE agrees with the stakeholders input regarding standby and off-mode and did not change its standby and off mode analysis for the final rule.

Chapter 7 of the final rule TSD provides details on DOE's energy use analysis for consumer pool heaters.

F. Life-Cycle Cost and Payback Period Analysis

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

- The LCC is the total consumer expense of an appliance or product over the life of that product, consisting of total installed cost (manufacturer selling price, 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 pool heaters in the absence of new or amended energy conservation standards. In contrast, the PBP for a given efficiency level is measured relative to the baseline product.

For each considered efficiency level in each product class, DOE calculated the LCC and PBP for a nationally representative set of consumers. As stated previously, DOE developed household samples primarily from the 2015 RECS and 2012 CBECS.[64] For each sample household, DOE determined the energy consumption for the consumer pool heaters 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 pool heaters.

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

[64] At the time of this analysis, only the housing characteristics data for 2020 RECS and CBECS 2018 were published by EIA. The energy consumption and expenditures data were not yet available. The 2015 RECS and CBECS 2012 data set remains the most recent full data released at the time of this analysis.

pool heaters user samples. For this rulemaking, the Monte Carlo approach is implemented in MS Excel together with the Crystal Ball™ add-on.[65] The model calculated the LCC for products at each efficiency level for 10,000 consumer pool heater installations 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 pool heaters as if each were to purchase a new product in the first full year of required compliance with new or amended standards. New and amended standards apply to consumer pool heaters manufactured 5 years after the date on which any new or amended standard is published. (42 U.S.C. 6295(g)(10)(B)) Therefore, DOE used 2028 as the first full year of compliance with any amended standards for consumer pool heaters.

Table IV.12 summarizes the approach and data DOE used to derive inputs to the LCC and PBP calculations. The subsections that follow provide further discussion. Details of the spreadsheet model, and of all the inputs to the LCC and PBP analyses, are contained in chapter 8 of the final rule TSD and its appendices.

TABLE IV.12—SUMMARY OF INPUTS AND METHODS FOR THE LCC AND PBP ANALYSIS *

Inputs	Source/method
Product Cost	Derived by multiplying MPCs by manufacturer and retailer markups and sales tax, as appropriate. Used historical data to derive a price scaling index to project product costs.
Installation Costs	Baseline installation cost determined with data from RS Means. Assumed no change with efficiency level.
Annual Energy Use	The total annual energy use multiplied by the hours per year. Average number of hours based on field data.
	Variability: Based on the 2015 RECS and 2018 CBECS.
Energy Prices	*Natural Gas:* Based on EIA's Natural Gas Navigator data for 2021.
	Propane: Based on EIA's SEDS for 2020.
	Electricity: Based on EIA's Form 861 data for 2021.
	Variability: Regional energy prices determined for each state and District of Columbia.
	Marginal prices used for both natural gas and electricity.
Energy Price Trends	Based on *AEO2022* price projections.
Repair and Maintenance Costs	Based on 2021 RS Means data and other sources. Assumed variation in cost by efficiency.
Product Lifetime	*Average:* 11 years.
Discount Rates	Approach involves identifying all possible debt or asset classes that might be used to purchase the considered appliances, or might be affected indirectly. Primary data source was the Federal Reserve Board's Survey of Consumer Finances.
Compliance Date	2028.

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

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. Many 82-percent thermal efficiency (EL 0 and EL 1) gas-fired pool heaters without low-NO_X burners are currently available that do not meet low-NO_X criteria in California, Utah, and Texas.[66] Thus, for the NOPR, DOE included the additional cost of a low-NO_X burner to all gas-fired pool heaters installed in certain California,[67] Utah,[68] or Texas [69] locations and applications. DOE assigned a fraction of installations outside these three regions the low-NO_X burner cost adder since the models are so widespread.[70]

Rheem stated that low NO_X pool heaters are marketed throughout the United States, but Rheem had no comment on the fraction of low NO_X pool heaters sold outside California, Utah, or Texas. Rheem noted that certain regulations in California covering low NO_X pool heaters are being amended and recommended that DOE account for these changes in the analysis. (Rheem, No. 19 at p. 6) AHRI and PHTA appreciated that the

[65] Crystal Ball™ is commercially-available software tool to facilitate the creation of these types of models by generating probability distributions and summarizing results within Excel, available at *www.oracle.com/technetwork/middleware/crystalball/overview/index.html* (last accessed October 15, 2022).

[66] Low-NO_X gas-fired pool heaters account for 11 percent of gas-fired pool heaters at EL 0 and 59 percent of pool heaters at EL 1.

[67] Low-NO_X gas-fired pool heaters with a rated heat input capacity less than or equal to 2,000,000 Btu/h Hour are required in South Coast Air Quality Management District (''SCAQMD'') and San Joaquin Valley Air Pollution Control District (''SJAPCD''). SCAQMD Rule 1146.2, available at *www.aqmd.gov/docs/default-source/rule-book/reg-xi/rule-1146-2.pdf;* SJAPCD Rule 4308, available at *www.valleyair.org/rules/currntrules/03-4308_CleanRule.pdf* (last accessed October 15, 2022). Low NO_X gas-fired pool heaters with a rated heat input capacity 400,001 to 2,000,000 Btu/h are required in Bay Area Air Quality Management District (''BAAQMD''). Regulation 9, available at *www.baaqmd.gov/~/media/dotgov/files/rules/reg-9-rule-6-nitrogen-oxides-emissions-from-natural-gasfired-water-heaters/documents/rg0906.pdf?la=en* (last accessed October 15, 2022).

[68] Low-NO_X gas-fired pool heaters with a rated heat input capacity less than 2,000,000 Btu/Hour. Utah Code 15A–6–102, available at *le.utah.gov/xcode/Title15A/Chapter6/15A-6-S102.html?v=C15A-6-S102_2017050920170509* (last accessed October 15, 2022).

[69] Low NO_X gas-fired pool heater with a rated heat input capacity less than or equal to 2,000,000 Btu/h Hour are required (except for units installed in single-family residences, used exclusively to heat swimming pools and hot tubs). Texas Administrative Code, Control of Air Pollution from Nitrogen Compounds, available at *texreg.sos.state.tx.us/public/readtac$ext.ViewTAC?tac_view=5&ti=30&pt=1&ch=117&sch=E&div=3&rl=Y* (last accessed October 15, 2022).

[70] Pires, K. *It's A Low-NO_X Life.* AQUA. November 2008, available at *aquamagazine.com/it-s-a-low-nox-life.html* (last accessed October 15, 2022).

Department is including low-NO_X equipment in their analysis. However, the added costs for low-NO_X burners needs to be applied for the entire country and not just the specific states listed, as the majority of manufacturers no longer distribute gas-fired pool heaters that are not low-NO_X. (AHRI and PHTA, No. 20 at p. 7) Hayward expects that nearly all gas products in all regions will use low-NO_X burners. (Hayward, No. 17 at p. 6)

For the final rule, DOE increased the fraction of installations outside California, Utah, and Texas that have a low-NO_X burner cost adder, since the majority of manufacturers no longer distribute gas-fired pool heaters that are not low-NOx. By 2028, the analysis assumes that 88 percent of all gas-fired pool heaters have a low-NO_X burner.

For the NOPR, DOE developed separate product price projections for baseline electric resistance pool heaters, heat pump pool heaters, and gas-fired pool heaters using shipment-weighted wholesaler listed prices from 2003–2019 from the 2020 Pkdata report.[71]

AHRI and PHTA recommended that DOE reevaluate the price trends based on the current economic and supply chain challenges. (AHRI and PHTA, No. 20 at p. 7) Fluidra stated that the equipment pricing goes up year over year since the 2015 analysis. They added that electronic component shortages and electrification codes have had a significant cost impact to both manufacturers and consumers due to decrease of supply and increase of demand. Fluidra noted that the economy of scale for the pool industry compared to space heating HVAC is significantly smaller, therefore pool equipment manufacturers do not see the same price breaks for volume as other industries. (Fluidra, No. 18, p. 3)

DOE updated its analysis using the latest PKdata, which shows that since 2015 prices have been going up slightly for electric resistance, heat pump, and gas-fired pool heaters. In contrast, between 2003 and 2014 prices of this equipment had been decreasing. Given that it is uncertain to project what the commodity prices and economic and supply chain challenges will be in the future, DOE decided to use a constant price assumption as the default price factor index to project future pool heater prices for the final rule. DOE performed a sensitivity analysis on price trend as detailed in appendix 8C of the final rule TSD. Further details about the development of the price trends can be found in chapter 8 and appendix 8C of the final rule TSD.

2. Installation Cost

Installation cost includes labor, overhead, and any miscellaneous materials and parts needed to install the product. DOE estimates all the installation costs associated with fitting a consumer pool heater in a new housing unit, as a replacement for an existing pool heater, or in an existing pool without a pool heater (new owners). This includes any additional costs, such as electric modifications that would be required to install equipment at various efficiency levels. Installation cost includes labor, overhead, and any miscellaneous materials and parts needed to install the product. DOE used data from RS Means 2022 [72] to estimate the baseline installation cost for consumer pool heaters.

Rheem recommends installations be performed by a licensed professional and that the installation must be in accordance with local codes, or, in the absence of local codes, with the latest edition of the National Fuel Gas Code, ANSI Z223.1/NFPA54 and National Electrical Code, ANSI/NFPA 70, and for Canada, the latest edition of CAN/CSA–B149 Installation Codes, and Canadian Electrical Code, CSA C22.1 Part 1 and Part 2. (Rheem, No. 19 at p. 7)

DOE's analysis assumes that pool heater installations are performed by licensed professionals and DOE's labor costs are for the appropriate crew type based on RS Means data.

For electric pool heaters, DOE accounted for the increased cost of additional electrical requirements for new swimming pool and new owner installations. For new electric pool heater owners (including owners of new swimming pools and owners of existing swimming pools), DOE assumed that an electric resistance pool heater would have higher electrical connection installation costs in comparison to the electrical requirements for a heat pump pool heater. For replacements in outdoor swimming pools, DOE assumed that the installation costs would be the same for all efficiency levels because the old consumer pool heater already has adequate electrical service for the new pool heater. For replacements in indoor installations, DOE assumed that they are all electrical resistance and that replacement with a heat pump pool heater would add a significant cost to run water piping and an electrical connection to outside the building, where the heat pump pool heater will be installed.

Rheem stated that for gas-fired pool heaters it supports the proposed EL 2 to the extent it is applied to outdoor installations not requiring added venting systems. Rheem added that although 84% thermal efficiency is close to the condensing efficiency threshold, for outdoor installations it can be achieved without the risk of increased vent system corrosion. (Rheem, No. 19 at p. 4) Rheem stated that for gas fired heaters, there are different required clearances from combustible surfaces for indoor and outdoor installations and that for indoor installations, venting is required and increasing thermal efficiency too high poses a risk of increased vent corrosion due to condensation. In addition, Rheem stated that the venting system varies by installation configuration and climate. (Rheem, No. 19 at p. 7)

DOE's analysis for gas-fired pool heater installations does not include any added cost for a venting systems for EL2 and EL 3 for outdoor installations. For EL 0 and EL 1 with atmospheric venting, DOE added the cost of a draft hood for a fraction of outdoor installations in a high wind environment. For gas-fired pool heater installations (mainly for commercial applications), DOE took into account the added cost of venting for all gas-fired pool heaters, which varies by climate and installation configuration. See appendix 8D of the final rule TSD for more details.

Rheem stated that for heat pump pool heaters, installation must be at ≥3 feet from a gas heater, ≥60 inches of clearance above the heater, ≥12 inches from any wall, gutters above the heater to prevent roof runoff into the top of the unit, and redirection of lawn irrigation away from the unit and that Texas and Florida mandate the use of a minimum 3-inch-thick concrete pad, where the minimum edge distance to the unit is 6 inches. Further, if installing hurricane tie down brackets then the pad may need to be wider. (Rheem, No. 19 at p. 7) AHRI and PHTA stated that most electric pool heater installations are located in a space-constrained area (within 2 feet of an obstruction), which significantly increases the cost of installation. In many of these situations it is difficult to maintain enough clearance for the product itself without including the required clearance from obstructions for a heat pump to properly function. (AHRI and PHTA, No. 20 at p. 7) AHRI and PHTA noted that many

[71] Pkdata, 2020 Residential and Commercial Swimming Pool, Hot tub, and Pool Heater Customized Report for LBNL, October 15, 2020, available at: *www.pkdata.com/datapointstrade.html#/* (last accessed October 15, 2022).

[72] RS Means Company, Inc., *RS Means Residential Cost Data 2020* (2020), available at *www.rsmeans.com/* (last accessed October 15, 2022).

factors have changed since 2015 and there are numerous variables that need to be considered when determining installation costs for consumer pool heaters and DOE should update its estimates to account for significant cost increases where consumers will be required to replace an electric resistance pool heater in a constrained space with a heat pump water heater. (AHRI and PHTA, No. 20 at pp. 7–8) Hayward believed that space constraints are a primary value driver for resistance heaters and they expect that most resistance heaters are installed in locations that do not provide sufficient space for a heat pump. (Hayward, No. 17, p. 6) Fluidra stated that the consumers will likely not replace a space constrained electric resistance heater with a heat pump because the space and vent restrictions would be a significant problem. Fluidra added that heat pumps are optimized for outdoor installations and may not be effective when installed indoors, resulting in dramatically increased installation costs to convert and properly vent an indoor heat pump installation. (Fluidra, No. 18, p.3)

For the NOPR analysis, DOE included significant costs associated with space constraints for heat pump pool heaters installed to replace an electric resistance pool heater, including installing the heat pump pool heater far away (outdoors) from the current installation location. 87 FR 22640, 22674. In order to take into account stakeholder comments and regional code requirements, for this final rule, DOE refined its installation cost methodology to include additional costs associated with installing a heat pump pool heater as a replacement of an electric resistance pool heater, especially in space constrained installations. The additional costs account for the requirements such as clearance and concrete pads. On average the installation cost associated with installing a heat pump pool heater in a space constrained installation increased from $549 in the NOPR to $1,039 in the final rule. The fraction of installations assigned space constrained costs also increased from 15 percent to 20 percent. See appendix 8D of the final rule TSD for more details.

3. Annual Energy Consumption

For each sampled consumer pool heater installation, DOE determined the energy consumption for a consumer pool heaters at different efficiency levels using the approach described previously in section E.2 of this document.

a. Rebound Effect

Higher-efficiency consumer pool heaters reduce the operating costs for a consumer, which can lead to greater use of the consumer pool heater. A direct rebound effect occurs when a product that is made more efficient is used more intensively, such that the expected energy savings from the efficiency improvement may not fully materialize. At the same time, consumers benefit from increased utilization of products due to rebound. Overall consumer welfare (taking into account additional costs and benefits) is generally understood to increase from rebound. DOE did not find any data on the rebound effect that is specific to consumer pool heaters. In the April 2010 final rule, DOE estimated a rebound of 10 percent for pool heaters for the NIA, but did not include rebound in the LCC analysis. 75 FR 20112, 20165. Because of the uncertainty and lack of data specific to pool heaters necessary to generate a representative analysis, DOE does not include the rebound effect in the LCC analysis for this final rule. DOE does include the rebound effect in the NIA, for a conservative estimate of national energy savings (see section H.2).

4. Energy Prices

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

DOE derived residential and commercial average monthly marginal electricity and natural gas prices by state using 2021 data from EIA [73] [74] and average monthly residential and commercial LPG prices for the various regions using 2020 data from EIA.[75] The methodology and data sources are described in detail in appendix 8E of the final rule TSD.

DOE's methodology allows energy prices to vary by sector, state, and season. In the analysis, variability in energy prices is chosen to be consistent with the way the consumer economic and energy use characteristics are defined in the LCC analysis. See chapter 8 of the final rule TSD for details.

To estimate energy prices in future years, DOE multiplied the 2021 energy prices by the projection of annual average price changes for each of the nine census divisions from the Reference case in *AEO 2022,* which has an end year of 2050.[76] DOE used simple extrapolations of the average annual growth rate in prices from 2045 to 2050 based on the methods used in the 2022 Life-Cycle Costing Manual for the Federal Energy Management Program (''FEMP'').[77]

Joint Advocates stated that DOE underestimated cost savings from higher efficiency gas pool heaters by underestimating the future gas prices. Joint Advocates stated that as the movement towards electrification grows and the efficiencies of gas appliances improve, both customer base and overall natural gas sales will likely decline over time. Joint Advocates pointed to a 2022 analysis conducted by the NRDC which estimated the impact of customer exits (*i.e.,* consumers who switch to electric appliances and disconnect from the gas system) on gas prices for the remaining customers and found that gas prices would exceed 600% of the AEO projections in the Pacific and Mid-Atlantic regions under multiple electrification scenarios, and noted these results were consistent with other studies finding the same dynamic. (Joint Advocates, No. 13 at pp 3–4)

DOE's analysis uses the latest AEO energy price scenarios, which take into account the dynamics of the entire energy system, to project future energy prices. While DOE notes that future switching away from gas appliances may affect natural gas prices, at the present these dynamics, and policy

[73] U.S. Department of Energy—Energy Information Administration, Form EIA–861M (formerly EIA–826) Database Monthly Electric Utility Sales and Revenue Data (1990–2021), available at *www.eia.gov/electricity/data/eia861m/* (last accessed October 15, 2022).

[74] U.S. Department of Energy—Energy Information Administration, Natural Gas Navigator (1990–2021), available at *www.eia.gov/dnav/ng/ng_pri_sum_dcu_nus_m.htm* (last accessed October 15, 2022).

[75] U.S. Department of Energy—Energy Information Administration, 2020 State Energy Consumption, Price, and Expenditure Estimates (SEDS) (2020), available at *www.eia.gov/state/seds/* (last accessed October 15, 2022).

[76] U.S. Department of Energy—Energy Information Administration. *Annual Energy Outlook 2022 with Projections to 2050.* Washington, DC. Available at *www.eia.gov/forecasts/aeo/* (last accessed October 15, 2022).

[77] Lavappa, Priya D. and J. D. Kneifel. Energy Price Indices and Discount Factors for Life-Cycle Cost Analysis—2022 Annual Supplement to NIST Handbook 135. National Institute of Standards and Technology (NIST). NISTIR 85–3273–37, available at *www.nist.gov/publications/energy-price-indices-and-discount-factors-life-cycle-cost-analysis-2022-annual* (last accessed October 15, 2022).

responses to address issues that arise, are too uncertain to be relied upon in its analysis. If these dynamics materialize and solidify, they will be reflected in the latest EIA data and AEO price forecasts. At this time, the AEO price forecasts remain the best available source of data regarding probable future energy prices. DOE notes that if future natural gas prices end up higher than DOE estimates due to electrification, the economic justification for the standards adopted for gas-fired pool heaters in this final rule would become stronger still.

AHRI and PHTA stated that DOE may want to consider that for equipment such as pool heaters, where they may only need to operate a few hours a day, many consumers will be able to heat their pools at ''off-peak'' electric rates that are much lower than the average rates cited by the Department. Therefore, the costs of heating pool water would be lower than those estimated by DOE, and the subsequent savings are lower by the same percentage. AHRI and PHTA stated that more consumers have smart electric meters that may not have been considered in the Department's approach and that the consumers with smart electric meters will be able to take advantage of time of use and other variable electric rates to lower their electric costs. (AHRI and PHTA, No. 20 at p. 8)

While DOE agrees that consumers could possibly take advantage of ''off-peak'' electric rates in some installation applications, in reality there are limited data showing how customers will use ''off-peak'' electric rates. ''Off-peak'' rates might not coincide with the actual usage of the pool and vary from utility to utility. For example, PG&E offers ''off-peak'' rates that are designed to coincide with the electricity produced by solar generators (outside of the 4–9 p.m. peak pricing),[78] while FPU has peak rates in the summer months (May 1–Sept. 30) between 12 p.m. to 6 p.m. Using ''off-peak'' rates would require some planning or additional controls in the pool heater as well as the ability to ''over heat'' the pool/spa so that it is at the appropriate temperature once in use. It is not apparent whether consumers would be able to or want to take advantage of these rates. Therefore, at this time DOE did not use ''off-peak'' rates in its analysis.

[78] PG&E, Time-of-Use, available at *www.pge.com/en_US/residential/rate-plans/rate-plan-options/time-of-use-base-plan/tou-everyday.page* (last accessed October 15, 2022).

5. Maintenance and Repair Costs

Repair costs are associated with repairing or replacing product components that have failed in an appliance; maintenance costs are associated with maintaining the operation of the product. Typically, small incremental increases in product efficiency entail no, or only minor, changes in repair and maintenance costs compared to baseline efficiency products. DOE included additional repair costs for higher efficiency heat pump pool heaters and gas-fired pool heaters (including repair costs associated with electronic ignition, controls, and blowers for fan-assisted designs, compressor, evaporator fan) based on 2022 RS Means data.[79] DOE accounted for regional differences in labor costs by using RS Means regional cost factors.

AHRI and PHTA noted that the costs for repairs and parts have increased compared to the data used in this analysis, so the analysis should be updated. Additionally, AHRI and PHTA stated that DOE should consider a separate labor rate for the different pool heater applications when calculating maintenance and repair costs as well. They cited industry estimates as $90/hour—gas service and $120/hour—heat pump service. (AHRI and PHTA, No. 20 at pp. 8–9)

DOE's analysis uses RS Means labor rates that vary by state, but does not assign a different labor rate for the maintenance and repair costs for a gas-fired pool heater compared to a heat pump pool heater.

AHRI and PHTA stated that pool heating equipment is more likely to be repaired then replaced. AHRI and PHTA agreed with the DOE's repair and maintenance approach, specifically, that higher efficiency gas-fired pool heaters are more expensive to maintain—condensation neutralization adds costs, they are more complex and more likely to have technical issues and the heat pumps cost more to service and repair as they require technicians with refrigeration certification—therefore costs are higher as this work takes more time and an increased level of expertise. (AHRI and PHTA, No. 20 at pp. 8–9) BWC also noted that condensing gas-fired pool heaters will be more difficult and more expensive to maintain since these products are more complex, which makes them more likely to experience technical issues. (BWC, No. 12 at p. 4) Rheem supported the AHRI and PHTA comment on this topic. (Rheem, No. 19 at p.8)

[79] RS Means Company, Inc., *RS Means Facilities Repair and Maintenance 2022* (2022), available at *www.rsmeans.com/* (last accessed October 15, 2022).

DOE maintained its repair and maintenance cost methodology for the final rule. The methodology and data sources are described in detail in appendix 8F of the final rule TSD.

6. Product Lifetime

For the NOPR analysis, DOE used lifetime estimates from historical shipments data and pool heater stock data from RECS 1987–2015 and 2020 Pkdata. 87 FR 22640, 22676 This data allowed DOE to develop a survival function, which provides a distribution of lifetime ranging from 1 to 30 years with a mean value of 11 years. DOE assumes that the distribution of lifetimes accounts for the impact of the pool water quality on the life of the product, the level of maintenance of a consumer pool heater, and the fraction of consumers winterizing the consumer pool heater.

AHRI and PHTA supported the use of RECS and Pkdata to calculate lifetime estimates, but suggested that DOE should also consider regional impacts to lifetime estimates, since not including these regional impacts could mean that the lifetime is potentially over inflated compared to the real lifetime for these units. In addition, AHRI and PHTA stated that improper winterization of a heat pump could shorten the life of a heat pump. (AHRI and PHTA, No. 20 at p. 9) Rheem supported the AHRI and PHTA's comments on regional impacts to lifetime estimates. Rheem found that lower efficiency (legacy) units typically have a longer life than higher efficiency units, and noted that consumers who don't perform routine maintenance, especially winterization, will see lower lifetimes. (Rheem, No. 19 at p. 8) BWC generally agreed with DOE's lifetime average of 11 years for gas-fired pool heaters that are identified as representative models and recommended that DOE utilize most recently available data to learn more about common applications for these products and recalculate average product lifetimes for each common installation type. (BWC, No. 12 at p. 4) For the final rule, DOE updated its methodology to include the latest data including RECS 2020, CBECS 2018, and shipment and other data from 2022 PKdata. This resulted in the same average lifetime value of 11 years.

Appendix 8G of the final rule of the TSD includes a sensitivity analysis of higher and lower lifetime estimates as well as a table of consumer pool heater lifetime estimates from published literature and manufacturer input.

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 pool heaters based on the opportunity cost of consumer funds.

DOE applies weighted average discount rates calculated from consumer debt and asset data, rather than marginal or implicit discount rates.[80] 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 [81] (''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.

To establish commercial discount rates for the fraction of instances where businesses are using consumer pool heaters, DOE estimated the weighted-average cost of capital using data from Damodaran Online.[82] The weighted-average cost of capital is commonly used to estimate the present value of cash flows to be derived from a typical company project or investment. Most companies use both debt and equity capital to fund investments, so their cost of capital is the weighted average of the cost to the firm of equity and debt financing. DOE estimated the cost of equity using the capital asset pricing model, which assumes that the cost of equity for a particular company is proportional to the systematic risk faced by that company.

The average rate across all types of household debt and equity and income groups and commercial building business activity types, weighted by the shares of each type, is 3.9 percent for electric and gas-fired pool heaters. See chapter 8 of the 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 pool heaters for 2021 and the compliance year, DOE used the 2022 AHRI Directory of Certified Product Performance,[83] CEC's 2022 Modernized Appliance Efficiency Database System (''MAEDbS''),[84] [85] and DOE's 2021 Compliance Certification Management System (''CCMS'') [86] as well as manufacturer product literature.

The fraction of heat pump pool heaters was adjusted to take into account codes in Florida [87] and California [88] that require higher efficiency heat pump pool heaters. The region and market-specific fraction of electric resistance pool heaters was determined for each region and consumer pool heater market. For example, DOE assumed that warmer areas of the country such as Florida, which are better suited for heat pump installations, have a lower fraction of electric resistance installations (pool type 1, 2, 4, 5, and 7; see section IV.E.1 of this document), while large spas (pool type 3) have a larger fraction of electric resistance installations, and all indoor installations (pool type 6) were estimated to be electric resistance pool heaters. Based on input from manufacturer interviews for the NOPR, DOE adjusted its fraction of electric resistance pool heaters in 2021, as shown in Table IV.13, by assuming a larger growth in heat pump pool heater shipments compared to electric resistance pool heater shipments and an overall lower total fraction of electric resistance pool heaters. The fraction of heat pump pool heaters was also adjusted to take into account standards in Connecticut that require higher efficiency heat pump pool heaters,[89] in

[80] 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.

[81] 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/econres/scfindex.htm* (last accessed October 15, 2022).

[82] Damodaran Online, *Data Page: Costs of Capital by Industry Sector,* (2021), available at *pages.stern.nyu.edu/~adamodar/* (last accessed October 15, 2022).

[83] AHRI. *Directory of Certified Heat Pump Pool Heater Models.* October 9, 2021, available at *www.ahridirectory.org* (last accessed October 15, 2022).

[84] CEC. Modernized Appliance Efficiency Database System. October 9, 2021, available at *cacertappliances.energy.ca.gov/Pages/Search/AdvancedSearch.aspx* (last accessed October 15, 2022).

[85] CEC. Modernized Appliance Efficiency Database System. October 9, 2021, available at *cacertappliances.energy.ca.gov/Pages/Search/AdvancedSearch.aspx* (last accessed October 15, 2022).

[86] DOE. Compliance Certification Management System. October 9, 2021, available at *www.regulations.doe.gov/certification-data/* (last accessed October 15, 2022).

[87] 2017 Florida Energy & Conservation Code Chapter 4 section R403.10.5 states: ''Heat pump pool heaters shall have a minimum COP of 4.0 when tested in accordance with AHRI 1160, Table 2, Standard Rating Conditions-Low Air Temperature.'' State of Florida. Energy & Conservation Code, Chapter 4, available at *codes.iccsafe.org/content/FEC2017/chapter-4-re-residential-energy-efficiency?site_type=public* (last accessed October 15, 2022).

[88] California Title 20 Section 1605.3 (g)(3) states: ''For heat pump pool heaters manufactured on or after March 1, 2003, the average of the coefficient of performance (COP) at Standard Temperature Rating and the coefficient of performance (COP) at Low Temperature Rating shall be not less than 3.5.'' California Energy Commission. California Code of Regulations: Title 20. Public Utilities and Energy, Division 2. State Energy Resources Conservation and Development Commission, Chapter 4. Energy Conservation, Article 4. Appliance Efficiency Regulations (Refs & Annos), 1605.3. State Standards for Non-Federally-Regulated Appliances available at *govt.westlaw.com/calregs/Document/IEEDE2D64EF7B4F168C0E85379828A8C2?viewType=FullText&origination Context=documenttoc&transitionType=CategoryPageItem&contextData=(sc.Default)* (last accessed October 15, 2022).

[89] Connecticut's Regulations and Procedures for Establishing Energy Efficiency Standards for Certain Appliances and Products Section 16a–48–4(S)(4) states: ''Heat pump pool heaters shall have a coefficient of performance (COP) of not less than 3.5

Continued

addition to standards in California and Florida. To extrapolate from 2021 to 2028, DOE assumed different growth rates for the electric resistance and heat pump pool heater shipments. These assumptions resulted in an 8.8 percent overall market share for electric resistance pool heaters in 2028. See chapter 8 of the final rule TSD for further information on the derivation of the efficiency distributions.

TABLE IV.13—MARKET SHARE OF ELECTRIC RESISTANCE POOL HEATERS BY CONSUMER POOL HEATER MARKET AND REGION IN 2028

Consumer pool heater market type * and region	Electric resistance pool heater market share (%)		Sample weight of pool heater market (%)
	2021	2028	
Pool Type = 1 and 2, 4, 5, 7 (in Florida)	1.9	1.6	53.7
Pool Type = 1 and 2, 4, 5, 7 (in California, Connecticut)	3.8	3.2	6.3
Pool Type = 1 and 2, 4, 5, 7 (in Rest of Country)	7.5	6.3	29.8
Pool Type = 3 (in Florida)	18.8	15.8	0.8
Pool Type = 3 (in California, Connecticut)	37.5	31.7	1.1
Pool Type = 3 (in Rest of Country)	75.0	63.4	6.8
Pool Type = 6	87.5	73.9	1.4
Overall Electric Resistance Market Share	9.2	8.8	

* Consumer Pool Heater Market Types are described in Table IV.11.

During manufacturer interviews for the NOPR, DOE received input that consumer pool heaters with standing pilot only represented about 4 percent of gas-fired pool heater shipments. In addition, DOE accounted for the ban on pilot lights in gas-fired pool heaters in California,[90] Connecticut,[91] Florida,[92] and New York.[93]

The estimated market shares in the no-new-standards case for consumer pool heaters used for the final rule are shown in Table IV.14 and Table IV.15. See chapter 8 of the final rule TSD for further information on the derivation of the efficiency distributions.

TABLE IV.14—EFFICIENCY DISTRIBUTION IN THE NO-NEW-STANDARDS CASE FOR ELECTRIC POOL HEATERS IN 2028

Efficiency level	Representative TE_I (%)	National market share (%)
EL 0	99	8.8
EL 1	387	10.4
EL 2	483	59.2
EL 3	534	9.4
EL 4	551	9.3
EL 5	595	3.0

TABLE IV.15—EFFICIENCY DISTRIBUTION IN THE NO-NEW-STANDARDS CASE FOR GAS-FIRED POOL HEATERS IN 2028

Efficiency level	Representative TE_I (%)	National market share (%)
EL 0	61.1	4.1
EL 1	81.3	46.1
EL 2	83.3	41.1
EL 3	94.8	8.6

at standard temperature rating and at low temperature rating.'' State of Connecticut. Title 16a—Planning and Energy Policy. 2015, available at *eregulations.ct.gov/eRegsPortal/Browse/RCSA/Title_16aSubtitle_16a-48Section_16a-48-4/* (last accessed October 15, 2022).

[90] California Title 20 Section 1605.3 (g)(1) states: ''Energy Design Standard for Natural Gas Pool Heaters. Natural gas pool heaters shall not be equipped with constant burning pilots.'' California Energy Commission. California Code of Regulations: Title 20. Public Utilities and Energy, Division 2. State Energy Resources Conservation and Development Commission, Chapter 4. Energy Conservation, Article 4. Appliance Efficiency Regulations (Refs & Annos), 1605.3. State Standards for Non-Federally-Regulated Appliances available at *govt.westlaw.com/calregs/Document/IEEDE2D64EF7B4F168C0E85379828A8C2?viewType=FullText&originationContext=documenttoc&transitionType=CategoryPageItem&contextData=(sc.Default)* (last accessed October 15, 2022).

[91] Connecticut's Regulations and Procedures for Establishing Energy Efficiency Standards for Certain Appliances and Products Section 16a–48–4 (S) (2) states: ''Natural gas pool heaters shall not be equipped with a constantly burning pilot light.'' State of Connecticut. Title 16a—Planning and Energy Policy. 2015, available at *eregulations.ct.gov/eRegsPortal/Browse/RCSA/Title_16aSubtitle_16a-48Section_16a-48-4/* (last accessed October 15, 2022).

[92] 2017 Florida Energy & Conservation Code Chapter 4 section R403.10.4 states: ''Pool heaters fired by natural or LP gas shall not have continuously burning pilot lights.'' State of Florida. Energy & Conservation Code, Chapter 4, available at *codes.iccsafe.org/content/FEC2017/chapter-4-re-residential-energy-efficiency?site_type=public* (last accessed October 15, 2022).

[93] 2020 Energy Conservation Construction Code of New York State Chapter 4 section R403.10.1 states: ''Gas-fired heaters shall not be equipped with continuously burning ignition pilots.'' State of New York, available at *codes.iccsafe.org/content/NYSECC2020P1* (last accessed October 15, 2022).

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

While DOE acknowledges that economic factors may play a role when consumers, commercial building owners, or builders decide on what type of pool heater to install, assignment of pool heater efficiency for a given installation, based solely on economic measures such as life-cycle cost or simple payback period most likely would not fully and accurately reflect actual real-world installations. There are a number of market failures discussed in the economics literature that illustrate how purchasing decisions with respect to energy efficiency are unlikely to be perfectly correlated with energy use, as described below. DOE maintains that the method of assignment, which is in part random, is a reasonable approach, one that simulates behavior in the pool heater market, where market failures and other consumer preferences result in purchasing decisions not being perfectly aligned with economic interests, more realistically than relying only on apparent cost-effectiveness criteria derived from the limited information in CBECS or RECS. DOE further emphasizes that its approach does not assume that all purchasers of pool heaters 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 or buildings with large pool heater usage will be assigned higher efficiency pool heaters, and some homes or buildings with particularly low pool heater usage will be assigned baseline pool heaters, which aligns with the available data. By using this approach, DOE acknowledges the variety of market failures and other consumer behaviors present in the pool heater market. This approach minimizes any bias in the analysis by using random assignment, as opposed to assuming certain market conditions that are unsupported given the available evidence.

First, consumers are motivated by more than simple financial trade-offs. There are consumers who are willing to pay a premium for more energy-efficient products because they are environmentally conscious.[94] There are also several behavioral factors that can influence the purchasing decisions of complicated multi-attribute products, such as pool heaters. For example, consumers (or decision makers in an organization) are highly influenced by choice architecture, defined as the framing of the decision, the surrounding circumstances of the purchase, the alternatives available, and how they are presented for any given choice scenario.[95] 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.[96] Thaler, who won the Nobel Prize in Economics in 2017 for his contributions to behavioral economics, and Sunstein point out that these behavioral factors are strongest when the decisions are complex and infrequent, when feedback on the decision is muted and slow, and when there is a high degree of information asymmetry.[97] These characteristics describe almost all purchasing situations of appliances and equipment, including pool heaters. The installation of a new or replacement pool heater is done infrequently, as evidenced by the mean lifetime for pool heaters. Additionally, it would take at least one full pool heating season for any impacts on operating costs to be fully apparent. Further, if the purchaser of the pool heater 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 is the split-incentive or principal-agent problem. 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 pool heater to install, whereas the renter is responsible for paying energy bills. In new construction, builders influence the type of water heater used in many homes but do not pay operating costs. Finally, contractors install a large share of pool heaters in replacement situations, and they can exert a high degree of influence over the type of pool heater purchased.

In addition to the split-incentive problem, there are other market failures that are likely to affect the choice of pool heater efficiency made by consumers. For example, emergency replacements of pool heaters are strongly biased toward like-for-like replacement (*i.e.,* replacing the non-functioning equipment with a similar or identical product). The consideration of alternative product options is far more likely for planned replacements and installations in new construction.

Additionally, Davis and Metcalf[98] conducted an experiment demonstrating that the nature of the information available to consumers from EnergyGuide labels posted on air conditioning equipment results in an inefficient allocation of energy efficiency across households with different usage levels. Their findings indicate that households are likely to make decisions regarding the efficiency of the climate control equipment of their homes that do not result in the highest net present value for their specific usage pattern (*i.e.,* their decision is based on imperfect information and, therefore, is not necessarily optimal). This effect is likely to translate to pool heaters as well, whose efficiency rating, while visible to consumers at the time of purchase, is similar information to that found on an EnergyGuide label.

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[94] Ward, D.O., Clark, C.D., Jensen, K.L., Yen, S.T., & Russell, C.S. (2011): ''Factors influencing willingness-to pay for the ENERGY STAR® label,'' *Energy Policy, 39*(3), 1450–1458. (Available at: *www.sciencedirect.com/science/article/abs/pii/S0301421510009171*) (Last accessed Feb. 15, 2022).

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

[96] 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).

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

[98] 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 November 1, 2022).

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.[99] show that consumers tend to underestimate the energy use of large energy-intensive appliances and equipment (such as a pool heater), but overestimate the energy use of small appliances. Therefore, it is likely that consumers systematically underestimate the energy use associated with a pool heater, resulting in less cost-effective pool heater purchases.

These market failures affect a sizeable share of the consumer population. A study by Houde [100] indicates that there is a significant subset of consumers that appear to purchase appliances or equipment without taking into account their energy efficiency and operating costs at all.

There are market failures relevant to consumer pool heaters installed in commercial or community applications as well. It is often assumed that because commercial or community customers are businesses or organizations that have trained or experienced individuals making decisions regarding investments in cost-saving measures, some of the commonly observed market failures present in the general population of residential customers should not be as prevalent in a commercial setting. However, there are many characteristics of organizational structure and historic circumstance in commercial settings that can lead to underinvestment in energy efficiency.

First, a recognized problem in commercial settings is the principal-agent problem, where the building owner (or building developer) selects the equipment and the tenant (or subsequent building owner) pays for energy costs.[101] [102] Indeed, more than a quarter of commercial buildings in the CBECS 2012 sample are occupied at least in part by a tenant, not the building owner (indicating that, in DOE's experience, the building owner likely is not responsible for paying energy costs). There are other similar misaligned incentives embedded in the organizational structure within a given firm or business that can impact the choice of a pool heater. For example, if one department or individual within an organization is responsible for capital expenditures (and therefore equipment selection) while a separate department or individual is responsible for paying the energy bills, a market failure similar to the principal-agent problem can result.[103] Additionally, managers may have other responsibilities and often have other incentives besides operating cost minimization, such as satisfying shareholder expectations, which can sometimes be focused on short-term returns.[104] Decision-making related to commercial buildings is highly complex and involves gathering information from and for a variety of different market actors. It is common to see conflicting goals across various actors within the same organization as well as information asymmetries between market actors in the energy efficiency context in commercial building construction.[105]

Second, the nature of the organizational structure and design can influence priorities for capital budgeting, resulting in choices that do not necessarily maximize profitability.[106] Even factors as simple as unmotivated staff or lack of priority-setting and/or a lack of a long-term energy strategy can have a sizable effect on the likelihood that an energy efficient investment will be undertaken.[107] U.S. tax rules for commercial buildings may incentivize lower capital expenditures, since capital costs must be depreciated over many years, whereas operating costs can be fully deducted from taxable income or passed through directly to building tenants.[108]

Third, there are asymmetric information and other potential market failures in financial markets in general, which can affect decisions by firms with regard to their choice among alternative investment options, with energy efficiency being one such option.[109]

[99] 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 November 1, 2022).

[100] 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 November 1, 2022).

[101] Vernon, D., and Meier, A. (2012). ''Identification and quantification of principal-agent problems affecting energy efficiency investments and use decisions in the trucking industry,'' *Energy Policy,* 49, 266–273.

[102] Blum, H. and Sathaye, J. (2010). ''Quantitative Analysis of the Principal-Agent Problem in Commercial Buildings in the U.S.: Focus on Central Space Heating and Cooling,'' Lawrence Berkeley National Laboratory, LBNL–3557E. (Available at: *escholarship.org/uc/item/6p1525mg*) (Last accessed November 1, 2022).

[103] Prindle, B., Sathaye, J., Murtishaw, S., Crossley, D., Watt, G., Hughes, J., and de Visser, E. (2007). ''Quantifying the effects of market failures in the end-use of energy,'' Final Draft Report Prepared for International Energy Agency. (Available from International Energy Agency, Head of Publications Service, 9 rue de la Federation, 75739 Paris, Cedex 15 France).

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

[105] International Energy Agency (IEA). (2007). Mind the Gap: Quantifying Principal-Agent Problems in Energy Efficiency. OECD Pub. (Available at: *www.iea.org/reports/mind-the-gap*) (Last accessed November 1, 2022)

[106] DeCanio, S.J. (1994). ''Agency and control problems in US corporations: the case of energy-efficient investment projects,'' *Journal of the Economics of Business,* 1(1), 105–124.

Stole, L.A., and Zwiebel, J. (1996). ''Organizational design and technology choice under intrafirm bargaining,'' *The American Economic Review,* 195–222.

[107] Rohdin, P., and Thollander, P. (2006). ''Barriers to and driving forces for energy efficiency in the non-energy intensive manufacturing industry in Sweden,'' *Energy,* 31(12), 1836–1844.

Takahashi, M and Asano, H (2007). ''Energy Use Affected by Principal-Agent Problem in Japanese Commercial Office Space Leasing,'' In *Quantifying the Effects of Market Failures in the End-Use of Energy.* American Council for an Energy-Efficient Economy. February 2007.

Visser, E and Harmelink, M (2007). ''The Case of Energy Use in Commercial Offices in the Netherlands,'' In *Quantifying the Effects of Market Failures in the End-Use of Energy.* American Council for an Energy-Efficient Economy. February 2007.

Bjorndalen, J. and Bugge, J. (2007). ''Market Barriers Related to Commercial Office Space Leasing in Norway,'' In *Quantifying the Effects of Market Failures in the End-Use of Energy.* American Council for an Energy-Efficient Economy. February 2007.

Schleich, J. (2009). ''Barriers to energy efficiency: A comparison across the German commercial and services sector,'' *Ecological Economics,* 68(7), 2150–2159.

Muthulingam, S., *et al.* (2013). ''Energy Efficiency in Small and Medium-Sized Manufacturing Firms,'' *Manufacturing & Service Operations Management,* 15(4), 596–612. (Finding that manager inattention contributed to the non-adoption of energy efficiency initiatives).

Boyd, G.A., Curtis, E.M. (2014). ''Evidence of an 'energy management gap' in US manufacturing: Spillovers from firm management practices to energy efficiency,'' *Journal of Environmental Economics and Management,* 68(3), 463–479.

[108] Lovins, A. (1992). Energy-Efficient Buildings: Institutional Barriers and Opportunities. (Available at: *rmi.org/insight/energy-efficient-buildings-institutional-barriers-and-opportunities/*) (Last accessed November 1, 2022).

[109] Fazzari,, S.M., Hubbard, R.G., Petersen, B.C., Blinder, A.S., and Poterba, J.M. (1988). ''Financing constraints and corporate investment,'' *Brookings Papers on Economic Activity,* 1988(1), 141–206.

Cummings, J.G., Hassett, K.A., Hubbard, R.G., Hall, R.E., and Caballero, R.J. (1994). ''A reconsideration of investment behavior using tax reforms as natural experiments,'' *Brookings Papers on Economic Activity,* 1994(2), 1–74.

DeCanio, S.J., and Watkins, W.E. (1998). ''Investment in energy efficiency: do the characteristics of firms matter?'' *Review of Economics and Statistics,* 80(1), 95–107.

Hubbard R.G. and Kashyap A. (1992). ''Internal Net Worth and the Investment Process: An Application to U.S. Agriculture,'' *Journal of Political Economy,* 100, 506–534.

Asymmetric information in financial markets is particularly pronounced with regard to energy efficiency investments.[110] There is a dearth of information about risk and volatility related to energy efficiency investments, and energy efficiency investment metrics may not be as visible to investment managers,[111] which can bias firms towards more certain or familiar options. This market failure results not because the returns from energy efficiency as an investment are inherently riskier, but because information about the risk itself tends not to be available in the same way it is for other types of investment, like stocks or bonds. In some cases energy efficiency is not a formal investment category used by financial managers, and if there is a formal category for energy efficiency within the investment portfolio options assessed by financial managers, they are seen as weakly strategic and not seen as likely to increase competitive advantage.[112] This information asymmetry extends to commercial investors, lenders, and real-estate financing, which is biased against new and perhaps unfamiliar technology (even though it may be economically beneficial).[113] Another market failure known as the first-mover disadvantage can exacerbate this bias against adopting new technologies, as the successful integration of new technology in a particular context by one actor generates information about cost-savings, and other actors in the market can then benefit from that information by following suit; yet because the first to adopt a new technology bears the risk but cannot keep to themselves all the informational benefits, firms may inefficiently underinvest in new technologies.[114]

In sum, the commercial sector faces many market failures that can result in an under-investment in energy efficiency. This means that discount rates implied by hurdle rates [115] and required payback periods of many firms are higher than the appropriate cost of capital for the investment.[116] The preceding arguments for the existence of market failures in the commercial sector is corroborated by empirical evidence. One study in particular showed evidence of substantial gains in energy efficiency that could have been achieved without negative repercussions on profitability, but the investments had not been undertaken by firms.[117] The study found that multiple organizational and institutional factors caused firms to require shorter payback periods and higher returns than the cost of capital for alternative investments of similar risk. Another study demonstrated similar results with firms requiring very short payback periods of 1–2 years in order to adopt energy-saving projects, implying hurdle rates of 50 to 100 percent, despite the potential economic benefits.[118] A number of other case studies similarly demonstrate the existence of market failures preventing the adoption of energy-efficient technologies in a variety of commercial sectors around the world, including office buildings,[119] supermarkets,[120] and the electric motor market.[121]

The existence of market failures in the residential and commercial sectors is well supported by the economics literature and by a number of case studies. If DOE developed an efficiency distribution that assigned pool heater efficiency in the no-new-standards case solely according to energy use or economic considerations such as life-cycle cost or payback period, the resulting distribution of efficiencies within the building sample would not reflect any of the market failures or behavioral factors above. DOE thus concludes such a distribution would not be representative of the pool heater market. Further, even if a specific household/building/organization is not subject to the market failures above, the purchasing decision of pool heater efficiency can be highly complex and influenced by a number of factors not captured by the building characteristics available in the RECS or CBECS samples. These factors can lead to households or building owners choosing a pool heater 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 2015 or CBECS 2012).

Responding to the April 2022 NOPR, Fluidra suggested that, for gas-fired pool heaters in 2028, the market share for EL2 should be significantly higher than that for EL1, adding that the new market share significantly favors EL2 gas-fire pool heaters. Fluidra also suggested that the EL0 market share for gas-fired pool heaters should be zero, stating that this level would not comply with the existing minimum efficiency requirement of 82 percent thermal efficiency. (Fluidra, No. 18 at p. 3).

In response, DOE notes that EL0 is defined as products which minimally comply with the existing thermal efficiency standards and include a standing pilot ignition system (see section IV.C.1.a for details), and therefore, in a no-new-standards case, these products would continue to be sold in the market. DOE assumed that the market share of EL 0 would decrease over time, compared to the 8 percent market share assumed in the 2010 Heating Products Final Rule based on manufacturer input. DOE does not currently have shipments data by efficiency to distinguish between EL 1 and EL 2, but based on available model data, the market shares appear to be similar. These model data informed the efficiency distribution used in the analysis.

[110] Mills, E., Kromer, S., Weiss, G., and Mathew, P.A. (2006). ''From volatility to value: analysing and managing financial and performance risk in energy savings projects,'' *Energy Policy,* 34(2), 188–199.

Jollands, N., Waide, P., Ellis, M., Onoda, T., Laustsen, J., Tanaka, K., and Meier, A. (2010). ''The 25 IEA energy efficiency policy recommendations to the G8 Gleneagles Plan of Action,'' *Energy Policy,* 38(11), 6409–6418.

[111] Reed, J.H., Johnson, K., Riggert, J., and Oh, A.D. (2004). ''Who plays and who decides: The structure and operation of the commercial building market,'' U.S. Department of Energy Office of Building Technology, State and Community Programs. (Available at: *www1.eere.energy.gov/buildings/publications/pdfs/commercial_initiative/who_plays_who_decides.pdf*) (Last accessed November 1, 2022).

[112] Cooremans, C. (2012). ''Investment in energy efficiency: do the characteristics of investments matter?'' *Energy Efficiency,* 5(4), 497–518.

[113] Lovins 1992, op. cit. The Atmospheric Fund. (2017). Money on the table: Why investors miss out on the energy efficiency market. (Available at: *taf.ca/publications/money-table-investors-energy-efficiency-market/*) (Last accessed November 1, 2022).

[114] Blumstein, C. and Taylor, M. (2013). Rethinking the Energy-Efficiency Gap: Producers, Intermediaries, and Innovation. Energy Institute at Haas Working Paper 243. (Available at: *haas.berkeley.edu/wp-content/uploads/WP243.pdf*) (Last accessed November 1, 2022).

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

[116] DeCanio 1994, op. cit.

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

[118] Andersen, S.T., and Newell, R.G. (2004). ''Information programs for technology adoption: the case of energy-efficiency audits,'' *Resource and Energy Economics,* 26, 27–50.

[119] Prindle 2007, op. cit. Howarth, R.B., Haddad, B.M., and Paton, B. (2000). ''The economics of energy efficiency: insights from voluntary participation programs,'' *Energy Policy,* 28, 477–486.

[120] Klemick, H., Kopits, E., Wolverton, A. (2017). ''Potential Barriers to Improving Energy Efficiency in Commercial Buildings: The Case of Supermarket Refrigeration,'' *Journal of Benefit-Cost Analysis,* 8(1), 115–145.

[121] de Almeida, E.L.F. (1998). ''Energy efficiency and the limits of market forces: The example of the electric motor market in France'', *Energy Policy,* 26(8), 643–653. Xenergy, Inc. (1998). United States Industrial Electric Motor Systems Market Opportunity Assessment. (Available at: *www.energy.gov/sites/default/files/2014/04/f15/mtrmkt.pdf*) (Last accessed January 20, 2022).

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 full 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 new and 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.[122] 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.

For the NOPR, DOE estimated consumer pool heater shipments by projecting shipments in three market segments: (1) replacements; (2) new swimming pool owners; and (3) new owners with an existing swimming pool that did not previously have a pool heater (both in residential and commercial applications),[123] as follows:

(1) To project consumer pool heater replacement shipments in the residential and commercial sectors, DOE developed retirement functions for consumer pool heaters from the lifetime estimates (see section IV.F.6 of this document) and applied them to the existing products in the stock. DOE estimated the existing stock of products using estimated historical shipments [124] [125] [126] [127] and the survival function for consumer pool heaters from the lifetime estimates. DOE took into account replacement rate of retired (failed) consumer pool heaters.

(2) To project shipments to the new swimming pool and spa market in the residential and commercial sector, DOE utilized projected new swimming pool (inground and above ground) installations and saturation rates. DOE estimated projected new swimming pool (inground and above ground) installations based on 2016 Pkdata,[128] and 2020 Pkdata [129] and projected saturation rates based on saturation data from 2020 Pkdata and 1990–2015 RECS data.[130]

(3) To project shipments to new owners in existing swimming pools that did not previously have a consumer pool heater in the residential sector, DOE estimated that a small fraction of existing swimming pools would add a consumer pool heater.[131]

AHRI and PHTA supported the fact that DOE updated its analysis based on 2015 feedback that resulted in a lower average annual growth and acknowledged that many unknown factors exist that could impact this projection. (AHRI and PHTA, No. 20 at p. 9)

For the final rule, DOE kept the same methodology for projecting shipments and updated its shipments estimates based on the latest data available, including 2022 Pkdata,[132] RECS 2020 and CBECS 2018 data. The 2022 PKData also included estimated 2003–2021 inground pool heater shipments, which were used to calibrate DOE's shipments model. See chapter 9 of the final rule TSD for details.

Because the standards-case projections take into account the increase in purchase price and the decrease in operating costs caused by amended standards, projected shipments for a standards case typically deviate from those for the no-new-standards case. Because purchase price tends to have a larger impact than operating cost on appliance purchase decisions, standards-case projections typically show a decrease in product shipments relative to the no-new-standards case.

Rheem generally supported the relative price elasticity approach and agrees that an increase in energy conservation standards will result in a reduction of shipments for a period, as compared to the no new standards case. (Rheem, No. 19 at p. 8) In response, DOE maintained its approach to estimate the impact of the considered standards on consumer pool heater shipments. Appendix 10C of the final rule TSD describes this analysis, which includes a sensitivity analysis.

BWC suggested that the Department consider ongoing building electrification efforts in cities and states

[122] 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.

[123] DOE assumed in the October 2015 NODA that new owners also account for potential switching between gas and electric pool heater products.

[124] DOE had limited historical shipments data for electric pool heaters, so DOE ''backcasted'' the shipments model (*i.e.,* applied the shipments model to years prior to 2015) to estimate historical shipments.

[125] U.S. Department of Energy-Office of Codes and Standards, Technical Support Document: Energy Efficiency Standards for Consumer Products: Room Air Conditioners, Water Heaters, Direct Heating Equipment, Mobile Home Furnaces, Kitchen Ranges and Ovens, Pool Heaters, Fluorescent Lamp Ballasts & Television Sets, 1993. Washington, DC Vol. 1 of 3. Report No. DOE/EE–0009.

[126] Association of Pool & Spa Professionals (APSP). 2003–2009 Gas-fired Pool Heater Shipments Data (Comment #135 for 2010 Heating Products Final Rule), available at *www.regulations.gov/document/EERE-2006-STD-0129-0135* (last accessed October 15, 2022).

[127] 2016 Pkdata provided estimated combined historical shipments for electric and gas-fired pool heaters used in commercial applications from 2010–2015.

[128] Pkdata. 2016 Residential and Commercial Swimming Pool, Hot tub, and Pool Heater Customized Report for LBNL, June 21, 2016, available at *www.pkdata.com/datapointstrade.html#/* (last accessed October 15, 2022).

[129] Pkdata. 2020 Residential Swimming Pool, Hot tub, and Pool Heater Customized Report for LBNL, October 15, 2020, available at *www.pkdata.com/datapointstrade.html#/* (last accessed October 15, 2022).

[130] U.S. EIA. 1990, 1993, 1997, 2001, 2005, 2009, and 2015 RECS Survey Data, available at *www.eia.gov/consumption/residential/* (last accessed October 15, 2022).

[131] Number of existing swimming pools without an electric or gas pool heater was based on 1990–2015 RECS data.

[132] Pkdata. 2022 Residential Swimming Pool, Hot tub, and Pool Heater Customized Report for LBNL, October 1, 2022, available at *www.pkdata.com/datapointstrade.html#/* (last accessed October 15, 2022).

throughout the country related to assumptions for gas-fired pool heaters. (BWC, No. 12 at p. 4) Rheem recommended DOE fully evaluate the impact of standards on fuel switching. Rheem noted that DOE stated in section 9.5.1 of the TSD that they did not consider the potential impact of consumers opting to switch from an electric to gas or gas to electric pool heater, suggesting that installation issues associated with a fuel change would limit switching. Rheem agreed that adding a propane tank (and associated supply service) or an electrical panel upgrade would limit fuel switching, but extending the gas line and accounting for venting would not prevent a consumer to switch from electric resistance to gas in installations where gas is already available. (Rheem, No. 19 at p. 7–8) AHRI and PHTA had concerns with EL4 for electric pool heaters, as the proposed standards would increase the consumer purchase cost, reduce overall sales, lengthen payback periods, and incentivize fuel switching to gas-fired pool heaters due to the price increase for electric pool heaters. (AHRI and PHTA, No. 20 at p. 5) Joint Advocates supported DOE's conclusion that the potential for fuel switching as a result of the proposed standard levels is limited because, as DOE explained, the costs associated with switching from an electric pool heater to a gas pool heater (*e.g.,* having to extend a gas line) would likely limit switching, and heat pump pool heaters already make up more than 90 percent of the electric pool heater market. (Joint Advocates, No. 13 at p. 3)

DOE agrees with Joint Advocates that the costs associated with switching from an electric pool heater to a gas-fired pool heater (such as extending the gas line, adding a propane tank, or accounting for venting) would tend to limit such switching. However, it also agrees with Rheem that extending the gas line and accounting for venting would not prevent a consumer to switch from electric resistance to gas in installations where gas is already available. DOE also agrees that ongoing electrification efforts could impact the decision to switch from gas, but has limited data on the potential fraction of shipments that might switch from gas-fired pool heaters to electric pool heaters in the no-new amended standards case.

For the final rule analysis, assumptions regarding future policies encouraging electrification of households and electric pool heating were speculative at the time of analysis, so such policies were not incorporated into the shipments projection. DOE agrees that ongoing electrification policies at the Federal, State, and local level are likely to encourage installation of electric pool heaters in new homes and adoption of electric pool heaters in homes that currently use gas-fired pool heaters. However, there are many uncertainties about the timing and impact of these policies that make it difficult to fully account for their likely impact on gas and electric pool heater market shares in the time frame for this analysis (*i.e.,* 2028 through 2057). Nonetheless, DOE has modified some of its projections to attempt to account for impacts that seem most likely in the relevant time frame. For example, DOE accounted for the 2022 update to Title 24 in California [133] and for the decision of the California Public Utilities Commission to entirely eliminate ratepayer subsidies for the extension of new gas lines beginning in July 2023. Together, these policies are reasonably expected to lead to the phase-out of gas-fired pool heaters in new single-family homes in California. The California Air Resources Board has also adopted a 2022 State Strategy for the State Implementation Plan that would effectively ban sales of new gas-fired pool heaters beginning in 2030.[134] However, because a final decision on an implementing rule would not happen until 2025, DOE did not include this policy in its analysis for the final rule. The assumptions are described in chapter 9 and appendix 9A of the final rule TSD.

DOE acknowledges that these and other electrification policies may result in a larger decrease in shipments of gas-fired water heaters than projected in this final rule, especially if stronger policies are adopted in coming years. However, this would occur in the no-new-standards case, and thus would only reduce the energy savings estimated to result from this proposed rule. For example, if incentives and rebates shifted 5 percent of shipments in the no-new-amended standards case from gas-fired pool heaters to heat pump pool heaters, then the energy savings estimated for gas-fired pool heaters that would result from this proposed rule would decline by approximately 5 percent. The estimated consumer impacts are likely to be similar, however, except that the percentage of consumers with no impact at a given efficiency level would increase. However, at this time the impact of many of these policies remains too uncertain to be included in the shipments analysis.

H. National Impact Analysis

The NIA assesses the national energy savings (''NES'') and the NPV from a national perspective of total consumer costs and savings that would be expected to result from new or amended standards at specific efficiency levels.[135] (''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.[136] For the present analysis, DOE projected the energy savings, operating cost savings, product costs, and NPV of consumer benefits over the lifetime of consumer pool heaters sold from 2028 through 2057.

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.16 summarizes the inputs and methods DOE used for the NIA

[133] The 2022 update includes heat pumps as a performance standard baseline for water or space heating in single-family homes, and space heating in multi-family homes. Builders will need to either include one high-efficiency heat pump in new constructions or subject those buildings to more stringent energy efficiency standards.

[134] *https://ww2.arb.ca.gov/resources/documents/2022-state-strategy-state-implementation-plan-2022-state-sip-strategy#:~:text=The%202022%20State%20SIP%20Strategy,all%20nonattainment%20areas%20across%20California.*

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

[136] For the NIA, DOE adjusts the installed cost data from the LCC analysis to exclude sales tax, which is a transfer.

analysis for the final rule. Discussion of these inputs and methods follows the table. See chapter 10 of the final rule TSD for further details.

TABLE IV.16—SUMMARY OF INPUTS AND METHODS FOR THE NATIONAL IMPACT ANALYSIS

Inputs	Method
Shipments	Annual shipments from shipments model.
Compliance Date of Standard	2028.
Efficiency Trends	*No-new-standards case:* Based on historical data. *Standards cases:* Roll-up in the compliance year and then DOE estimated growth in shipment-weighted efficiency in all the standards cases, except max-tech.
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 do not change with efficiency level.
Energy Price Trends	*AEO2022* projections (to 2050) and extrapolation thereafter.
Energy Site-to-Primary and FFC Conversion	A time-series conversion factor based on *AEO2022.*
Discount Rate	Three and seven percent.
Present Year	2022.

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 pool heaters over the entire shipments projection period, DOE used available historical shipments data and manufacturer input. The approach is further described in chapter 10 of the final rule TSD.

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

To develop no-new standards case efficiency trends after 2020, DOE assumed an annual decreasing trend of negative 2 percent in the market share for the minimum efficiency levels (EL 0) for both electric and gas-fired pool heaters. This resulted in a market share for EL 0 of 8 percent in 2028 and 4 percent in 2057 for electric pool heaters and 4 percent in 2028 and 2 percent in 2057 for gas-fired pool heaters.

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 *AEO2022.* 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. For the NOPR, DOE did not include the rebound effect in the NPV analysis. 87 FR 22640, 22681. DOE did not find any data on the rebound effect specific to consumer pool heaters. DOE applied a rebound effect of 10 percent for consumer pool heaters used in residential applications, based on studies of other residential products, and 0 percent for consumer pool heaters used in commercial applications (see section IV.F.3.a of this document for more details). The calculated NES at each efficiency level is therefore reduced by 10 percent in residential applications. For the final rule analysis, DOE included the rebound effect in the NPV analysis by accounting for the additional net benefit from increased consumer pool heaters usage, as described in section IV.H.3 of this document.

Rheem agreed that there could be some rebound effect if energy conservation standards are increased. While it is unlikely that a consumer would increase the temperature of their pool, it is possible that a consumer will be less diligent with shutting off pool heating between periods of pool usage during the heating season. (Rheem, No. 19 at p.7) BWC agreed with DOE's estimate that there will be very little, if any, rebound effect for these products installed in commercial applications. (BWC, No. 12 at p. 4) AHRI and PHTA did not believe the approach of using other residential products to determine the rebound effect is appropriate for pool heating because consumers who choose to install pool heating will use them the same regardless of product efficiency. (AHRI and PHTA, No. 20 at p. 8) They stated that they did not believe there is a rebound effect for pool heaters. *Id.*

DOE continued to incorporate a rebound effect in order to have a conservative estimate of the potential energy savings from an energy conservation standard on pool heaters. DOE notes that an estimated rebound of 10 percent is modest and comparable to several other residential end uses, which typically range from 0 to 15 percent. While the inclusion of the rebound effect at the energy savings level reduces energy savings and the inclusion in the net present value analysis increases the net present value, overall the exclusion of the rebound effect would not be sufficient to change DOE's conclusion regarding economic justification.

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 [137] that EIA uses to prepare its *Annual Energy Outlook.* The FFC factors incorporate losses in production and delivery in the case of natural gas (including fugitive emissions) and additional energy used to produce and deliver the various fuels used by power plants. The approach used for deriving FFC measures of energy use and emissions is described in appendix 10B of the final rule TSD.

3. Net Present Value Analysis

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

As discussed in section IV.F.1 of this document, DOE developed consumer pool heaters price trends based on 2022 PKData. DOE applied the same constant trend to project prices for each product class at each considered efficiency level. DOE's projection of product prices is described in appendix 10C of the 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 pool heaters. In addition to the default price trend, DOE considered two product price sensitivity cases: (1) a declining price trend case based on 2003–2014 price data and (2) an increasing price trend case based on 2015–2021 data. The derivation of these price trends and the results of these sensitivity cases are described in appendix 10C of the final rule TSD.

The operating cost savings are the sum of the differences in energy cost savings, maintenance, and repair costs. The maintenance and repair costs derivation is described in section IV.F.5 of this document. 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 regional energy prices by the projection of annual national-average residential energy price changes in the Reference case from *AEO2022,* which has an end year of 2050. To estimate price trends after 2050, DOE used the average of annual growth rates in prices from 2045 through 2050.[138] As part of the NIA, DOE also analyzed scenarios that used inputs from variants of the *AEO2022* Reference case that have lower and higher economic growth. Those cases have lower and higher energy price trends compared to the Reference case. NIA results based on these cases are presented in appendix 10C of the final rule TSD.

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

In calculating the NPV, DOE multiplies the net savings in future years by a discount factor to determine their present value. For this final rule, DOE estimated the NPV of consumer benefits using both a 3-percent and a 7-percent real discount rate. DOE uses these discount rates in accordance with guidance provided by the Office of Management and Budget (''OMB'') to Federal agencies on the development of regulatory analysis.[139] 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 final rule, DOE analyzed the impacts of the considered standard levels on two subgroups: (1) senior-only and (2) small business. The analysis used subsets of the RECS 2015 sample composed of households and CBECS 2012 sample composed of commercial buildings 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 final rule TSD describes the consumer subgroup analysis.

J. Manufacturer Impact Analysis

1. Overview

DOE performed an MIA to estimate the financial impacts of new and amended energy conservation standards on manufacturers of consumer pool heaters and to estimate the potential

[137] 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 October 15, 2022).

[138] Lavappa, Priya D. and J.D. Kneifel. Energy Price Indices and Discount Factors for Life-Cycle Cost Analysis—2022 Annual Supplement to NIST Handbook 135. National Institute of Standards and Technology (NIST). NISTIR 85–3273–37, available at *www.nist.gov/publications/energy-price-indices-and-discount-factors-life-cycle-cost-analysis-2022-annual* (last accessed October 15, 2022).

[139] United States Office of Management and Budget. *Circular A–4: Regulatory Analysis.* September 17, 2003. Section E. Available at *www.whitehouse.gov/omb/memoranda/m03-21.html* (last accessed October 15, 2022).

impacts of such standards on 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 new and amended energy conservation standards might affect domestic manufacturing employment, capacity, and competition, as well as how standards contribute to overall regulatory burden. Finally, the MIA serves to identify any disproportionate impacts on manufacturer subgroups, including small business manufacturers.

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

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

DOE conducted the MIA for this rulemaking in three phases. In Phase 1 of the MIA, DOE prepared a profile of the consumer pool heaters manufacturing industry based on the market and technology assessment, preliminary manufacturer interviews, and publicly available information. This included a top-down analysis of consumer pool heaters 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 pool heaters manufacturing industry, including company filings of form 10–K from the SEC,[140] corporate annual reports, the U.S. Census Bureau's ''Economic Census,'' [141] and reports from D&B Hoovers.[142]

In Phase 2 of the MIA, DOE prepared a framework industry cash-flow analysis to quantify the potential impacts of new and 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 pool heaters in order to develop other key GRIM inputs, including product and capital conversion costs, and to gather additional information on the anticipated effects of energy conservation standards on revenues, direct employment, capital assets, industry competitiveness, and subgroup impacts.

In Phase 3 of the MIA, DOE conducted structured, detailed interviews with representative manufacturers. During these interviews, DOE discussed engineering, manufacturing, procurement, and financial topics to validate assumptions used in the GRIM and to identify key issues or concerns. See section IV.J.3 of this document for a description of the key issues raised by manufacturers during the interviews. As part of Phase 3, DOE also evaluated subgroups of manufacturers that may be disproportionately impacted by new and 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 (''LVMs''), niche players, and/or manufacturers exhibiting a cost structure that largely differs from the industry average. DOE identified one subgroup for a separate impact analysis: small business manufacturers. The small business subgroup is discussed in section VI.B, ''Review under the Regulatory Flexibility Act'' and in chapter 12 of the final rule TSD.

2. Government Regulatory Impact Model and Key Inputs

DOE uses the GRIM to quantify the changes in cash flow due to new and 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 new and amended energy conservation standard. The GRIM spreadsheet uses the inputs to arrive at a series of annual cash flows, beginning in 2023 (the base year of the analysis) and continuing to 2057. DOE calculated INPVs by summing the stream of annual discounted cash flows during this period. For manufacturers of consumer pool heaters, DOE used a real discount rate of 7.4 percent, which was derived from industry financials and then modified according to feedback received during manufacturer interviews.

The GRIM calculates cash flows using standard accounting principles and compares changes in INPV between the no-new-standards case and each standards case. The difference in INPV between the no-new-standards case and a standards case represents the financial impact of the new and amended energy conservation standards on manufacturers. As discussed previously, DOE developed critical GRIM inputs using a number of sources, including publicly available data, results of the engineering 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

[140] See online at *www.sec.gov/edgar.shtml* (Last accessed on October 17, 2022).

[141] See online at *www.census.gov/programs-surveys/asm/data/tables.html* (Last accessed on October 17, 2022).

[142] See online at *app.avention.com* (Last accessed on October 17, 2022).

GRIM, the discount rate, and other financial parameters can be found in chapter 12 of the final rule TSD.

a. Manufacturer Production Costs

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

In the MIA, DOE used the MPCs calculated in the engineering analysis, as described in section IV.C of this document. DOE used information from its teardown analysis, described in section IV.C.3 of this document to disaggregate the MPCs into material, labor, depreciation, and overhead costs. To calculate the MPCs for products above the baseline, DOE added incremental material, labor, depreciation, and overhead costs from the engineering cost-efficiency curves to the baseline MPCs. These cost breakdowns were validated with manufacturers during manufacturer interviews.

For a complete description of the MPCs, see chapter 5 of the final rule TSD.

b. Shipments Projections

The GRIM estimates manufacturer revenues based on total unit shipment projections and the distribution of those shipments by efficiency level. Changes in sales volumes and efficiency mix over time can significantly affect manufacturer finances. For this analysis, the GRIM uses the NIA's annual shipment projections derived from the shipments analysis from 2023 (the base year) to 2057 (the end year of the analysis period). See chapter 9 of the final rule TSD for additional details.

c. Product and Capital Conversion Costs

New and 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) product conversion costs; and (2) capital conversion costs. Product conversion costs are investments in research, development, testing, marketing, and other non-capitalized costs necessary to make product designs comply with new and amended energy conservation standards. 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.

To evaluate the level of capital conversion costs manufacturers would likely incur to comply with new and amended energy conservation standards, DOE used data gathered from manufacturer interviews as well as information derived from the product teardown analysis and engineering model. In developing its conversion cost estimates, DOE conservatively assumed manufacturers would redesign all noncompliant consumer gas-fired and heat pump pool heaters to comply with new and amended energy conservation standards (electric resistance pool heaters are discussed further in this section). Manufacturers could choose to drop some models that do not meet the levels prescribed by new and amended standards. Therefore, total product and capital conversion costs may be lower than the estimates calculated as part of this analysis.

In response to the April 2022 NOPR, several interested parties commented on the conversion cost estimates used in the April 2022 NOPR analysis. BWC stated that DOE underestimated the amount of time and resources required to meet compliance of the proposed consumer pool heater standards and test procedures. (BWC, No. 12 at pp. 4–5) Fluidra stated they could provide information regarding industry capital and product conversion costs of compliance associated with the analyzed energy conservation standards for consumer pool heaters evaluated in this NOPR only in a confidential manufacturer interview. (Fluidra, No. 18 at p. 4) Rheem also stated that they are willing to discuss DOE's conversion cost analysis with DOE's consultant during a confidential meeting. (Rheem, No. 19 at p. 9) AquaCal also claimed that the EL 4 proposed by DOE for electric consumer pool heaters would have a major impact on the heat pump pool heater industry from cost to engineer and produce. (AquaCal, No. 11 at p. 1)

After the April 2022 NOPR was published, DOE interviewed several manufacturers to discuss specific conversion costs their companies would likely incur at each efficiency level. BWC stated that the DOE significantly underestimated the burden that manufacturers would face to redesign products. They claimed that redesigning gas-fired consumer pool heaters to meet the EL 2 levels would require more time and resources than the 18 months of engineering time per model that DOE estimated in the April 2022 NOPR analysis. As this would require modifications to input rates and heat exchanger designs, and product testing, all of which would require more than 18 months of engineering time. BWC also stated that manufacturers would need to conduct a variety of testing including combustion, emissions, and certification testing in addition to redesigning non-compliant models. (BWC, No. 12 at pp. 2–3)

DOE updated the conversion cost estimates for this final rule analysis based on these comments and the confidential manufacturer interviews conducted after the publication of the April 2022 NOPR.

Product conversion costs are calculated on a per model basis and are primarily driven by engineering R&D costs and testing costs. R&D costs include engineering time necessary to redesign non-compliant consumer pool heater models. DOE assumed that manufacturers would discontinue all their electric resistance consumer pool heater models for any standard level above baseline for electric consumer pool heaters, because electric resistance consumer pool heaters use different technologies and designs than heat pump consumer pool heaters. Consequently, no redesign costs are assigned to the redesign of electric resistance consumer pool heater models.

For heat pump consumer pool heaters, all design options include growing the size of the evaporator. DOE assumed that the per model redesign effort, for electric heat pump consumer pool heaters, is the same to redesign a product to meet EL 2 and EL 3 but would require more engineering design time to redesign a product to meet EL 4 and EL 5. However, the number of models that would be required to be redesigned would vary for each EL required by the analyzed standard. In the April 2022 NOPR analysis, DOE estimated six months of engineering time per model for electric heat pump consumer pool heaters to meet all analyzed ELs. 87 FR 22640, 22684–22685. However, based on confidential interviews with manufacturers conducted after the publication of the April 2022 NOPR, manufacturers stated that there would be a higher per model redesign effort to meet standards at EL 4 and EL 5, compared to meeting standards at EL 2 or EL 3. Manufacturers stated that more complicated engineering designs would be required to be used at EL 4 and EL 5 as well as tighter manufacturing tolerances that would require more engineering time. Therefore, DOE increased the engineering effort for electric heat pump consumer pool heaters to meet EL 4 and EL 5. For this final rule, DOE estimated a redesign effort of six months of engineering time per model for electric heat pump consumer pool heaters to meet EL 2 and EL 3 (the same estimate used in the April 2022 NOPR), and 12 months of engineering time per model to meet EL 4 and EL 5 (based on feedback provided during confidential manufacturer interviews).

For gas-fired consumer pool heaters, DOE estimated that the redesign effort varies for each efficiency level. The design option analyzed at EL 1 replaces the standing pilot with an electronic ignition system. This entails a component swap and requires the addition of a sparker. DOE estimates a total of two months of engineering time per model to redesign a model with a standing pilot to an electronic ignition. The design option analyzed at EL 2 incorporates a blower. Product conversion costs involve the selection, qualification, and safety testing of the blower. In the April 2022 NOPR analysis DOE estimated 18 months of engineering time per model to meet EL 2, and 24 months of engineering time per model to meet EL 3 for gas-fired consumer pool heaters. 87 FR 22640, 22685. However, based on confidential interviews with manufacturer conducted after the publication of the April 2022 NOPR, DOE increased the engineering effort for gas-fired consumer pool heaters to meet EL 2 and EL 3. Manufacturers stated that at EL 2 there would be a much smaller margin between the standards required at EL 2 and efficiencies at which gas-fired pool heater will condense. Therefore, there will be a significant engineering effort to ensure both product reliability and compliance at EL 2. Therefore, in this Final Rule analysis, DOE estimated a redesign effort of 24 months of engineering time to redesign a gas-fired consumer pool heater model to meet EL 2 (per model). The design option analyzed at max-tech level incorporates condensing technology, which requires a significant amount of redesign to fine tune the gas-fired consumer pool heater such that it can accommodate condensate. Manufacturers stated that they will have to change the material for most of their heat exchangers, which would require substantially more resources than estimated in the April 2022 NOPR analysis. Therefore, in this Final Rule analysis, DOE estimated a redesign effort of 48 months of engineering time to redesign a gas-fired consumer pool heater model to meet EL 3 (per model). Based on this additional, and more recent, information provided during manufacturers interviews DOE increased the estimated per model conversion costs for gas-fired consumer pool heaters at EL 2 and EL 3.

In addition to these redesign costs, DOE estimated a variety of testing costs including certification testing, verification testing, and combustion and emissions testing (for gas-fired consumer pool heaters). DOE estimated that gas-fired consumer pool heaters would require approximately 100 hours of testing to meet EL 1; 1,200 hours of testing to meet EL 2; and 3,500 hours of testing to meet EL 3 for each model that would need to be redesigned due to energy conservation standards. These testing costs include engineers, lab technicians, and all other employees involved in the testing process. For electric heat pump consumer pool heaters DOE estimated testing costs would be approximately $6,500 per model for all efficiency levels analyzed that would need to be redesigned due to energy conservation standards.

Capital conversion costs are estimated on a per manufacturer basis. DOE developed a list of manufacturers of gas-fired, heat pump, and electric resistance consumer pool heaters using manufacturer's websites and public databases such as AHRI,[143] DOE's publicly available CCD,[144] and CEC's MAEDbS.[145] For gas-fired consumer pool heaters, capital conversion costs would not be required at EL 1, since manufacturers would likely meet this EL by switching the ignition system from a standing pilot to electronic ignition. This is a component swap and likely would not require any capital investments. At EL 2, DOE estimated each manufacturer making gas-fired consumer pool heaters would be required to invest approximately $1 million per manufacturer to incorporate the blower that would likely be needed to meet this EL. At EL 3, manufacturers would likely be required to use condensing technology to meet this EL. This would require larger investments from manufacturers to necessitate major changes to tooling to make condensing heat exchangers as well as changes to injection molding machinery to accommodate larger cabinet sizes. At EL 2, DOE estimated each manufacturer making gas-fired consumer pool heaters would be required to invest approximately $4 million per manufacturer to incorporate condensing technology for all gas-fired consumer pool heater models manufactured. This $4 million investment per manufacturer would be in addition to the $1 million required to achieve EL 2.

For electric heat pump consumer pool heaters, DOE estimated that a manufacturer that makes their own heat exchangers would be required to make approximately $2.5 million in capital investments (per manufacturer) to meet EL 3 and above. For a manufacturer that does not make their own heat exchangers, would be required to make approximately $130,000 in tooling costs to be able to incorporate a larger heat exchanger into their products.

Lastly, for this final rule analysis DOE updated the model database of consumer pool heaters from the database that was used in the NOPR analysis, to reflect all consumer pool heater models that are currently available on the market. DOE used the most recent data available from DOE's CCD, CEC's MAEDbS, and AHRI's certification database for this final rule analysis. DOE identified a total of 79 unique basic models for gas-fired consumer pool heaters, 190 unique basic models for electric heat pump consumer pool heaters, and 20 unique basic models for electric resistance consumer pool heaters. These unique basic model counts, along with their estimated ELs, were used when estimating the total industry product and capital conversion costs used in this final rule analysis.

DOE assumed all conversion costs will occur between the year of publication of the final rule and the year by which manufacturers must comply with new and amended energy conservation standards. Additionally, for the final rule analysis DOE updated the conversion cost estimates from 2020 dollars into 2021 dollars.

The conversion cost estimates used in the GRIM can be found in Table IV.17 and in section IV.J.2.c of this document. For additional information on the estimated capital and product conversion costs, see chapter 12 of the final rule TSD.

[143] See *www.ahridirectory.org* (Last accessed on October 10, 2022).

[144] See *www.regulations.doe.gov/certification-data* (Last accessed on October 10, 2022).

[145] See *cacertappliances.energy.ca.gov/Pages/Search/AdvancedSearch.aspx* (Last accessed on October 10, 2022).

TABLE IV.17—INDUSTRY PRODUCT AND CAPITAL CONVERSION COSTS PER EFFICIENCY LEVEL

	Units	Product class	Efficiency level				
			EL 1	EL 2	EL 3	EL 4	EL 5
Product Conversion Costs	*2021$ millions*	Gas-Fired	$0.1	$14.1	$63.1		
		Electric	1.2	2.6	9.0	$19.9	$24.8
Capital Conversion Costs	*2021$ millions*	Gas-Fired	0.0	5.0	29.0		
		Electric	0.0	0.8	9.5	9.5	9.5

d. Stranded Assets

In addition to capital and product conversion costs, new and amended energy conservation standards could create stranded assets (*i.e.,* tooling and equipment that would have been used for a longer time if the energy conservation standard had not made them obsolete). In the compliance year, manufacturers write down the remaining undepreciated book value of existing tooling and equipment rendered obsolete by new and amended energy conservation standards.

DOE assumed that manufacturers discontinue all electric resistance consumer pool heaters for any electric consumer pool heater standard established above baseline. Manufacturers of electric resistance consumer pool heaters typically purchase components from vendors and assemble them in-house. These manufacturers do not own capital equipment or machinery and therefore stranded assets are limited for electric resistance consumer pool heater manufacturers.

In response to the NOPR, AHRI and PHTA stated they have no information at this time to suggest that the estimates provided for stranded assets are inaccurate. (AHRI and PHTA, No. 20 at p. 9) Rheem stated that it was willing to discuss DOE's stranded asset analysis with DOE's consultant during a confidential meeting. (Rheem, No. 19 at p. 9)

For the final rule analysis DOE converted the April 2022 NOPR stranded asset estimates from 2020$ into 2021$. DOE did not make any other updates to these stranded asset estimates.

e. 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 non-production cost 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.

In the April 2022 NOPR analysis DOE used a manufacturer markup of 1.33 for gas-fired consumer pool heaters and a manufacturer markup of 1.28 for electric consumer pool heaters. 87 FR 22640, 22686. AHRI and PHTA encouraged DOE to conduct additional manufacturer interviews to ensure it captures products and conditions that best represent the current state of markups. (AHRI and PHTA, No. 20 at p. 6) As stated previously, DOE conducted interviews with manufacturers after the publication of the April 2022 NOPR. During these manufacturer interviews, several manufacturers stated the estimated manufacturer markups for each product class of consumer pool heaters used in the April 2022 NOPR analysis were lower than their manufacturer markups for those products. To address this, DOE revisited all publicly traded consumer pool heater manufacturer's financial statements for the past 5 years. For this time frame, all publicly traded consumer pool heater manufacturers had a corporate-level manufacturer markups greater than 1.33 (the highest manufacturer markup used in the April 2022 NOPR analysis) and during manufacturer interviews conducted after the publication of the April 2022 NOPR, all manufacturers stated that the manufacturer markups used in the April 2022 NOPR analysis should be increased. DOE recognizes that corporate-level manufacturer markups can significantly vary by products (for manufacturers that manufacture multiple products). However, DOE revised the manufacturer markups for this final rule analysis, based on the public corporate-level data and the confidential product-specific data provided by manufacturers during manufacturer interviews. DOE increased the gas-fired consumer pool heater manufacturer markup from 1.33 used in the April 2022 NOPR analysis to 1.44 and increased the electric consumer pool heater manufacturer markup from 1.28 used in the April 2022 NOPR analysis to 1.39 for this final rule analysis.

For the MIA, DOE modeled two standards-case markup scenarios to represent uncertainty regarding the potential impacts on prices and profitability for manufacturers following the implementation of new and amended energy conservation standards: (1) a preservation of gross margin scenario; and (2) a preservation of operating profit scenario. These scenarios lead to different manufacturer margins that, when applied to the MPCs, result in varying revenue and cash flow impacts.

Under the preservation of gross margin scenario, DOE applied a single uniform "gross margin" across all efficiency levels, which assumes that manufacturers would be able to maintain the same amount of profit as a percentage of revenues at all efficiency levels within a product class. As MPCs increase with efficiency, this scenario implies that the absolute dollar markup will increase as well. Therefore, DOE assumes that this scenario represents the upper bound to industry profitability under energy conservation standards.

Under the preservation of operating profit scenario, DOE modeled a situation in which manufacturers are not able to increase per-unit operating profit in proportion to increases in MPCs. Under this scenario, as the MPCs increase, manufacturers are generally required to reduce the manufacturer markup to maintain a cost competitive offering in the market. Therefore, gross margin (as a percentage) shrinks in the standards cases. This manufacturer markup scenario represents the lower bound to industry profitability under new and amended energy conservation standards.

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

3. Manufacturer Interviews

DOE conducted interviews with manufacturers following the October 2015 NODA, which was used to conduct parts of the April 2022 NOPR analysis. Additionally, DOE conducted interviews with manufacturers following the publication of the April 2022 NOPR. Both of these rounds of manufacturer interviews informed the final rule analysis. In these interviews, DOE asked manufacturers to describe their major concerns with new and amended consumer pool heater energy conservation standards. During manufacturers interviews conducted prior to the publication of the April 2022 NOPR, manufacturers identified three major areas of concern: (1) use of integrated thermal efficiency metric for electric consumer pool heaters; (2) cost and complexity of installing condensing gas-fired consumer pool heaters; and (3) impact on profitability. These concerns were discussed in the April 2022 NOPR (*see* 87 FR 22640, 22686).

Additionally, manufacturers identified two areas of concern regarding the April 2022 NOPR analysis during manufacturer interviews conducted after the publication of the April 2022 NOPR: (1) analyzed MPCs, MSPs, and manufacturer markups being low and needing to reflect the latest economic status; and (2) conversion costs estimated in the April 2022 NOPR analysis being too low.

Manufacturer interviews are conducted under non-disclosure agreements (''NDAs''), so DOE does not document these discussions in the same way that it does public comments in the comment summaries and DOE's responses throughout the rest of this document.

a. Manufacturer Product Costs, Manufacturer Selling Prices, and Manufacturer Markups

Manufacturers stated that there have been increases in costs of shipping, materials, and labor due to disruptions in the global supply chains, inflation, and other factors related to COVID–19 since the analysis was conducted for the April 2022 NOPR. Manufacturers urged DOE to update specific costs to be more reflective of the current market conditions. Additionally, manufacturers stated that the manufacturer markups used in the April 2022 NOPR were smaller than the manufacturer markups in the current consumer pool heater market. As discussed in section IV.C.2 of this document, DOE increased the MPCs used in this final rule analysis to better reflect the current market conditions consumer pool heater manufacturers are facing. Additionally, as discussed in section IV.J.2.e of this document, DOE increased the manufacturer markups used in this final rule analysis to better represent the current consumer pool heater market.

b. Conversion Costs

Manufacturers stated that DOE underestimated the conversion costs that manufacturers would incur for both gas-fired and electric consumer pool heater manufacturers that were estimated in the April 2022 NOPR. Manufacturers claimed that, in addition to underestimating the redesign costs, DOE also did not accurately account for the additional combustion, emissions, and other safety testing that manufacturers would have to conduct if they had to redesign a gas-fired consumer pool heater model. As discussed in section IV.J.2.c of this document, DOE increased the estimated conversion costs used in this final rule analysis and included additional testing costs associated with redesigning gas-fired consumer pool heater models.

K. Emissions Analysis

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

The analysis of electric power sector emissions of CO_2, NO_X, SO_2, and Hg uses emissions intended to represent the marginal impacts of the change in electricity consumption associated with amended or new standards. The methodology is based on results published for the *AEO,* including a set of side cases that implement a variety of efficiency-related policies. The methodology is described in appendix 13A in the final rule TSD. The analysis presented in this rulemaking uses projections from *AEO2022*. 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).[146]

The on-site operation of consumer pool heaters involves combustion of fossil fuels and results in emissions of CO_2, NO_X, SO_2, CH_4, and N_2O where these products are used. Site emissions of these gases were estimated using Emission Factors for Greenhouse Gas Inventories and, for NO_X and SO_2, emissions intensity factors from an EPA publication.[147]

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

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

AHRI and PHTA noted that the proposed EL for electric pool heaters requires the use of heat pump technology. Therefore, DOE should consider refrigerant leaks in its emissions analysis. (AHRI and PHTA, No. 20 at pp. 910)

In response, given that the vast majority of the electric pool heater market is already at efficiency levels using heat pumps, any analysis including refrigerant leaks would not alter the economic justification for the rule. DOE also notes that refrigerant leaks are not captured within the scope of DOE's emissions analysis, which focuses on power plant emissions and emissions from site combustion.

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. *AEO2022* generally represents current legislation and environmental regulations, including recent government actions, that were in place at the time of preparation of *AEO2022,* including the emissions control programs discussed in the following paragraphs.[148]

SO_2 emissions from affected electric generating units (''EGUs'') are subject to

[146] Available at *www.epa.gov/sites/production/files/2021-04/documents/emission-factors_apr2021.pdf* (last accessed October 15, 2022).

[147] 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 October 15, 2022).

[148] For further information, *see* the Assumptions to *AEO2022* 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 October 15, 2022).

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.[149] *AEO2022* incorporates implementation of CSAPR, including the update to the CSAPR ozone season program emission budgets and target dates issued in 2016. 81 FR 74504 (Oct. 26, 2016). Compliance with CSAPR is flexible among EGUs and is enforced through the use of tradable emissions allowances. Under existing EPA regulations, for states subject to SO_2 emissions limits under CSAPR, any excess SO_2 emissions allowances resulting from the lower electricity demand caused by the adoption of an efficiency standard could be used to permit offsetting increases in SO_2 emissions by another regulated EGU.

However, beginning in 2016, SO_2 emissions began to fall as a result of the Mercury and Air Toxics Standards (''MATS'') for power plants. 77 FR 9304 (Feb. 16, 2012). The 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 *AEO2022.*

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 *AEO2022* 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 *AEO2022,* which incorporates the MATS.

L. Monetizing Emissions Impacts

As part of the development of this final rule, for the purpose of complying with the requirements of Executive Order 12866, DOE considered the estimated monetary benefits from the reduced emissions of CO_2, CH_4, N_2O, NO_X, and SO_2 that are expected to result from each of the TSLs considered. In order to make this calculation analogous to the calculation of the NPV of consumer benefit, DOE considered the reduced emissions expected to result over the lifetime of products shipped 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 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 Interagency Working Group on the Social Cost of Greenhouse Gases (IWG). On social cost of emissions, Environmental Advocates suggested that DOE strengthen its economic and policy justifications, such as by explicitly concluding that the theory and evidence for international reciprocity justify a focus on the full global values and consider including a discussion of domestic-only estimates. Environmental Advocates stated that DOE should consider conducting sensitivity analysis using a sounder domestic-only estimate as a backstop and should explicitly conclude that the rule is cost-benefit justified even using a domestic-only valuation that may still undercount climate benefits—and that the rule is easily cost-benefit justified even without counting any climate benefits. Environmental Advocates stated that DOE should continue to use of the interim SC–GHG values in its rulemakings as conservative estimates. (Environmental Advocates, No. 14 at p. 2)

1. Monetization of Greenhouse Gas Emissions

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

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

DOE estimated the global social benefits of CO_2, CH_4, and N_2O reductions (*i.e.,* SC–GHGs) using the estimates presented in the Technical Support Document: Social Cost of

[149] 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).

Carbon, Methane, and Nitrous Oxide Interim Estimates under Executive Order 13990, published in February 2021 by the IWG. The SC–GHGs 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, SC–GHGs 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–GHGs therefore, reflects the societal value of reducing emissions of the gas in question by one metric ton. The SC–GHGs is the theoretically appropriate value to use in conducting benefit-cost analyses of policies that affect CO_2, N_2O and CH4 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 until revised estimates have been developed reflecting the latest, peer-reviewed science.

The SC–GHGs estimates presented here were developed over many years, using transparent process, peer-reviewed methodologies, the best science available at the time of that process, and with input from the public. Specifically, in 2009, the IWG, that included the DOE and other executive branch agencies and offices was established to ensure that agencies were using the best available science and to promote consistency in the social cost of carbon (SC–CO_2) values used across agencies. The IWG published SC–CO_2 estimates in 2010 that were developed from an ensemble of three widely cited integrated assessment models (IAMs) that estimate global climate damages using highly aggregated representations of climate processes and the global economy combined into a single modeling framework. The three IAMs were run using a common set of input assumptions in each model for future population, economic, and CO_2 emissions growth, as well as equilibrium climate sensitivity—a measure of the globally averaged temperature response to increased atmospheric CO_2 concentrations. These estimates were updated in 2013 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.*[150] and underwent a standard double-blind peer review process prior to journal publication.

In 2015, as part of the response to public comments received to a 2013 solicitation for comments on the SC–CO_2 estimates, the IWG announced a National Academies of Sciences, Engineering, and Medicine review of the SC–CO_2 estimates to offer advice on how to approach future updates to ensure that the estimates continue to reflect the best available science and methodologies. In January 2017, the National Academies released their final report, Valuing Climate Damages: Updating Estimation of the Social Cost of Carbon Dioxide, and recommended specific criteria for future updates to the SC–CO_2 estimates, a modeling framework to satisfy the specified criteria, and both near-term updates and longer-term research needs pertaining to various components of the estimation process (National Academies, 2017).[151] Shortly thereafter, in March 2017, President Trump issued Executive Order 13783, which disbanded the IWG, withdrew the previous TSDs, and directed agencies to ensure SC–CO_2 estimates used in regulatory analyses are consistent with the guidance contained in OMB's Circular A–4, ''including with respect to the consideration of domestic versus international impacts and the consideration of 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 the E.O. that reflect the full impact of GHG emissions, including by taking global damages into account. The interim SC–GHG estimates published in February 2021 are used here to estimate the climate benefits for this proposed rulemaking. The E.O. instructs the IWG to update the interim SC–GHG estimates by January 2022, taking into consideration the advice of the National Academies of Science, Engineering, and Medicine as reported in Valuing Climate Damages: Updating Estimation of the Social Cost of Carbon Dioxide (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 U.S. GHG mitigation activities requires consideration of how those actions may affect mitigation activities by other countries, as those international mitigation actions will provide a benefit to U.S. citizens and residents by mitigating climate impacts that affect U.S. citizens and residents. A wide range of scientific and economic experts have emphasized the issue of reciprocity as support for considering global damages of GHG emissions. If the United States does not consider impacts on other countries, it is difficult to convince other countries to consider the impacts of their emissions on the United States. The only way to achieve an

[150] 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.

[151] 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.

efficient allocation of resources for emissions reduction on a global basis—and so benefit the U.S. and its citizens—is for all countries to base their policies on global estimates of damages. As a member of the IWG involved in the development of the February 2021 SC–GHG TSD, DOE agrees with this assessment and, therefore, in this proposed rule DOE centers attention on a global measure of SC–GHG. This approach is the same as that taken in DOE regulatory analyses from 2012 through 2016. A robust estimate of climate damages that accrue only to U.S. citizens and residents does not currently exist in the literature. As explained in the February 2021 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,[152] 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 developments in the literature pertaining to this issue. DOE also notes that while OMB Circular A–4, as published in 2003, recommends using 3% and 7% discount rates as ''default'' values, Circular A–4 also reminds agencies that ''different regulations may call for different emphases in the analysis, depending on the nature and complexity of the regulatory issues and the sensitivity of the benefit and cost estimates to the key assumptions.'' On discounting, Circular A–4 recognizes that ''special ethical considerations arise when comparing benefits and costs across generations,'' and Circular A–4 acknowledges that analyses may appropriately ''discount future costs and consumption benefits . . . at a lower rate than for intragenerational analysis.'' In the 2015 Response to Comments on the Social Cost of Carbon for Regulatory Impact Analysis, OMB, DOE, and the other IWG members recognized that ''Circular A–4 is a living document'' and ''the use of 7 percent is not considered appropriate for intergenerational discounting. There is wide support for this view in the academic literature, and it is recognized in Circular A–4 itself.'' Thus, DOE concludes that a 7% discount rate is not appropriate to apply to value the social cost of greenhouse gases in the analysis presented in this analysis.

To calculate the present and annualized values of climate benefits, DOE uses the same discount rate as the rate used to discount the value of damages from future GHG emissions, for internal consistency. That approach to discounting follows the same approach that the February 2021 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.''

Environmental Advocates suggested that DOE consider including additional justification for adopting the range of discount rates endorsed by the Working Group and appropriately deciding not to apply a 7% capital-based discount rate to climate impacts. Environmental Advocates stated that DOE should provide additional justification for combining climate effects discounted at an appropriate consumption-based rate with other costs and benefits discounted at a capital-based rate. Environmental Advocates stated that DOE should also argue that it is appropriate generally to focus its analysis of this rule on consumption-based rates given that most costs and benefits are projected to fall to consumption rather than to capital investments. Environmental Advocates suggested that DOE consider providing additional sensitivity analysis using discount rates of 2% or lower for climate impacts. (Environmental Advocates, No. 14 at p. 2)

DOE notes that it presents its results using four different discount rates for the SC–GHG, combined with consumer impacts at both 3 and 7 percent, in section V.B.8. For presentational purposes, DOE uses the climate benefits associated with the average SC–GHG at a 3-percent discount rate when summarizing national impacts. 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 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

[152] Interagency Working Group on Social Cost of Carbon. Social Cost of Carbon for Regulatory Impact Analysis under Executive Order 12866. 2010. United States Government. Available at *www.epa.gov/sites/default/files/2016-12/documents/scc_tsd_2010.pdf* (last accessed October 15, 2022); Interagency Working Group on Social Cost of Carbon. Technical Update of the Social Cost of Carbon for Regulatory Impact Analysis Under Executive Order 12866. 2013. Available at *www.federalregister.gov/documents/2013/11/26/2013-28242/technical-support-document-technical-update-of-the-social-cost-of-carbon-for-regulatory-impact* (last accessed October 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 October 15, 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 October 15, 2022).

inputs and are calculated using a range of discount rates. As explained in the February 2021 SC–GHG TSD, the IWG has recommended that agencies revert to the same set of four values drawn from the SC–GHG distributions based on three discount rates as were used in regulatory analyses between 2010 and 2016 and were subject to public comment. For each discount rate, the IWG combined the distributions across models and socioeconomic emissions scenarios (applying equal weight to each) and then selected a set of four values recommended for use in benefit-cost analyses: an average value resulting from the model runs for each of three discount rates (2.5 percent, 3 percent, and 5 percent), plus a fourth value, selected as the 95th percentile of estimates based on a 3 percent discount rate. The fourth value was included to provide information on potentially higher-than-expected economic impacts from climate change. As explained in the February 2021 SC–GHG TSD, and DOE agrees, this update reflects the immediate need to have an operational SC–GHG for use in regulatory benefit-cost analyses and other applications that was developed using a transparent process, peer-reviewed methodologies, and the science available at the time of that process. Those estimates were subject to public comment in the context of dozens of proposed rulemakings as well as in a dedicated public comment period in 2013.

There are a number of limitations and uncertainties associated with the SC–GHG estimates. First, the current scientific and economic understanding of discounting approaches suggests discount rates appropriate for intergenerational analysis in the context of climate change are likely to be less than 3 percent, near 2 percent or lower.[153] 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 inter-regional and intersectoral linkages are modeled, uncertainty in the extrapolation of damages to high temperatures, and inadequate representation of the relationship between the discount rate and uncertainty in economic growth over long time horizons. Likewise, the socioeconomic and emissions scenarios used as inputs to the models do not reflect new information from the last decade of scenario generation or the full range of projections. The modeling limitations do not all work in the same direction in terms of their influence on the SC–CO_2 estimates. However, as discussed in the February 2021 TSD, the IWG has recommended that, taken together, the limitations suggest that the interim SC–GHG estimates used in this 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 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 final rule were based on the values developed for the IWG's February 2021 TSD. Table IV.18 shows the updated sets of SC–CO_2 estimates from the IWG's TSD in 5-year increments from 2020 to 2050. The full set of annual values that DOE used is presented in appendix 14–A of the final rule TSD. 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.[154]

TABLE IV.18—ANNUAL SC–CO_2 VALUES FROM 2021 INTERAGENCY UPDATE, 2020–2050

[2020$ per metric ton CO_2]

Year	Discount rate and statistic			
	5% Average	3% Average	2.5% Average	3% 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

For 2051 to 2070, DOE used SC–CO_2 estimates published by EPA, adjusted to 2020$.[155] These estimates are based on methods, assumptions, and parameters identical to the 2020–2050 estimates published by the IWG. DOE expects additional climate benefits to accrue for any longer-life consumer pool heaters after 2070, but a lack of available SC–CO_2 estimates for emissions years beyond 2070 prevents DOE from monetizing these potential benefits in this analysis.

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 2021$ using the implicit price deflator for gross domestic product (''GDP'') from the Bureau of Economic

[153] Interagency Working Group on Social Cost of Greenhouse Gases (IWG). 2021. Technical Support Document: Social Cost of Carbon, Methane, and Nitrous Oxide Interim Estimates under Executive Order 13990. February. United States Government. Available at: *www.whitehouse.gov/briefing-room/blog/2021/02/26/a-return-to-science-evidence-based-estimates-of-the-benefits-of-reducing-climate-pollution/* (last accessed October 15, 2022).

[154] 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.

[155] *See* EPA, Revised 2023 and Later Model Year Light-Duty Vehicle GHG Emissions Standards: Regulatory Impact Analysis, Washington, DC, December 2021. Available at *www.epa.gov/system/files/documents/2021-12/420r21028.pdf* (last accessed October 15, 2022).

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 final rule were based on the values developed for the February 2021 TSD. Table IV.19 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 14–A of the 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.19—ANNUAL SC–CH_4 AND SC–N_2O VALUES FROM 2021 INTERAGENCY UPDATE, 2020–2050

[2020$ per metric ton]

Year	SC–CH_4 discount rate and statistic				SC–N_2O discount rate and statistic			
	5% Average	3% Average	2.5% Average	3% 95th percentile	5% Average	3% Average	2.5% Average	3% 95th percentile
2020	670	1,500	2,000	3,900	5,800	18,000	27,000	48,000
2025	800	1,700	2,200	4,500	6,800	21,000	30,000	54,000
2030	940	2,000	2,500	5,200	7,800	23,000	33,000	60,000
2035	1,100	2,200	2,800	6,000	9,000	25,000	36,000	67,000
2040	1,300	2,500	3,100	6,700	10,000	28,000	39,000	74,000
2045	1,500	2,800	3,500	7,500	12,000	30,000	42,000	81,000
2050	1,700	3,100	3,800	8,200	13,000	33,000	45,000	88,000

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 2021$ 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.

2. Monetization of Other Emissions Impacts

For the final rule, DOE estimated the monetized value of NO_X and SO_2 emissions reductions from electricity generation using benefit per ton estimates for that sector from the EPA's Benefits Mapping and Analysis Program.[156] 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 range; for years beyond 2040 the values are held constant. DOE derived values specific to the sector for consumer pool heaters using a method described in appendix 14B of the final rule TSD.

DOE also estimated the monetized value of NO_X and SO_2 emissions reductions from site use of natural gas in PRODUCT 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.[157] The EPA document provides high and low estimates for 2025 and 2030 at 3- and 7-percent discount rates.[158] DOE used the same linear interpolation and extrapolation as it did with the values for electricity generation.

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

M. Utility Impact Analysis

The utility impact analysis estimates the changes in installed electrical capacity and generation projected to result for each considered TSL. The analysis is based on published output from the NEMS associated with *AEO2022*. 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 *AEO2022* Reference case and various side cases. Details of the methodology are provided in the appendices to chapters 13 and 15 of the final rule TSD.

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

[156] Estimating the Benefit per Ton of Reducing $PM_{2.5}$ Precursors from 21 Sectors. *www.epa.gov/benmap/estimating-benefit-ton-reducing-pm25-precursors-21-sectors*.

[157] ''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.

[158] ''Area sources'' are a category in the 2018 document from EPA, but are not used in the 2021 document cited previously. See: *www.epa.gov/sites/default/files/2018-02/documents/sourceapportionmentbpttsd_2018.pdf* (last accessed October 15, 2022).

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 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.[159] 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 final rule using an input/output model of the U.S. economy called Impact of Sector Energy Technologies version 4 (''ImSET'').[160] 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 over-estimate actual job impacts over the long run for this rule. Therefore, DOE used ImSET only to generate results for near-term timeframes (2028–2033), where these uncertainties are reduced. For more details on the employment impact analysis, see chapter 16 of the final rule TSD.

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 pool heaters. It addresses the TSLs examined by DOE, the projected impacts of each of these levels if adopted as energy conservation standards for consumer pool heaters, and the standards levels that DOE is adopting in this final rule. Additional details regarding DOE's analyses are contained in the final rule TSD supporting this document.

A. Trial Standard Levels

In general, DOE typically evaluates potential 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 final rule, DOE analyzed the benefits and burdens of six TSLs for consumer pool heaters. DOE developed TSLs that combine efficiency levels for each analyzed product class. DOE presents the results for the TSLs in this document, while the results for all efficiency levels that DOE analyzed are in the 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 pool heaters.

TSL 6 represents the maximum technologically feasible (''max-tech'') energy efficiency for all product classes. TSL 5 represents efficiency levels below max-tech for both electric and gas-fired pool heaters and represents the maximum energy savings excluding max-tech efficiency levels. A much greater fraction of gas-fired pool heater consumers experience a net cost compared to electric pool heater consumers at TSL 5. Therefore, TSL 4 is constructed with the same efficiency level for electric pool heaters (*i.e.,* EL 4) but reduces the efficiency level for gas-fired pool heaters (*i.e.,* EL 1). Finally, because EL 1 is the lowest analyzed efficiency level above baseline, TSLs 3, 2, and 1 are also constructed with EL 1 for gas-fired pool heaters as opposed to analyzing a no-new-standards case for this product class. TSLs 3, 2, and 1 consist of the remaining efficiency levels for electric pool heaters.

TABLE V.1—TRIAL STANDARD LEVELS FOR CONSUMER POOL HEATERS

Product class	Trial standard level					
	1	2	3	4	5	6
	Efficiency Level and Representative TE_I					
Electric Pool Heaters	1 (387%)	2 (483%)	3 (534%)	4 (551%)	4 (551%)	5 (595%)

[159] *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.bea.gov/scb/pdf/regional/perinc/meth/rims2.pdf* (last accessed October 15, 2022).

[160] 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.

TABLE V.1—TRIAL STANDARD LEVELS FOR CONSUMER POOL HEATERS—Continued

Product class	Trial standard level					
	1	2	3	4	5	6
	Efficiency Level and Representative TE_I					
Gas-fired Pool Heaters	1 (81.3%)	1 (81.3%)	1 (81.3%)	1 (81.3%)	2 (83.3%)	3 (94.8%)

B. Economic Justification and Energy Savings

1. Economic Impacts on Individual Consumers

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

a. Life-Cycle Cost and Payback Period

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

Table V.2 through Table V.5 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 POOL HEATERS

TSL	Representative TE_i (%)	Average costs (2021$)				Simple payback (years)	Average lifetime (years)
		Installed cost	First year's operating cost	Lifetime operating cost	LCC		
1	342	4,117	556	4,771	8,888	0.3	11.2
2	483	4,226	460	3,968	8,193	0.4	11.2
3	534	4,326	420	3,637	7,963	0.4	11.2
4,5	551	4,472	406	3,521	7,993	0.5	11.2
6	595 (Max Tech)	4,666	392	3,404	8,070	0.6	11.2

Note: The results for each TSL are calculated assuming that all consumers use products at that efficiency level.

TABLE V.3—AVERAGE LCC SAVINGS RELATIVE TO THE NO-NEW-STANDARDS CASE FOR ELECTRIC POOL HEATERS

TSL	Representative TE_i (%)	Life-cycle cost savings	
		Average LCC savings* (2021$)	Percent of consumers that experience net cost (%)
1	342	8,090	1.1
2	483	4,403	2.3
3	534	1,302	22.4
4,5	551	1,130	45.3
6	595 (Max Tech)	946	62.9

* The savings represent the average LCC for affected consumers.

TABLE V.4—AVERAGE LCC AND PBP RESULTS FOR GAS-FIRED POOL HEATERS

TSL	Representative TE_i (%)	Average costs (2021$)				Simple payback (years)	Average lifetime (years)
		Installed cost	First year's operating cost	Lifetime operating cost	LCC		
1,2,3,4	81.3	3,479	1,819	15,462	18,940	0.2	11.2
5	83.3	3,723	1,785	15,182	18,906	2.3	11.2

TABLE V.4—AVERAGE LCC AND PBP RESULTS FOR GAS-FIRED POOL HEATERS—Continued

TSL	Representative TE_i (%)	Average costs (2021$)				Simple payback (years)	Average lifetime (years)
		Installed cost	First year's operating cost	Lifetime operating cost	LCC		
6	94.7(Max Tech)	4,655	1,617	13,805	18,460	4.2	11.2

Note: The results for each TSL are calculated assuming that all consumers use products at that efficiency level.

TABLE V.5—AVERAGE LCC SAVINGS RELATIVE TO THE NO-NEW-STANDARDS CASE FOR GAS-FIRED POOL HEATERS

TSL	Representative TE_i (%)	Life-cycle cost savings	
		Average LCC savings * (2021$)	Percent of consumers that experience net cost (%)
1,2,3,4	81.3	783	0.2
5	83.3	80	39.1
6	94.7 (Max Tech)	497	72.6

* The savings represent the average LCC for affected consumers.

b. Consumer Subgroup Analysis

In the consumer subgroup analysis, DOE estimated the impact of the considered TSLs on senior-only households and small businesses. Table V.6 and Table V.7 compare the average LCC savings and PBP at each efficiency level for the consumer subgroups with similar metrics for the entire consumer sample for Electric Pool Heaters and Gas-fired Pool Heaters. In most cases, the average LCC savings and PBP for senior-only households and small business at the considered efficiency levels are not substantially different from the average for all households. Chapter 11 of the final rule TSD presents the complete LCC and PBP results for the subgroups.

TABLE V.6—COMPARISON OF LCC SAVINGS AND PBP FOR CONSUMER SUBGROUPS AND ALL HOUSEHOLDS; ELECTRIC POOL HEATERS

	Senior-only households	Small business	All households
Average LCC Savings (2021$)			
1	3,560	19,451	8,090
2	1,635	19,457	4,403
3	309	11,380	1,302
4,5	176	11,087	1,130
6	19	10,469	946
Payback Period (years)			
1	0.6	0.3	0.3
2	0.7	0.3	0.4
3	0.8	0.3	0.4
4,5	1.0	0.3	0.5
6	1.2	0.4	0.6
Consumers with Net Benefit (%)			
1	4%	41%	8%
2	9%	43%	17%
3	45%	78%	56%
4,5	31%	77%	42%
6	19%	72%	34%
Consumers with Net Cost (%)			
1	1%	6%	1%
2	3%	6%	2%
3	34%	10%	22%
4,5	57%	15%	45%
6	78%	27%	63%

TABLE V.7—COMPARISON OF LCC SAVINGS AND PBP FOR CONSUMER SUBGROUPS AND ALL HOUSEHOLDS; GAS-FIRED POOL HEATERS

	Senior-only households	Small business	All households
Average LCC Savings (2021$)			
1,2,3,4	752	151	783
5	(132)	821	80
6	(788)	5,572	497
Payback Period (years)			
1,2,3,4	0.1	0.6	0.2
5	2.7	2.1	2.3
6	9.7	1.3	4.2
Consumers with Net Benefit (%)			
1,2,3,4	5%	1%	4%
5	5%	34%	11%
6	3%	71%	19%
Consumers with Net Cost (%)			
1,2,3,4	0%	0%	0%
5	49%	13%	39%
6	89%	19%	73%

c. Rebuttable Presumption Payback

As discussed in section III.F.2 of this document, EPCA establishes a rebuttable presumption that an energy conservation standard is economically justified if the increased purchase cost for a product that meets the standard is less than three times the value of the first-year energy savings resulting from the standard. In calculating a rebuttable presumption payback period for each of the considered TSLs, DOE used discrete values, and, as required by EPCA, based the energy use calculation on the DOE test procedures for consumer pool heaters. 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.8 presents the rebuttable-presumption payback periods for the considered TSLs for consumer pool heaters. While DOE examined the rebuttable-presumption criterion, it considered whether the standard levels considered for this rule are economically justified through a more detailed analysis of the economic impacts of those levels, pursuant to 42 U.S.C. 6295(o)(2)(B)(i), that considers the full range of impacts to the consumer, manufacturer, Nation, and environment. The results of that analysis serve as the basis for DOE to definitively evaluate the economic justification for a potential standard level, thereby supporting or rebutting the results of any preliminary determination of economic justification.

TABLE V.8—REBUTTABLE-PRESUMPTION PAYBACK PERIODS

TSL	Electric pool heaters	Gas-fired pool heaters
1	1.36	0.12
2	1.59	0.12
3	1.83	0.12
4	2.22	0.12
5	2.22	2.24
6	2.72	7.57

2. Economic Impacts on Manufacturers

DOE performed an MIA to estimate the impact of new and amended energy conservation standards on manufacturers of consumer pool heaters. The next section describes the expected impacts on manufacturers at each considered TSL. Chapter 12 of the final rule TSD explains the analysis in further detail.

a. Industry Cash Flow Analysis Results

In this section, DOE provides GRIM results from the analysis, which examines changes in the industry that would result from new and amended energy conservation standards. The following tables summarize the estimated financial impacts (represented by changes in INPV) of potential new and amended energy conservation standards on manufacturers of consumer pool heaters, as well as the conversion costs that DOE estimates manufacturers of consumer pool heaters would incur at each TSL.

As discussed in section IV.J.2.e of this document, DOE modeled two manufacturer markup scenarios to evaluate a range of cash flow impacts on the consumer pool heater industry: (1) the preservation of gross margin scenario and (2) the preservation of operating profit scenario. DOE considered the preservation of gross margin scenario by applying a ''gross margin percentage'' for each product class across all efficiency levels. As MPCs increase with efficiency, this scenario implies that the absolute dollar markup will increase. DOE assumed a manufacturer markup of 1.44 for gas-fired consumer pool heaters and 1.39 for electric consumer pool heaters. This manufacturer markup is consistent with the one DOE assumed in the engineering analysis and the no-new-standards case of the GRIM. Because this scenario assumes that a manufacturer's absolute dollar markup would increase as MPCs increase in the standards cases, it represents the upper-bound to industry profitability under potential new and amended energy conservation standards.

The preservation of operating profit scenario reflects manufacturers' concerns about their inability to maintain margins as MPCs increase to reach more-stringent efficiency levels. In this scenario, while manufacturers make the necessary investments required to convert their facilities to produce compliant products, operating profit remains the same in absolute dollars, but decreases as a percentage of revenue.

Each of the modeled manufacturer markup scenarios results in a unique set of cash-flows and corresponding industry values at each TSL. In the following discussion, the INPV results refer to the difference in industry value between the no-new-standards case and each standards case resulting from the sum of discounted cash-flows from 2023 through 2057. To provide perspective on the short-run cash-flow impact, DOE includes in the discussion of results a comparison of free cash flow between the no-new-standards case and the standards case at each TSL in the year before new and amended standards are required.

Table V.9 and Table V.10 show the MIA results for both product classes at each TSL using the manufacturer markup scenarios previously described.

TABLE V.9—MANUFACTURER IMPACT ANALYSIS FOR CONSUMER POOL HEATERS UNDER THE PRESERVATION OF GROSS MARGIN SCENARIO

	Units	No-new-standards case	Trial standard level *					
			1	2	3	4	5	6
INPV	*2021$ millions*	585.7	585.2	584.5	577.0	575.0	587.7	631.6
Change in INPV	*2021$ millions*		(0.6)	(1.2)	(8.7)	(10.7)	2.0	45.9
	%		(0.1)	(0.2)	(1.5)	(1.8)	0.3	7.8
Product Conversion Costs	*2021$ millions*		1.3	2.6	9.1	20.0	34.0	88.0
Capital Conversion Costs	*2021$ millions*			0.8	9.5	9.5	14.5	38.5
Total Investment Required	*2021$ millions*		1.3	3.4	18.6	29.4	48.4	126.4

* Numbers in parentheses indicate a negative number. Numbers may not sum exactly due to rounding.

TABLE V.10—MANUFACTURER IMPACT ANALYSIS FOR CONSUMER POOL HEATERS UNDER THE PRESERVATION OF OPERATING PROFIT SCENARIO

	Units	No-new-standards case	Trial standard level *					
			1	2	3	4	5	6
INPV	*2021$ millions*	585.7	583.6	581.9	570.8	563.0	548.4	482.7
Change in INPV	*2021$ millions*		(2.2)	(3.9)	(15.0)	(22.8)	(37.3)	(103.0)
	%		(0.4)	(0.7)	(2.6)	(3.9)	(6.4)	(17.6)
Product Conversion Costs	*2021$ millions*		1.3	2.6	9.1	20.0	34.0	88.0
Capital Conversion Costs	*2021$ millions*			0.8	9.5	9.5	14.5	38.5
Total Investment Required	*2021$ millions*		1.3	3.4	18.6	29.4	48.4	126.4

* Numbers in parentheses indicate a negative number. Numbers may not sum exactly due to rounding.

At TSL 1, DOE estimates that impacts on INPV will range from −$2.2 million to −$0.6 million, or a change in INPV of −0.4 to −0.1 percent. At TSL 1, industry free cash-flow is $50.5 million, which is a decrease of approximately $0.5 million compared to the no-new-standards case value of $51.0 million in 2027, the year leading up to the adopted standards.

TSL 1 would set the energy conservation standard for both gas-fired consumer pool heaters and electric consumer pool heaters at EL 1. DOE estimates that 96 percent of gas-fired consumer pool heater shipments and 92 percent of electric consumer pool heater shipments already meet or exceed the efficiency levels analyzed at TSL 1. Gas-fired consumer pool heater manufacturers would likely need to redesign any models with a standing pilot light. DOE assumed this would require approximately two months of engineering time per model, which would cost manufacturers approximately $0.1 million. Electric heat pump consumer pool heater manufacturers would incur approximately $1.2 million in product conversion costs primarily to test all compliant electric consumer pool heater models to demonstrate compliance with standards at TSL 1. DOE estimates consumer pool heater manufacturers will incur minimal to no capital conversion costs at TSL 1.

Furthermore, no electric resistance pool heaters meet or exceed the electric consumer pool heater efficiency level analyzed at TSL 1 or above. DOE estimates manufacturers will not incur conversion costs for electric resistance pool heaters, because of the expectation that these consumer pool heater products will be discontinued, as described in section IV.J.2.c of this document.

At TSL 1, the shipment-weighted average MPC for all consumer pool heaters increases by 0.5 percent relative to the no-new-standards case shipment-weighted average MPC for all consumer pool heaters in 2028. In the preservation of gross margin scenario, manufacturers are able to fully pass on this slight cost increase to consumers. The slight increase in shipment-weighted average MPC for consumer pool heaters is slightly outweighed by the $1.3 million in conversion costs, causing a slightly negative change in INPV at TSL 1 under the preservation of gross margin 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 0.5 percent shipment-weighted average MPC increase results in a reduction in the manufacturer margin after the compliance year. This reduction in the manufacturer margin and the $1.3 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, DOE estimates that impacts on INPV will range from −$3.9 million to −$1.2 million, or a change in INPV of −0.7 percent to −0.2 percent. At TSL 2, industry free cash-flow is $49.7 million, which is a decrease of approximately $1.3 million compared to the no-new-standards case value of

$51.0 million in 2027, the year leading up to the adopted standards.

TSL 2 would set the energy conservation standard at EL 1 for gas-fired consumer pool heaters and at EL 2 for electric consumer pool heaters. DOE estimates that 96 percent of gas-fired consumer pool heater shipments and 81 percent of electric consumer pool heater shipments already meet or exceed the efficiency levels analyzed at TSL 2. Gas-fired consumer pool heater manufacturers would likely need to redesign any models with a standing pilot light. DOE assumed this would cost manufacturers approximately $0.1 million. To bring non-compliant electric heat pump consumer pool heaters into compliance and to test all electric heat pump consumer pool heaters to demonstrate compliance with standards at TSL 2, electric heat pump consumer pool heater manufacturers would incur approximately $2.6 million in product conversion costs and $0.8 million in capital conversion costs at TSL 2.

At TSL 2, the shipment-weighted average MPC for all consumer pool heaters increases by 0.8 percent relative to the no-new-standards case shipment-weighted average MPC for all consumer pool heaters in 2028. In the preservation of gross margin scenario, the slight increase in shipment-weighted average MPC for consumer pool heaters is slightly outweighed by the $3.4 million in conversion costs, causing a slightly negative change in INPV at TSL 2 under the preservation of gross margin scenario.

Under the preservation of operating profit scenario, the 0.8 percent shipment-weighted average MPC increase results in a reduction in the manufacturer margin after the compliance year. This reduction in the manufacturer margin and the $3.4 million in conversion costs incurred by manufacturers cause a slightly negative change in INPV at TSL 2 under the preservation of operating profit scenario.

At TSL 3, DOE estimates that impacts on INPV will range from −$15.0 million to −$8.7 million, or a change in INPV of −2.6 percent to −1.5 percent. At TSL 3, industry free cash-flow is $43.5 million, which is a decrease of approximately $7.5 million compared to the no-new-standards case value of $51.0 million in 2027, the year leading up to the adopted standards.

TSL 3 would set the energy conservation standard at EL 1 for gas-fired consumer pool heaters and at EL 3 for electric consumer pool heaters. DOE estimates that 96 percent of gas-fired consumer pool heater shipments and 22 percent of electric consumer pool heater shipments already meet or exceed the efficiency levels analyzed at TSL 3. Gas-fired consumer pool heater manufacturers would likely need to redesign any models with a standing pilot light. DOE assumed this would cost manufacturers approximately $0.1 million. To bring non-compliant electric heat pump consumer pool heaters into compliance and to test all electric heat pump consumer pool heaters to demonstrate compliance with standards at TSL 3, electric heat pump consumer pool heater manufacturers would incur approximately $9.0 million in product conversion costs and $9.5 million in capital conversion costs at TSL 3.

At TSL 3, the shipment-weighted average MPC for all consumer pool heaters increases by 1.9 percent relative to the no-new-standards case shipment-weighted average MPC for all consumer pool heaters in 2028. In the preservation of gross margin scenario, the increase in shipment-weighted average MPC for consumer pool heaters is outweighed by the $18.6 million in conversion costs, causing a slightly negative change in INPV at TSL 3 under the preservation of gross margin scenario.

Under the preservation of operating profit scenario, the 1.9 percent shipment-weighted average MPC increase results in a reduction in the manufacturer margin after the compliance year. This reduction in the manufacturer margin and the $18.6 million in conversion costs incurred by manufacturers cause a slightly negative change in INPV at TSL 3 under the preservation of operating profit scenario.

At TSL 4, DOE estimates that impacts on INPV will range from −$22.8 million to −$10.7 million, or a change in INPV of −3.9 percent to −1.8 percent. At TSL 4, industry free cash-flow is $39.6 million, which is a decrease of approximately $11.4 million compared to the no-new-standards case value of $51.0 million in 2027, the year leading up to the adopted standards.

TSL 4 would set the energy conservation standard at EL 1 for gas-fired consumer pool heaters and at EL 4 for electric consumer pool heaters. DOE estimates that 96 percent of gas-fired consumer pool heaters and 12 percent of electric consumer pool heaters meet or exceed the efficiency levels analyzed at TSL 4. Gas-fired consumer pool heater manufacturers would likely need to redesign any models with a standing pilot light. DOE assumed this would cost manufacturers approximately $0.1 million. To bring non-compliant electric heat pump consumer pool heaters into compliance and to test all electric heat pump consumer pool heaters to demonstrate compliance with standards at TSL 4, electric heat pump consumer pool heater manufacturers would incur approximately $19.9 million in product conversion costs and $9.5 million in capital conversion costs at TSL 4.

At TSL 4, the shipment-weighted average MPC for all consumer pool heaters increases by 3.6 percent relative to the no-new-standards case shipment-weighted average MPC for all consumer pool heaters in 2028. In the preservation of gross margin scenario, the increase in shipment-weighted average MPC for consumer pool heaters is outweighed by the $29.4 million in conversion costs, causing a slightly negative change in INPV at TSL 4 under the preservation of gross margin scenario.

Under the preservation of operating profit scenario, the 3.6 percent shipment-weighted average MPC increase results in a reduction in the manufacturer margin after the compliance year. This reduction in the manufacturer margin and the $29.4 million in conversion costs incurred by manufacturers causing a slightly negative change in INPV at TSL 4 under the preservation of operating profit scenario.

At TSL 5, DOE estimates that impacts on INPV will range from −$37.3 million to $2.0 million, or a change in INPV of −6.4 percent to 0.3 percent. At TSL 5, industry free cash-flow is $32.4 million, which is a decrease of approximately $18.6 million compared to the no-new-standards case value of $51.0 million in 2027, the year leading up to the adopted standards.

TSL 5 would set the energy conservation standard at EL 2 for gas-fired consumer pool heaters and at EL 4 for electric consumer pool heaters. DOE estimates that 50 percent of gas-fired consumer pool heaters and 12 percent of electric consumer pool heaters meet or exceed the efficiency levels analyzed at TSL 5. Gas-fired consumer pool heater manufacturers would likely need to incorporate a blower for gas-fired pool heaters. DOE assumed this would cost manufacturers approximately $14.1 million in product conversion costs and $5.0 million in capital conversion costs. To bring non-compliant electric heat pump consumer pool heaters into compliance and to test all electric heat pump consumer pool heaters to demonstrate compliance with standards at TSL 5, electric heat pump consumer pool heater manufacturers would incur approximately $19.9 million in product conversion costs and $9.5 million in capital conversion costs at TSL 5.

At TSL 5, the shipment-weighted average MPC for all consumer pool heaters increases by 10.0 percent relative to the no-new-standards case shipment-weighted average MPC for all consumer pool heaters in 2028. In the preservation of gross margin scenario, the increase in shipment-weighted average MPC for consumer pool heaters outweighs the $48.4 million in conversion costs, causing a slightly positive change in INPV at TSL 5 under the preservation of gross margin scenario.

Under the preservation of operating profit scenario, the 10.0 percent shipment-weighted average MPC increase results in a reduction in the manufacturer margin after the compliance year. This reduction in manufacturer margin and the $48.4 million in conversion costs incurred by manufacturers cause a moderately negative change in INPV at TSL 5 under the preservation of operating profit scenario.

At TSL 6, DOE estimates that impacts on INPV will range from −$103.0 million to $45.9 million, or a change in INPV of −17.6 percent to 7.8 percent. At TSL 6, industry free cash-flow is $2.4 million, which is a decrease of approximately $48.6 million compared to the no-new-standards case value of $51.0 million in 2027, the year leading up to the adopted standards.

TSL 6 would set the energy conservation standard at EL 3 for gas-fired consumer pool heaters and at EL 5 for electric consumer pool heaters. This represents max-tech for both product classes. DOE estimates 9 percent of gas-fired consumer pool heaters and 3 percent of electric consumer pool heaters meet the efficiency levels analyzed at TSL 6. Gas-fired consumer pool heater manufacturers would likely need to incorporate condensing technology and electrical upgrades for standby mode and off mode power consumption for all gas-fired pool heaters. DOE assumed this would cost manufacturers approximately $63.1 million in product conversion costs and $29.0 million in capital conversion costs. To bring non-compliant electric heat pump consumer pool heaters into compliance and to test all electric heat pump consumer pool heaters to demonstrate compliance with standards at TSL 6, electric heat pump consumer pool heater manufacturers would likely need to incorporate heat pump component improvements and electrical upgrades for standby mode and off mode power consumption for all electric pool heaters. DOE assumed this would incur approximately $24.8 million in product conversion costs and $9.5 million in capital conversion costs at TSL 6.

At TSL 6, the shipment-weighted average MPC for all consumer pool heaters significantly increases by 37.0 percent relative to the no-new-standards case shipment-weighted average MPC for all consumer pool heaters in 2028. In the preservation of gross margin scenario, the large increase in shipment-weighted average MPC for consumer pool heaters outweighs the $126.4 million in conversion costs, causing a moderately positive change in INPV at TSL 6 under the preservation of gross margin scenario.

Under the preservation of operating profit scenario, the 37.0 percent shipment-weighted average MPC increase results in a significant reduction in the manufacturer margin after the compliance year. This large reduction in manufacturer margin and the significant $126.4 million in conversion costs incurred by manufacturers cause a moderately 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 new and amended energy conservation standards on direct employment in the consumer pool heaters 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.

Production employees are those who are directly involved in fabricating and assembling products within an original equipment manufacturer facility. Workers performing services that are closely associated with production operations, such as materials handling tasks using forklifts, are included as production labor, as well as line supervisors.

DOE used the GRIM to calculate the number of production employees from labor expenditures. DOE used statistical data from the U.S. Census Bureau's 2019 Annual Survey of Manufacturers (''ASM'') and the results of the engineering analysis to calculate industry-wide labor expenditures. 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 the GRIM were then converted to domestic production employment levels by dividing production labor expenditures by the annual payment per production worker.

Non-production employees account for those workers that are not directly engaged in the manufacturing of the covered product. This could include sales, human resources, engineering, and management. DOE estimated non-production employment levels by multiplying the number of consumer pool heater production workers by a scaling factor. The scaling factor is calculated by taking the ratio of the total number of employees, and the total production workers associated with the industry North American Industry Classification System (''NAICS'') code 333414, which covers consumer pool heater manufacturing.

Using the GRIM, DOE estimates that there would be 875 domestic production workers, and 505 non-production workers for consumer pool heaters in 2028 in the absence of new and amended energy conservation standards. Table V.11 shows the range of the impacts of energy conservation standards on U.S. production on consumer pool heaters.

TABLE V.11—TOTAL NUMBER OF DOMESTIC CONSUMER POOL HEATER PRODUCTION WORKERS IN 2028

	No-new-standards case	Trial standard level *					
		1	2	3	4	5	6
Domestic Production Workers in 2028	875	870	870	873	871	869	1,074
Domestic Non-Production Workers in 2028	505	502	502	504	503	501	620
Total Direct Employment in 2028	1,380	1,372	1,372	1,377	1,374	1,370	1,694

TABLE V.11—TOTAL NUMBER OF DOMESTIC CONSUMER POOL HEATER PRODUCTION WORKERS IN 2028—Continued

	No-new-standards case	Trial standard level *					
		1	2	3	4	5	6
Potential Changes in Total Direct Employment in 2028		(32)–(8)	(32)–(8)	(32)–(3)	(32)–(6)	(32)–(10)	(371)–314

* Numbers in parentheses indicate a negative number. Numbers may not sum exactly due to rounding.

The direct employment impacts shown in Table V.11 represent the potential changes in direct employment that could result following the compliance date for consumer pool heaters. Employment could increase or decrease due to the labor content of the various products being manufactured domestically that meet the analyzed standards or if manufacturers decided to move production facilities abroad because of the new and amended standards. At one end of the range, DOE assumes that all manufacturers continue to manufacture the same scope of the products domestically after new and amended standards are required. However, since the labor content of consumer pool heaters varies by efficiency level, this can either result in an increase or decrease in domestic employment, even if all domestic product remains in the U.S.[161] The other end of the range assumes that some domestic manufacturing either is eliminated or moves abroad due to the analyzed new and amended standards. DOE assumes that for electric consumer pool heaters, only the electric resistance consumer pool heater employees would be impacted at all TSLs analyzed. DOE estimates there would be approximately 32 domestic production and non-production employees manufacturing electric resistance consumer pool heaters in 2028. Therefore, DOE assumes that for all TSLs analyzed, there would be a reduction in 32 domestic employees due to electric resistance consumer pool heaters no longer being manufactured domestically. For gas-fired consumer pool heaters, DOE assumes there would not be any impact to domestic production until TSL 6, max-tech. At this TSL, DOE assumes that up to half of all domestic gas-fired consumer pool heater production could move abroad due to the new and amended standards at TSL 6. TSL 6 would most likely require manufacturers of gas-fired consumer pool heaters to use condensing technology and implement electrical component upgrades. Based on information from manufacturer interviews, this would require a significant investment to replace or re-tool existing production equipment. Some manufacturers of gas-fired consumer pool heaters could explore moving existing domestic production facilities abroad if the majority of the existing gas-fired consumer pool heater production equipment would need to be replaced or significantly re-tooled. DOE estimated there would be approximately 678 domestic production workers manufacturing gas-fired pool heaters in 2028. Therefore, DOE estimates that if standards were set at TSL 6, max-tech, there could be a loss of up to 371 domestic production employees responsible for manufacturing consumer pool heaters.[162] Additional detail on the analysis of direct employment can be found in chapter 12 of the final rule TSD.

c. Impacts on Manufacturing Capacity

DOE identified potential manufacturing production capacity constraints at max-tech for both gas-fired consumer pool heaters and electric consumer pool heaters. There are 18 consumer pool heater manufacturers that manufacture electric consumer pool heaters covered by this rulemaking. Only three electric consumer pool heater manufacturers currently offer models that meet the efficiency level required at max-tech for electric consumer pool heaters, and each of these three electric consumer pool heater manufacturers only offer a single model that meets the efficiency level required at max-tech for electric consumer pool heaters. All other electric consumer pool heater models offered by electric consumer pool heater manufacturers do not meet the efficiency level required at max-tech for electric pool heaters covered by this rulemaking.

There are six consumer pool heater manufacturers that manufacture gas-fired consumer pool heaters covered by this rulemaking. Only one gas-fired consumer pool heater manufacturer currently offers a model that meet the efficiency level required at max-tech for gas-fired pool heaters. All other gas-fired consumer pool heater models offered by gas-fired consumer pool heater manufacturers do not meet the efficiency level required at max-tech for gas-fired pool heaters covered by this rulemaking.

At max-tech (for both gas-fired consumer pool heaters and electric consumer pool heaters), most consumer pool heater manufacturers would therefore be required to redesign every consumer pool heater model covered by this rulemaking. It is unclear if most manufacturers would have the engineering capacity to complete the necessary redesigns (required to meet energy conservation standards at max-tech) within the 5-year compliance period. If some manufacturers require more than 5 years to redesign all their covered consumer pool heater models, they will likely prioritize redesigns based on sales volume. There is risk that some consumer pool heater models will become either temporarily or permanently unavailable after the compliance date.

DOE did not identify any significant manufacturing production capacity constraints for the design options below max-tech that were being evaluated for this final rule. All gas-fired consumer pool heater manufacturers offer products that meet the EL below max-tech for gas-fired pool heaters, and more than half of the electric consumer pool heater manufacturers offer products that meet the EL below max-tech for electric consumer pool heaters. The design options below max-tech evaluated for this final rule are readily available as products that are on the market currently. The materials used to manufacture models at all ELs below max-tech are widely available on the market. As a result, DOE does not anticipate that the industry will likely experience any capacity constraints directly resulting from energy conservation standards at any of the ELs that are below max-tech.

[161] TSL 6 is estimated to have an increase in domestic employment, while TSL 1 through TSL 5, are estimated to have a reduction in domestic employment, assuming all production remains in the U.S.

[162] 339 domestic production employees, manufacturing gas-fired consumer pool heaters, and 32 domestic production and non-production employees manufacturing electric resistance consumer pool heaters.

d. Impacts on Subgroups of Manufacturers

As discussed in section IV.J.1 of this document, using average cost assumptions to develop an industry cash-flow estimate may not be adequate for assessing differential impacts among manufacturer subgroups. Small manufacturers, niche manufacturers, and manufacturers exhibiting a cost structure substantially different from the industry average could be affected disproportionately. DOE used the results of the industry characterization to group manufacturers exhibiting similar characteristics. Consequently, DOE identified small business manufacturers as a subgroup for a separate impact analysis.

For the small business subgroup analysis, DOE applied the small business size standards published by the Small Business Administration (''SBA'') to determine whether a company is considered a small business. The size standards are codified at 13 CFR part 121. To be categorized as a small business under NAICS code 333414, ''heating equipment (except warm air furnaces) manufacturing,'' a consumer pool heater manufacturer and its affiliates may employ a maximum of 500 employees. The 500-employee threshold includes all employees in a business's parent company and any other subsidiaries. Based on this classification, DOE identified six potential manufacturers that qualify as domestic small businesses.

All six small businesses manufacture electric consumer pool heaters and none of them manufacture gas-fired consumer pool heaters. Therefore, only new standards set for electric consumer pool heaters would impact any of the small businesses. Five of the six small businesses exclusively manufacture electric heat pump consumer pool heaters, while the other small business exclusively manufacturers electric resistance consumer pool heaters.

The small business subgroup analysis is discussed in more detail in chapter 12 of the final rule TSD. DOE examines the potential impacts on small business manufacturers in section VI.B of this document.

e. Cumulative Regulatory Burden

One aspect of assessing manufacturer burden involves looking at the cumulative impact of multiple DOE standards and the regulatory actions of other Federal agencies and States that affect the manufacturers of a covered product or equipment. While any one regulation may not impose a significant burden on manufacturers, the combined effects of several existing or impending regulations may have serious consequences for some manufacturers, groups of manufacturers, or an entire industry. Multiple regulations affecting the same manufacturer can strain profits and lead companies to abandon product lines or markets with lower expected future returns than competing products. For these reasons, DOE conducts an analysis of cumulative regulatory burden as part of its rulemakings pertaining to appliance efficiency.

BWC commented that a large amount regulatory burden will be placed on their company and other consumer pool heater manufacturers since DOE has multiple rulemaking cycles happening for other products manufactured by consumer pool heater manufacturers concurrently, including residential water heaters, commercial water heaters, and residential boilers, in addition to this consumer pool heater rulemaking. BWC claims that all of these amended standards, along with DOE underestimating the amount of time and resources required to meet compliance of the proposed consumer pool heater standards and test procedures will place an overwhelming regulatory burden on these manufacturers and the market. (BWC, No. 12 at pp. 4–5)

Rheem indicated it would experience a high degree of cumulative regulatory burden because almost all of the products and equipment it manufactures are subject to ongoing DOE rulemakings. Rheem stated that it expects compliance with new and amended standards for consumer pool heaters to require significant product redesign and reset of production facilities between 2026 and 2029. Thus, Rheem urged DOE to take steps to alleviate cumulative regulatory burden, for instance, considering the AIM Act phasedown of high GWP refrigerants. (Rheem, No. 19 at pp. 9–10)

Fluidra provided a list of applicable codes and standards for pool heaters that represent a cumulative regulatory burden to manufacturers including: ANSI/CSA—Gas Appliance Standard; UL Electrical Standard; California Energy Commission; Florida Energy Code; DOE Federal Efficiency; ASME; AHRI; ASHRAE; NSF; and FCC/IC. (Fluidra, No. 18 at p. 4)

DOE evaluates product-specific regulations that will take effect approximately 3 years before or after the estimated 2028 compliance date of any new and amended energy conservation standards for consumer pool heaters. This information is presented in Table V.12.

TABLE V.12—COMPLIANCE DATES AND EXPECTED CONVERSION EXPENSES OF FEDERAL ENERGY CONSERVATION STANDARDS AFFECTING CONSUMER POOL HEATER MANUFACTURERS

Federal energy conservation standard	Number of manufacturers *	Number of manufacturers affected from this rule **	Approx. standards year	Industry conversion costs (millions)	Industry conversion costs/product revenue *** (%)
Portable Air Conditioners 85 FR 1378 (Jan. 10, 2020)	11	2	2025	$320.9 (2015$)	6.7
Room Air Conditioners ‡	8	1	2026	$24.8 (2021$)	0.4
Commercial Water Heating Equipment † 87 FR 30610 (May 19, 2022)	14	3	2026	$34.6 (2020$)	4.7
Consumer Furnaces (non-weatherized gas & mobile home) † 87 FR 40590 (July 7, 2022	15	1	2029	$150.6 (2020$)	1.4

* This column presents the total number of manufacturers identified in the energy conservation standard rule contributing to cumulative regulatory burden.

** This column presents the number of manufacturers producing consumer pool heaters that are also listed as manufacturers in the listed energy conservation standard contributing to cumulative regulatory burden.

*** This column presents industry conversion costs as a percentage of product revenue during the conversion period. Industry conversion costs are the upfront investments manufacturers must make to sell compliant products/equipment. The revenue used for this calculation is the revenue from just the covered product/equipment associated with each row. The conversion period is the time frame over which conversion costs are made and lasts from the publication year of the final rule to the compliance year of the energy conservation standard. The conversion period typically ranges from 3 to 5 years, depending on the rulemaking.
† Indicates a NOPR publication. Values may change on publication of a final rule.
‡ At the time of issuance of this consumer pool heaters rulemaking, the rulemaking has been issued and is pending publication in the **Federal Register**. Once published, the room air conditioners final rule will be available at: *www.regulations.gov/docket/EERE-2014-BT-STD-0059.*

In addition to the rulemaking listed in Table V.12 DOE has ongoing rulemakings for other products or equipment that consumer pool heater manufacturers produce, including consumer furnaces (oil, electric, and weatherized gas); [163] consumer boilers; [164] consumer furnace fans; [165] consumer water heaters; [166] and dedicated-purpose pool pumps.[167] However, none of these rulemakings have published a NOPR or final rule to be able to estimate the size of the expected conversion costs manufacturers of these products or equipment must make.

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 new and amended standards for consumer pool heaters, DOE compared their energy consumption under the no-new-standards case to their anticipated energy consumption under each TSL. The savings are measured over the entire lifetime of products purchased in the 30-year period that begins in the year of anticipated compliance with amended standards (2028–2057). Table V.13 presents DOE's projections of the national energy savings for each TSL considered for consumer pool heaters. The savings were calculated using the approach described in section IV.H of this document.

TABLE V.13—CUMULATIVE NATIONAL ENERGY SAVINGS FOR CONSUMER POOL HEATERS; 30 YEARS OF SHIPMENTS
[2028–2057]

Energy savings	Product class	Trial standard level					
		1	2	3	4	5	6
		(quads *)					
Primary energy	Electric Pool Heaters	0.22	0.28	0.38	0.41	0.41	0.46
	Gas-fired Pool Heaters	0.02	0.02	0.02	0.02	0.25	2.34
	Total	0.24	0.29	0.39	0.43	0.66	2.80
FFC energy	Electric Pool Heaters	0.23	0.29	0.39	0.43	0.43	0.47
	Gas-fired Pool Heaters	0.02	0.02	0.02	0.02	0.27	2.60
	Total	0.25	0.31	0.41	0.45	0.70	3.07

* quads = quadrillion British thermal units.
Note numbers may not add to totals, due to rounding.

OMB Circular A–4 [168] requires agencies to present analytical results, including separate schedules of the monetized benefits and costs that show the type and timing of benefits and costs. Circular A–4 also directs agencies to consider the variability of key elements underlying the estimates of benefits and costs. For this rulemaking, DOE undertook a sensitivity analysis using 9 years, rather than 30 years, of product shipments. The choice of a 9-year period is a proxy for the timeline in EPCA for the review of certain energy conservation standards and potential revision of and compliance with such revised standards.[169] The review timeframe established in EPCA is generally not synchronized with the product lifetime, product manufacturing cycles, or other factors specific to consumer pool heaters. Thus, such results are presented for informational purposes only and are not indicative of any change in DOE's analytical methodology. The NES sensitivity analysis results based on a 9-year analytical period are presented in Table V.14. The impacts are counted over the lifetime of consumer pool heaters purchased in 2028–2036.

[163] *www.regulations.gov/docket/EERE-2021-BT-STD-0031.*

[164] *www.regulations.gov/docket/EERE-2019-BT-STD-0036.*

[165] *www.regulations.gov/docket/EERE-2021-BT-STD-0029.*

[166] *www.regulations.gov/docket/EERE-2017-BT-STD-0019.*

[167] *www.regulations.gov/docket/EERE-2022-BT-STD-0001.*

[168] U.S. Office of Management and Budget. *Circular A–4: Regulatory Analysis.* September 17, 2003. *www.whitehouse.gov/omb/circulars_a004_a-4/* (last accessed October 15, 2022).

[169] Section 325(m) of 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.

TABLE V.14—CUMULATIVE NATIONAL ENERGY SAVINGS FOR CONSUMER POOL HEATERS; 9 YEARS OF SHIPMENTS
[2028–2036]

Energy savings	Product class	Trial standard level 1	2	3	4	5	6
		(quads *)					
Primary energy	Electric Pool Heaters	0.07	0.09	0.11	0.12	0.12	0.13
	Gas-fired Pool Heaters	0.01	0.01	0.01	0.01	0.07	0.62
	Total	0.08	0.09	0.12	0.13	0.19	0.76
FFC energy	Electric Pool Heaters	0.07	0.09	0.12	0.13	0.13	0.14
	Gas-fired Pool Heaters	0.01	0.01	0.01	0.01	0.07	0.69
	Total	0.08	0.10	0.12	0.14	0.20	0.83

* quads = quadrillion British thermal units.
Note numbers may not add to totals, due to rounding.

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 pool heaters. In accordance with OMB's guidelines on regulatory analysis,[170] DOE calculated NPV using both a 7-percent and a 3-percent real discount rate. Table V.15 shows the consumer NPV results with impacts counted over the lifetime of products purchased in 2028–2057.

TABLE V.15—CUMULATIVE NET PRESENT VALUE OF CONSUMER BENEFITS FOR CONSUMER POOL HEATERS; 30 YEARS OF SHIPMENTS
[2028–2057]

Discount rate	Product class	Trial standard level 1	2	3	4	5	6
		(billion 2021$)					
7 percent	Electric Pool Heaters	0.64	0.78	0.99	0.96	0.96	0.87
	Gas-fired Pool Heaters	0.05	0.05	0.05	0.05	0.23	2.66
	Total	0.70	0.84	1.04	1.01	1.18	3.53
3 percent	Electric Pool Heaters	1.48	1.82	2.33	2.32	2.32	2.20
	Gas-fired Pool Heaters	0.12	0.12	0.12	0.12	0.68	7.41
	Total	1.60	1.93	2.45	2.44	3.00	9.60

Parentheses indicate negative (-) values.
Note numbers may not add to totals, due to rounding.

The NPV results based on the aforementioned 9-year analytical period are presented in Table V.16. The impacts are counted over the lifetime of products purchased in 2028–2036. 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.16—CUMULATIVE NET PRESENT VALUE OF CONSUMER BENEFITS FOR CONSUMER POOL HEATERS; 9 YEARS OF SHIPMENTS
[2028–2036]

Discount rate	Product class	Trial standard level 1	2	3	4	5	6
		(billion 2020$)					
7 percent	Electric Pool Heaters	0.35	0.43	0.52	0.51	0.51	0.47
	Gas-fired Pool Heaters	0.03	0.03	0.03	0.03	0.10	1.23
	Total	0.38	0.45	0.55	0.54	0.62	1.69

[170] U.S. Office of Management and Budget. *Circular A–4: Regulatory Analysis.* September 17, 2003. *www.whitehouse.gov/omb/circulars_a004_a-4/* (last accessed October 15, 2022).

TABLE V.16—CUMULATIVE NET PRESENT VALUE OF CONSUMER BENEFITS FOR CONSUMER POOL HEATERS; 9 YEARS OF SHIPMENTS—Continued

[2028–2036]

Discount rate	Product class	Trial standard level 1	2	3	4	5	6
			(billion 2020$)				
3 percent	Electric Pool Heaters	0.63	0.76	0.94	0.94	0.94	0.90
	Gas-fired Pool Heaters	0.05	0.05	0.05	0.05	0.23	2.52
	Total	0.68	0.81	1.00	0.99	1.17	3.42

Parentheses indicate negative (−) values.
Note numbers may not add to totals, due to rounding.

The previous results reflect the use of a default trend to estimate the change in price for consumer pool heaters over the analysis period (see section IV.F.1 of this document). DOE also conducted a sensitivity analysis that considered one scenario with an increasing rate of price change than the reference case and one scenario with a decreasing rate of price change compared to the reference case. The results of these alternative cases are presented in appendix 10C of the final rule TSD. In the decreasing-price case, the NPV of consumer benefits is higher than in the default case. In the increasing-price 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 pool heaters will reduce energy expenditures for consumers of those products, with the resulting net savings being redirected to other forms of economic activity. These expected shifts in spending and economic activity could affect the demand for labor. As described in section IV.N of this document, DOE used an input/output model of the U.S. economy to estimate indirect employment impacts of the TSLs that DOE considered. There are uncertainties involved in projecting employment impacts, especially changes in the later years of the analysis. Therefore, DOE generated results for near-term timeframes (2028–2033), where these uncertainties are reduced.

The results suggest that the adopted standards are likely to have a negligible impact on the net demand for labor in the economy. The net change in jobs is so small that it would be imperceptible in national labor statistics and might be offset by other, unanticipated effects on employment. Chapter 16 of the final rule TSD presents detailed results regarding anticipated indirect employment impacts.

4. Impact on Utility or Performance of Products

As discussed in section IV.C.1.b of this document, DOE has concluded that the standards adopted in this final rule will not lessen the utility or performance of the consumer pool heaters under consideration in this rulemaking. Manufacturers of these products currently offer units that meet or exceed the adopted standards.

5. Impact of Any Lessening of Competition

DOE considered any lessening of competition that would be likely to result from new or amended standards. As discussed in section III.F.1.e of this document, EPCA directs the Attorney General of the United States (''Attorney General'') to determine the impact, if any, of any lessening of competition likely to result from a proposed standard and to transmit such determination in writing to the Secretary within 60 days of the publication of a proposed rule, together with an analysis of the nature and extent of the impact. To assist the Attorney General in making this determination, DOE provided the Department of Justice (''DOJ'') with copies of the NOPR and the TSD for review. In its assessment letter responding to DOE, DOJ concluded that the proposed energy conservation standards for consumer pool heaters are unlikely to have a significant adverse impact on competition. DOE is publishing the Attorney General's assessment at the end of this final rule.

6. Need of the Nation To Conserve Energy

Enhanced energy efficiency, where economically justified, improves the Nation's energy security, strengthens the economy, and reduces the environmental impacts (costs) of energy production. 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 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 pool heaters is expected to yield environmental benefits in the form of reduced emissions of certain air pollutants and greenhouse gases. Table V.17 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 final rule TSD.

The NPV results based on the aforementioned 9-year analytical period are presented in. The impacts are counted over the lifetime of products purchased in 2028–2036. 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.17—CUMULATIVE EMISSIONS REDUCTION FOR CONSUMER POOL HEATERS SHIPPED IN 2028–2057

	Trial standard level					
	1	2	3	4	5	6
Site and Power Sector Emissions						
CO_2 (*million metric tons*)	7.9	9.6	12.7	13.9	26.1	138.1
CH_4 (*thousand tons*)	0.5	0.7	0.9	1.0	1.2	3.7
N_2O (*thousand tons*)	0.1	0.1	0.1	0.1	0.2	0.4
NO_X (*thousand tons*)	13.0	13.8	15.4	16.0	198.0	217.5
SO_2 (*thousand tons*)	3.2	3.9	5.4	5.9	5.9	7.4
Hg (*tons*)	0.02	0.03	0.03	0.04	0.04	0.04
Upstream Emissions						
CO_2 (*million metric tons*)	0.7	0.8	1.1	1.2	2.8	17.4
CH_4 (*thousand tons*)	65.9	78.3	101.3	110.4	283.1	1,836.5
N_2O (*thousand tons*)	0.003	0.004	0.005	0.01	0.01	0.03
NO_X (*thousand tons*)	10.4	12.4	16.0	17.5	42.8	271.0
SO_2 (*thousand tons*)	0.04	0.05	0.1	0.1	0.1	0.2
Hg (*tons*)	0.0001	0.0001	0.0001	0.0001	0.0001	0.0002
Total FFC Emissions						
CO_2 (*million metric tons*)	8.6	10.4	13.7	15.0	28.9	155.5
CH_4 (*thousand tons*)	66.4	78.9	102.2	111.4	284.4	1840.2
N_2O (*thousand tons*)	0.1	0.1	0.1	0.1	0.2	0.4
NO_X (*thousand tons*)	23.4	26.2	31.4	33.5	240.8	488.5
SO_2 (*thousand tons*)	3.2	4.0	5.4	6.0	6.0	7.6
Hg (*tons*)	0.02	0.03	0.03	0.04	0.04	0.04

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 pool heaters. Section IV.L of this document discusses the estimated SC–CO_2 values that DOE used. Table V.18 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 final rule TSD.

TABLE V.18—PRESENT VALUE OF CO_2 EMISSIONS REDUCTION FOR CONSUMER POOL HEATERS SHIPPED IN 2028–2057

TSL	SC–CO_2 case discount rate and statistics			
	5% Average	3% Average	2.5% Average	3% 95th percentile
	(million 2021$)			
1	79.0	342.4	536.7	1,040.6
2	94.8	411.6	645.4	1,250.8
3	123.9	539.6	846.9	1,639.4
4	135.5	590.5	926.9	1,793.9
5	258.6	1,132.9	1,780.9	3,440.3
6	1,381.0	6,079.2	9,568.7	18,454.8

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 pool heaters. Table V.19 presents the value of the CH_4 emissions reduction at each TSL, and Table V.20 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 final rule TSD.

TABLE V.19—PRESENT VALUE OF METHANE EMISSIONS REDUCTION FOR CONSUMER POOL HEATERS SHIPPED IN 2028–2057

TSL	SC–CH_4 case discount rate and statistics (million 2021$)			
	5% Average	3% Average	2.5% Average	3% 95th percentile
	(million 2021$)			
1	27.9	83.8	117.2	221.7

TABLE V.19—PRESENT VALUE OF METHANE EMISSIONS REDUCTION FOR CONSUMER POOL HEATERS SHIPPED IN 2028–2057—Continued

TSL	$SC–CH_4$ case discount rate and statistics (million 2021$)			
	5% Average	3% Average	2.5% Average	3% 95th percentile
	(million 2021$)			
2	33.0	99.3	139.0	262.9
3	42.4	128.1	179.4	338.9
4	46.1	139.6	195.5	369.2
5	117.3	356.9	500.4	943.4
6	758.0	2,312.0	3,243.5	6,108.7

TABLE V.20—PRESENT VALUE OF NITROUS OXIDE EMISSIONS REDUCTION FOR CONSUMER POOL HEATERS SHIPPED IN 2028–2057

TSL	$SC–N_2O$ case discount rate and statistics (million 2021$)			
	5% (average)	3% (average)	2.5% (average)	3% (95th percentile)
	(million 2021$)			
1	0.3	1.1	1.7	2.9
2	0.3	1.3	2.1	3.6
3	0.4	1.8	2.8	4.8
4	0.5	2.0	3.1	5.3
5	0.6	2.4	3.7	6.3
6	1.5	6.2	9.6	16.4

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 pool heaters. The dollar-per-ton values that DOE used are discussed in section IV.L of this document. Table V.21 presents the present value for NO_X emissions reduction for each TSL calculated using 7-percent and 3-percent discount rates, and Table V.22 presents similar results for SO_2 emissions reductions. The results in these tables reflect application of EPA's low dollar-per-ton values, which DOE used to be conservative. The time-series of annual values is presented for the selected TSL in chapter 14 of the final rule TSD.

TABLE V.21—PRESENT VALUE OF NO_X EMISSIONS REDUCTION FOR CONSUMER POOL HEATERS SHIPPED IN 2028–2057

TSL	7% Discount rate	3% Discount rate
	million 2021$	
1	215.8	546.0
2	256.6	652.6
3	330.8	848.9
4	360.4	927.1
5	740.8	1,939.0
6	4,191.7	11,116.6

TABLE V.22—PRESENT VALUE OF SO_2 EMISSIONS REDUCTION FOR CONSUMER POOL HEATERS SHIPPED IN 2028–2057

TSL	7% Discount rate	3% Discount rate
	million 2021$	
1	69.7	171.9
2	85.1	211.4
3	113.4	284.9
4	124.7	314.0
5	123.9	312.1

TABLE V.22—PRESENT VALUE OF SO_2 EMISSIONS REDUCTION FOR CONSUMER POOL HEATERS SHIPPED IN 2028–2057—Continued

TSL	7% Discount rate	3% Discount rate
	million 2021$	
6	151.3	383.3

DOE has not considered the monetary benefits of the reduction of Hg for this final rule. 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 Hg, direct PM, and other co-pollutants may be significant.

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.23 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 in 2028–2057. 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 pool heaters shipped in 2028–2057.

TABLE V.23—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 2021$)						
5% Average SC–GHG case	2.4	2.9	3.7	3.9	5.6	23.3
3% Average SC–GHG case	2.7	3.3	4.3	4.4	6.7	29.5
2.5% Average SC–GHG case	3.0	3.6	4.6	4.8	7.5	34.0
3% 95th percentile SC–GHG case	3.6	4.3	5.6	5.8	9.6	45.7
Using 7% discount rate for Consumer NPV and Health Benefits (billion 2021$)						
5% Average SC–GHG case	1.1	1.3	1.6	1.7	2.4	10.0
3% Average SC–GHG case	1.4	1.7	2.2	2.2	3.5	16.3
2.5% Average SC–GHG case	1.6	2.0	2.5	2.6	4.3	20.7
3% 95th percentile SC–GHG case	2.2	2.7	3.5	3.7	6.4	32.5

C. Conclusion

When considering new or amended energy conservation standards, the standards that DOE adopts for any type (or class) of covered product must be designed to achieve the maximum improvement in energy efficiency that the Secretary determines is technologically feasible and economically justified. (42 U.S.C. 6295(o)(2)(A)) In determining whether a standard is economically justified, the Secretary must determine whether the benefits of the standard exceed its burdens by, to the greatest extent practicable, considering the seven statutory factors discussed previously. (42 U.S.C. 6295(o)(2)(B)(i)) The new or amended standard must also result in significant conservation of energy. (42 U.S.C. 6295(o)(3)(B))

For this final rule, DOE considered the impacts of new and amended standards for consumer pool heaters at each TSL, beginning with the maximum technologically feasible level, to determine whether that level was economically justified. Where the max-tech level was not justified, DOE then considered the next most efficient level and undertook the same evaluation until it reached the highest efficiency level that is both technologically feasible and economically justified and saves a significant amount of energy.

To aid the reader as DOE discusses the benefits and/or burdens of each TSL, tables in this section present a summary of the results of DOE's quantitative analysis for each TSL. In addition to the quantitative results presented in the tables, DOE also considers other burdens and benefits that affect economic justification. These include the impacts on identifiable subgroups of consumers who may be disproportionately affected by a national standard and impacts on employment.

DOE also notes that the economics literature provides a wide-ranging discussion of how consumers trade off upfront costs and energy savings in the absence of government intervention. Much of this literature attempts to explain why consumers appear to undervalue energy efficiency improvements. There is evidence that consumers undervalue future energy savings as a result of (1) a lack of information; (2) a lack of sufficient salience of the long-term or aggregate benefits; (3) a lack of sufficient savings to warrant delaying or altering purchases; (4) excessive focus on the short term, in the form of inconsistent weighting of future energy cost savings relative to available returns on other investments; (5) computational or other difficulties associated with the evaluation of relevant tradeoffs; and (6) a divergence in incentives (for example, between renters and owners, or builders and purchasers). Having less than perfect foresight and a high degree of uncertainty about the future, consumers may trade off these types of investments at a higher than expected rate between current consumption and uncertain future energy cost savings.

In DOE's current regulatory analysis, potential changes in the benefits and costs of a regulation due to changes in consumer purchase decisions are included in two ways. First, if consumers 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 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.[171]

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.[172] DOE welcomes comments on how to more fully assess the potential impact of

[171] 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.*

[172] Sanstad, A.H. *Notes on the Economics of Household Energy Consumption and Technology Choice.* 2010. Lawrence Berkeley National Laboratory. *www1.eere.energy.gov/buildings/appliance_standards/pdfs/consumer_ee_theory.pdf* (last accessed October 15, 2022).

energy conservation standards on consumer choice and how to quantify this impact in its regulatory analysis in future rulemakings.

1. Benefits and Burdens of TSLs Considered for Consumer Pool Heaters Standards

Table V.24 and Table V.25 summarize the quantitative impacts estimated for each TSL for consumer pool heaters. The national impacts are measured over the lifetime of consumer pool heaters purchased in the 30-year period that begins in the anticipated year of compliance with amended standards (2028–2057). The energy savings, emissions reductions, and value of emissions reductions refer to full-fuel-cycle results. DOE is presenting monetized benefits 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.24—SUMMARY OF ANALYTICAL RESULTS FOR CONSUMER POOL HEATERS TSLs: NATIONAL IMPACTS

Category	TSL 1	TSL 2	TSL 3	TSL 4	TSL 5	TSL 6
Cumulative FFC National Energy Savings						
Quads	0.25	0.31	0.41	0.45	0.70	3.07
Cumulative FFC Emissions Reduction						
CO_2 (*million metric tons*)	8.6	10.4	13.7	15.0	28.9	155.5
CH_4 (*thousand tons*)	66.4	78.9	102.2	111.4	284.4	1,840.2
N_2O (*thousand tons*)	0.1	0.1	0.1	0.1	0.2	0.4
NO_X (*thousand tons*)	23.4	26.2	31.4	33.5	240.8	488.5
SO_2 (*thousand tons*)	3.2	4.0	5.4	6.0	6.0	7.6
Hg (*tons*)	0.02	0.03	0.03	0.04	0.04	0.04
Present Value of Monetized Benefits and Costs (3% discount rate, billion 2021$)						
Consumer Operating Cost Savings	1.7	2.1	2.8	3.1	4.3	15.7
Climate Benefits *	0.4	0.5	0.7	0.7	1.5	8.4
Health Benefits **	0.7	0.9	1.1	1.2	2.3	11.5
Total Benefits †	2.9	3.5	4.6	5.0	8.0	35.6
Consumer Incremental Product Costs ‡	0.1	0.2	0.3	0.6	1.3	6.1
Consumer Net Benefits	1.6	1.9	2.4	2.4	3.0	9.6
Total Net Benefits	2.7	3.3	4.3	4.4	6.7	29.5
Present Value of Monetized Benefits and Costs (7% discount rate, billion 2021$)						
Consumer Operating Cost Savings	0.8	0.9	1.2	1.3	1.8	6.7
Climate Benefits *	0.4	0.5	0.7	0.7	1.5	8.4
Health Benefits **	0.3	0.3	0.4	0.5	0.9	4.3
Total Benefits †	1.5	1.8	2.3	2.5	4.2	19.4
Consumer Incremental Product Costs ‡	0.1	0.1	0.2	0.3	0.7	3.1
Consumer Net Benefits	0.7	0.8	1.0	1.0	1.2	3.5
Total Net Benefits	1.4	1.7	2.2	2.2	3.5	16.3

Note: This table presents the costs and benefits associated with pool heaters shipped in 2028–2057. These results include benefits to consumers which accrue after 2057 from the products shipped in 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, but the Department does not have a single central SC–GHG point estimate. 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 Interagency Working Group on the Social Cost of Greenhouse Gases (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, but the Department does not have a single central SC–GHG point estimate. DOE emphasizes the importance and value of considering the benefits calculated using all four sets of SC–GHG estimates.

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

TABLE V.25—SUMMARY OF ANALYTICAL RESULTS FOR CONSUMER POOL HEATERS TSLs: MANUFACTURER AND CONSUMER IMPACTS

Category	TSL 1	TSL 2	TSL 3	TSL 4	TSL 5	TSL 6
Manufacturer Impacts						
Industry NPV (million 2021$) (No-new-standards case INPV = 585.7)	583.6–585.2	581.9–584.5	570.8–577.0	563.0–575.0	548.4–587.7	482.7–631.6
Industry NPV (% change)	(0.4)–(0.1)	(0.7)–(0.2)	(2.6)–(1.5)	(3.9)–(1.8)	(6.4)–0.3	(17.6)–7.8

TABLE V.25—SUMMARY OF ANALYTICAL RESULTS FOR CONSUMER POOL HEATERS TSLS: MANUFACTURER AND CONSUMER IMPACTS—Continued

Category	TSL 1	TSL 2	TSL 3	TSL 4	TSL 5	TSL 6
Consumer Average LCC Savings (2021$)						
Electric Pool Heaters	8,090	4,403	1,302	1,130	1,130	946
Gas-fired Pool Heaters	783	783	783	783	80	497
Shipment-Weighted Average *	8,090	4,403	1,302	1,276	748	728
Consumer Simple PBP (years)						
Electric Pool Heaters	0.3	0.4	0.4	0.5	0.5	0.6
Gas-fired Pool Heaters	0.2	0.2	0.2	0.2	2.3	4.2
Shipment-Weighted Average *	0.3	0.4	0.4	0.2	1.8	3.2
Percent of Consumers that Experience a Net Cost						
Electric Pool Heaters	1.1	2.3	22.4	45.3	45.3	62.9
Gas-fired Pool Heaters	0.2	0.2	0.2	0.2	39.1	72.6
Shipment-Weighted Average *	0.3	0.7	6.6	6.8	40.9	69.8

Parentheses indicate negative (-) values.
* Weighted by shares of each product class in total projected shipments in 2028.

DOE first considered TSL 6, which represents the max-tech efficiency levels for all product classes. Approximately 3.0 percent of electric pool heaters and 8.6 percent of gas-fired pool heaters are estimated to meet these levels in 2028 (as shown in Table IV.14 and Table IV.15). The max-tech efficiency levels are achieved using the most efficient heat pump technology for electric pool heaters and condensing technology for gas-fired pool heaters (as well as electrical upgrades to reduce the standby mode and off mode power consumption of electric pool heaters and gas-fired pool heaters). TSL 6 would save an estimated 3.07 quads of energy, an amount DOE considers significant. Under TSL 6, the NPV of consumer benefit would be $3.5 billion using a discount rate of 7 percent, and $9.6 billion using a discount rate of 3 percent.

The cumulative emissions reductions at TSL 6 are 156 Mt of CO_2, 7.6 thousand tons of SO_2, 489 thousand tons of NO_X, 0.04 tons of Hg, 1,840 thousand tons of CH_4, and 0.4 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 $8.4 billion. The estimated monetary value of the health benefits from reduced SO_2 and NO_X emissions at TSL 6 is $4.3 billion using a 7-percent discount rate and $11.5 billion using a 3-percent discount rate.

Using a 7-percent discount rate for consumer benefits and costs, health benefits from reduced SO_2 and NO_X emissions, and the 3-percent discount rate case for climate benefits from reduced GHG emissions, the estimated total NPV at TSL 6 is $16.3 billion. Using a 3-percent discount rate for all benefits and costs, the estimated total NPV at TSL 6 is $29.5 billion. The estimated total NPV is provided for additional information, however DOE primarily relies upon the NPV of consumer benefits when determining whether a proposed standard level is economically justified.

At TSL 6, the average LCC impact is a savings of $946 for electric pool heaters and $497 for gas-fired pool heaters. The simple payback period is 0.6 years for electric pool heaters and 4.2 years for gas-fired pool heaters. The fraction of consumers experiencing a net LCC cost is 62.9 percent for electric pool heaters and 72.6 percent for gas-fired pool heaters. This is driven largely by variation in hours of use across consumer subgroups.

At TSL 6, the projected change in INPV ranges from a decrease of $103.0 million to an increase of $45.9 million, which corresponds to a decrease of 17.6 percent and an increase of 7.8 percent, respectively. DOE estimates that industry must invest $126.4 million to comply with standards set at TSL 6. DOE estimates that approximately 8.6 percent of gas-fired consumer pool heater shipments and 3.0 percent of electric consumer pool heater shipments would meet the efficiency levels analyzed at TSL 6.

There are 18 consumer pool heater manufacturers that manufacture electric consumer pool heaters covered by this rulemaking. Only three electric consumer pool heater manufacturers currently offer a model that meets the efficiency level required at TSL 6 for electric consumer pool heaters. All other electric consumer pool heater models offered by consumer pool heater manufacturers do not meet the efficiency level required at TSL 6 for electric pool heaters covered by this rulemaking.

There are six consumer pool heater manufacturers that manufacture gas-fired consumer pool heaters covered by this rulemaking. One gas-fired consumer pool heater manufacturer currently offers one model that meets the efficiency level required at TSL 6 for gas-fired pool heaters. All other gas-fired consumer pool heater models offered by the other five gas-fired consumer pool heater manufacturers do not meet the efficiency level required at TSL 6 for gas-fired pool heaters covered by this rulemaking.

At TSL 6, most consumer pool heater manufacturers would be required to redesign every consumer pool heater model covered by this rulemaking. It is unclear if most manufacturers would have the engineering capacity to complete the necessary redesigns within the 5-year compliance period. If manufacturers require more than 5 years to redesign all their covered consumer pool heater models, they will likely prioritize redesigns based on sales volume.

The Secretary concludes that at TSL 6 for consumer pool heaters, 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 a high percentage of consumers, and the impacts on manufacturers, including the large conversion costs, profit margin impacts that could result in a large reduction in INPV, and the lack of manufacturers currently offering products meeting the efficiency levels required at this TSL, including most small businesses. A majority of electric pool heater consumers (62.9 percent) and gas-fired pool heater consumers (72.6 percent) would experience a net cost due to the increases in purchase costs. Only three consumer pool heater manufacturers offer models that meet the efficiency level required at TSL 6 for electric consumer pool heaters covered by this rulemaking, and only one consumer pool heater manufacturer offers models that meet the efficiency level required at TSL 6 for gas-fired consumer pool heaters covered by this rulemaking. Due to the limited amount of engineering resources each manufacturer has, it is unclear if most manufacturers will be able to redesign their entire product offerings of consumer pool heaters covered by this rulemaking in the 5-year compliance period. Lastly, only two small businesses offer consumer pool heater models that meet the efficiency levels required at TSL 6. No other small businesses offer any consumer pool heater models that meet the efficiency levels required at TSL 6. Consequently, the Secretary has concluded that TSL 6 is not economically justified.

DOE then considered TSL 5, which represents efficiency level 4 for electric consumer pool heaters and efficiency level 2 for gas-fired consumer pool heaters. Approximately 12.3 percent of electric pool heaters and 49.7 percent of gas-fired pool heaters are estimated to meet these levels in 2028 (as shown in Table IV.14 and Table IV.15). For electric pool heaters, this level utilizes heat pump technology. For gas-fired pool heaters, the level utilizes electronic ignition and blower driven gas/air mix (as shown in Table IV.6). TSL 5 would save an estimated 0.70 quads of energy, an amount DOE considers significant. Under TSL 5, the NPV of consumer benefit would be $1.2 billion using a discount rate of 7 percent, and $3.0 billion using a discount rate of 3 percent.

The cumulative emissions reductions at TSL 5 are 29 Mt of CO_2, 6.0 thousand tons of SO_2, 489 thousand tons of NO_X, 0.03 tons of Hg, 284 thousand tons of CH_4, and 0.4 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 $1.5 billion. The estimated monetary value of the health benefits from reduced SO_2 and NO_X emissions at TSL 5 is $0.9 billion using a 7-percent discount rate and $2.3 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 TSL 5 is $3.5 billion. Using a 3-percent discount rate for all benefits and costs, the estimated total NPV at TSL 5 is $6.7 billion. The estimated total NPV is provided for additional information, however DOE primarily relies upon the NPV of consumer benefits when determining whether a proposed standard level is economically justified.

At TSL 5, the average LCC impact is a savings of $1,130 for electric pool heaters and $80 for gas-fired pool heaters. The simple payback period is 0.5 years for electric pool heaters and 2.3 years for gas-fired pool heaters. The fraction of consumers experiencing a net LCC cost is 45.3 percent for electric pool heaters and 39.1 percent for gas-fired pool heaters.

At TSL 5, the projected change in INPV ranges from a decrease of $37.3 million to an increase of $2.0 million, which correspond to a decrease of 6.4 percent and an increase of 0.3 percent, respectively. DOE estimates that industry must invest $48.4 million to comply with standards set at TSL 5. DOE estimates that approximately 49.7 percent of gas-fired consumer pool heater shipments and 12.3 percent of electric consumer pool heater shipments would meet or exceed the efficiency levels analyzed at TSL 5. All 6 gas-fired consumer pool heater manufacturers and 10 of the 18 electric consumer pool heater manufacturers currently offer models that meet or exceed the efficiency levels required at TSL 5.

After considering the analysis and weighing the benefits and burdens, the Secretary has concluded that at a standard set at TSL 5 for consumer pool heaters would be economically justified. At this TSL, the average LCC savings for both electric and gas-fired pool heater consumers are positive. The FFC national energy savings are significant, and the NPV of consumer benefits is positive using both a 3-percent and 7-percent discount rate. Notably, the benefits to consumers outweigh the cost to manufacturers. At TSL 5, the NPV of consumer benefits, even measured at the more conservative discount rate of 7 percent, is over 32 times higher than the maximum estimated manufacturers' loss in INPV. The standard levels at TSL 5 are economically justified even without weighing the estimated monetary value of emissions reductions, representing $1.5 billion in climate benefits (associated with the average SC–GHG at a 3-percent discount rate), and $0.9 billion (using a 3-percent discount rate) or $2.3 billion (using a 7-percent discount rate) in health benefits.

Accordingly, the Secretary has concluded that TSL 5 would offer the maximum improvement in efficiency that is technologically feasible and economically justified and would result in the significant conservation of energy.

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 the maximum improvement in energy efficiency that is 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 new and amended energy conservation standards, DOE notes that, as compared to TSL 6, TSL 5 has higher average LCC savings for consumers of electric pool heaters, significantly smaller percentages of consumers of electric pool heaters and gas-fired pool heaters experiencing a net cost, a lower maximum decrease in INPV, and lower manufacturer conversion costs.

Although results are presented here in terms of TSLs, DOE analyzed and evaluated all possible ELs for each product class in its analysis. For both gas-fired pool heaters and electric pool heaters, TSL 5 is comprised of the highest efficiency level below max-tech. Therefore, DOE below considers the max-tech efficiency levels for both gas-fired pool heaters and electric pool heaters.

For gas-fired pool heaters, the max-tech efficiency level results in a large percentage of consumers that experience a net LCC cost due to the increases in purchase costs. While the average LCC would be positive, this is due to a small segment of consumers receiving the bulk of the benefits. Additionally, there would be a significant impact to manufacturers at EL 3, as most gas-fired pool heater manufacturers would be required to redesign every gas-fired pool heater model covered by this rulemaking. Most of the costs to manufacturers at TSL 6 is driven by the increased cost to gas-fired pool heater manufacturers, as indicated in the analysis in Section V.2. of this document. It is unclear if most manufacturers would have the engineering capacity to complete the necessary redesigns within the 5-year compliance period.

For electric pool heaters the max-tech efficiency level is currently only achieved by three of the 18 manufacturers, resulting in large conversion costs and potentially significant reductions in INPV. The max-tech efficiency level also results in a large percentage of consumers that experience a net LCC cost due to the increases in purchase costs.

Additionally, at the max-tech efficiency levels for both electric pool heaters and gas-fired pool heaters there is a substantial risk of manufacturers being unable to offer a competitive range of equipment across the range of input capacities currently available. The benefits of max-tech efficiency levels for electric pool heaters and gas-fired pool heaters do not outweigh the negative impacts to consumers and manufacturers. Therefore, DOE has concluded that the max-tech efficiency levels are not justified. The ELs one level below max-tech, representing the finalized standard levels in TSL 5, significantly reduce the number of consumers experiencing a net cost and reduce the potential decrease in INPV and conversion costs to the point where DOE has concluded these levels are economically justified, as discussed for TSL 5 in the preceding paragraphs.

Therefore, based on the previous considerations, DOE adopts the energy conservation standards for consumer pool heaters at TSL 5. The amended energy conservation standards for consumer pool heaters, which are expressed as TE_I, are shown in Table V.26.

DOE understands that pool heater use can vary widely depending on a number of factors, including climate, size of the pool, whether it serves as a commercial facility, and annual usage. As the annual usage increases, the economics of purchasing more-efficient pool heaters improve. For example, for high-usage pool heaters such as those serving recreation centers or indoor pool facilities that are operated year round, condensing pool heaters would provide higher than average utility bill savings as compared to the increase in first cost to purchase the more-efficient equipment. While DOE is not adopting a standard requiring condensing technology for gas-fired pool heaters in this final rule, DOE believes there is merit to voluntary programs and education campaigns highlighting the value of these more-efficient options for high-use pool heater operations, in terms of both the net cost savings available for such consumers and the public benefits flowing from the energy savings. DOE encourages trade associations and other groups representing consumers likely to have relatively higher annual usage of their pool heaters—such as hotels and other lodging facilities, gymnasiums and spas, community pools, and schools—to communicate with their members about the private and public benefits of considering more-efficient options and also to engage, to the extent appropriate, with manufacturers and distributors to discuss the market interest in more-efficient options. Outside the context of this final rule, DOE will consider whether it can facilitate further consumer education about these products. Related to these efforts, DOE may explore additional information collection such as notices of data availability (NODAs) or requests for information (RFIs) to further inform TSL analyses regarding hours of use assumptions and price elasticity variations across consumer subgroups. This information may be helpful both in improving underlying analyses including regarding distributional impacts in future ECS, and may also improve the effectiveness of agency outreach regarding voluntary adoption for high-use consumers of appliances.

Table V.26 Amended Energy Conservation Standards for Consumer Pool Heaters

Product Class	Integrated Thermal Efficiency TE_I† (*percent*)
Electric Pool Heater	$\frac{600PE}{PE + 1{,}619}$
Gas-Fired Pool Heater	$\frac{84(Q_{IN} + 491)}{Q_{IN} + 2{,}536}$

†PE is the active electrical power for consumer pool heaters and Q_{IN} is the input capacity as determined in accordance with the DOE test procedure in appendix P.

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 2021$) of the benefits from operating products that meet the adopted standards (consisting primarily of operating cost savings from using less energy), minus increases in product purchase costs, and (2) the annualized monetary value of the climate and health benefits.

Table V.27 shows the annualized values for consumer pool heaters under TSL 5, expressed in 2021$. 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 $74.1 per year in increased equipment costs, while the estimated annual benefits are $208.0 million in reduced equipment operating costs, $88.3 million in climate benefits, and $97.7 million in health benefits. In this case, the net benefit will amount to $319.8 million per year.

Using a 3-percent discount rate for all benefits and costs, the estimated cost of the standards is $75.3 million per year in increased equipment costs, while the estimated annual benefits are $252.7 million in reduced operating costs, $88.3 million in climate benefits, and $133.1 million in health benefits. In this case, the net benefit will amount to $398.8 million per year.

TABLE V.27—ANNUALIZED MONETIZED BENEFITS AND COSTS OF ADOPTED STANDARDS (TSL 5) FOR CONSUMER POOL HEATERS

	Million 2021$/year		
	Primary estimate	Low-net-benefits estimate	High-net-benefits estimate
3% discount rate			
Consumer Operating Cost Savings	252.7	238.5	270.0
Climate Benefits *	88.3	85.3	91.2
Health Benefits **	133.1	128.8	137.6
Total Benefits †	474.1	452.6	498.7
Consumer Incremental Product Costs ‡	75.3	76.5	73.4
Net Monetized Benefits	398.8	376.1	425.4
7% discount rate			
Consumer Operating Cost Savings	208.0	197.5	220.3
Climate Benefits * (3% discount rate)	88.3	85.3	91.2
Health Benefits **	97.7	94.8	100.7
Total Benefits †	393.9	377.6	412.2
Consumer Incremental Product Costs ‡	74.1	74.6	73.2
Net Monetized Benefits	319.8	303.0	339.1

VI. Procedural Issues and Regulatory Review

A. Review Under Executive Orders 12866 and 13563

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), 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 this preamble, this final regulatory action is consistent with these principles.

Section 6(a) of E.O. 12866 also requires agencies to submit ''significant regulatory actions'' to OIRA for review. OIRA has determined that this final regulatory action constitutes a ''significant regulatory action'' within the scope of section 3(f)(1) of E.O. 12866. Accordingly, pursuant to section 6(a)(3)(C) of E.O. 12866, DOE has provided to OIRA an assessment, including the underlying analysis, of benefits and costs anticipated from the final regulatory action, together with, to the extent feasible, a quantification of those costs; and an assessment, including the underlying analysis, of costs and benefits of potentially effective and reasonably feasible alternatives to the planned regulation, and an explanation why the planned regulatory action is preferable to the identified potential alternatives. These assessments are summarized in this preamble and further detail can be found in the technical support document for this rulemaking.

B. Review Under the Regulatory Flexibility Act

The Regulatory Flexibility Act (5 U.S.C. 601 *et seq.*) requires preparation of an initial regulatory flexibility analysis (''IRFA'') and a final regulatory flexibility analysis (''FRFA'') for any rule that by law must be proposed for public comment, unless the agency certifies that the rule, if promulgated, will not have a significant economic impact on a substantial number of small entities. As required by E.O. 13272, ''Proper Consideration of Small Entities in Agency Rulemaking,'' 67 FR 53461 (Aug. 16, 2002), DOE published procedures and policies on February 19, 2003, to ensure that the potential impacts of its rules on small entities are properly considered during the rulemaking process. 68 FR 7990. DOE has made its procedures and policies available on the Office of the General Counsel's website (*www.energy.gov/gc/office-general-counsel*). DOE has prepared the following FRFA for the products that are the subject of this rulemaking.

For manufacturers of consumer pool heaters, the SBA has set a size threshold, which defines those entities classified as ''small businesses'' for the purposes of the statute. DOE used the SBA's small business size standards to determine whether any small entities would be subject to the requirements of the rule. (*See* 13 CFR part 121.) The size standards are listed by North American Industry Classification System (''NAICS'') code and industry description and are available at *www.sba.gov/document/support-table-size-standards.* Manufacturing of consumer pool heaters is classified under NAICS 333414, ''Heating Equipment (except Warm Air Furnaces) Manufacturing.'' The SBA sets a threshold of 500 employees or fewer for an entity to be considered as a small business for this category.

1. Description of Reasons Why Action Is Being Considered

DOE has undertaken this rulemaking pursuant to 42 U.S.C. 6295(e)(4)(B), which requires DOE to conduct a second round of amended standards rulemaking for consumer pool heaters. The Energy Policy and Conservation Act, as amended (EPCA), also requires that not later than six years after issuance of any final rule establishing or amending a standard, DOE must publish either a notice of the determination that standards for the product do not need to be amended, or a notice of proposed rulemaking including new proposed energy conservation standards. (42 U.S.C. 6295(m)(1)) This rulemaking is in accordance with DOE's obligations under EPCA.

2. Objectives of, and Legal Basis for, Rule

As discussed previously in section II, Title III, Part B of EPCA, sets forth a variety of provisions designed to improve energy efficiency and established the Energy Conservation Program for Consumer Products Other Than Automobiles, a program covering most major household appliances and certain industrial and commercial equipment. The National Appliance Energy Conservation Act of 1987 (NAECA), Public Law 100–12, amended EPCA to establish energy conservation standards for residential pool heaters and set requirements to conduct two cycles of rulemaking to determine whether these standards should be amended. (42 U.S.C. 6295(e)(2) and (4)) The first of these two rulemakings, which amended standards for gas-fired pool heaters, concluded with the promulgation of a final rule on April 16, 2010. 75 FR 20112. (Codified at 10 CFR 430.32(k)). This rulemaking satisfies the statutory requirements under EPCA to conduct a second round of review of the pool heaters standard. (42 U.S.C. 6295(e)(4)(B)) This rulemaking is also in accordance the six-year review required under 42 U.S.C. 6295(m)(1).

3. Description on Estimated Number of Small Entities Regulated

For manufacturers of consumer pool heaters, the SBA has set a size threshold, which defines those entities classified as ''small businesses'' for the purposes of the statute. DOE used the SBA's small business size standards to determine whether any small entities would be subject to the requirements of this proposed rule. *See* 13 CFR part 121. The size standards are listed by NAICS code and industry description and are available at *www.sba.gov/document/support-table-size-standards.*

Manufacturing of consumer pool heaters is classified under NAICS code 333414, ''heating equipment (except warm air furnaces) manufacturing.'' The SBA sets a threshold of 500 employees or fewer for an entity to be considered as a small business for this category.

DOE reviewed the potential standard levels considered in this final rule under the provisions of the Regulatory Flexibility Act and the procedures and policies published on February 19, 2003. During its market survey, DOE used publicly available information to identify potential small manufacturers. DOE's research involved industry trade association membership directories (*e.g.,* AHRI), information from previous rulemakings, individual company websites, and market research tools (*e.g.,* D&B Hoover's reports) to create a list of companies that manufacture consumer pool heaters. DOE also asked stakeholders and industry representatives if they were aware of any additional small manufacturers during manufacturer interviews. DOE reviewed publicly available data and contacted various companies on its complete list of manufacturers to determine whether they met the SBA's definition of a small business manufacturer. DOE screened out companies that do not offer products impacted by this rulemaking, do not meet the definition of a ''small business,'' or are foreign owned and operated.

DOE identified 20 companies manufacturing consumer pool heaters covered by this rulemaking. Of these manufacturers, DOE identified six companies that meet SBA's definition of a small business. All six domestic small businesses only manufacture electric pool heaters. DOE did not identify any domestic small businesses that manufacture gas-fired pool heaters.

DOE was able to reach and discuss potential standards with two of the six small businesses. Additionally, DOE requested information about small businesses and potential impacts on small businesses while interviewing large manufacturers.

Gas-fired pool heaters account for most of the consumer pool heater market, with approximately 72 percent of all consumer pool heater units shipped annually. Within the electric consumer pool heater market, approximately 92 percent of shipments are heat pump pool heaters and only a small fraction of the shipments are electric resistance consumer pool heaters. (See chapter 9 of the final rule TSD for more information on the shipments analysis conducted for this rulemaking.) Although the electric consumer pool heater market is smaller than the gas-fired consumer pool heater market, it is also more fragmented. Whereas DOE identified six manufacturers of gas-fired consumer pool heaters, DOE identified 18 manufacturers of electric consumer pool heaters (four of the companies make both gas-fired and electric consumer pool heaters).

Four manufacturers dominate the market for electric pool heaters, three large manufacturers and one small business. The rest of the market is served by a combination of large and small businesses with market shares estimated to be in the single digits. Of these manufacturers, DOE identified six as domestic small businesses. All six domestic small businesses only manufacture electric pool heaters. Of those six, five only manufacture electric heat pump pool heaters. The other small business only manufactures electric resistance pool heaters. DOE did not identify any domestic small businesses that manufacture gas-fired pool heaters.

4. Description and Estimate of Compliance Requirements Including Differences in Cost, if Any, for Different Groups of Small Entities

As stated previously, DOE identified six small manufacturers of electric consumer pool heaters and no small manufacturers of gas-fired consumer pool heaters. Accordingly, this analysis of small business impacts focuses exclusively on the electric consumer pool heater industry.

This final rule adopts minimum energy conservation standards for electric consumer pool heaters at efficiency levels above those capable of being achieved by electric resistance pool heaters. Given that the designs of electric heat pump pool heaters and electric resistance pool heaters use different types of technology, DOE assumes manufacturers of electric resistance consumer pool heaters would discontinue those electric resistance consumer pool heater models rather than redesign them as electric heat pump consumer pool heaters. As a result, expected impacts on manufacturers vary based on the type of electric consumer pool heaters they manufacture.

As described in section IV.J.2.c of this document, there are two types of conversion costs that small businesses could incur due to the adopted standard for electric consumer pool heaters: product conversion costs and capital conversion costs. Product conversion costs are investments in R&D, testing, marketing, and other non-capitalized costs necessary to make product designs comply with new and amended energy conservation standards. 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. Manufacturers will only need to make these investments if they have products that do not meet the adopted energy conservation standards. Testing costs are costs manufacturers must make to test their electric consumer pool heaters in accordance with DOE's test procedure to demonstrate compliance with adopted energy conservation standards. Manufacturers must do this for all compliant electric consumer pool heaters that are in the scope of this rulemaking.

DOE estimates there are two small businesses that do not have any electric heat pump consumer pool heater models that would meet the adopted standard for electric consumer pool heaters. DOE applied the conversion cost methodology described in section IV.J.2.c of this document to calculate each small business's estimate product and capital conversion costs. To calculate product conversion costs, DOE estimated it would take 12 months of engineering time to redesign a single electric heat pump consumer pool heater model to meet the adopted standards for electric consumer pool heater (EL 4). DOE estimates that there are approximately 50 electric heat pump consumer pool heater unique basic models manufactured by small businesses that may need to be redesigned to comply with the adopted energy conservation standard for electric consumer pool heaters. To calculate capital conversion costs DOE estimates that most small businesses would need to make investments in tooling to accommodate electric heat pump consumer pool heater models with a larger evaporator. Small business conversion costs are presented in Table VI.1.

The five small businesses that manufacture electric heat pump consumer pool heaters would incur testing costs to demonstrate compliance in accordance with DOE's test procedure to the electric consumer pool heater energy conservation standard. Electric consumer pool heaters are currently not subject to a DOE energy conservation standard. This final rule establishes new energy conservation standards for electric consumer pool heaters. Therefore, all manufacturers, including small businesses, will have to test all electric consumer pool heaters that are subject to this rulemaking after the compliance date of the energy conservation standards established in this final rule. DOE estimates that small businesses manufacture approximately 65 unique basic models of electric heat pump consumer pool heaters. All 65 electric heat pump consumer pool heater models will need to be tested after the compliance date. DOE estimates a per model testing cost for these electric heat pump consumer pool heater models of approximately $6,500 per model. Small business conversion and testing costs are presented in Table VI.1.

TABLE VI.1—SMALL BUSINESS COSTS

	Small business costs (2021$ millions)	Average cost per small business (2021$ millions)
Product Conversion Costs	6.35	1.27
Capital Conversion Costs	0.65	0.13
Testing Costs for Compliance	0.42	0.08
Total Small Business Costs	7.42	1.48

DOE estimates the average small business will incur approximately $1.48 million per small business. DOE assumes that all consumer pool heater manufacturers would spread these costs over the five-year compliance timeframe, as compliance with the standards adopted in this final rule is required within five years after the publication of this document. Therefore, DOE assumes that the average consumer pool heater small business would incur on average $296,000 annually in each of the five years leading up to the compliance date for consumer pool heaters. Using publicly available data, DOE estimated the average annual revenue of the five small businesses that manufacturer electric heat pump consumer pool heaters to be $13.7 million. Table VI.2 compares these average small business costs to average annual revenue of small businesses.

TABLE VI.2—AVERAGE SMALL BUSINESS COSTS COMPARED TO ANNUAL REVENUE

	Estimated compliance costs (2021$ millions)	Annual revenue (2021$ millions)	Compliance costs as a percent of annual revenue (%)	5 Years of revenue (2021$ millions)	Compliance costs as a percent of 5 years of revenue (%)
Average Small Business	1.48	13.7	10.8	68.5	2.2

Lastly, for the one small business that manufactures only electric resistance consumer pool heaters, based on public company literature, this small business manufactures approximately nine electric resistance consumer pool heaters that would not be able to meet the adopted energy conservation standards for electric consumer pool heaters and therefore would no longer be allowed to sell these products in the United States. This small business also manufactures electric resistance spa heaters and commercial electric resistance heating products that would still be allowed to be sold in the United States, even after the compliance date of this final rule. This manufacturer's business and competitive position in the electric consumer pool heater market will be negatively impacted, since the adopted standards result in a minimum efficiency level that is not feasible for electric resistance pool heaters to achieve. This small business does not offer any compliant consumer pool heater products that could serve as a replacement product for the non-compliant electric resistance consumer pool heaters. However, this small business can still sell electric resistance spa heaters in the United States and will still be able to export electric resistance consumer pool heaters to other countries, including into Canada.

5. Duplication, Overlap, and Conflict with Other Rules and Regulations

DOE is not aware of any rules or regulations that duplicate, overlap, or conflict with the rule being considered here.

6. Significant Alternatives to the Rule

The discussion in the previous section analyzes impacts on small businesses that would result from the adopted standards, represented by TSL 5. In reviewing alternatives to the adopted standards, DOE examined energy conservation standards set at lower efficiency levels. While TSL 1, TSL 2, TSL 3, and TSL 4 would reduce the impacts on small business manufacturers, it would come at the expense of a reduction in energy savings. TSL 1 achieves 64 percent lower energy savings compared to the energy savings at TSL 5 and between 42 percent and 47 percent lower consumer NPV savings compared to the consumer NPV savings at TSL 5 (at a 3 percent discount rate and a 7 percent discount rate respectively); TSL 2 achieves 56 percent lower energy savings compared to the energy savings at TSL 5 and between 33 percent and 37 percent lower consumer NPV savings compared to the consumer NPV savings at TSL 5 (at a 3 percent discount rate and a 7 percent discount rate respectively); TSL 3 achieves 42 percent lower energy savings compared to the energy savings at TSL 5 and between 17 percent and 20 percent lower consumer NPV savings compared to the consumer NPV savings at TSL 5 (at a 3 percent discount rate and a 7 percent discount rate respectively); TSL 4 achieves 36 percent lower energy savings compared to the energy savings at TSL 5 and between 17 percent and 20 percent lower consumer NPV savings compared to the consumer NPV savings at TSL 5 (at a 3 percent discount rate and a 7 percent discount rate respectively).

Establishing standards at TSL 5 balances the benefits of the energy savings at TSL 5 with the potential burdens placed on consumer pool heaters manufacturers, including small business manufacturers. Accordingly, DOE is not adopting one of the other TSLs considered in the analysis, or the other policy alternatives examined as part of the regulatory impact analysis and included in chapter 17 of the final rule TSD.

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

C. Review Under the Paperwork Reduction Act

Manufacturers of consumer pool heaters must certify to DOE that their products comply with any applicable energy conservation standards. In certifying compliance, manufacturers must test their products according to the DOE test procedures for consumer pool heaters, including any amendments adopted for those test procedures. DOE has established regulations for the certification and recordkeeping requirements for all covered consumer products and commercial equipment, including consumer pool heaters. (*See* generally 10 CFR part 429). The collection-of-information requirement for the certification and recordkeeping is subject to review and approval by OMB under the Paperwork Reduction Act (''PRA''). This requirement has been approved by OMB under OMB control number 1910–1400. Public reporting burden for the certification is estimated to average 35 hours per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information.

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

D. Review Under the National Environmental Policy Act of 1969

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

E. Review Under Executive Order 13132

E.O. 13132, ''Federalism,'' 64 FR 43255 (Aug. 10, 1999), imposes certain requirements on Federal agencies formulating and implementing policies or regulations that preempt State law or that have federalism implications. The Executive order requires agencies to examine the constitutional and statutory authority supporting any action that would limit the policymaking discretion of the States and to carefully assess the necessity for such actions. The Executive order also requires agencies to have an accountable process to ensure meaningful and timely input by State and local officials in the development of regulatory policies that have federalism implications. On March 14, 2000, DOE published a statement of policy describing the intergovernmental consultation process it will follow in the development of such regulations. 65 FR 13735. DOE has examined this rule and has determined that it would not have a substantial direct effect on the States, on the relationship between the national government and the States, or on the distribution of power and responsibilities among the various levels of government. EPCA governs and prescribes Federal preemption of State regulations as to energy conservation for the products that are the subject of this final rule. States can petition DOE for exemption from such preemption to the extent, and based on criteria, set forth in EPCA. (42 U.S.C. 6297) Therefore, no further action is required by Executive Order 13132.

F. Review Under Executive Order 12988

With respect to the review of existing regulations and the promulgation of new regulations, section 3(a) of E.O. 12988, ''Civil Justice Reform,'' imposes on Federal agencies the general duty to adhere to the following requirements: (1) eliminate drafting errors and ambiguity, (2) write regulations to minimize litigation, (3) provide a clear legal standard for affected conduct rather than a general standard, and (4) promote simplification and burden reduction. 61 FR 4729 (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 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 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 pool heaters manufacturers in the years between the final rule and the compliance date for the new standards and (2) incremental additional expenditures by consumers to purchase higher-efficiency consumer pool heaters, starting at the compliance date for the applicable standard.

Section 202 of UMRA authorizes a Federal agency to respond to the content requirements of UMRA in any other statement or analysis that accompanies the final rule. (2 U.S.C. 1532(c)) The content requirements of section 202(b) of UMRA relevant to a private sector mandate substantially overlap the economic analysis requirements that apply under section 325(o) of EPCA and Executive Order 12866. This **SUPPLEMENTARY INFORMATION** section and the TSD for this 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(e)(4)(B) and 42 U.S.C. 6295(m), this final rule establishes new and amended energy conservation standards for consumer pool heaters that are designed to achieve the maximum improvement in energy efficiency that DOE has determined to be both technologically feasible and economically justified, as required by 42 U.S.C. 6295(o)(2)(A) and 6295(o)(3)(B). A full discussion of the alternatives considered by DOE is presented in chapter 17 of the TSD for this final rule.

H. Review Under the Treasury and General Government Appropriations Act, 1999

Section 654 of the Treasury and General Government Appropriations Act, 1999 (Pub. L. 105–277) requires Federal agencies to issue a Family Policymaking Assessment for any rule that may affect family well-being. This rule would not have any impact on the autonomy or integrity of the family as an institution. Accordingly, DOE has concluded that it is not necessary to prepare a Family Policymaking Assessment.

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 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 new and amended energy conservation standards for consumer pool heaters, is not a significant energy action because the standards are not likely to have a significant adverse effect on the supply, distribution, or use of energy, nor has it been designated as such by the Administrator at OIRA. Accordingly, DOE has not prepared a Statement of Energy Effects on this final rule.

L. Information Quality

On December 16, 2004, OMB, in consultation with the Office of Science and Technology Policy (''OSTP''), issued its Final Information Quality Bulletin for Peer Review (''the Bulletin''). 70 FR 2664 (Jan. 14, 2005). The Bulletin establishes that certain scientific information shall be peer reviewed by qualified specialists before it is disseminated by the Federal Government, including influential scientific information related to agency regulatory actions. The purpose of the Bulletin is to enhance the quality and credibility of the Government's scientific information. Under the Bulletin, the energy conservation standards rulemaking analyses are ''influential scientific information,'' which the Bulletin defines as ''scientific information the agency reasonably can determine will have, or does have, a clear and substantial impact on important public policies or private sector decisions.'' 70 FR 2664, 2667.

In response to OMB's Bulletin, DOE conducted formal peer reviews of the energy conservation standards development process and the analyses that are typically used and prepared a report describing that peer review.[173] Generation of this report involved a rigorous, formal, and documented evaluation using objective criteria and qualified and independent reviewers to make a judgment as to the technical/scientific/business merit, the actual or anticipated results, and the productivity and management effectiveness of programs and/or projects. Because available data, models, and technological understanding have changed since 2007, DOE has engaged with the National Academy of Sciences to review DOE's analytical methodologies to ascertain whether modifications are needed to improve the Department's analyses. DOE is in the process of evaluating the resulting report.[174]

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 it has been determined that the rule is a ''major rule'' as defined by 5 U.S.C. 804(2).

The following standards included in this final rule were previously approved for incorporation by reference for the locations in which they appear in the regulatory text: ANSI Z21.56 and ASHRAE 146.

VII. Approval of the Office of the Secretary

The Secretary of Energy has approved publication of this final rule.

List of Subjects

10 CFR Part 429

Administrative practice and procedure, Confidential business information, Energy conservation, Household appliances, Reporting and recordkeeping requirements.

10 CFR Part 430

Administrative practice and procedure, Confidential business information, Energy conservation, Household appliances, Imports, Incorporation by reference, Intergovernmental relations, Reporting and recordkeeping requirements, Small businesses.

[173] The 2007 ''Energy Conservation Standards Rulemaking Peer Review Report'' is available at the following website: *energy.gov/eere/buildings/downloads/energy-conservation-standards-rulemaking-peer-review-report-0* (last accessed October 17, 2022).

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

Signing Authority

This document of the Department of Energy was signed on March 30, 2023, by Francisco Alejandro Moreno, Acting 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 May 17, 2023.

Treena V. Garrett,

Federal Register Liaison Officer, U.S. Department of Energy.

For the reasons stated in the preamble, DOE amends parts 429 and 430 of chapter II, subchapter D, of title 10 of the Code of Federal Regulations, as set forth below:

PART 429—CERTIFICATION, COMPLIANCE, AND ENFORCEMENT FOR CONSUMER PRODUCTS AND COMMERCIAL AND INDUSTRIAL EQUIPMENT

■ 1. The authority citation for part 429 continues to read as follows:

Authority: 42 U.S.C. 6291–6317; 28 U.S.C. 2461 note.

■ 2. Amend § 429.134 by adding paragraph (cc) to read as follows:

§ 429.134 Product-specific enforcement provisions.

* * * * *

(cc) *Pool heaters.* Beginning on May 30, 2028:

(1) *Verification of input capacity for gas-fired pool heaters.* The input capacity of each tested unit will be measured pursuant to the test requirements of § 430.23(p) of this subchapter. The results of the measurement(s) will be compared to the represented value of input capacity certified by the manufacturer for the basic model. The certified input capacity will be considered valid only if the measurement(s) (either the measured input capacity for a single unit sample or the average of the measured input capacity for a multiple unit sample) is within two percent of the certified input capacity.

(i) If the representative value of input capacity is found to be valid, the certified input capacity will serve as the basis for determination of the applicable standard and the mean measured input capacity will be used as the basis for calculation of the integrated thermal efficiency standard for the basic model.

(ii) If the representative value of input capacity is not within two percent of the certified input capacity, DOE will first attempt to increase or decrease the gas pressure within the range specified in manufacturer's installation and operation manual shipped with the gas-fired pool heater being tested to achieve the certified input capacity (within two percent). If the input capacity is still not within two percent of the certified input capacity, DOE will attempt to modify the gas inlet orifice. If the input capacity still is not within two percent of the certified input capacity, the mean measured input capacity (either for a single unit sample or the average for a multiple unit sample) determined from the tested units will serve as the basis for calculation of the integrated thermal efficiency standard for the basic model.

(2) *Verification of active electrical power for electric pool heaters.* The active electrical power of each tested unit will be measured pursuant to the test requirements of § 430.23 of this subchapter. The results of the measurement(s) will be compared to the represented value of active electrical power city certified by the manufacturer for the basic model. The certified active electrical power will be considered valid only if the measurement(s) (either the measured active electrical power for a single unit sample or the average of the measured active electrical power for a multiple unit sample) is within five percent of the certified active electrical power.

(i) If the representative value of active electrical power is found to be valid, the certified active electrical power will serve as the basis for determination of the applicable standard and the mean measured active electrical power will be used as the basis for calculation of the integrated thermal efficiency standard for the basic model.

(ii) If the representative value of active electrical power is not within five percent of the certified active electrical power, the mean measured active electrical power (either for a single unit sample or the average for a multiple unit sample) determined from the tested units will serve as the basis for calculation of the integrated thermal efficiency standard for the basic model.

PART 430—ENERGY CONSERVATION PROGRAM FOR CONSUMER PRODUCTS

■ 3. The authority citation for part 430 continues to read as follows:

Authority: 42 U.S.C. 6291–6309; 28 U.S.C. 2461 note.

■ 4. Amend § 430.2 by adding in alphabetical order definitions for ''Electric pool heater'', ''Electric spa heater'', ''Gas-fired pool heater'', and ''Oil-fired pool heater'' to read as follows:

§ 430.2 Definitions.

* * * * *

Electric pool heater means a pool heater other than an electric spa heater that uses electricity as its primary energy source.

* * * * *

Electric spa heater means a pool heater that—

(1) Uses electricity as its primary energy source;

(2) Has an output capacity (as measured according to appendix P to subpart B of part 430) of 11 kW or less; and

(3) Is designed to be installed within a portable electric spa.

* * * * *

Gas-fired pool heater means a pool heater that uses gas as its primary energy source.

* * * * *

Oil-fired pool heater means a pool heater that uses oil as its primary energy source.

* * * * *

■ 5. Appendix P of subpart B of part 430 is amended by:

■ a. Revising the introductory note;

■ b. Revising sections 1., 5.2, and 5.3; and

■ c. Adding sections 5.5, 5.5.1, and 5.5.2;

The revisions and additions read as follows:

Appendix P to Subpart B of Part 430—Uniform Test Method for Measuring the Energy Consumption of Pool Heaters

Note: On and after November 27, 2023, any representations made with respect to the energy use or efficiency of all pool heaters must be made in accordance with the results of testing pursuant to this appendix. Until November 27, 2023, manufacturers must test gas-fired pool heaters in accordance with this appendix, or appendix P as it appeared at 10 CFR part 430, subpart B revised as of January 1, 2021. Prior to November 27, 2023, if a manufacturer makes representations of standby mode and off mode energy consumption, then testing must also include the provisions of this appendix, or appendix P as it appeared at 10 CFR part 430, subpart B revised as of January 1, 2021, related to standby mode and off mode energy consumption.

1. *Definitions:*

Active electrical power means the maximum electrical power consumption in active mode for an electric pool heater.

Active mode means the condition during the pool heating season in which the pool heater is connected to the power source, and the main burner, electric resistance element, or heat pump is activated to heat pool water.

Coefficient of performance (COP), as applied to heat pump pool heaters, means the ratio of heat output in kW to the total power input in kW.

Electric heat pump pool heater means an appliance designed for heating nonpotable water and employing a compressor, water-cooled condenser, and outdoor air coil.

Electric resistance pool heater means an appliance designed for heating nonpotable water and employing electric resistance heating elements.

Fossil fuel-fired pool heater means an appliance designed for heating nonpotable water and employing gas or oil burners.

Hybrid pool heater means an appliance designed for heating nonpotable water and employing both a heat pump (compressor, water-cooled condenser, and outdoor air coil) and a fossil fueled burner as heating sources.

Input capacity means the maximum fuel input rate for a fossil fuel-fired pool heater.

Off mode means the condition during the pool non-heating season in which the pool heater is connected to the power source, and neither the main burner, nor the electric resistance elements, nor the heat pump is activated, and the seasonal off switch, if present, is in the ''off'' position.

Output capacity for an electric pool or spa heater means the maximum rate at which energy is transferred to the water.

Seasonal off switch means a switch that results in different energy consumption in off mode as compared to standby mode.

Standby mode means the condition during the pool heating season in which the pool heater is connected to the power source, and neither the main burner, nor the electric resistance elements, nor the heat pump is activated.

* * * * *

5.2 *Average annual fossil fuel energy for pool heaters.* For electric resistance and electric heat pump pool heaters, the average annual fuel energy for pool heaters, $E_F = 0$.

For fossil fuel-fired pool heaters, the average annual fuel energy for pool heaters, E_F, is defined as:

$$E_F = BOH\ Q_{IN} + (POH - BOH)\ Q_{PR} + (8760 - POH)\ Q_{off,R}$$

Where:

BOH = average number of burner operating hours = 104 h,

POH = average number of pool operating hours = 4,464 h,

Q_{IN} = input capacity, in Btu/h, calculated as the quantity CF x Q x H in the equation for thermal efficiency in section 2.10.1 of ANSI Z21.56 (incorporated by reference; see § 430.3) and divided by 0.5 h (For electric resistance and electric heat pump pool heaters, $Q_{IN} = 0$.),

Q_{PR} = average energy consumption rate of continuously operating pilot light, if employed, = (Q_P/1 h),

Q_P = energy consumption of continuously operating pilot light, if employed, as measured in section 4.2 of this appendix, in Btu,

8760 = number of hours in one year,

$Q_{off,R}$ = average off mode fossil fuel energy consumption rate = Q_{off}/(1 h), and

Q_{off} = off mode energy consumption as defined in section 4.3 of this appendix.

5.3 *Average annual electrical energy consumption for pool heaters.* The average annual electrical energy consumption for pool heaters, E_{AE}, is expressed in Btu and defined as:

(1) $E_{AE} = E_{AE,active} + E_{AE,standby,off}$

(2) $E_{AE,active} = BOH * PE$

(3) $E_{AE,standby,off} = (POH - BOH)\ P_{W,SB}(Btu/h) + (8760 - POH)\ P_{W,OFF}(Btu/h)$

where:

$E_{AE,active}$ = electrical consumption in the active mode,

$E_{AE,standby,off}$ = auxiliary electrical consumption in the standby mode and off mode,

PE = active electrical power, calculated as:

= $2E_c$, for fossil fuel-fired heaters tested according to section 2.10.1 of ANSI Z21.56 and for electric resistance pool heaters, in Btu/h,

= 3.412 $PE_{aux,rated}$, for fossil fuel-fired heaters tested according to section 2.10.2 of ANSI Z21.56, in Btu/h,

= $E_{c,HP}$ * (60/t_{HP}), for electric heat pump pool heaters, in Btu/h.

E_c = electrical consumption in Btu per 30 min. This includes the electrical consumption (converted to Btus) of the pool heater and, if present, a recirculating pump during the 30-minute thermal efficiency test. The 30-minute thermal efficiency test is defined in section 2.10.1 of ANSI Z21.56 for fossil fuel-fired pool heaters and section 9.1.4 of ASHRAE 146 (incorporated by reference; see § 430.3) for electric resistance pool heaters. 2 = conversion factor to convert unit from per 30 min. to per h.

$PE_{aux,rated}$ = nameplate rating of auxiliary electrical equipment of heater, in Watts

$E_{c,HP}$ = electrical consumption of the electric heat pump pool heater (converted to equivalent unit of Btu), including the electrical energy to the recirculating pump if used, during the thermal efficiency test, as defined in section 9.1 of ASHRAE 146, in Btu.

t_{HP} = elapsed time of data recording during the thermal efficiency test on electric heat pump pool heater, as defined in section 9.1 of ASHRAE 146, in minutes.

BOH = as defined in section 5.2 of this appendix,

POH = as defined in section 5.2 of this appendix,

$P_{W,SB}$ (Btu/h) = electrical energy consumption rate during standby mode expressed in Btu/h = 3.412 $P_{W,SB}$, Btu/h,

$P_{W,SB}$ = as defined in section 4.2 of this appendix,

$P_{W,OFF}$ (Btu/h) = electrical energy consumption rate during off mode expressed in Btu/h = 3.412 $P_{W,OFF}$, Btu/h, and

$P_{W,OFF}$ = as defined in section 4.3 of this appendix.

* * * * *

5.5 *Output capacity for electric pool heaters.*

5.5.1 Calculate the output capacity of an electric heat pump pool heater as:

$Q_{OUT,HP} = k * W * (T_{ohp} - T_{ihp}) * (60/t_{HP})$

where k is the specific heat of water, W is the mass of water collected during the test, T_{ohp} is the average outlet water temperature during the standard rating test, T_{ihp} is the average inlet water temperature during the standard rating test, all as defined in section 11.2 of ASHRAE 146, and t_{HP} is the elapsed time in minutes of data recording during the thermal efficiency test on electric heat pump pool heater, as defined in section 9.1 of ASHRAE 146.

5.5.2 Calculate the output capacity of an electric resistance pool heater as:

$Q_{OUT,ER} = k * W * (T_{mo} - T_{mi}) * (60/30)$

where k is the specific heat of water, W is the mass of water collected during the test, T_{mo} is the average outlet water temperature recorded during the primary test, and T_{mi} is the average inlet water temperature record during the primary test, all as defined in section 11.1 of ASHRAE 146, and 60/30 is the conversion factor to convert unit from per 30 minutes to per hour.

■ 6. Amend § 430.32 by revising paragraph (k) to read as follows:

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

* * * * *

(k) *Pool heaters.* (1) Gas-fired pool heaters manufactured on and after April 16, 2013 and before May 30, 2028, shall have a thermal efficiency not less than 82%.

(2) Gas-fired pool heaters and electric pool heaters manufactured on and after May 30, 2028, shall have an integrated thermal efficiency not less than the following:

Product Class	Integrated Thermal Efficiency (percent)
Gas-fired Pool Heater	$\frac{84(Q_{IN} + 491)}{Q_{IN} + 2{,}536}$
Electric Pool Heater	$\frac{600PE}{PE + 1{,}619}$

where Q_{IN} is the certified input capacity of a gas-fired pool heater basic model, in Btu/h, and PE is the certified active electrical power of an electric pool heater, in Btu/h.

* * * * *

Note: The following letter will not appear in the Code of Federal Regulations.

U.S. DEPARTMENT OF JUSTICE, Antitrust Division, RFK Main Justice Building, 950 Pennsylvania Avenue NW, Washington, DC 20530–0001, (202) 514–2401/(202) 616–2645 (Fax).

June 16, 2022

Ami Grace-Tardy, Assistant General Counsel for Legislation, Regulation and Energy Efficiency, 1000 Independence Ave. SW, U.S. Department of Energy, Washington, DC 20585.

Dear Assistant General Counsel Grace-Tardy:

I am responding to your April 15, 2022 letter seeking the views of the Attorney General about the potential impact on competition of proposed energy conservation standards for consumer pool heaters. Your request was submitted under Section 325(o)(2)(B)(i)(V) of the Energy Policy and Conservation Act, as amended (ECPA), 42 U.S.C. 6295(o)(2)(B)(i)(V), and 42 U.S.C. 6316(a), which requires the Attorney General to make a determination of the impact of any lessening of competition that is likely to result from the imposition of proposed energy conservation standards. The Attorney General's responsibility for responding to requests from other departments about the effect of a program on competition has been delegated to the Assistant Attorney General for the Antitrust Division in 28 CFR 0.40(g). The Assistant Attorney General for the Antitrust Division has authorized me, as the Policy Director for the Antitrust Division, to provide the Antitrust Division's views regarding the potential impact on competition of proposed energy conservation standards on his behalf.

In conducting its analysis, the Antitrust Division examines whether a proposed standard may lessen competition, for example, by substantially limiting consumer choice or increasing industry concentration. A lessening of competition could result in higher prices to manufacturers and consumers. We have reviewed the proposed standards contained in the Notice of Proposed Rulemaking (87 FR 22640, April 15, 2022), and the related technical support documents. We also reviewed the transcript from the public meeting held on May 4, 2022 and reviewed public comments submitted by industry members in response to DOE's Request for Information and Notice of Data Availability in this matter.

Based on the information currently available, we do not believe that the proposed energy conservation standards for consumer pool heaters are likely to have a significant adverse impact on competition.

Sincerely,

David G.B. Lawrence,

Director of Policy

[FR Doc. 2023–10849 Filed 5–26–23; 8:45 am]

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