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10 CFR Parts 429 and 431

Energy Conservation Program: Energy Conservation Standards for Pumps; Final Rule

DEPARTMENT OF ENERGY

10 CFR Parts 429 and 431

[Docket Number EERE–2011–BT–STD–0031]

RIN 1904–AC54

Energy Conservation Program: Energy Conservation Standards for Pumps

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

ACTION: Final rule.

SUMMARY: The Energy Policy and Conservation Act of 1975 (EPCA), as amended, sets forth a variety of provisions designed to improve energy efficiency. Part C of Title III establishes the ''Energy Conservation Program for Certain Industrial Equipment.'' The covered equipment includes pumps. In this final rule, the U.S. Department of Energy (DOE) adopts new energy conservation standards for pumps. DOE has determined that the new energy conservation standards for pumps would result in significant conservation of energy, and are technologically feasible and economically justified.

DATES: The effective date of this rule is March 28, 2016. Compliance with the new standards established for pumps in this final rule is required on and after January 27, 2020.

ADDRESSES: The docket, 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, some documents listed in the index, such as those containing information that is exempt from public disclosure, may not be publicly available.

A link to the docket Web page can be found at: *www.regulations.gov/#!docketDetail;D=EERE-2011-BT-STD-0031*. The *www.regulations.gov* Web page will contain instructions on how to access all documents, including public comments, in the docket.

For further information on how to review the docket, contact Ms. Brenda Edwards at (202) 586–2945 or by email: *Brenda.Edwards@ee.doe.gov*.

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SUPPLEMENTARY INFORMATION:

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I. Synopsis of the Final Rule

Title III of the Energy Policy and Conservation Act of 1975 (42 U.S.C. 6291, *et seq.;* ''EPCA''), Public Law 94–163, sets forth a variety of provisions designed to improve energy efficiency. Part C of Title III, which for editorial reasons was re-designated as Part A–1 upon incorporation into the U.S. Code (42 U.S.C. 6311–6317), establishes the ''Energy Conservation Program for Certain Industrial Equipment.'' Covered industrial equipment includes pumps, the subject of this document. (42 U.S.C. 6311(1)(H)).[1]

The standards for certain pumps set forth in this document reflect the consensus of a stakeholder negotiation. A working group was established under the Appliance Standards and Rulemaking Federal Advisory Committee (ASRAC) in accordance with the Federal Advisory Committee Act (FACA) and the Negotiated Rulemaking Act (NRA). (5 U.S.C. App.; 5 U.S.C. 561–570) The purpose of the working group was to discuss and, if possible, reach consensus on proposed standards for pump energy efficiency. On June 19, 2014, the working group successfully reached consensus on proposed energy conservation standards for specific rotodynamic, clean water pumps used in a variety of commercial, industrial, agricultural, and municipal applications. See section II.B for further discussion of the working group, section II.C for the industry sectors covered, and section III.C for a description of the relevant pumps.

The new standards are expressed as a Pump Energy Index (PEI). PEIs for each equipment class and the respective nominal design speed are shown in Table I.1. These standards apply to all equipment classes listed in Table I.1 and manufactured in, or imported into, the United States on and after January 27, 2020.

TABLE I.1—NEW ENERGY CONSERVATION STANDARDS FOR PUMPS

[Compliance starting January 27, 2020]

Equipment class *	Standard level ** PEI	Efficiency percentile	C-Values
ESCC.1800.CL	1.00	25	128.47
ESCC.3600.CL	1.00	25	130.42
ESCC.1800.VL	1.00	25	128.47
ESCC.3600.VL	1.00	25	130.42
ESFM.1800.CL	1.00	25	128.85
ESFM.3600.CL	1.00	25	130.99
ESFM.1800.VL	1.00	25	128.85
ESFM.3600.VL	1.00	25	130.99
IL.1800.CL	1.00	25	129.30
IL.3600.CL	1.00	25	133.84
IL.1800.VL	1.00	25	129.30
IL.3600.VL	1.00	25	133.84
RSV.1800.CL	1.00	† 0	129.63
RSV.3600.CL	1.00	† 0	133.20
RSV.1800.VL	1.00	† 0	129.63
RSV.3600.VL	1.00	† 0	133.20
VTS.1800.CL	1.00	†† 0	138.78
VTS.3600.CL	1.00	25	134.85
VTS.1800.VL	1.00	†† 0	138.78
VTS.3600.VL	1.00	25	134.85

* Equipment class designations consist of a combination (in sequential order separated by periods) of: (1) An equipment family (ESCC = end suction close-coupled, ESFM = end suction frame mounted/own bearing, IL = inline, RSV = radially split, multi-stage, vertical, in-line diffuser casing, VTS = submersible turbine); (2) a nominal design speed (1800 = 1800 revolutions per minute (rpm), 3600 = 3600 rpm); and (3) an operating mode (CL = constant load, VL = variable load). For example, ''ESCC.1800.CL'' refers to the ''end suction close-coupled, 1,800 rpm, constant load'' equipment class. See discussion in chapter 5 of the final rule technical support document (TSD) for a more detailed explanation of the equipment class terminology.

** A pump model is compliant if its PEI rating is less than or equal to the adopted standard.

† The standard level for RSV was set at a level that harmonized with the current European Union energy conservation standard level. See discussion in section IV.A.2.a for more detail regarding matters related to harmonization.

†† The standard level for VTS.1800 was set based on the baseline C-value for VTS.3600 pumps due to limited data availability. See discussion in section IV.A.2.b for more detail.

[1] All references to EPCA in this document refer to the statute as amended through the Energy Efficiency Improvement Act of 2015, Public Law 114–11 (Apr. 30, 2015).

Under the adopted standards, a pump model would be compliant if its PEI rating is less than or equal to the adopted standard. PEI is defined as the pump efficiency rating (PER) for a given pump model (at full impeller diameter), divided by a calculated minimally compliant PER for the given pump model. PER is defined as a weighted average of the electric input power supplied to the pump over a specified load profile, represented in units of horsepower (hp). A value of PEI greater than 1.00 would indicate that the pump does not comply with DOE's energy conservation standard, while a value less than 1.00 would indicate that the pump is more efficient than the standard requires.

The minimally compliant PER is unique to each pump model and is a function of specific speed (a dimensionless quantity describing the geometry of the pump); flow at best efficiency point (BEP); and a specified C-value. A C-value is the translational component of a three-dimensional polynomial equation that describes the attainable hydraulic efficiency of pumps as a function of flow at BEP, specific speed, and C-value.
Thus, when a C-value is used to define an efficiency level, that efficiency level can be considered equally attainable across the full scope of flow and specific speed encompassed by this final rule.

A certain percentage of pumps currently on the market will not meet each efficiency level. That percentage can be referred to as the efficiency percentile. For example, if 10% of the pumps on the market do not meet a specified efficiency level, that efficiency level represents the lower 10th percentile of efficiency. The efficiency percentile is an effective descriptor of the impact of a selected efficiency level (selected C-value) on the current market.

The C-values listed in Table I.1 correspond to the lower 25th percentile of efficiency for the End Suction Close-Coupled (ESCC), End Suction Frame Mounted/Own Bearings (ESFM), and In-line (IL) equipment classes. For the Submersible Turbine (VTS) equipment classes,[2] the C-values of 3600 rpm speed pumps correspond to the lower 25th percentile of efficiency, while those of 1800 rpm speed pumps correspond to the baseline efficiency level. The C-values for the radially split, multi-stage, vertical, in-line diffuser casing (RSV) equipment class harmonize with the standards recently enacted in the European Union.[3] Models in the RSV equipment class are known to be global platforms with no differentiation between products sold into the United States and European Union markets.[4] Section III.C describes the PEI metric in further detail.

A. Benefits and Costs to Consumers

Table I.2 presents DOE's evaluation of the economic impacts of the adopted standards on consumers of pumps, as measured by the average life-cycle cost (LCC) savings and the simple payback period (PBP).[5] The average LCC savings are positive for all equipment classes for which consumers would be impacted by the adopted standards[6] and the PBP is less than the average lifetime of pumps, which is estimated to range between 11 and 23 years depending on equipment class, with an average of 15 years (see section IV.F.2.g).

TABLE I.2—IMPACTS OF ADOPTED ENERGY CONSERVATION STANDARDS ON CONSUMERS OF PUMPS

Equipment class	Average LCC savings (2014$)	Simple payback period (years)
ESCC.1800	163	2.2
ESCC.3600	92	1.0
ESFM.1800	174	2.9
ESFM.3600	549	0.8
IL.1800	147	2.9
IL.3600	138	2.0
RSV.1800	N/A	N/A
RSV.3600	N/A	N/A
VTS.1800	N/A	N/A
VTS.3600	17	3.1

Notes: DOE relied on available data for bare pumps with no information on configuration. Therefore, DOE conducted analysis at the level of equipment type and nominal design speed only. DOE is adopting identical standards for both CL and VL equipment classes.Economic results are not presented for RSV.1800, RSV.3600, and VTS.1800 classes because the adopted standard is at the baseline.

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 (2015 to 2049). Using a real discount rate of 11.8 percent,[7] DOE estimates that the (INPV) for manufacturers of pumps in the case without new standards is $120.0 million in 2014$. Under the

[2] In the test procedure final rule (See EERE–2013–BT–TP–0055), DOE changed the terminology for this equipment class from "vertical turbine submersible" to "submersible turbine" for consistency with the definition of this equipment class. DOE is adopting the acronym "ST" in the regulatory text for long-term consistency with the defined term but has retained the "VTS" abbreviation in the preamble for consistency with the energy conservation standards NOPR and all Working Group discussions and recommendations to date (Docket No. EERE–2013–BT–NOC–0039).

[3] Council of the European Union. 2012. Commission Regulation (EU) No 547/2012 of 25 June 2012 implementing Directive 2009/125/EC of the European Parliament and of the Council with regard to ecodesign requirements for water pumps. Official Journal of the European Union. L 165, 26 June 2012, pp. 28–36.

[4] Market research, limited confidential manufacturer data, and direct input from the CIP working group indicate that RSV models sold in the United States market are global platforms with hydraulic designs equivalent to those in the European market.

[5] The average LCC savings are measured relative to the no-new-standards case efficiency distribution, which depicts the market in the compliance year (see section IV.H.2). The simple PBP, which is designed to compare specific pump efficiency levels, is measured relative to the baseline model (see section IV.C.1.b).

[6] DOE also calculates a distribution of LCC savings; the percentage of consumers that would have negative LCC savings (net cost) under the adopted standards is shown in section V.B.1.a.

[7] DOE estimated draft financial metrics, including the industry discount rate, based on data from Securities and Exchange Commission (SEC) filings. DOE presented the draft financial metrics to manufacturers in MIA interviews and adjusted those values based on feedback from industry. The complete set of financial metrics and more detail about the methodology can be found in section 12.4.3 of TSD chapter 12.

standards adopted in this final rule, DOE expects INPV impacts to be between a loss of 32.9 percent to an increase of 7.0 percent of INPV, which is between approximately −$39.5 million and $8.4 million. Additionally, based on DOE's interviews with pump manufacturers, DOE does not expect significant impacts on manufacturing capacity or loss of employment for the industry as a whole to result from the standards for pumps. DOE expects the industry to incur $81.2 million in conversion costs.

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

C. National Benefits [8]

DOE's analyses indicate that the adopted energy conservation standards for pumps would save a significant amount of energy. Relative to the case without new standards, the lifetime energy savings for pumps purchased in the 30-year period that begins in the anticipated year of compliance with the new standards (2020–2049), amount to 0.29 quadrillion Btu (quads).[9] This represents a savings of one percent relative to the energy use of these products in the case without new standards (referred to as the ''no-new-standards case'').

The cumulative net present value (NPV) of total consumer costs and savings of the standards for pumps ranges from $0.39 billion (at a 7-percent discount rate) to $1.1 billion (at a 3-percent discount rate). This NPV expresses the estimated total value of future operating-cost savings minus the estimated increased equipment costs for pumps purchased in 2020–2049.

In addition, the standards for pumps would have significant environmental benefits. DOE estimates that the standards would result in cumulative greenhouse gas emission reductions (over the same period as for energy savings) of 17 million metric tons (Mt) [10] of carbon dioxide (CO_2), 9.5 thousand tons of sulfur dioxide (SO_2), 31 tons of nitrogen oxides (NO_X), 75 thousand tons of methane (CH_4), 0.20 thousand tons of nitrous oxide (N_2O), and 0.035 tons of mercury (Hg).[11] The cumulative reduction in CO_2 emissions through 2030 amounts to 2.7 Mt, which is equivalent to the emissions resulting from the annual electricity use of more than 0.37 million homes.

The value of the CO_2 reductions is calculated using a range of values per metric ton of CO_2 (otherwise known as the Social Cost of Carbon, or SCC) developed by a recent Federal interagency process.[12] The derivation of the SCC values is discussed in section IV.L.1. Using discount rates appropriate for each set of SCC values, DOE estimates that the net present monetary value of the CO_2 emissions reduction (not including CO_2 equivalent emissions of other gases with global warming potential) is between $0.11 billion and $1.6 billion, with a value of $0.52 billion using the central SCC case represented by $40.0/t in 2015. DOE also estimates that the net present monetary value of the NO_X emissions reduction to be $0.04 billion at a 7-percent discount rate, and $0.09 billion at a 3-percent discount rate.[13]

Table I.3 summarizes the national economic benefits and costs expected to result from the adopted standards for pumps.

TABLE I.3—SUMMARY OF NATIONAL ECONOMIC BENEFITS AND COSTS OF ADOPTED ENERGY CONSERVATION STANDARDS FOR PUMPS *

Category	Present value Billion 2014$	Discount rate (%)
Benefits		
Consumer Operating Cost Savings	0.5	7
	1.4	3
CO_2 Reduction Value ($12.2/t case) **	0.1	5
CO_2 Reduction Value ($40.0/t case) **	0.5	3
CO_2 Reduction Value ($62.3/t case) **	0.8	2.5
CO_2 Reduction Value ($117/t case) **	1.6	3
NO_X Reduction Monetized Value †	0.04	7
	0.09	3
Total Benefits ††	1.1	7
	2.0	3

[8] All monetary values in this section are expressed in 2014 dollars and, where appropriate, are discounted to 2015 unless explicitly stated otherwise. Energy savings in this section refer to the full-fuel-cycle savings (see section IV.H for discussion).

[9] A quad is equal to 10^{15} British thermal units (Btu). 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.

[10] A metric ton is equivalent to 1.1 short tons. Results for NO_X and Hg are presented in short tons.

[11] DOE calculated emissions reductions relative to the no-new-standards-case, which reflects key assumptions in the *Annual Energy Outlook 2015* (*AEO 2015*) Reference case, which generally represents current legislation and environmental regulations for which implementing regulations were available as of October 31, 2014.

[12] *Technical Update of the Social Cost of Carbon for Regulatory Impact Analysis Under Executive Order 12866.* Interagency Working Group on Social Cost of Carbon, United States Government (May 2013; revised July 2015) (Available at: *www.whitehouse.gov/sites/default/files/omb/inforeg/scc-tsd-final-july-2015.pdf*).

[13] DOE estimated the monetized value of NO_X emissions reductions using benefit per ton estimates from the *Regulatory Impact Analysis titled, ''Proposed Carbon Pollution Guidelines for Existing Power Plants and Emission Standards for Modified and Reconstructed Power Plants,''* published in June 2014 by EPA's Office of Air Quality Planning and Standards. (Available at: *http://www3.epa.gov/ttnecas1/regdata/RIAs/111dproposalRIAfinal0602.pdf*.) See section IV.L.2 for further discussion. Note that the agency is presenting a national benefit-per-ton estimate for particulate matter emitted from the Electricity Generating Unit sector based on an estimate of premature mortality derived from the ACS study (Krewski et al., 2009). If the benefit-per-ton estimates were based on the Six Cities study (Lepuele et al., 2011), the values would be nearly two-and-a-half times larger. Because of the sensitivity of the benefit-per-ton estimate to the geographical considerations of sources and receptors of emissions, DOE intends to investigate refinements to the agency's current approach of one national estimate by assessing the regional approach taken by EPA's Regulatory Impact Analysis for the Clean Power Plan Final Rule. Note that DOE is currently investigating valuation of avoided SO_2 and Hg emissions.

TABLE I.3—SUMMARY OF NATIONAL ECONOMIC BENEFITS AND COSTS OF ADOPTED ENERGY CONSERVATION STANDARDS FOR PUMPS *—Continued

Category	Present value Billion 2014$	Discount rate (%)
Costs		
Consumer Incremental Installed Costs	0.2	7
	0.3	3
Total Net Benefits		
Including CO_2 and NO_X Reduction Monetized Value ††	0.9	7
	1.7	3

* This table presents the costs and benefits associated with pumps shipped in 2020–2049. These results include benefits to consumers which accrue after 2049 from the products purchased in 2020–2049. The costs account for the incremental variable and fixed costs incurred by manufacturers due to the standard, some of which may be incurred in preparation for the rule.

** The CO_2 values represent global monetized values of the SCC, in 2014$, in 2015 under several scenarios of the updated SCC values. The first three cases use the averages of SCC distributions calculated using 5%, 3%, and 2.5% discount rates, respectively. The fourth case represents the 95th percentile of the SCC distribution calculated using a 3% discount rate. The SCC time series incorporate an escalation factor.

† The $/ton values used for NO_X are described in section IV.L.2. DOE estimated the monetized value of NO_X emissions reductions using benefit per ton estimates from the *Regulatory Impact Analysis titled, "Proposed Carbon Pollution Guidelines for Existing Power Plants and Emission Standards for Modified and Reconstructed Power Plants,"* published in June 2014 by EPA's Office of Air Quality Planning and Standards. (Available at: *http://www3.epa.gov/ttnecas1/regdata/RIAs/111dproposalRIAfinal0602.pdf.*) See section IV.L.2 for further discussion. Note that the agency is presenting a national benefit-per-ton estimate for particulate matter emitted from the Electricity Generating Unit sector based on an estimate of premature mortality derived from the ACS study (Krewski et al., 2009). If the benefit-per-ton estimates were based on the Six Cities study (Lepuele et al., 2011), the values would be nearly two-and-a-half times larger. Because of the sensitivity of the benefit-per-ton estimate to the geographical considerations of sources and receptors of emissions, DOE intends to investigate refinements to the agency's current approach of one national estimate by assessing the regional approach taken by EPA's Regulatory Impact Analysis for the Clean Power Plan Final Rule.

†† Total Benefits for both the 3% and 7% cases are derived using the series corresponding to average SCC with 3-percent discount rate ($40.0/t case).

The benefits and costs of the adopted standards, for pumps sold in 2020–2049, can also be expressed in terms of annualized values. The monetary values for the total annualized net benefits are the sum of (1) the national economic value of the benefits in reduced operating costs, minus (2) the increases in product purchase prices and installation costs, plus (3) the value of the benefits of CO_2 and NO_X emission reductions, all annualized.[14]

Although DOE believes that the value of operating cost savings and CO_2 emission reductions are both important, two issues are relevant. First, the national operating cost savings are domestic U.S. consumer monetary savings that occur as a result of market transactions, whereas the value of CO_2 reductions is based on a global value. Second, the assessments of operating cost savings and CO_2 savings are performed with different methods that use different time frames for analysis. The national operating cost savings are measured for the lifetime of pumps shipped in 2020–2049. Because CO_2 emissions have a very long residence time in the atmosphere,[15] the SCC values in future years reflect future CO_2-emissions impacts that continue beyond 2100.

Estimates of annualized benefits and costs of the adopted standards are shown in Table I.4. The results under the primary estimate are as follows. Using a 7-percent discount rate for benefits and costs other than CO_2 reduction, (for which DOE used a 3-percent discount rate along with the SCC series that has a value of $40.0/t in 2015),[16] the estimated cost of the standards in this rule is $17 million per year in increased equipment costs, while the estimated annual benefits are $58 million in reduced equipment operating costs, $30 million in CO_2 reductions, and $3.7 million in reduced NO_X emissions. In this case, the net benefit amounts to $74 million per year. Using a 3-percent discount rate for all benefits and costs and the SCC series has a value of $40.0/t in 2015, the estimated cost of the standards is $17 million per year in increased equipment costs, while the estimated annual benefits are $78 million in reduced operating costs, $30 million in CO_2 reductions, and $5.4 million in reduced NO_X emissions. In this case, the net benefit amounts to $96 million per year.

[14] To convert the time-series of costs and benefits into annualized values, DOE calculated a present value in 2015, 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 2015. The calculation uses discount rates of 3 and 7 percent for all costs and benefits except for the value of CO_2 reductions, for which DOE used case-specific discount rates, as shown in Table I.3. 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.

[15] The atmospheric lifetime of CO_2 is estimated of the order of 30–95 years. Jacobson, MZ (2005), "Correction to 'Control of fossil-fuel particulate black carbon and organic matter, possibly the most effective method of slowing global warming,' " *J. Geophys. Res.* 110. pp. D14105.

[16] DOE used a 3-percent discount rate because the SCC values for the series used in the calculation were derived using a 3-percent discount rate (see section IV.L.1).

TABLE I.4—ANNUALIZED BENEFITS AND COSTS OF ADOPTED ENERGY CONSERVATION STANDARDS FOR PUMPS *

	Discount rate	Million 2014$/year		
		Primary estimate	Low net benefits estimate	High net benefits estimate
Benefits				
Consumer Operating Cost Savings	7%	58	52	68.
	3%	78	70	94.
CO_2 Reduction Value ($12.2/t case) **	5%	8.7	8.1.	9.5.
CO_2 Reduction Value ($40.0/t case) **	3%	30	28	33.
CO_2 Reduction Value ($62.3/t case) **	2.5%	44	41	48.
CO_2 Reduction Value ($117/t case) **	3%	91	84	99.
NO_X Reduction Value †	7%	3.7	3.5	9.0.
	3%	5.4	5.0	13.
Total Benefits ††	7% plus CO_2 range	70 to 152	64 to 140	86 to 176.
	7%	91	83	109.
	3% plus CO_2 range	92 to 174	83 to 159	116 to 206.
	3%	113	102	139.
Costs				
Consumer Incremental Equipment Costs	7%	17	19	17.
	3%	17	20	18.
Net Benefits				
Total ††	7% plus CO_2 range	53 to 136	45 to 121	69 to 159.
	7%	74	65	92.
	3% plus CO_2 range	75 to 157	63 to 139	99 to 189.
	3%	96	83	122.

* This table presents the annualized costs and benefits associated with pumps shipped in 2020–2049. These results include benefits to consumers which accrue after 2049 from the pumps purchased from 2020–2049. The results account for the incremental variable and fixed costs incurred by manufacturers due to the standard, some of which may be incurred in preparation for the rule. The Primary, Low Benefits, and High Benefits Estimates utilize projections of energy prices and shipments from the *AEO 2015* Reference case, Low Economic Growth case, and High Economic Growth case, respectively. In addition, incremental equipment costs reflect constant real prices in the Primary Estimate, an increase in the Low Benefits Estimate, and a decrease in the High Benefits Estimate. The methods used to derive projected price trends are explained in IV.F.2.a.

** The CO_2 values represent global monetized values of the SCC, in 2014$, in 2015 under several scenarios of the updated SCC values. The first three cases use the averages of SCC distributions calculated using 5%, 3%, and 2.5% discount rates, respectively. The fourth case represents the 95th percentile of the SCC distribution calculated using a 3% discount rate. The SCC time series incorporate an escalation factor.

† The $/ton values used for NO_X are described in section IV.L.2. DOE estimated the monetized value of NO_X emissions reductions using benefit per ton estimates from the Regulatory Impact Analysis titled, ''Proposed Carbon Pollution Guidelines for Existing Power Plants and Emission Standards for Modified and Reconstructed Power Plants,'' published in June 2014 by EPA's Office of Air Quality Planning and Standards. (Available at: *http://www3.epa.gov/ttnecas1/regdata/RIAs/111dproposalRIAfinal0602.pdf*.) See section IV.L.2 for further discussion. For DOE's Primary Estimate and Low Net Benefits Estimate, the agency is presenting a national benefit-per-ton estimate for particulate matter emitted from the Electric Generating Unit sector based on an estimate of premature mortality derived from the ACS study (Krewski et al., 2009). For DOE's High Net Benefits Estimate, the benefit-per-ton estimates were based on the Six Cities study (Lepuele et al., 2011), which are nearly two-and-a-half times larger than those from the ACS study. Because of the sensitivity of the benefit-per-ton estimate to the geographical considerations of sources and receptors of emission, DOE intends to investigate refinements to the agency's current approach of one national estimate by assessing the regional approach taken by EPA's Regulatory Impact Analysis for the Clean Power Plan Final Rule.

†† Total Benefits for both the 3% and 7% cases are derived using the series corresponding to the average SCC with 3-percent discount rate ($40.0/t case). In the rows labeled ''7% plus CO_2 range'' and ''3% plus CO_2 range,'' the operating cost and NO_X benefits are calculated using the labeled discount rate, and those values are added to the full range of CO_2 values.

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

D. Conclusion

Based on the analyses culminating in this final rule, DOE found the benefits to the nation of the standards (energy savings, LCC savings for most consumers, positive NPV of consumer benefit, and emission reductions) outweigh the burdens (potential loss of INPV and LCC increases for some users of these products). DOE has concluded that the standards in this final rule represent the maximum improvement in energy efficiency that is technologically feasible and economically justified, and would result in significant conservation of energy.

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 pumps.

A. Authority

Title III of the Energy Policy and Conservation Act of 1975 ''EPCA''), Public Law 94–163, codified at 42 U.S.C. 6291 *et seq.,* sets forth a variety of provisions designed to improve energy efficiency. Part C of Title III, which for editorial reasons was re-designated as Part A–1 upon incorporation into the U.S. Code (42 U.S.C. 6311 *et seq.*), establishes the ''Energy Conservation Program for Certain Industrial Equipment.'' The covered equipment includes pumps, the subject of this rulemaking. (42 U.S.C. 6311(1)(A)) [17] There are currently no

[17] All references to EPCA in this document refer to the statute as amended through the Energy Efficiency Improvement Act of 2015, Public Law 114–11 (Apr. 30, 2015).

energy conservation standards for pumps.

Pursuant to EPCA, DOE's energy conservation program for covered equipment consists essentially of four parts: (1) Testing; (2) labeling; (3) the establishment of Federal energy conservation standards; and (4) certification and enforcement procedures. 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 6316(a)) 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 equipment. (42 U.S.C. 6314(d)) Similarly, DOE must use these test procedures to determine whether the equipment complies with standards adopted pursuant to EPCA. *Id.* The DOE test procedures for pumps appear at title 10 of the Code of Federal Regulations (CFR) part 431, subpart Y, appendix A.

DOE must follow specific statutory criteria for prescribing new or amended standards for covered products, including pumps. Any new or amended standard for a covered product must be designed to achieve the maximum improvement in energy efficiency that is technologically feasible and economically justified. (42 U.S.C. 6313(a)(6)(C), 6295(o), and 6316(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) and 6316(a)) Moreover, DOE may not prescribe a standard: (1) For certain products, including pumps, 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) and 6316(a)) In deciding whether a proposed standard is economically justified, DOE must determine whether the benefits of the standard exceed its burdens. 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 equipment 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) and 6316(a))

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)) and 6316(a))

EPCA, as codified, also contains what is known as an ''anti-backsliding'' provision, which prevents the Secretary from prescribing any new 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)) and 6316(a)) 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) and 6316(a))

Additionally, EPCA specifies requirements when promulgating an energy conservation standard for a covered equipment that has two or more subcategories. DOE must specify a different standard level for a group of equipment that has the same function or intended use if DOE determines that equipment within such group: (A) Consume a different kind of energy from that consumed by other covered equipment within such type (or class); or (B) have a capacity or other performance-related feature which other equipment within such type (or class) do not have and such feature justifies a higher or lower standard. (42 U.S.C. 6295(q)(1)) and 6316(a)) In determining whether a performance-related feature justifies a different standard for a group of equipment, 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)) and 6316(a))

Federal energy conservation requirements generally supersede State laws or regulations concerning energy conservation testing, labeling, and standards. (42 U.S.C. 6297(a)–(c)) and 6316(a)) DOE may, however, grant waivers of Federal preemption for particular State laws or regulations, in accordance with the procedures and other provisions set forth under 42 U.S.C. 6297(d).

B. Background

Prior to this final rule, DOE did not have energy conservation standards for pumps. In considering whether to establish standards for pumps, DOE issued a Request for Information (RFI) on June 13, 2011. 76 FR 34192. DOE received several comments in response to the RFI. In December 2011, DOE received a letter from the Appliance Standards Awareness Project (ASAP) and the Hydraulic Institute indicating that efficiency advocates (including ASAP, American Council for an Energy-Efficient Economy, Natural Resources Defense Council, and Northwest Energy Efficiency Alliance) and pump manufacturers (as represented by the Hydraulic Institute) had initiated discussions regarding potential energy conservation standards for pumps. (EERE–2011–BT–STD–0031–0011.) In subsequent letters in March and April 2012, and in a meeting with DOE in May 2012, the stakeholders reported on a tentative path forward on energy conservation standards for clean water pumps, inclusive of the motor and controls, and certification and labeling. (EERE–2011–BT–STD–0031–0010 and –0012.)

On February 1, 2013, DOE published a document in the **Federal Register** that announced the availability of the ''Commercial and Industrial Pumps Energy Conservation Standard Framework Document,'' solicited comment on the document, and invited all stakeholders to a public meeting to discuss the document. 78 FR 7304. The Framework Document described the procedural and analytical approaches that DOE anticipated using to evaluate energy conservation standards for pumps, addressed stakeholder comments related to the RFI, and identified and solicited comment on various issues to be resolved in the rulemaking. (EERE–2011–BT–STD–0031–0013.)

DOE held the framework public meeting on February 20, 2013 and received many comments that helped identify and resolve issues pertaining to pumps relevant to this rulemaking.

As noted previously, DOE established a working group to negotiate proposed energy conservation standards for pumps. Specifically, on July 23, 2013, DOE issued a notice of intent to establish a commercial and industrial pumps working group (''CIP Working Group''). 78 FR 44036. The working group was established under the Appliance Standards and Rulemaking Federal Advisory Committee (ASRAC) in accordance with the Federal Advisory Committee Act (FACA) and the Negotiated Rulemaking Act (NRA). (5 U.S.C. App.; 5 U.S.C. 561–570) The purpose of the working group was to discuss and, if possible, reach consensus on proposed standard levels for the energy efficiency of pumps. The working group was to consist of representatives of parties having a defined stake in the outcome of the proposed standards, and the group would consult as appropriate with a range of experts on technical issues.

DOE received 19 nominations for membership. Ultimately, the working group consisted of 16 members, including one member from the ASRAC and one DOE representative. (See Table II.1) The working group met in-person during seven sets of meetings held December 18–19, 2013 and January 30–31, March 4–5, March 26–27, April 29–30, May 28–29, and June 17–19, 2014.

TABLE II.1—ASRAC PUMP WORKING GROUP MEMBERS AND AFFILIATIONS

Member	Affiliation
Lucas Adin	U.S. Department of Energy.
Tom Eckman	Northwest Power and Conservation Council (ASRAC Member).
Robert Barbour	TACO, Inc.
Charles Cappelino	ITT Industrial Process.
Greg Case	Pump Design, Development and Diagnostics.
Gary Fernstrom	Pacific Gas & Electric Company, San Diego Gas & Electric Company, Southern California Edison, and Southern California Gas Company.
Mark Handzel	Xylem Corporation.
Albert Huber	Patterson Pump Company.
Joanna Mauer	Appliance Standards Awareness Project.
Doug Potts	American Water.
Charles Powers	Flowserve Corporation, Industrial Pumps.
Howard Richardson	Regal Beloit.
Steve Rosenstock	Edison Electric Institute.
Louis Starr	Northwest Energy Efficiency Alliance.
Greg Towsley	Grundfos USA.
Meg Waltner	Natural Resources Defense Council.

To facilitate the negotiations, DOE provided analytical support and supplied the group with a variety of analyses and presentations, all of which are available in the docket (*www.regulations.gov/#!docketDetail;D=EERE-2013-BT-NOC-0039*). These analyses and presentations, developed with direct input from the working group members, include preliminary versions of many of the analyses discussed in this rulemaking, including a market and technology assessment; screening analysis; engineering analysis; energy use analysis; markups analysis; life cycle cost and payback period analysis; shipments analysis; national impact analysis; and manufacturer impact analysis.

On June 19, 2014, the working group reached consensus on proposed energy conservation standards for specific types of pumps. The working group assembled their recommendations into a term sheet (See EERE–2013–BT–NOC–0039–0092) that was presented to, and approved by the ASRAC on July 7, 2014. DOE considered the approved term sheet, along with other comments received during the rulemaking process, in developing the proposed energy conservation standards. DOE published the notice of proposed rulemaking (NOPR) on April 2, 2015 with proposed standards for pumps. 80 FR 17826. DOE received multiple comments from interested parties and considered these comments in the preparation of the final rule. Relevant comments and DOE's responses are provided in the appropriate sections of this document.

C. Relevant Industry Sectors

The energy conservation standards adopted in this final rule will primarily affect the pump and pumping equipment manufacturing industry. The North American Industry Classification System (NAICS) classifies this industry under code 333911. DOE identified 86 manufacturers of pumps covered under this adopted rule, with 56 of those being domestic manufacturers. The leading U.S. industry association for the pumps covered under this adopted rule is the Hydraulic Institute (HI).

III. General Discussion

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

In developing this final rule, DOE reviewed comments received on the April 2015 energy conservation standards NOPR (herein referred to as ''NOPR''). 80 FR 17826. Commenters included: The Hydraulic Institute (HI); Wilo USA (Wilo); Pacific Gas and Electric Company, San Diego Gas and Electric, Southern California Gas Company, and Southern California Edison collectively, the CA IOUs); Edison Electric Institute (EEI); The Appliance Standards Awareness Project (ASAP), Natural Resources Defense Council (NRDC), the Northwest Energy Efficiency Alliance, and the Northwest Power and Conservation Council (collectively, the Advocates); the Cato Institute; and the U.S. Chamber of Commerce, the American Chemistry Council, the American Forest & Paper

Association, the American Fuel & Petrochemical Manufacturers, the American Petroleum Institute, the Brick Industry Association, the Council of Industrial Boiler Owners, the National Association of Manufacturers, the National Mining Association, the National Oilseed Processors Association, and the Portland Cement Association (collectively, ''the Associations''). DOE addressed all relevant stakeholder comments and requests throughout this final rule.

DOE notes that they received two comments in support of the proposed standards in general. Specifically, the Advocates and the CA IOUs supported the proposed standards (which are consistent with TSL 2 in the final rule) and believed they reflect the negotiations of the ASRAC working group. (Advocates, No. 49 at p. 1; [18] CA IOUs, No. 50 at p. 1) The following sections describe the specifics of DOE's proposed standard and all relevant comments from interested parties.

A. Definition of Covered Equipment

Although pumps are listed as covered equipment under 42 U.S.C. 6311(1)(A), the term ''pump'' is not defined in EPCA. In the test procedure final rule (See EERE–2013–BT–TP–0055) DOE defined ''pump'' to clarify what constitutes covered equipment. The definition reflects the consensus reached by the CIP Working Group in its negotiations: ''Pump'' means equipment designed to move liquids (which may include entrained gases, free solids, and totally dissolved solids) by physical or mechanical action and includes a bare pump and, if included by the manufacturer at the time of sale, mechanical equipment, driver and controls. In the test procedure final rule, DOE also defined ''bare pump,'' ''mechanical equipment,'' ''driver,'' and ''controls,'' as recommended by the CIP Working Group.

B. Scope of the Energy Conservation Standards in this Rulemaking

The pumps for which DOE is setting energy conservation standards in this rulemaking are consistent with the scope of applicability of the test procedure final rule. (See EERE–2013–BT–TP–0055) This scope is also consistent with the recommendations of the CIP Working Group and includes the following five equipment categories, which are defined in the test procedure final rule:

- End suction close-coupled,
- End suction frame mounted/own bearings,
- In-line,
- Radially split, multi-stage, vertical, in-line diffuser casing, and
- Submersible turbine.

As discussed in the test procedure final rule (See EERE–2013–BT–TP–0055), DOE is further limiting the scope of this rulemaking to clean water pumps. DOE defined ''clean water pump'' as a pump that is designed for use in pumping water with a maximum non-absorbent free solid content of 0.016 pounds per cubic foot, and with a maximum dissolved solid content of 3.1 pounds per cubic foot, provided that the total gas content of the water does not exceed the saturation volume, and disregarding any additives necessary to prevent the water from freezing at a minimum of 14 °F.

In the test procedure final rule (See EERE–2013–BT–TP–0055), DOE also specified several kinds of pumps that fall within one of the five equipment categories and are clean water pumps, but will not be subject to the test procedure, in accordance with CIP Working Group recommendations. DOE has not adopted standards for these pumps in this rule:

(a) Fire pumps;
(b) self-priming pumps;
(c) prime-assist pumps;
(d) magnet driven pumps;
(e) pumps designed to be used in a nuclear facility subject to 10 CFR part 50—Domestic Licensing of Production and Utilization Facilities; and
(f) a pump meeting the design and construction requirements set forth in Military Specification MIL–P–17639F, ''Pumps, Centrifugal, Miscellaneous Service, Naval Shipboard Use'' (as amended); MIL–P–17881D, ''Pumps, Centrifugal, Boiler Feed, (Multi-Stage)'' (as amended); MIL–P–17840C, ''Pumps, Centrifugal, Close-Coupled, Navy Standard (For Surface Ship Application)'' (as amended); MIL–P–18682D, ''Pump, Centrifugal, Main Condenser Circulating, Naval Shipboard'' (as amended); MIL–P–18472G, ''Pumps, Centrifugal, Condensate, Feed Booster, Waste Heat Boiler, And Distilling Plant'' (as amended). Military specifications and standards are available for review at *http://everyspec.com/MIL-SPECS*.

In the test procedure final rule (See EERE–2013–BT–TP–0055), DOE defined ''fire pump,'' ''self-priming pump,'' ''prime-assist pump,'' and ''magnet driven pump.'' DOE also limited the applicability of the test procedure to those pumps with the following characteristics:

- 25 gallons/minute and greater (at BEP at full impeller diameter);
- 459 feet of head maximum (at BEP at full impeller diameter and the number of stages specified for testing);
- Design temperature range from 14 to 248 °F;
- Pumps designed to operate with either: (*1*) a 2- or 4-pole induction motor, or (*2*) a non-induction motor with a speed of rotation operating range that includes speeds of rotation between 2,880 and 4,320 revolutions per minute and/or 1,440 and 2,160 revolutions per minute, and in either case, the driver and impeller must rotate at the same speed; [19]
- For VTS pumps, 6 inch or smaller bowl diameter; and
- For ESCC and ESFM pumps, specific speed less than or equal to 5000 when calculated using U.S. customary units.[20]

In this final rule, DOE is not adopting standards for pumps that do not have these characteristics. DOE responded to all comments on these scope parameters in the test procedure final rule (See EERE–2013–BT–TP–0055) including those from Wilo regarding horsepower, BEP flow, and speed, provided in the energy conservation standards docket (See Wilo, No. 44 at p. 1–2).

DOE also specified in the test procedure final rule (See EERE–2013–BT–TP–0055) that all pump models must be rated and certified in a full impeller configuration, as recommended by the CIP Working Group. (See EERE–2013–BT–NOC–0039–0092, Recommendation No. 7).[21] DOE also

[18] A notation in the form ''Advocates, No. 49 at p. 1'' identifies a written comment that DOE has received and has included in the docket of this rulemaking (Docket No. EERE–2011–BT–STD–0031). This particular notation refers to (1) a comment submitted by the Advocates, (2) in document number 49 in the docket of this rulemaking, and (3) appearing on page 1 of document number 49.

[19] The CIP Working Group recommendation specified pumps designed for nominal 3600 or 1800 revolutions per minute (rpm) driver speed. However, it was intended that this would include pumps driven by non-induction motors as well. DOE believes that its clarification accomplishes the same intent while excluding niche pumps sold with non-induction motors that may not be able to be tested according to the proposed test procedure. The test procedure final rule contains additional details.

[20] DOE notes that the NOPR included a scope limitation of 1 to 200 hp. In the test procedure final rule, these parameters have been included in the equipment category definitions. Therefore, the limitation is no longer listed separately.

[21] The CIP Working Group made this recommendation because a given pump may be distributed to a particular customer with its impeller trimmed, and impeller trim has a direct impact on a pump's performance characteristics. For any pump sold with a trimmed impeller, it was recommended that the certification rating for that pump model with a full diameter impeller would apply. This approach would limit the overall burden when measuring the energy efficiency of a given pump. In addition, a rating at full impeller diameter will typically be the most consumptive rating for the pump.

specified a definition for full impeller in that rule.

C. Test Procedure and Metric

DOE established a uniform test procedure for determining the energy consumption of certain pumps, as well as sampling plans for the purposes of demonstrating compliance with the energy conservation standards that DOE is adopting in this final rule. In the test procedure final rule (See EERE–2013–BT–TP–0055), DOE prescribed test methods for measuring the energy consumption of pumps, inclusive of motors and/or controls, by measuring the produced hydraulic power and measuring or calculating the shaft power and/or electric input power to the motor or controls. Consistent with the recommendations of the CIP Working Group, DOE specified that these methods be based on Hydraulic Institute (HI) Standard 40.6–2014, ''Hydraulic Institute Standard for Method for Rotodynamic Pump Efficiency Testing,'' hereinafter referred to as ''HI 40.6–2014.'' (See EERE–2013–BT–NOC–0039–0092, Recommendation No. 10.) DOE specified additions to HI 40.6–2014 to account for the energy performance of motors and/or controls, which is not addressed in HI 40.6–2014.

Wilo commented on several elements of the test procedure. Namely, Wilo noted that there are no standard losses associated with VFDs; that calculation-based methods in the test procedure should be eliminated; and that the allowed fluctuations in power measure such as voltage and frequency will cause error and discrepancy between tests conducted by manufacturers and DOE. (Wilo, No. 44 at p. 3). DOE has addressed these comments in the pumps test procedure final rule (See EERE–2013–BT–TP–0055).

The test procedure final rule (See EERE–2013–BT–TP–0055) specifies that the energy conservation standards for pumps be expressed in terms of a constant load PEI (PEI_{CL}) for pumps sold without continuous or non-continuous controls (*i.e.,* either bare pumps or pumps sold inclusive of motors but not continuous or non-continuous controls) or a variable load PEI (PEI_{VL}) for pumps sold with continuous or non-continuous controls. The PEI_{CL} or PEI_{VL}, as applicable, describes the weighted average performance of the rated pump, inclusive of any motor and/or controls, at specific load points, normalized with respect to the performance of a ''minimally compliant pump'' (as defined in section III.C.1) without controls. The metrics are defined as follows:

$$PEI_{CL} = \left[\frac{PER_{CL}}{PER_{STD}}\right]$$

$$PEI_{VL} = \left[\frac{PER_{VL}}{PER_{STD}}\right] \quad \textbf{Eq. 1}$$

Where:

PER_{CL} = the equally-weighted average electric input power to the pump measured (or calculated) at the driver input over a specified load profile, as tested in accordance with the DOE test procedure. This metric applies only to pumps in a fixed speed equipment class. For bare pumps, the test procedure specifies the default motor loss values to use in the calculations of driver input.

PER_{VL} = the equally-weighted average electric input power to the pump measured (or calculated) at the controller input over a specified load profile as tested in accordance with the DOE test procedure. This metric applies only to pumps in a variable speed equipment class.

PER_{STD} = the PER rating of a minimally compliant pump (as defined in section III.C.1). It can be described as the allowable weighted average electric input power to the specific pump, as calculated in the test procedure. This metric applies to all equipment classes.

A value of PEI greater than 1.00 indicates that the pump consumes more energy than allowed by DOE's energy conservation standard and thus does not comply. A value less than 1.00 indicates that the pump consumes less energy than the level required by the standard.

HI requested that DOE release a calculation tool for both PEI_{CL} and PEI_{VL}, to ensure that all manufacturers are rating pumps in the same manner. (HI, No. 45 at pp. 2–3). Wilo also commented that, in absence of such a calculation tool, parties could potentially make errors in calculating PEI. (Wilo, No. 44 at p. 3). As a convenience to interested parties, DOE has provided a draft Excel spreadsheet designed to perform the calculations necessary to determine PEI.[22] DOE notes that interested parties should not rely on this spreadsheet and should consult the final test procedure rule (See EERE–2013–BT–TP–0055) for the formulas for calculating PEI. Ultimately, it is the responsibility of any party certifying the performance of a given pump to ensure the accuracy of calculation of PEI according to the DOE test procedure.

1. PER of a Minimally Compliant Pump

DOE is using a standardized, minimally compliant bare pump, inclusive of a minimally compliant motor, as a reference pump for each combination of flow at BEP and specific speed. The efficiency of a minimally compliant pump is defined as a function of certain physical properties of the bare pump, such as flow at BEP and specific speed (Ns), as shown in equation 2:

$$\eta_{pump,STD} = -0.8500 * \ln(Q_{100\%})^2 - 0.3800 * \ln(Ns) * \ln(Q_{100\%}) - 11.480 * \ln(Ns)^2 + 17.800 * \ln(Q_{100\%}) + 179.80 * \ln(Ns) - (C + 555.60) \quad \textbf{Eq. 2}$$

Where:

$Q_{100\%}$= BEP flow rate of the tested pump at full impeller diameter and nominal speed of rotation (gpm),

Ns = specific speed of the tested pump at 60 Hz and calculated using U.S. customary units, and

C = a constant that is set for the surface based on the speed of rotation and equipment category of the pump model.

As noted in the test procedure final rule, DOE developed this equation based on the equation used in the EU to develop its regulations for clean water pumps, translated to 60 Hz electrical input power and U.S. customary units.[23]

The C-value is the translational component of the three-dimensional polynomial equation that controls pump efficiency by a constant factor across the

[22] The draft PEI calculator is available at: *http://www.energy.gov/eere/buildings/downloads/draft-pei-calculator.*

[23] The equation to define the minimally compliant pump in the EU is of the same form, but employs different coefficients to reflect the fact that the flow will be reported in m^3/h at 50 Hz and the specific speed will also be reported in metric units. Specific speed is a dimensionless quantity, but has a different magnitude when calculated using metric versus U.S. customary units. DOE notes that an exact translation from metric to U.S. customary units is not possible due to the logarithmic relationship of the terms.

entire range of flow and specific speed. A positive or negative change in C-value corresponds to a decrease or increase in the pump efficiency of a minimally compliant pump, respectively. The efficiency of the minimally compliant pump calculated from this function corresponds to pump efficiency at BEP flow. This value is adjusted to determine the minimally compliant pump efficiency at 75 percent and 110 percent of BEP flow using the scaling values implemented in the EU regulations for clean water pumps. Namely, the efficiency at 75 percent of BEP flow is assumed to be 94.7 percent of that at 100 percent of BEP flow and the pump efficiency at 110 percent of BEP flow is assumed to be 98.5 percent of that at 100 percent of BEP flow.

Using the efficiency of a minimally compliant pump, PER for a minimally compliant pump is determined using equation 3:

$$PER_{STD} = \sum_{i=75\%,100\%,110\%} \omega_i \left(\frac{P_{u,i}}{\alpha_i \times \left[\eta_{pump,STD} / 100 \right]} + L_i \right)$$

$$= \omega_{75\%} \left(\frac{P_{u,75\%}}{0.947 \times \left[\eta_{pump,STD} / 100 \right]} + L_{75\%} \right) + \omega_{100\%} \left(\frac{P_{u,100\%}}{1.000 \times \left[\eta_{pump,STD} / 100 \right]} + L_{100\%} \right)$$

$$+ \omega_{110\%} \left(\frac{P_{u,110\%}}{0.985 \times \left[\eta_{pump,STD} / 100 \right]} + L_{110\%} \right)$$

Eq. 3

Where:

ω_i = weighting at each load point i (equal weighting or 0.3333 in this case);

$P_{u,i}$ = the measured hydraulic output power at load point i of the tested pump (hp);

α_i = 0.947 for 75 percent of the BEP flow rate, 1.000 for 100 percent of the BEP flow rate, and 0.985 for 110 percent of the BEP flow rate;

$\eta_{pump,STD}$ = the minimally compliant pump efficiency, as determined in accordance with equation 2,

L_i = the motor losses at load point i, as determined in accordance with the procedure specified in the DOE test procedure, and

i = load point corresponding to 75%, 100%, and 110% of BEP flow, as determined in accordance with the DOE test procedure.

Equation 3 defines PER as a function of the average power input to the pump motor at three load points, 75%, 100%, and 110% of BEP flow. The input power to the motor at each load point comprises a shaft input power term and a motor loss term. The shaft input power is computed as the quotient of hydraulic output power divided by the minimally compliant pump efficiency, where the pump hydraulic output power for the minimally compliant pump is the same as that for the particular pump being evaluated. As described in the test procedure final rule, the corresponding motor loss term is calculated assuming a minimally compliant motor that is sized for the calculated shaft input power at 120% BEP flow, as well as the default part-load loss curve. The applicable minimum motor efficiency is determined as a function of construction (*i.e.,* open or enclosed), number of poles, and horsepower as specified by DOE's energy conservation standards for electric motors at 10 CFR 431.25. PER_{STD} is then determined as the weighted average input power to the motor at each load point, as shown in equation 3.

DOE selected several C-values to establish the efficiency levels analyzed in this final rule. Each C-value and efficiency level accounts for pump efficiency at all load points as well as motor losses, and does so equivalently across the full scope of flow and specific speed encompassed by this final rule. See section IV.C.4 for a complete examination of the efficiency levels analyzed in this rulemaking.

D. Compliance Date

Pump manufacturers must comply with the energy conservation standards established in this final rule as of January 27, 2020. The compliance date is consistent with the recommendations of the CIP Working Group. (See EERE–2013–BT–NOC–0039–0092, Recommendation No. 9) In its analysis, DOE used an analysis period of 2020 through 2049.

E. Technological Feasibility

1. General

EPCA requires that any new or amended energy conservation standard that DOE prescribes be designed to achieve the maximum improvement in energy efficiency that DOE determines is technologically feasible. (42 U.S.C. 6295(o)(2)(A) and 6316(a).) In determining the maximum possible improvement in energy efficiency, DOE conducts a screening analysis based on all current technology options and working prototype designs that could improve the efficiency of the products or equipment that are the subject of the rulemaking. 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.

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; and (3) adverse impacts on health or safety. (10 CFR part 430, subpart C, appendix A, section 4(a)(4)(ii)–(iv).) Section IV.B of this final rule discusses the results of the screening analysis for pumps, particularly the designs DOE considered, those it screened out, and those that are the basis for the trial standard levels (TSLs) 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 equipment, it must determine the maximum improvement in energy efficiency or maximum reduction in energy use that is technologically feasible for such equipment. (42 U.S.C. 6295(p)(1) and 6316(a)). Accordingly, in the engineering analysis, DOE determined the maximum technologically feasible (''max-tech'') improvements in energy efficiency for pumps, using the design options that passed the screening analysis.

F. Energy Savings

1. Determination of Savings

For each TSL, DOE projected energy savings from the pumps that are the subject of this rulemaking purchased in the 30-year period that begins in the first full year of compliance with new standards (2020–2049).[24] The savings are measured over the entire lifetime of pumps 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 currently exists in the marketplace in the absence of mandatory efficiency standards, and it considers market forces and policies that affect demand for more efficient products. To estimate the no-new-standards case, DOE used data provided by the CIP Working Group, as discussed in section IV.H.2.

DOE used its national impact analysis (NIA) spreadsheet model to estimate energy savings from potential new standards for the equipment that is the subject of this rulemaking. The NIA spreadsheet model (described in section IV.H of this document) calculates energy savings in 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. To calculate this primary energy savings, DOE derives annual conversion factors from the model used to prepare the Energy Information Administration's (EIA) *2015 Annual Energy Outlook (AEO).*

DOE also estimates full-fuel-cycle (FFC) energy savings, as discussed in DOE's statement of policy and notice of policy amendment. 76 FR 51282 (August 18, 2011), as amended at 77 FR 49701 (August 17, 2012). 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 efficiency standards. DOE's approach is based on the calculation of an FFC multiplier for each of the energy types used by the covered equipment. For more information on FFC energy savings, see section IV.H.1.a.

2. Significance of Savings

To adopt 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)) and 6316(a).) Although the term ''significant'' is not defined in the Act, the U.S. Court of Appeals, for the District of Columbia Circuit in *Natural Resources Defense Council* v. *Herrington,* 768 F.2d 1355, 1373 (D.C. Cir. 1985), indicated opined that Congress intended ''significant'' energy savings in the context of EPCA to be savings that were not ''genuinely trivial.'' The energy savings for all the TSLs considered in this rulemaking, including the adopted standards, are nontrivial, and, therefore, DOE considers them ''significant'' within the meaning of section 325 of EPCA.

G. Economic Justification

1. Specific Criteria

As noted above, 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) and 6316(a).) The following sections discuss how DOE has addressed each of those seven factors in this rulemaking.

a. Economic Impact on Manufacturers and Consumers

In determining the impacts of a potential new or amended standard on manufacturers, DOE conducts a manufacturer impact analysis (MIA), as discussed in section IV.J. 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) Industry net present value (INPV), which values the industry on the basis of expected future cash flows; (2) cash flows by year; (3) changes in revenue and income; and (4) other measures of impact, as appropriate. Second, DOE analyzes and reports the impacts on different types of manufacturers, including impacts on small manufacturers. Third, DOE considers the impact of standards on domestic manufacturer employment and manufacturing capacity, as well as the potential for standards to result in plant closures and loss of capital investment. Finally, DOE takes into account cumulative impacts of various DOE regulations and other regulatory requirements on manufacturers.

For individual consumers, measures of economic impact include the changes in LCC and payback period (PBP) associated with new or amended standards. These measures are discussed further in the following section. For consumers in the aggregate, DOE also calculates the national net present value of the economic impacts applicable to a particular rulemaking. DOE also evaluates the LCC impacts of potential new standards on identifiable subgroups of consumers that may be affected disproportionately by a national 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) and 6316(a).) 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

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

values, with probabilities attached to each value.

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

For its LCC and PBP analysis, DOE assumes that consumers will purchase the covered products in the first year of compliance with new 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 standards. DOE's LCC and PBP analysis is discussed in further detail in section IV.F.

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) and 6316(a).) As discussed in section IV.H, DOE uses the NIA spreadsheet to project national energy savings.

d. Lessening of Utility or Performance of Products

In establishing classes of equipment, and in evaluating design options and the impact of potential standard levels, DOE evaluates potential new standards that would not lessen the utility or performance of the considered products. (42 U.S.C. 6295(o)(2)(B)(i)(IV) and 6316(a).) Based on data available to DOE, the standards adopted in the final rule would not reduce the utility or performance of the equipment 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) and 6316(a).) 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)) and 6316(a).) DOE transmitted a copy of its proposed rule to the Attorney General with a request that the Department of Justice (DOJ) provide its determination on this issue. In a letter dated July 10, 2015, DOJ stated that it did not have sufficient information to conclude that the proposed energy conservation standards or test procedure likely will substantially lessen competition in any particular product or geographic market. However, DOJ noted that the possibility exists that the proposed energy conservation standards and test procedure—which will apply to a broad range of pumps—may result in anticompetitive effects in certain pump markets. Specifically in relation to the proposed standards, DOJ expressed concern that ''by design, the bottom quartile of pumps in each class of covered pumps will not meet the new standards. The non-compliance of the bottom quartile of pump models may result in some manufacturers stopping production of pumps altogether and fewer firms producing models that comply with the new standards. At this point, it is not possible to determine the impact on any particular product or geographic market.''

Although the terminology in this rule is different from that typically used in energy conservation standards rulemaking documents, as requested by the Pumps Working Group, the options for non-compliant models are no different from other rules. In all energy conservation standards rulemakings that set new standards or amend standards, a certain percentage of the market is affected by the standard. The percentage of affected pumps is represented by any models below the amended standard, which may have a distribution of efficiencies (*i.e.,* some pump models will be closer to the new or amended standard level than others). It is not unusual for a large fraction of models (sometimes greater than 25%) to be at or near the baseline and thus be impacted. As in all rulemakings, manufacturers have a choice between re-designing a non-compliant model to meet the standard and discontinuing it.

The ASRAC working group indicated that between 5 and 10% of models requiring redesign may be dropped because current sales are very low. (Docket No. EERE–2013–BT–NOC–0039, May 28 Pumps Working Group Meeting, p. 61–63) Manufacturers indicated that additional models may be dropped where they can be replaced by another existing equivalent model currently made by the same manufacturer, often under an alternative brand. (Docket No. EERE–2013–BT–NOC–0039, April 29 Pumps Working Group Meeting, p. 100) In either case, the elimination of these models would not have an adverse impact on the market or overall availability of pumps to serve particular applications.

For these reasons, DOE has concluded that the standard levels included in this final rule will not result in adverse impacts on competition within the pump marketplace. The remaining concerns in the DOJ letter regarding the test procedure have been addressed in the parallel test procedure rulemaking (Docket No. EERE–2013–BT–TP–0055).

f. Need for National Energy Conservation

DOE also considers the need for national energy conservation in determining whether a new or amended standard is economically justified. (42 U.S.C. 6295(o)(2)(B)(i)(VI)) and 6316(a)) 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.

The adopted standards also are likely to result in environmental benefits in the form of reduced emissions of air pollutants and greenhouse gases associated with energy production and use. DOE conducts an emissions analysis to estimate how potential new standards may affect these emissions, as discussed in section IV.K; the 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.

g. Other Factors

EPCA allows the Secretary of Energy, in determining whether a standard is economically justified, to consider any other factors that the Secretary deems to be relevant. (42 U.S.C. 6295(o)(2)(B)(i)(VII)) and 6316(a).) To the extent interested parties submit any relevant information regarding economic justification that does not fit into the other categories described above, DOE could consider such information under ''other factors.''

2. Rebuttable Presumption

EPCA creates a rebuttable presumption that an energy conservation standard is economically justified if the additional cost to the consumer of a product that meets the standard is less than three times the value of the first year's energy savings resulting from the standard, as calculated under the applicable DOE test procedure. 42 U.S.C. 6295(o)(2)(B)(iii) and 6316(a) DOE's LCC and PBP analyses generate values used to calculate the effect potential new or 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) and 6316(a). 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 results are discussed in section V.B.1.c of this final rule.

IV. Methodology and Discussion of Related Comments

This section addresses the analyses DOE performed for this rulemaking. Separate subsections address each component of DOE's analyses.

DOE used four analytical tools to estimate the impact of the standards adopted in this document. The first tool is a spreadsheet that calculates LCC and PBP of potential new energy conservation standards. The second tool is a spreadsheet that provides shipments projections and calculates national energy savings and net present value resulting from potential energy conservation standards. DOE uses the third spreadsheet tool, the Government Regulatory Impact Model (GRIM), to assess manufacturer impacts. These three spreadsheet tools are available on the DOE Web site for this rulemaking: *http://www.regulations.gov/#!docketDetail;D=EERE-2011-BT-STD-0031*. Additionally, DOE used output from the latest version of EIA's National Energy Modeling System (NEMS) for the emissions and utility impact analyses. NEMS is a public domain, multi-sector, partial equilibrium model of the U.S. energy sector. EIA uses NEMS to prepare its *Annual Energy Outlook (AEO),* a widely known energy forecast for the United States.

A. Market and Technology Assessment

When beginning an energy conservation standards rulemaking, DOE develops information that provides an overall picture of the market for the equipment concerned, including the purpose of the equipment, the industry structure, and market characteristics. This activity includes both quantitative and qualitative assessments based primarily on publicly available information (*e.g.,* manufacturer specification sheets, industry publications) and data submitted by manufacturers, trade associations, and other stakeholders. The subjects addressed in the market and technology assessment for this rulemaking include: (1) Quantities and types of equipment sold and offered for sale; (2) retail market trends; (3) equipment covered by the rulemaking; (4) equipment classes; (5) manufacturers; (6) regulatory requirements and non-regulatory programs (such as rebate programs and tax credits); and (7) technologies that could improve the energy efficiency of the equipment under examination. DOE researched manufacturers of pumps and made a particular effort to identify and characterize small business manufacturers in this sector. See chapter 3 of the final rule TSD for further discussion of the market and technology assessment.

1. Equipment Classes

When evaluating and establishing energy conservation standards, DOE divides covered equipment into equipment classes by the type of energy used, capacity, or other performance-related features that would justify a different standard from that which would apply to other equipment classes. In the NOPR, DOE proposed to divide pumps into equipment classes based on the following three factors:

1. Basic pump equipment category,
2. Configuration, and
3. Nominal design speed.

In the NOPR, DOE also noted that some clean water pumps are sold for use with engines or turbines rather than electric motors, and as such, would use a different fuel type (*i.e.,* fossil fuels rather than electricity). However, because of the small market share of clean water pumps using these fuel types, in the test procedure final rule, DOE specifies that any pump sold with, or for use with, a driver other than an electric motor would be rated as a bare pump.[25] Therefore, in the NOPR, DOE did not disaggregate equipment classes by fuel type.

As discussed in section III.B, there were five pump equipment categories considered in NOPR, each of which form the basis for the individual equipment classes; these categories are:

- End suction close coupled;
- End suction frame mounted/own bearings;
- In-line;
- Radially split, multi-stage, vertical, in-line diffuser casing; and
- Submersible turbine.

In the NOPR, DOE proposed to define a pump's configuration by the equipment with which it is sold. Pumps sold inclusive of motors and continuous or non-continuous controls (as defined in the test procedure), capable of operation at multiple driver shaft speeds are defined as variable load (VL); pumps sold as bare pumps or with motors without such controls, capable only of operation at a fixed shaft speed, are defined as constant load (CL).

The CIP Working Group also recommended separate energy efficiency standards for equipment categories at the nominal speeds for two- and four-pole motors. (See EERE–2013–BT–NOC–0039–0092, p. 4, Recommendation No. 9.) In its NOPR analysis, DOE found that across the market, pumps at each nominal speed demonstrate distinctly different energy-related performance. For the same load point (flow and head), 2-pole pumps were typically found to be less efficient than 4-pole pumps. Their higher operating speeds, however, allow a 2-pole pump serving the same load as a 4-pole pump to be significantly smaller in size. The smaller size is a consumer utility to consumers who face space constraints in their installation location.

To account for the variability in efficiency between 2- and 4-pole pumps, in the NOPR, DOE proposed that for both constant load and variable load pumps, the equipment classes should also be differentiated on the basis of nominal design speed. Therefore, within the scope of the NOPR, pumps were to be defined as being designed for either 3,600 or 1,800 rpm nominal driver speeds. Pumps defined as having a 3,600 rpm nominal driver speed are designed to operate with a 2-pole induction motor or with a non-induction motor with a speed of rotation operating range that includes speeds of rotation between 2,880 and 4,320 rpm. Pumps defined as having an 1,800 rpm nominal driver speed are designed to operate with a 4-pole induction motor or with a non-induction motor with a speed of rotation operating range that includes speeds of rotation between

[25] Such a rating would include the hydraulic efficiency of the bare pump as well as the efficiency of a minimally-compliant electric motor, as described in section III.C.1.

1,440 and 2,160 rpm. Throughout this document, a 3,600 rpm nominal speed is abbreviated as 3600, and a 1,800 rpm nominal speed is abbreviated as 1800.

Taking into account the basic pump equipment category, nominal design speed, and configuration, DOE proposed the following twenty equipment classes in the NOPR:

- ESCC.1800.CL;
- ESCC.3600.CL;
- ESCC.1800.VL;
- ESCC.3600.VL;
- ESFM.1800.CL;
- ESFM.3600.CL;
- ESFM.1800.VL;
- ESFM.3600.VL;
- IL.1800.CL;
- IL.3600.CL;
- IL.1800.VL;
- IL.3600.VL;
- RSV.1800.CL;
- RSV.3600.CL;
- RSV.1800.VL;
- RSV.3600.VL;
- VTS.1800.CL;
- VTS.3600.CL;
- VTS.1800.VL; and
- VTS.3600.VL.

DOE received no comments regarding their proposed equipment classes and associated methodology; consequently, DOE has maintained these equipment classes in this final rule. Chapter 3 of the final rule TSD provides further detail on the definition of equipment classes.

As noted in section III.C and specified in the test procedure final rule, CL equipment classes are rated with the PEI_{CL} metric, and VL equipment classes are rated with the PEI_{VL} metric. In the NOPR, however, DOE relied on available data for bare pumps. DOE received no comment regarding the use of bare pump data to represent all equipment classes, as such, DOE's final rule analysis is based on equipment category and nominal design speed only—reported results do not use a ''.CL'' or ''.VL'' designation. Separate CL and VL equipment classes are maintained because CL and VL pumps have distinctly different utilities to the consumer (constant vs. variable load systems) and as a result require different metric and testing methods.

2. Scope of Analysis and Data Availability

DOE collected data to conduct all final rule analyses for the following equipment classes directly: [26]

- ESCC.1800,
- ESCC.3600,
- ESFM.1800,
- ESFM.3600,
- IL.1800,
- IL.3600, and
- VTS.3600.

The following subsections summarize DOE's approach for the remaining equipment classes:

- RS–V.1800;
- RS–V.3600; and
- VT–S.1800.

a. Radially Split, Multi-Stage, Vertical, in-Line Diffuser Casing

In the NOPR, DOE used available information to identify baseline and the maximum technologically feasible efficiency levels for this class. DOE identified these efficiency levels based on a review of the efficiency data for RSV pumps in a database generated using market research and confidential manufacturer information, and that included models offered for sale in the United States by three major manufacturers of RSV pumps. DOE found no models less efficient than the European Union's MEI 40 standard level, which took effect on January 1, 2015.[27] Details of this analysis are presented in Chapter 5 of the TSD. This analysis, in conjunction with confidential discussions with manufacturers, led DOE to conclude that RSV models sold in the United States market are global platforms with hydraulic designs equivalent to those in the European market. DOE presented this conclusion to the CIP Working Group for consideration, where it was supported and reaffirmed on numerous occasions (See, *e.g.* EERE–2013–BT–NOC–0039–0109 at pp. 91–97, EERE–2013–BT–NOC–0039–0105 at pp. 293–300, EERE–2013–BT–NOC–0039–0106 at pp. 38–40, 62–67, 88–95; EERE–2013–BT–NOC–0039–0108 at pp. 119.) Additionally, both HI and Wilo commented in agreement with this conclusion (HI, No. 45 at p. 3; Wilo, No. 44 at p. 4). As a result, in this final rule, DOE is setting the baseline and max-tech levels equivalent to those established in Europe. Specifically, the baseline is the European minimum efficiency standard,[28] and the max-tech level is the European level referred to as ''the indicative benchmark for the best available technology.'' [29]

Available data did not support the development of a cost-efficiency relationship or additional efficiency levels for RSV equipment. As a result, in this final rule DOE is specifying a standard level for RSV that is equivalent to the baseline, consistent with the recommendation of the CIP Working Group. (See EERE–2013–BT–NOC–0039–0092, p. 4, Recommendation No. 9). Based on the data available and recommendation of the CIP Working Group, DOE concludes that this standard level is representative of the typical minimum efficiency configuration sold in this equipment class, and no significant impact is expected for either the consumers or manufacturers. Chapter 5 of the final rule TSD provides complete details on RSV data availability and the development of the baseline efficiency level.

b. Submersible Turbine, 1800 RPM

In the NOPR DOE proposed to set the energy conservation standard level for VTS.1800 at the same C-values as those for the VTS.3600 equipment based on a preliminary consensus of the CIP working group. DOE and the working group pursued this approach due to limited availability of performance data for the VTS.1800 equipment class; the mechanical similarity between VTS.1800 and VTS.3600 equipment; and a concern that because of the mechanical similarity, bare VTS.1800 pumps (which are identical to bare VTS.3600 pumps) could be sold into the market as unregulated equipment, if DOE set a standard only for VTS.3600 equipment. However, at the time of consensus, working group members were asked to perform research on their four-pole VTS product lines and provide feedback on the proposed C-values. (See EERE–2013–BT–NOC–0039–0105 at pp. 300–308; EERE–2013–BT–NOC–0039–0106 at pp. 38–40, 62–67) In the NOPR, DOE requested comment on whether any pump models would meet the proposed standard at a nominal speed of 3600 but fail at a nominal speed of 1800 if the same C-values were used for each equipment class.

In response, Wilo commented that duplicated C-values could be eliminated and DOE could use data from only 3600

[26] DOE again notes that all analyses are based on data for bare pumps. This data is broken out by equipment category and nominal design speed only. As such the ''.CL'' or ''.VL'' designations are not listed.

[27] Council of the European Union. 2012. Commission Regulation (EU) No 547/2012 of 25 June 2012 implementing Directive 2009/125/EC of the European Parliament and of the Council with regard to ecodesign requirements for water pumps. Official Journal of the European Union. L 165, 26 June 2012, pp. 28–36.

[28] Note that this final rule and the European Union regulation use different metrics to represent efficiency. DOE used available data to establish harmonized baseline and max-tech efficiency levels using the DOE metric.

[29] Council of the European Union. 2012. Commission Regulation (EU) No 547/2012 of 25 June 2012 implementing Directive 2009/125/EC of the European Parliament and of the Council with regard to ecodesign requirements for water pumps. Official Journal of the European Union. L 165, 26 June 2012, pp. 28–36.

rpm (2-pole) pumps, which would set the minimum standards at a slightly lower efficiency. (Wilo, No. 44 at p. 4) Wilo's comment implies that 1800 rpm (4-pole) pumps, in general, are typically more efficient than analogous 3600 rpm models; this implication agrees with the preliminary consensus reached by the CIP Working Group.

HI commented that the submersible turbines as defined in this regulation are designed for 2-pole speeds and that C-values derived for submersible turbines in the April 2015 proposed rule are valid only for those pumps with 2-pole motors, and not those with four-pole motors. (HI, No. 45 at p. 3).

DOE considered HI and Wilo's comments in establishing an energy conservation standard for VTS.1800 equipment. Per Wilo's comment, DOE recognizes that in other analyzed equipment categories, pumps using 4-pole motors are generally more efficient than an equivalent pump using a 2-pole motor at a given flow and specific speed. However, insufficient data exists to confirm that 4-pole VTS pumps are more efficient than equivalent 2-pole versions. DOE also notes that it did not use any data from four-pole pumps to establish the C-values for 2-pole VTS pumps.

DOE agrees with HI that submersible turbines in the scope of this rulemaking are primarily designed for 2-pole speeds. In the NOPR, DOE stated that every 4-pole based model is constructed from a bare pump that was originally designed for use with a 2-pole motor. DOE also acknowledged that total shipments for the VTS.1800 equipment are estimated to be less than 1-percent of VTS.3600 equipment. While the C-values were derived from pumps with 2-pole motors, as discussed previously, the C-values were set equal for VTS.1800 and VTS.3600 due to lack of data for VTS.1800 and concerns that bare VTS.1800 pumps (which are identical to bare VTS.3600 pumps) could be sold into the market as unregulated equipment, if DOE set a standard only for VTS.3600.

Upon further review, DOE concludes that setting standards only for pumps that have bowl diameters less than or equal to 6 inches limits the possibility that manufacturers would design VTS pumps for use with 4-pole motors. Specifically, submersible pumps with 6 inch or less bowl diameter are primarily designed for wells. Reducing the speed of the motor would require additional bowl assemblies that would significantly increase the cost of the pump.

For these reasons, DOE updated its analysis of the VTS.1800 equipment class. In this final rule, DOE maintained its approach in identifying baseline and max-tech levels for VTS.1800, utilizing data from VTS.3600 equipment. Specifically, DOE established the baseline and max-tech levels for VTS.1800 at a C-value equivalent to the VTS.3600 baseline and max-tech levels. Available data did not support the development of a cost-efficiency relationship, or additional efficiency levels for VTS.1800 equipment. As a result, after consideration of working group and additional stakeholder input, DOE is setting an energy conservation standard for VTS.1800 pumps at the baseline level. DOE will continue to monitor VTS products in the market and may consider revisions in future rulemakings.

3. Technology Assessment

Throughout DOE's NOPR analyses, DOE considered technologies that may improve pump efficiency. DOE received no comments regarding additional technologies to consider; accordingly, DOE has made no changes to its considered technologies for the final rule. Chapter 3 of the final rule TSD details each of these technology options, which include:

- Improved hydraulic design;
- Improved surface finish on wetted components;
- Reduced running clearances;
- Reduced mechanical friction in seals;
- Reduction of other volumetric losses;
- Addition of a variable speed drive (VSD);
- Improvement of VSD efficiency; and
- Reduced VSD standby and off mode power usage.

a. Applicability of Technology Options to Reduced Diameter Impellers

In the NOPR, DOE proposed setting energy conservation standards for pump efficiency based on the pump's full impeller diameter characteristics, which would require testing the pump at its full impeller diameter. DOE did not receive any comments related to full impeller diameter testing. As such, DOE's analyses of technology options have been made with respect to the full diameter model. In setting standards only on the full diameter, DOE considered that improvements made to the full diameter pumps will also improve the efficiency for all trimmed or reduced diameter variants.

b. Elimination of Technology Options Due to Low Energy Savings Potential.

In the NOPR, DOE eliminated some technologies that were determined to provide little or no potential for efficiency improvement for one of the following additional reasons: (a) The technology does not significantly improve efficiency; (b) the technology is not applicable to the equipment for which standards are being considered or does not significantly improve efficiency across the entire scope of each equipment class; and (c) efficiency improvements from the technology degrade quickly.

Furthermore, in the NOPR, DOE found that most of the considered technology options have limited potential to improve the efficiency of pumps. In addition, DOE found that several of the options also do not pass the screening criteria listed in section III.B. DOE did not receive any comments related to the elimination of technology options due to low energy savings potential. DOE discusses the elimination of all of these technologies in section III.B.

B. Screening Analysis

In the NOPR, DOE used four screening factors to determine which technology options are suitable for further consideration in a standards rulemaking. If a technology option failed to meet any one of the factors, it was removed from consideration. The factors for screening design options include:

(1) Technological feasibility. Technologies incorporated in commercial products or in working prototypes will be considered technologically feasible.

(2) Practicability to manufacture, install and service. If mass production of a technology in commercial products and reliable installation and servicing of the technology could be achieved on the scale necessary to serve the relevant market at the time of the effective date of the standard, then that technology will be considered practicable to manufacture, install and service.

(3) Adverse impacts on product utility or product availability.

(4) Adverse impacts on health or safety. 10 CFR part 430, subpart C, appendix A, sections (4)(a)(4) and (5)(b).

1. Screened Out Technologies

DOE did not receive any comments related to the technology options that were screened out in the NOPR. As such, the conclusions of DOE's screening analysis are unchanged from the NOPR. The following subsections outline DOE's screening methodology and conclusions.

Improved Surface Finish on Wetted Components

DOE observed through analysis that manual smoothing poses a number of significant drawbacks—(1) the process is manually-intensive, which makes it impractical to implement in a production environment, (2) the efficiency improvements from this process degrade over a short period of time, and (3) the relative magnitude of efficiency improvements are small (*e.g.,* approximately 20:1 for a baseline pump with a specific speed of 2,500 rpms) when compared to other options, such as hydraulic redesign. After considering these limitations and the relative benefits that might be possible from including this particular option, DOE concluded that manual smoothing operations would not be likely to significantly improve the energy efficiency across the entire scope of each equipment class in this rule. Consequently, DOE screened this technology option out. Chapters 3 and 4 of final rule TSD provide further details on the justification for screening out this technology.

In addition to smoothing operations, DOE also evaluated two additional methods for improving surface finish; (1) surface coating or plating, and (2) improved casting techniques. In addition to being unable to significantly improve efficiency across the entire scope of each equipment class, surface coatings and platings were also screened out due to reliability and durability concerns, and improved casting techniques were screened out because the efficiency improvements from the technology degrade quickly. Chapters 3 and 4 of final rule TSD provide further details on these methods for surface finish improvement, and justification for screening out each one.

Reduced Running Clearances

Manufacturer interview responses indicate that clearances are currently set as tight as possible, given the limitations of current wear ring materials, machining tolerances, and pump assembly practices. To tighten clearance any further without causing operational contact between rotating and static components would require larger (stiffer) shafts, and larger (stiffer) bearings. Without these stiffer components, operational contact will lead to accelerated pump wear and loosened clearances. Loosened clearances cause the initial efficiency improvements to quickly degrade. Alternatively, the use of larger components to improve the stiffness to appropriate levels results in increased mechanical losses. These losses negate the potential improvements gained from reduced clearances. Consequently, DOE eliminated this technology option because of the concerns about reliability and quick degradation of efficiency improvements. For additional details on the screening of reduced running clearances, see chapter 4 of the final rule TSD.

Reduced Mechanical Friction in Seals

DOE evaluated mechanical seal technologies that offered reduced friction when compared to commonly used alternatives. DOE concluded from this evaluation that the reduction in friction resulting from improved mechanical seals would be too small to significantly improve efficiency across the entire scope of each equipment class. For additional details, see chapters 3 and 4 of the final rule TSD.

Reduction of Other Volumetric Losses

The most common causes of volumetric losses (other than previously discussed technology options) are thrust balance holes. (Thrust balance holes are holes located in the face of an impeller that act to balance the axial loads on the impeller shaft and thus reduce wear on rub surfaces and bearings). DOE found that removal of thrust balance holes from existing impellers will reduce pump reliability. DOE notes that manufacturers may be able to decrease volumetric losses by reducing the number and/or diameter of thrust balance holes as a part of a full hydraulic redesign. For additional details, see chapters 3 and 4 of the final rule TSD.

Addition of a Variable Speed Drive (VSD)

Because there are many application types and load profiles that would not benefit from a VSD, and many applications for which energy use would increase with a VSD, DOE eliminated the use of VSDs from the list of technology options. For additional details, see chapters 3 and 4 of the final rule TSD.

Improvement of VSD Efficiency

Because DOE has eliminated the use of VSDs as a technology option, improvement of VSD efficiency was screened out as technology option. For additional details, see chapters 3 and 4 of the final rule TSD.

Reduced VSD Standby and Off Mode Power Usage

Although improving VSD efficiency and standby/off mode power may help improve overall pump efficiency, DOE concluded that not all pumps for which DOE is considering standards in this rule would benefit from the use of a VSD. As such, DOE screened out improved VSD efficiency and reduced standby and off mode power usage as design options in the engineering analysis. For additional details, see chapter 4 of the final rule TSD.

2. Remaining Technologies

In the NOPR, DOE concluded that only improved hydraulic design met all four screening criteria (*i.e.,* practicable to manufacture, install, and service and no adverse impacts on consumer utility, product availability, health, or safety). Furthermore, DOE concluded that improved hydraulic design is technologically feasible, as there is equipment currently available in the market that has utilized this technology option. As such, DOE considered improved hydraulic design as a design option in the engineering analysis. 80 FR 17826, 17843 (April 2, 2015)

In response to DOE's conclusions, HI commented that hydraulic redesign towards higher efficiency may impact suction performance, which subsequently may cause issues with increased cavitation, as well as reduced mechanical seal and bearing life. (HI, No. 45 at p. 6). In response, DOE notes in the NOPR DOE established and analyzed market-based efficiency levels. This means that for all analyzed efficiency levels, a full range of equipment already exists in the market. Specifically, the standard level proposed in the NOPR and established in this final rule was selected by the CIP Working Group and determined to be technologically feasible. Therefore, DOE concludes that improved hydraulic design, as analyzed, does not have a negative impact on utility. For additional details, see chapter 4 of the final rule TSD.

C. Engineering Analysis

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

DOE conducted the engineering analyses for this rulemaking using a design-option approach. The decision to use this approach was made due to several factors, including the wide variety of equipment analyzed, the lack of numerous levels of equipment efficiency currently available in the market, and the limited design options available for the equipment. More specifically, for the hydraulic redesign option, DOE used industry research to determine changes in manufacturing costs and associated increases in energy efficiency. DOE directly analyzed costs for the equipment classes listed in section IV.A.2. Consistent with HI's recommendation (HI, Framework Public Meeting Transcript at p. 329) and available data, DOE concluded that it was infeasible to determine the upfront costs (engineering time, tooling, new patterns, qualification, etc.) associated with hydraulic redesign via reverse engineering.

The following sections briefly discuss the methodology used in the engineering analysis. Complete details of the engineering analysis are available in chapter 5 of the final rule TSD.

1. Representative Equipment for Analysis

a. Representative Configuration Selection

For the NOPR engineering analysis, DOE directly analyzed the cost-efficiency relationship for all equipment classes specified in in section IV.C.8, over the full range of sizes, for all pumps falling within the proposed scope. Within the engineering analysis, ''size'' is defined by a pump's flow at BEP and specific speed. Analyzing over the full size range allowed DOE to use representative configurations for each equipment class, rather than an approach that analyzes a representative unit from each class. A representative unit has a defined size and defined features, while a representative configuration defines only the features of the pump, allowing the cost-efficiency analysis to consider a large range of data points that occur over the full range of sizes.

In selecting representative configurations, DOE researched the offerings of major manufacturers to select configurations generally representative of the typical offerings produced within each equipment class. Configurations and features were based on high-shipment-volume designs prevalent in the market. The key features that define each representative configuration include impeller material, impeller production method, volute/casing material, volute/casing production method, and seal type.

For the ESCC, ESFM, and IL equipment classes, the representative configuration was defined as a pump fitted with a cast bronze impeller; cast-iron volute; and mechanical seal. For the RSV and VTS equipment classes, the representative configuration was defined as a pump fitted with sheet metal-based fabricated stainless-steel impeller(s), and sheet metal-based fabricated stainless-steel casing and internal static components. 80 FR 17826, 17844 (April 2, 2015) DOE received no comments regarding its approach to representative units; consequently, DOE utilized the same representative unit configurations in this final rule. Chapter 5 of the TSD provides further detail on representative configurations.

b. Baseline Configuration

The baseline configuration defines the lowest efficiency equipment in each analyzed equipment class. This configuration represents equipment that utilizes the lowest efficiency technologies present in the market. In the NOPR, DOE directly analyzed the cost-efficiency relationship over the full range of pump sizes; as such, in the NOPR, DOE defined a baseline configuration applicable across all sizes, rather than a more specific baseline model. This baseline configuration ultimately defines the energy consumption and associated cost for the lowest efficiency equipment analyzed in each class. In the NOPR, DOE established baseline configurations by reviewing available manufacturer performance and sales data for equipment manufactured at the time of the analysis. 80 FR 17826, 17844 (April 2, 2015) DOE received no comments regarding baseline configurations; consequently, DOE has maintained this methodology in this final rule. Chapter 5 of the final rule TSD sets forth the process that DOE used to select the baseline configuration for each equipment class and discusses the baseline in greater detail.

2. Design Options

After conducting the screening analysis, DOE considered hydraulic redesign as a design option in the final rule engineering analysis.

3. Available Energy Efficiency Improvements

In the NOPR, DOE assessed the available energy efficiency improvements resulting from a hydraulic redesign for each equipment class. This assessment was informed by manufacturer performance and cost data, confidential manufacturer interview responses, general industry research, and stakeholder input gathered at the CIP Working Group public meetings. DOE concluded that a hydraulic redesign is capable of improving the efficiency of a pump up to and including the max-tech level (discussed in section IV.C.4.a). The efficiency gains that a manufacturer realizes from a hydraulic redesign are expected to be commensurate with the level of effort and capital a manufacturer invests in redesign. 80 FR 17826, 17844 (April 2, 2015) DOE received no comments regarding this assessment; consequently, DOE maintained this methodology in this final rule. Section IV.C.6 discusses the relationship between efficiency gains and conversion cost in more detail.

4. Efficiency Levels Analyzed

In assessing the cost associated with hydraulic redesign, and carrying through to all downstream analyses, DOE analyzed several efficiency levels for the NOPR. Each level corresponds to a specific C-value, as shown in Table IV.2. 80 FR 17826, 17844 (April 2, 2015)

TABLE IV.1—NOPR EFFICIENCY LEVELS ANALYZED WITH CORRESPONDING C-VALUES

Equipment class	EL 0	EL 1	EL 2	EL 3	EL 4	EL 5
	Baseline	10th efficiency percentile	25th efficiency percentile	40th efficiency percentile	55th efficiency percentile	70th efficiency percentile/max tech
ESCC.1800	134.43	131.63	128.47	126.67	125.07	123.71
ESCC.3600	135.94	134.60	130.42	128.92	127.35	125.29
ESFM.1800	134.99	132.95	128.85	127.04	125.12	123.71
ESFM.3600	136.59	134.98	130.99	129.26	127.77	126.07
IL.1800	135.92	133.95	129.30	127.30	126.00	124.45
IL.3600	141.01	138.86	133.84	131.04	129.38	127.35
RSV.1800 *	129.63	N/A	N/A	N/A	N/A	124.73
RSV.3600 *	133.20	N/A	N/A	N/A	N/A	129.10
VTS.1800	137.62	135.93	134.13	130.83	128.92	127.29
VTS.3600	137.62	135.93	134.13	130.83	128.92	127.29

* For RSV equipment, DOE established only baseline and max-tech efficiency levels due to limited data availability.

DOE did not receive any comments related to ESCC, ESFM, IL, or RSV pumps and has maintained the same efficiency levels for these equipment categories in this final rule. DOE received feedback related to VTS pumps and has accordingly updated efficiency levels for the VTS.3600 and VTS.1800 equipment classes. DOE calculated new C-values for each efficiency level based on updated data for submersible motors submitted by HI. (See EERE–2013–BT–TP–0055–0008 at pp. 19–20) More detailed discussion of this data can be found in the pumps test procedure final rule. Additionally, based on feedback from HI suggesting that standards for 2-pole VTS pumps (*i.e.* VTS.3600) should not apply to 4-pole VTS pumps (*i.e.* VTS.1800), DOE analyzed baseline and max-tech efficiency levels for the VTS.1800 equipment class. This feedback was previously discussed in section IV.A.2.b. In the final rule, DOE updated efficiency levels for VTS pumps based on stakeholder feedback. The final rule efficiency levels and corresponding C-values are shown in Table IV.2. (See section III.C for more information about C-values and the related equations.)

TABLE IV.2—FINAL RULE EFFICIENCY LEVELS ANALYZED WITH CORRESPONDING C-VALUES

Equipment class	EL0	EL1	EL 2	EL 3	EL 4	EL 5
	Baseline	10th efficiency percentile	25th efficiency percentile	40th efficiency percentile	55th efficiency percentile	70th efficiency percentile/max tech
ESCC.1800	134.43	131.63	128.47	126.67	125.07	123.71
ESCC.3600	135.94	134.60	130.42	128.92	127.35	125.29
ESFM.1800	134.99	132.95	128.85	127.04	125.12	123.71
ESFM.3600	136.59	134.98	130.99	129.26	127.77	126.07
IL.1800	135.92	133.95	129.30	127.30	126.00	124.45
IL.3600	141.01	138.86	133.84	131.04	129.38	127.35
RSV.1800 *	129.63	N/A	N/A	N/A	N/A	124.73
RSV.3600 *	133.20	N/A	N/A	N/A	N/A	129.10
VTS.1800 *	138.78	N/A	N/A	N/A	N/A	127.15
VTS.3600	138.78	136.92	134.85	131.92	129.25	127.15

* For RSV and VTS.1800 equipment, DOE established only baseline and max-tech efficiency levels due to limited data availability.

a. Maximum Technologically Feasible Levels

Efficiency level five (EL5), as shown in Table IV.2, represents the maximum technologically feasible (''max-tech'') efficiency level for the ESCC, ESFM, IL, RSV, and VTS equipment classes. To set the max-tech level for the applicable equipment classes, DOE performed an analysis to determine the maximum improvement in energy efficiency that is technologically feasible for each equipment class.

DOE considers technologies to be technologically feasible if they are incorporated in any currently available equipment or working prototypes. A max-tech level results from the combination of design options predicted to result in the highest efficiency level possible for an equipment class.

DOE determined during the NOPR stage, based on available information and consistent with the conclusions of the CIP Working Group, that pumps are a mature technology, with all available design options already existing in the marketplace.[30] Therefore, DOE assumed in its analysis that the max-tech efficiency level coincides with the maximum available efficiency already offered in the marketplace. As a result, DOE performed a market-based analysis to determine max-tech/max-available levels. Based on this analysis, and as a result of the wide range of pumps in each equipment class (1–200 hp), DOE established a max-tech level for each equipment class at the 70th efficiency percentile. This max-tech level was set so that there are existing pumps available in the market that both meet this level and have varying shaft input powers over the entire range of 1–200 hp. As a result, for each equipment class, the max-tech level is representative of the maximum efficiency achievable for pumps that is inclusive of the entire horsepower range. A preliminary version of this analysis was provided to the CIP

[30] See EERE–2013–BT–NOC–0039–0072, pp.103–105.

Working Group during the April 29–30, 2014 meetings, and DOE did not receive feedback on any alternative max-tech efficiency levels. (EERE–2013–BT–NOC–0039–0051, pp. 17–32) DOE incorporated the 70th efficiency percentile as the highest TSL level evaluated in the NOPR (80 FR 17826, 17845 (April 2, 2015)) and received no further comments. DOE therefore maintained these max-tech efficiency levels in this final rule. Chapter 5 of final rule TSD provides complete details on DOE's market-based max-tech analysis and results.

5. Manufacturers Production Cost Assessment Methodology

a. Changes in MPC Associated With Hydraulic Redesign

In the NOPR, DOE performed an analysis for each equipment class to determine the change in manufacturer production cost (MPC), if any, associated with a hydraulic redesign. 80 FR 17826, 17845 (April 2, 2015) For this analysis, DOE reviewed the manufacturer selling price (MSP), component cost, performance, and efficiency data supplied by both individual manufacturers and HI. DOE, with the support of the majority of the CIP Working Group, concluded that for all equipment classes, a hydraulic redesign is not expected to increase the MPC of the representative pump configuration used for analysis.[31] Specifically, a hydraulic redesign is not expected to increase production or purchase cost of a pump's two primary components; the impeller and the volute.

In the NOPR, DOE acknowledged that actual changes in MPC experienced by individual manufacturers will vary, and that in some cases redesigns may actually increase or decrease the cost of the impeller and/or volute. However, available information indicates that the flat MPC-versus-efficiency relationship best represents the aggregated pump industry as a whole. DOE did not receive any comments on changes in MPC. Consequently, in this final rule, DOE maintains its conclusions that hydraulic redesign is not expected to increase the MPC of the representative pump configuration used for analysis. Chapter 5 of the final rule TSD provides complete details on DOE's MPC-efficiency analysis and results.

b. Manufacturer Production Cost (MPC) Model

In the NOPR, for each equipment class, DOE developed a scalable cost model to estimate MPC across all pump sizes. Given a pump's specific speed and BEP flow, the cost model outputs an estimated MPC. Because hydraulic redesign is not expected to result in an increase in MPC, the model is efficiency-independent and predicts the same MPC for all pumps of the identical BEP flow, specific speed, and equipment class, regardless of efficiency.

The NOPR MPC model was developed using data supplied by both HI and individual manufacturers. 80 FR 17826, 17845 (April 2, 2015) This data set includes information on the MSP, manufacturer markup, shipments volumes, model performance and efficiency, and various other parameters. DOE did not receive any comments on the MPC model. Consequently, DOE utilized the same MPC model in this final rule. Chapter 5 of the final rule TSD provides additional detail on the development of the MPC model.

6. Product and Capital Conversion Costs

DOE expects that hydraulic redesigns will result in significant conversion costs for manufacturers as they attempt to bring their pumps into compliance with the proposed standard. 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 a new or amended energy conservation standard. Capital conversion costs are investments in property, plant, and equipment necessary to adapt or change existing production facilities such that new product designs can be fabricated and assembled.

In the NOPR, DOE used a bottom-up approach to evaluate the magnitude of the product and capital conversion costs the pump industry would incur to comply with new energy conservation standards. 80 FR 17826, 17845–17846 (April 2, 2015) For this approach, DOE first determined the industry-average cost, per model, to redesign pumps of varying sizes to meet each of the proposed efficiency levels. DOE then modeled the distribution of unique pump models that would require redesign at each efficiency level. For each efficiency level, DOE multiplied each unique failing model by its associated cost to redesign and summed the total to reach an estimate of the total product and capital conversion cost for the industry.

Data supplied to DOE by HI was used as the basis for the industry-average cost, per model, to redesign a failing pump model. HI, through an independent third party, surveyed 15 manufacturers regarding the product and conversion costs associated with redesigning one-, 50-, and 200-hp pumps from the 10th to the 40th percentile of market efficiency. Specifically, HI's survey contained cost categories for the following: Redesign; prototype and initial test; patterns and tooling; testing; working capital; and marketing.

DOE validated the HI survey data with independent analysis and comparable independently collected manufacturer interview data. In addition, data from the EU pumps regulation preparatory study[32] was used to augment the HI survey data and scale costs to various efficiency levels above and below the 40th percentile.

DOE used a pump model database, containing various performance parameters, to model the distribution of unique pump models that would require redesign at each efficiency level. The database is comprised of a combination of data supplied by HI and data that DOE collected independently from manufacturers. For the ESCC, ESFM, IL, and VTS equipment classes, the database is of suitable size to be representative of the industry as a whole. Table IV.3 presents the resulting product and capital conversion costs for each equipment class, at each efficiency level.

DOE received comments that were consistent with the conversion costs presented in the NOPR, as discussed in section IV.J.3. Consequently, DOE is maintaining the same product and capital conversion costs in this final rule. However, DOE adjusted conversion costs for the VTS.1800 class, as DOE could not establish intermediate efficiency levels due to lack of data, as discussed in section IV.A.2.b. As a result, in Table IV.3, VTS.3600 and VTS.1800 are listed separately, as different efficiency levels were established for each of these equipment classes. Complete details on the calculation of industry aggregate

[31] Refer to the following transcripts in which the conclusion of no change in MPC with improved efficiency is presented to the working group and discussed: EERE–2013–BT–NOC–0039–0072, pp. 114–130 and pp. 270–273; EERE–2013–BT–NOC–0039–0109, p. 264).

[32] AEA Energy & Environment. 2008, Appendix 6: Lot 11—'Circulators in buildings,' Report to European Commission.

product and capital conversion costs are found in chapter 5 of the final rule TSD.

TABLE IV.3—TOTAL CONVERSION COST AT EACH EFFICIENCY LEVEL

All values in millions of 2014 dollars	EL 0	EL 1	EL 2	EL 3	EL 4	EL 5
ESCC/ESFM *	0	12.6	50.1	112.2	213.5	349.8
IL	0	5.1	20.3	46.0	89.5	146.1
VTS.3600 ††	0	2.6	9.5	19.4	38.4	62.2
VTS.1800 ††	0	N/A **	N/A **	N/A **	N/A **	Data Not Available †
RSV	0	N/A **	N/A **	N/A **	N/A **	Data Not Available †

* Due to commonality in design and components, DOE calculated the conversion costs for ESCC and ESFM in aggregate. These values were later disaggregated, as appropriate, in downstream analyses.
** Intermediate efficiency levels were not established for VTS.1800 and RSV equipment classes. Please see section IV.A.2 for further detail.
† Although max-tech efficiency levels were established for VTS.1800 and RSV equipment classes, the available data was insufficient to establish a cost-efficiency relationship at max-tech. Please see section IV.A.2 for further detail.
†† VTS.3600 and VTS.1800 are listed separately as different efficiency levels have been established for each equipment class. Please see section IV.A.2 for more details.

7. Manufacturer Markup Analysis

To account for manufacturers' non-production costs and profit margin, DOE applies a non-production cost multiplier (the manufacturer markup) to the full MPC. The resulting MSP is the price at which the manufacturer can recover all production and non-production costs and earn a profit. To meet the new energy conservation standards set forth in this rule, DOE expects that manufacturers will hydraulically redesign their product lines, which may result in new and increased capital and equipment conversion costs. Depending on the competitive environment for this equipment, some or all of the increased conversion costs may be passed from manufacturers to retailers and eventually to consumers in the form of higher purchase prices. The MSP should be high enough to recover the full cost of the equipment (*i.e.,* full production and non-production costs) and overhead (including amortized product and capital conversion costs), and still yield a profit. The manufacturer markup has an important bearing on profitability. A high markup under a standards scenario suggests manufacturers can readily pass along more of the increased capital and equipment conversion costs to consumers. A low markup suggests that manufacturers will not be able to recover as much of the necessary investment in plant and equipment.

To support the downstream analyses, DOE investigated industry markups in detail, characterizing industry-average markups, individual manufacturer markup structures, and the industry-wide markup structure.

a. Industry-Average Markups

In the NOPR, industry-average manufacturer markups were developed by weighting individual manufacturer markup estimates on a market share basis, as manufacturers with larger market shares more significantly affect the market average. 80 FR 17826, 17846 (April 2, 2015) DOE did not receive any comments on these industry-average markups and used the same markups in this final rule.

b. Individual Manufacturer Markup Structures

In the NOPR, DOE concluded that within an equipment class, each manufacturer maintains a flat markup, based on data and information gathered during the manufacturer interviews. This means that each manufacturer targets a single markup value for models offered in an equipment class, regardless of size, efficiency, or other design features. Tiered product offerings and markups do not exist at the individual manufacturer level. 80 FR 17827, 17846 (April 2, 2015) DOE received no comments regarding these individual manufacturer markup structure conclusions. Consequently, DOE has carried through these conclusion into their final rule analysis.

c. Industry-Wide Markup Structure

DOE also used the markup data gathered during the manufacturer interviews to assess the industry-wide markup structure. Although tiered product offerings and markups do not exist at the individual manufacturer level, DOE concluded in the NOPR that when analyzed as whole, the industry exhibits a relationship between manufacturer markup and efficiency. 80 FR 17827, 17846–17847 (April 2, 2015) DOE's analysis showed that on the industry-wide scale, the lowest efficiency models tend to garner lower markups than higher efficiency models, up to about the 25th percentile of efficiency. Beyond the 25th percentile, the relationship flattens out, and no correlation is seen between markup and efficiency. The data suggest that this relationship is a result of certain manufacturers positioning themselves with more or less efficient product portfolios and charging markups commensurate with their position in the marketplace. They also indicate (consistent with the views of the CIP Working Group) that the market does not value efficiency beyond the lower 25th percentile. (EERE–2013–BT–NOC–0039–0072, pp. 269–278; EERE–2013–BT–NOC–0039–0054, pp. 67–69) In both manufacturer interviews and working group comments, manufacturers stated that efficiency is not currently the primary selling point or cost driver for the majority of pumps within the scope of the proposed rule. Rather, other factors, such as reliability, may influence price significantly and are known to be more influential in the purchaser's decision making process. (EERE–2013–BT–NOC–0039–0072, pp. 269–278)

DOE notes that in the NOPR analysis, the development of the markup-efficiency relationship was based on data from the IL equipment class. In the NOPR phase, DOE, with support of the CIP Working Group, concluded that the markup structure of the IL equipment class is representative of the ESCC, ESFM, and VTS equipment classes.[33]

Based on comments previously discussed in section IV.A.2.b, DOE has concluded that available data do not support the development of a cost-efficiency relationship for the VTS.1800 equipment class. Beyond the removal of the VTS.1800 equipment class from the analysis, DOE did not receive any additional comments on the IL markup-efficiency relationship or the general

[33] Refer to the following transcript in which the conclusion that the markup structure of the IL equipment class is representative of the ESCC, ESFM, and VTS equipment classes is presented to the working group and no negative feedback is received: EERE–2013–BT–NOC–0039–0072, pp. 292–295.

methodology presented in the NOPR. Consequently, in this final rule, DOE applied the industry-wide IL markup-efficiency relationship to only the ESCC, ESFM, and VTS.3600 equipment classes. Chapter 5 of the final rule TSD provides complete details the markup-efficiency relationship analysis and results.

8. MSP-Efficiency Relationship

Ultimately, the goal of the engineering analysis is to develop an MSP-Efficiency relationship that can be used in downstream rulemaking analyses such as the Life Cycle Cost (LCC) analysis, the Payback Period (PBP) analysis, and the Manufacturer Impact Analysis (MIA).

For the NOPR downstream analyses, DOE evaluated the base case MSP-Efficiency relationship as well as two separate MSP-Efficiency relationship scenarios to represent the uncertainty regarding the potential impacts on prices and profitability for manufacturers following the implementation of new energy conservation standards. 80 FR 17827, 17847 (Apr. 2, 2015) The two scenarios are: (1) Flat pricing, and (2) cost recovery pricing. These scenarios result in varying revenue and cash flow impacts and were chosen to represent the lower and upper bounds of potential revenues for manufacturers. DOE did not received any additional comments on these two cost recovery scenarios. Consequently, DOE has maintained its methodology and scenarios in the analysis of this final rule. The scenarios are described in further detail in the following paragraphs.

The base pricing scenario represents a snapshot of the pump market, as it stands prior to this rulemaking. The base pricing scenario was developed by applying the markup-efficiency relationship presented in section IV.C.7.c to the MPC model presented in section IV.C.5.a. Both the markup and MPC model are based on data supplied by individual manufacturers. From these data, DOE created a scalable model that can determine MSP as a function of efficiency, specific speed, and flow at BEP.

Under the flat pricing standards case scenario, DOE maintains the same pricing as in the base case, which resulted in no price changes at a given efficiency level for the manufacturer's first consumer. Because this pricing scenario assumes that manufacturers would not increase their pricing as a result of standards, even as they incur conversion costs, this scenario is considered a lower bound for revenues.

In the cost recovery pricing scenario, manufacturer pricing is set so that manufacturers recover their conversion costs over the analysis period. This cost recovery is enabled by an increase in mark-up, which results in higher sales prices for pumps even as MPCs stay the same. The cost recovery calculation assumes manufacturers raise prices on models where a redesign is necessitated by the standard. The additional revenue due to the increase in markup results in manufacturers recovering 100 percent of their conversion costs over the 30-year analysis period, taking into account the time-value of money. The final MSP-efficiency relationship for this scenario is created by applying the markup-efficiency relationship to the MPC cost model presented in section IV.C.5.b., resulting in a scalable model that can determine MSP as a function of efficiency, specific speed, and flow at BEP. In the LCC and NIA analysis, DOE evaluated only the cost recovery pricing scenario, as it would be the most conservative case for consumers, resulting in the fewest benefits.[34]

D. Markups Analysis

DOE uses markups (*e.g.,* manufacturer markups, distributor markups, contractor markups) and sales taxes to convert the MSP estimates from the engineering analysis to consumer prices, which are then used in the LCC and PBP analysis and in the manufacturer impact analysis. The markups are multipliers that represent increases above the MSP. DOE develops baseline and incremental markups based on the equipment markups at each step in the distribution chain. The incremental markup relates the change in the manufacturer sales price of higher-efficiency models (the incremental cost increase) to the change in the consumer price.

Before developing markups, DOE defines key market participants and identifies distribution channels. In the NOPR, DOE used the following main distribution channels that describe how pumps pass from the manufacturer to end-users: (1) Manufacturer to distributor to contractor to end-users (70 percent of sales); (2) manufacturer to distributor to end-users (17 percent of sales); (3) manufacturer to original equipment manufacturer to end-users (8 percent of sales); (4) manufacturer to end-users (2 percent of sales); and (5) manufacturer to contractor to end-users (1 percent of sales). Other distribution channels exist but are estimated to account for a minor share of pump sales (combined 2 percent). 80 FR 17826, 17847 (April 2, 2015). In response to the NOPR, Wilo agreed that the market distribution channels included all appropriate intermediate steps, and the estimated market share of each channel. (Wilo, No. 44 at p. 4) DOE received no additional comments on this topic. Therefore, DOE maintained these distribution channels for this final rule.

In the NOPR, to develop markups for the parties involved in the distribution of the equipment, DOE utilized several sources, including: (1) The U.S. Census Bureau 2007 *Economic Census Manufacturing Industry Series* (NAICS 33 Series)[35] to develop original equipment manufacturer markups; (2) the U.S. Census Bureau 2012 *Annual Wholesale Trade Survey, Hardware, and Plumbing and Heating Equipment and Supplies Merchant Wholesalers*[36] to develop distributor markups; and (3) 2013 RS Means *Electrical Cost Data*[37] to develop mechanical contractor markups. 80 FR 17826, 17847 (April 2, 2015).

In addition to the markups, DOE derived State and local taxes from data provided by the Sales Tax Clearinghouse.[38] 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. (*Id.*)

DOE did not receive any comments on the markups or sales tax and has maintained this approach for the final rule.

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

E. Energy Use Analysis

The purpose of the energy use analysis is to determine the annual energy consumption of pumps at different efficiency levels and to assess the energy savings potential of increased pumps efficiency. The energy use analysis estimates the range of energy

[34] The cost recovery pricing scenario is the most conservative case (*i.e.,* resulting in the fewest benefits) for consumers and the most positive case for manufacturers (*i.e.,* resulting in the fewest negative impacts). In the MIA, DOE analyses this scenario and the flat pricing scenario, which results in the most positive case for consumer and the most conservative case for manufacturers.

[35] U.S. Census Bureau (2007). *Economic Census Manufacturing Industry Series (NAICS 33 Series) www.census.gov/manufacturing/asm.*

[36] U.S. Census Bureau (2012). *Annual Wholesale Trade Survey, Hardware, and Plumbing and Heating Equipment and Supplies Merchant Wholesalers (NAICS 4237). www.census.gov/wholesale/index.html.*

[37] RS Means (2013), Electrical Cost Data, 36th Annual Edition (Available at: *www.rsmeans.com*).

[38] Sales Tax Clearinghouse, Inc. (last accessed on January 10, 2014), *State sales tax rates along with combined average city and county rates, http://thestc.com/STrates.stm.*

use of pumps 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.

DOE analyzed the energy use of pumps to estimate the savings in energy costs that consumers would realize from more energy-efficient pump equipment. Annual energy use depends on a number of factors that depend on the utilization of the pump, particularly duty point (*i.e.,* flow, head, and power required for a given application), pump sizing, annual hours of operation, load profiles, and equipment losses. The annual energy use is calculated as a weighted sum of input power multiplied by the annual operating hours across all load points.

1. Duty Point

For the NOPR, DOE researched information on duty points for the commercial, industrial, and agricultural sectors from a variety of sources. DOE identified statistical samples only for the agricultural sector. Therefore, DOE used manufacturer shipment data to estimate the distribution of pumps in use by duty point. To account for the wide range of pump duty points in the field, DOE placed pump models in bins with varying power capacities using the shipment data provided by individual manufacturers. DOE grouped all pump models into nine power bins on a log-scale between 1 and 200 hp. Then, for each equipment class, DOE grouped the pump models into nine flow bins on a log-scale between minimum flow at BEP and maximum flow at BEP. Based on the power and flow binning process, DOE defined a representative unit for each of the combined power and flow bins. Within each bin, DOE defined the pump performance data (power and flow at BEP, pump curve and efficiency curve) as the shipment-weighted averages over all units in the bin. DOE used these data to calculate the annual energy use for each of the equipment classes. 80 FR 17826, 17848 (Apr. 2, 2015). DOE did not receive any comments and has maintained this approach in the final rule.

2. Pump Sizing

For the NOPR, DOE reviewed relevant guidelines and resources and introduced a variable called the BEP offset to capture variations in pump sizing practices in the field. The BEP offset is essentially the relative distance between the consumer's duty point and the pump's BEP. Pumps are often sized to operate within 75 percent to 110 percent of their BEP flow. Therefore, for the NOPR analysis, the BEP offset was assumed to be uniformly distributed between −0.25 (*i.e.,* 25% less than BEP flow) and 0.1 (10% more than BEP flow). 80 FR 17826, 17848 (April 2, 2015). DOE did not receive any comments on pump sizing and has maintained this approach in the final rule.

3. Operating Hours

For the NOPR, DOE estimated average annual operating hours by application based on inputs from a market expert and feedback from the CIP Working Group.[39] DOE developed statistical distributions to use in its energy use analysis. 80 FR 17826, 17848 (April 2, 2015). In response to the NOPR, Wilo commented that the average operating hours for the different pump equipment classes and applications in the scope of this rulemaking are based on assumptions and are not well documented in engineering resources. (Wilo, No. 44 at p. 4) Because operating hours are not well documented in engineering resources, DOE developed statistical distributions in the NOPR. DOE maintained its estimate on operating hours based on feedback from the CIP Working Group.

4. Load Profiles

Considering the range of all applications of the pump equipment classes for which DOE considered standards, in the NOPR DOE developed four load profiles, characterized by different weights at 50 percent, 75 percent, 100 percent, and 110 percent of the flow at the duty point. These load profiles represent different types of loading conditions in the field: flat load at BEP, flat/over-sized load weighted evenly at 50 percent and 75 percent BEP, variable load over-sized, and variable load under-sized. In the NOPR, based on discussion in the CIP Working Group, DOE estimated that only 10 percent of consumers would use pumps with the variable load/undersized load profile; the remaining load profiles were estimated to apply to 30 percent of consumers each. 80 FR 17826, 17848 (April 2, 2015). In response to the NOPR, Wilo commented that there are no established typical load profiles for pumps within U.S. engineering standards. (Wilo, No. 44 at p. 5) HI recommended that the equally weighted load profiles initially proposed during the CIP Working Group negotiations be used in the consumer sample. (HI, No. 45 at p. 3) After considering comments from HI and Wilo, and in the absence of established typical load profiles for pumps, DOE maintains the four distinct load profiles and weights outlined in the NOPR to define the range of applications available for pumps on the market.

To describe a pump's power requirements at points on the load profile away from the BEP, DOE used the shipment-weighted average pump curves, modeled as second-order polynomial functions, for each of the representative units. 80 FR 17826, 17849 (April 2, 2015). DOE received no comment on this approach and maintains it in this final rule.

5. Equipment Losses

Using the duty point, load profile, and operating hours, DOE calculated the energy use required for the end-use (or the energy which that is converted to useful hydraulic horsepower). However, the total energy use by pumps also depends on pump losses, motor losses, and control losses.

Pump losses account for the differences between pump shaft horsepower and hydraulic horsepower due to friction and other factors. In the NOPR, DOE took this into account using the efficiency information available in the manufacturer shipment data for each pump. To describe pump efficiency at points away from the BEP, DOE calculated shipment-weighted average efficiency curves for each representative unit, modeled as second-order polynomial functions. DOE used existing minimum motor efficiency standards in calculating annual energy use as well as the proposed default submersible motor efficiency values. DOE did not consider VFDs in the LCC analysis. 80 FR 17826, 17849 (April 2, 2015).

DOE received no comments on the use of these equipment losses in its energy use analysis. However, based on comments on the test procedure NOPR, DOE revised the default submersible motor efficiency values in the test procedure final rule. For the energy use analysis, DOE updated its submersible motor efficiency values to reflect those values.

DOE proposed in the test procedure NOPR that pumps sold with non-electric drivers be rated as bare pumps. Any hydraulic improvements made to the bare pump to comply with any applicable energy conservation standards would also result in energy savings if the pump is used with a non-electric driver. However, DOE

[39] Refer to the following transcripts in which operating hours are presented to the working group and no negative feedback is received: EERE–2013–BT–NOC–0039–0072, pp. 353–355; EERE–2013–BT–NOC–0039–0109, pp. 139–152.

estimated, based on information from consultants and the working group, that only 1–2% of pumps in scope are driven by non-electric drivers. Therefore, in the NOPR, DOE accounted for the energy use of all pumps as electricity use and did not account for fuel use in its analysis. DOE requested comment on the percent of pumps in scope operated by each fuel type other than electricity (*e.g.,* diesel, gasoline, liquid propane gas, or natural gas) and the efficiency or losses of each type of non-electric driver, including transmission losses if any, that would allow DOE to estimate the fuel use and savings of pumps sold with non-electric drivers. 80 FR 17826, 17849 (April 2, 2015).

DOE did not receive any input that would allow it to conduct this side analysis. HI agreed that non-electric drivers represent a very small percentage of drivers used with pumps and does not believe further evaluation on non-electric drivers is needed. (HI, No. 45 at p. 4) Consistent with HI's suggestion and lack of any additional input or data during public review, DOE did not include energy savings from non-electric drivers in the final rule. As in the NOPR, DOE accounted for the energy use of all pumps, including those used in agricultural applications with non-electric drivers, as electricity use.

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

F. Life-Cycle Cost and Payback Period Analysis

DOE conducts the life-cycle cost (LCC) and payback period (PBP) analysis to estimate the economic impacts of potential new standards on individual consumers of pump equipment. The LCC calculation considers total installed cost (equipment cost, sales taxes, distribution chain markups, and installation cost), operating expenses (energy, repair, and maintenance costs), equipment lifetime, and discount rate. DOE calculated the LCC for all consumers as if each would purchase a pump in the year that compliance is required with the standard. DOE presumes that the purchase year for all pump equipment for purposes of the LCC calculation is 2020, the first full year following the expected compliance date of late 2019. To compute LCCs, DOE discounted future operating costs to the time of purchase and summed them over the lifetime of the equipment.

DOE analyzed the effect of changes in installed costs and operating expenses by calculating the PBP of potential new standards relative to baseline efficiency levels. The PBP estimates the amount of time it would take the consumer to recover the incremental increase in the purchase price of more-efficient equipment through lower operating costs. In other words, the PBP is the change in purchase price divided by the change in annual operating cost that results from the energy conservation standard. DOE expresses this period in years. Similar to the LCC, the PBP is based on the total installed cost and operating expenses. However, unlike the LCC, DOE only considers the first year's operating expenses in the PBP calculation. Because the PBP does not account for changes in operating expense over time or the time value of money, it is also referred to as a simple PBP.

DOE's LCC and PBP analyses are presented in the form of a spreadsheet model, available on DOE's Web site for pumps.[40] DOE accounts for variability in energy use and prices, discount rates by doing individual LCC calculations for a large sample of pumps (10,000 for each equipment class) that are assigned different installation conditions. Installation conditions include consumer attributes such as sector and application, and usage attributes such as duty point and annual hours of operation. Each pump installation in the sample is equally weighted. The simple average over the sample is used to generate national LCC savings by efficiency level. The results of DOE's LCC and PBP analysis are summarized in section V.B.1.a and described in detail in chapter 8 of the final rule TSD.

1. Approach

DOE conducted the LCC analysis by developing a large sample of 10,000 pump installations, which represent the general population of pumps that would be affected by adopted energy conservation standards. Separate LCC analyses are conducted for each equipment class. Conceptually, the LCC distinguishes between the pump installation and the pump itself. The pump installation is characterized by a combination of consumer attributes (sector, application, electricity price, discount rate) and usage attributes (duty point, BEP offset, load profile, annual hours of operation, mechanical lifetime) that do not change among the considered efficiency levels. The pump itself is the regulated equipment, so its efficiency and selling price change in the analysis.

In the no-new-standards case, which represents the market in the absence of new energy efficiency standards, DOE assigns a specific representative pump to each pump installation. These pumps are chosen from the set of representative units described in the energy use analysis. The relative weighting of different representative units in the LCC sample is determined based on 2012 shipments data supplied by the manufacturers.

The no-new-standards case also includes an estimate of the distribution of equipment efficiencies. In the NOPR, DOE developed a no-new-standards case distribution of efficiency levels for pumps using the shipments data mentioned above. DOE assumed that this distribution would remain constant over time and applied the 2012 distribution in 2020. 80 FR 17826, 17850 (April 2, 2015). DOE received no comment on these assumptions and has maintained them for this final rule. Out of this distribution, DOE assigns a pump efficiency based on the relative weighting of different efficiencies. Chapter 8 of the final rule TSD contains details regarding the no-new-standards case efficiency distribution.

At each efficiency level, the pump assigned in the no-new-standards case has a PEI rating that either would or would not meet a standard set at that efficiency level. If the pump would meet the standard at a given efficiency level, the installation is left unchanged. For that installation, the LCC at the given TSL is the same as the LCC in the no-new-standards case and the standard does not impact that user. If the pump would not meet the standard at a given efficiency level, the no-new-standards case pump is replaced with a compliant unit (*i.e.,* a redesigned pump) having a higher selling price and higher efficiency, and the LCC is recalculated. The LCC savings at that efficiency level are defined as the difference between the LCC in the no-new-standards case and the LCC for the more efficient pump. The LCC is calculated for each pump installation at each efficiency level.

In the engineering analysis, DOE determines the total conversion costs required to bring the entire population of pump models up to a given efficiency level. DOE uses these conversion costs to calculate the selling price of a redesigned pump within each of the combined power and flow bins that define a representative unit. DOE assumes that all consumers whose no-new-standards case pump would not meet the standard at a given efficiency level will purchase the new redesigned pump at the new selling price, and that manufacturers recover the total conversion costs at each efficiency level. DOE allocates conversion costs to each

[40] See *www1.eere.energy.gov/buildings/appliance_standards/rulemaking.aspx/ruleid/14.*

representative unit based on the proportion of total revenues generated by that unit in the no-new-standards case.

DOE calculates the selling price in two stages. In the first stage, for each equipment class and efficiency level, DOE calculates the total revenue generated from all failing units, adds the total conversion costs to the revenues from failing units to generate the new revenue requirement, and defines a markup as the ratio of the new revenue requirement to the no-new-standards case revenue from failing units. This approach ensures that (1) the conversion costs are recovered from the sale of redesigned units and (2) the conversion costs are distributed across the different representative units in proportion to the amount of revenue each representative unit generates in the no-new-standards case.

In the second stage, DOE calculates a new selling price for each redesigned representative unit, *i.e.,* for each of the combined power and flow bins. In the no-new-standards case, each bin contains a set of pumps with varying efficiencies and varying prices. However, all pumps that fail at an efficiency level are given the same new price. Hence, the markup defined in stage one of the calculation cannot be applied directly to the selling price of a failing unit. Instead, DOE calculates revenues associates with all failing units in the bin, and applies the markup to this total to get the new revenue requirement for that bin. Then DOE defines the new selling price as the new revenue requirement divided by the number of failing units in the bin.

In general, the economic inputs to the LCC, (*e.g.,* discount rate and electricity price) depend on the sector, while the usage criteria (*e.g.,* hours of operation) may depend on the application. For the pumps analysis, DOE considered four sectors: industrial, commercial buildings, agricultural and municipal water utilities. DOE assigns electricity prices and discount rates based on the sector. DOE considered several applications, based on a review of available data, and determined that there is some correlation between application and operating hours. DOE did not find any information relating either the BEP offset (a pump sizing factor) or load profile to either sector or application, so DOE assigned these values randomly.

As noted above, DOE determines the distribution of representative units in the pump installation sample from the shipments data. Each representative unit can be thought of as a pump that operates at a representative duty point. To assign the consumer attributes (sector, application, etc.) to duty points, DOE reviewed several data sources to incorporate correlations between sector, application, equipment class and the distribution of duty points into the analysis. Specifically, DOE used a database of various industrial applications collected from several case studies and field studies, and a database on pump tests provided by the Pacific Gas & Electric Company, to construct the distribution of pumps by sector, application and speed as a function of power bin and equipment class. DOE used these distributions to determine the relative weighting of different sectors and applications in the LCC sample for each equipment class.

2. Life-Cycle Cost Inputs

For each efficiency level DOE analyzed, the LCC analysis required input data for the total installed cost of the equipment, its operating cost, and the discount rate. Table IV.4 summarizes the inputs and key assumptions DOE used to calculate the consumer economic impacts of all energy efficiency levels analyzed in this rulemaking. A more detailed discussion of the inputs follows.

TABLE IV.4—SUMMARY OF INPUTS AND KEY ASSUMPTIONS USED IN THE LCC AND PBP ANALYSES*

Inputs	Description
Affecting Installed Costs	
Equipment Price	Equipment price derived by multiplying manufacturer sales price or MSP (calculated in the engineering analysis) by distribution channel markups, as needed, plus sales tax from the markups analysis.
Installation Cost	Installation cost assumed to not change with efficiency level, and therefore is not included in this analysis.
Affecting Operating Costs	
Annual Energy Use	Annual unit energy consumption for each class of equipment at each efficiency level estimated by sector and application using simulation models.
Electricity Prices	DOE developed average electricity prices and projections of future electricity prices based on *Annual Energy Outlook 2015* (*AEO 2015*).[41]
Maintenance Cost	Maintenance cost assumed to not change with efficiency level, and therefore is not included in this analysis.
Repair Cost	Repair cost assumed to not change with efficiency level, and therefore is not included in this analysis.
Affecting Present Value of Annual Operating Cost Savings	
Equipment Lifetime	Pump equipment lifetimes estimated to range between 4 and 40 years, with an average lifespan of 15 years across all equipment classes, based on estimates from market experts and input from the CIP Working Group.
Discount Rate	Mean real discount rates for all sectors that purchase pumps range from 3.4 percent for municipal sector to 5.9 percent for industrial sector.
Analysis Start Year	Start year for LCC is 2020, which is the first full year following the estimated compliance date of late 2019.

TABLE IV.4—SUMMARY OF INPUTS AND KEY ASSUMPTIONS USED IN THE LCC AND PBP ANALYSES*—Continued

Inputs	Description
Analyzed Efficiency Levels	
Analyzed Efficiency Levels	DOE analyzed the baseline efficiency levels and five higher efficiency levels for each equipment class. See the engineering analysis for additional details on selections of efficiency levels and cost.

* 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.

[41] U.S. Energy Information Administration. *Annual Energy Outlook 2015* (2015) DOE/EIA–0383(2015). (Last Accessed August 30, 2015) (Available at: *www.eia.gov/forecasts/aeo/.*)

DOE analyzed the baseline efficiency levels (reflecting the lowest efficiency levels currently on the market) and five higher efficiency levels for each equipment class analyzed. Chapter 5 of the final rule TSD provides additional details on the selection of efficiency levels and cost.

a. Equipment Prices

The price of pump equipment reflects the application of distribution channel markups and sales tax to the manufacturer sales price (MSP), which is the cost established in the engineering analysis. For each equipment class, DOE generated MSPs for the baseline equipment and five higher equipment efficiencies in the engineering analysis. As described in section IV.D, DOE determined distribution channel costs and markups for pump equipment.

The markup is the percentage increase in price as the pump equipment passes through distribution channels. As explained in section IV.D, DOE assumed that pumps are delivered by the manufacturer through one of five distribution channels. The overall markups used in LCC analyses are weighted averages of all of the relevant distribution channel markups.

To project an equipment price trend for the NOPR, DOE derived an inflation-adjusted index of the Producer Price Index for pumps and pumping equipment over the period 1984–2013.[42] These data show a general price index increase from 1987 through 2009. Since 2009, there has been no clear trend in the price index. Given the relatively slow global economic activity in 2009 through 2013, the extent to which the future trend can be predicted based on the last two decades is uncertain and the observed data do not provide a firm basis for projecting future cost trends for pump equipment. Therefore, DOE used a constant price assumption as the default trend to project future pump prices in 2020. Thus, prices projected for the LCC and PBP analysis were equal to the 2012 values for each efficiency level in each equipment class. 80 FR 17826, 17851 (April 2, 2015).

Wilo commented that a more appropriate inflation-adjusted pump price trend for existing products would exceed the inflation rate by 0.5 percent. (Wilo, No. 44 at p. 5) HI commented that the additional costs to re-design more efficient pumps cannot be passed along to the market, based on practices evidenced from the EU regulations, therefore marked up prices are not reflected in the current pump price trend. (HI, No. 45 at p.4.) DOE notes that Wilo did not provide any data or evidence supporting its assertions regarding the expected inflation-adjusted pump price trend, and DOE has not identified any data beyond the PPI series that it reviewed in the NOPR. In response to HI, DOE notes that the equipment prices developed in the NOPR and also used as the basis for this final rule reflect manufacturer cost-recovery as a worst-case scenario for consumers. Therefore, although DOE used a constant price trend, the prices in the LCC year (2020) reflect an increase over the pump prices in 2012. For these reasons, DOE has not changed its assumption of a constant price trend for this final rule. Appendix 8A of the final rule TSD describes the historical data that were considered in developing the trend.

b. Installation Costs

In the NOPR, due to the absence of data to indicate at what efficiency level DOE may need to consider an increase in installation costs, DOE did not estimate installation costs for the LCC. 80 FR 17826, 17851 (April 2, 2015). In response to the NOPR, Wilo and HI both agreed that consumers will experience an increase in installation costs that scale with efficiency. Specifically, HI commented that in driving for higher efficiency, suction performance could be impacted resulting in higher NPSH required and lower margins of safety. Piping system design and foundation changes may be required for reliable operation. (HI, No. 45 at p.4) Wilo commented that if a constant-speed efficiency requirement becomes extensive, consumers would experience a 30 percent increase in installation costs, and added that some submersible turbine pumps would require a larger diameter size, therefore leading to increased installation costs. (Wilo, No. 44 at p. 5) Wilo also commented that pump configurations that do not meet the standard and require a VFD will experience an additional 30 percent increase in installation costs, supplementary to the cost of the VFD. (*Id.*)

In response to HI, DOE requested specific data to help inform any estimates of at what point an increase in efficiency would decrease suction performance. Without actual data, DOE cannot implement a scaling of costs with efficiency (NOPR public meeting transcript, No. 51 at p. 38–39) Commenters did not provide data regarding increases in cost with efficiency, what would drive the increased installation costs for pumps other than submersible turbines, or at what efficiency level such increases might occur. In addition, for submersible turbines (which are designed to fit in boreholes), commenters did not identify the efficiency level at which diameter size would be expected to increase. Finally, DOE notes that the efficiency levels were all analyzed using hydraulic redesign. Therefore, none of the considered levels, including the proposed levels, would require use of a VFD. While manufacturers may opt to sell pumps with VFDs instead of improving their hydraulic efficiency, DOE did not consider the use of VFDs as a design option and therefore did not account for the associated increase in installation costs in its analysis. In other words, DOE only incorporated installation costs associated to the design options considered when establishing the efficiency levels. Given that available data do not support increases in installation costs at specific efficiency levels for any pump category due to hydraulic redesign, DOE continues to assume in this final rule

[42] Series ID PCU333911333911; *www.bls.gov/ppi/*.

that installation costs would not increase as a function of efficiency level and has not taken installation costs into account in the final rule.

c. Annual Energy Use

In the NOPR, DOE estimated the annual electricity consumed by each class of pump equipment, by efficiency level, based on the energy use analysis described in section IV.E and in chapter 7 of the final rule TSD. 80 FR 17826, 17852 (April 2, 2015). DOE did not receive any comments on annual energy use, so it has maintained this approach in the final rule.

d. Electricity Prices

Electricity prices are used to convert changes in the electric consumption from higher-efficiency equipment into energy cost savings. For the NOPR, DOE used average national commercial and industrial electricity prices from the *AEO 2014* reference case. DOE applied the commercial price to pump installations in the commercial sector and the industrial price to installations in the industrial, agricultural, and municipal sectors. To establish prices beyond 2040 (the last year in the *AEO 2014* projection, DOE extrapolated the trend in prices from 2030 to 2040 for both the commercial and industrial sectors. 80 FR 17826, 17852 (April 2, 2015). DOE did not receive any comments on electricity prices. For the final rule, DOE has maintained the same approach but has updated the prices and price trends to *AEO 2015.*

e. Maintenance Costs

As discussed in the NOPR, DOE assumed that maintenance costs would not change with efficiency level and did not estimate a maintenance cost for this analysis. 80 FR 17826, 17852 (April 2, 2015). DOE did not receive any comments on maintenance costs and has maintained this approach for the final rule.

f. Repair Costs

As discussed in the NOPR, DOE assumed that repair costs are not expected to change with efficiency level and did not estimate a repair cost for this analysis. 80 FR 17826, 17852 (April 2, 2015). DOE did not receive any comments on repair costs and has maintained this approach for the final rule.

g. Equipment Lifetime

DOE defines ''equipment lifetime'' as the age when a given commercial or industrial pump is retired from service. In the NOPR, DOE developed distributions of lifetimes that vary by equipment class. The average across all equipment classes was 15 years. DOE also used a distribution of mechanical lifetime in hours to allow a negative correlation between annual operating hours and lifetime in years—pumps with more annual operating hours tend to have shorter lifetimes. In addition, based on discussions in the CIP Working Group meetings,[43] DOE introduced lifetime variation by pump speed—pumps running faster tend to have a shorter lifetime. 80 FR 17826, 17852 (April 2, 2015). DOE did not receive any comments on equipment lifetime, and therefore maintained this approach in the final rule.

Chapter 8 of the final rule TSD contains a detailed discussion of equipment lifetimes.

h. Discount Rates

The discount rate is the rate at which future expenditures are discounted to estimate their present value. The 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 the cost of capital is the weighted-average cost to the firm of equity and debt financing. In the NOPR, for all but the municipal sector, DOE used the capital asset pricing model to calculate the equity capital component, and financial data sources, primarily the Damodaran Online Web site,[44] to calculate the cost of debt financing. DOE derived the discount rates by estimating the cost of capital of companies that purchase pumping equipment. 80 FR 17826, 17852 (April 2, 2015).

For the municipal sector, DOE calculated the real average interest rate on state and local bonds over the period of 1983–2012 by adjusting the Federal Reserve Board nominal rates to account for inflation. This 30-year average is assumed to be representative of the cost of capital relevant to municipal end users over the analysis period. (*Id.*)

DOE did not receive any comments on the proposed discount rates, and therefore maintained its approach in the final rule. More details regarding DOE's estimates of consumer discount rates are provided in chapter 8 of the final rule TSD.

3. Payback Period

The PBP measures the amount of time it takes the commercial consumer to recover the assumed higher purchase expense of more-efficient equipment through lower operating costs. Similar to the LCC, the PBP is based on the total installed cost and the operating expenses for each application and sector, weighted by the probability of shipments to each market. Because the simple PBP does not take into account changes in operating expense over time or the time value of money, DOE considered only the first year's operating expenses to calculate the PBP, unlike the LCC, which is calculated over the lifetime of the equipment. Chapter 8 of the final rule TSD provides additional details about the PBP calculation.

4. Rebuttable-Presumption Payback Period

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 energy (and, as applicable, water) savings during the first year that the consumer will receive as a result of the standard, as calculated under the test procedure in place for that standard. (42 U.S.C. 6295(o)(2)(B)(iii) and 42 U.S.C. 6316(a). For each considered efficiency level, DOE determines the value of the first year's energy savings by calculating the quantity of those savings in accordance with the applicable DOE test procedure, and multiplying that amount by the average energy price forecast for the year in which compliance with the new standards would be required.

G. Shipments Analysis

In its shipments analysis, DOE developed shipment projections for pumps and, in turn, calculated equipment stock over the course of the analysis period. DOE used the shipments projection and the equipment stock to determine the NES. The shipments portion of the spreadsheet model projects pump shipments from 2020 through 2049.

In the NOPR, to develop the shipments model, DOE started with the 2012 shipment estimates by equipment type from HI (EERE–2013–BT–NOC–0039–0068). For the initial year, DOE distributed total shipments into the four sectors using estimates from the LCC, as discussed in section IV.F.1. To project shipments of pumps, DOE relied primarily on *AEO 2014* forecasts of various indicators for each sector: (1) Commercial floor space; (2) value of manufacturing shipments; (3) value of agriculture, mining, and construction

[43] See, *e.g.,* Docket No. EERE–2013–BT–NOC–0039–0073, p. 153.

[44] Damodaran financial data used for determining cost of capital are available at: *http://pages.stern.nyu.edu/~adamodar/* for commercial businesses (Last accessed February 12, 2014).

shipments; and (4) population (for the municipal sector).

DOE used the 2012 total industry shipments by equipment class estimated by HI to distribute total shipments in each year into the five equipment types. DOE then used 2012 shipment data collected directly from manufacturers to distribute shipments into the further disaggregated equipment classes accounting for nominal speeds. The distribution of sectors changes over time as a result of each sector's differing forecast in AEO, while the distribution of equipment classes remains constant over time.

DOE estimated that standards would have a negligible impact on pump shipments. Under most pricing scenarios, it is likely that following a standard, a consumer would be able to buy a more efficient pump for the same price as the less efficient pump they would have purchased before or without a standard. Therefore, rather than foregoing a pump purchase under a standards case, a consumer might simply switch brands or pumps to purchase a cheaper one that did not have to be redesigned. As a result, DOE used the same shipments projections in the standards case as in the no-new-standards case. 80 FR 17826, 17852 (April 2, 2015).

In response to the NOPR, HI agreed that total shipments will not change significantly with the proposed standards but commented that consumers may decide to repair rather than replace pumps. (HI, No. 45 at p. 4) Wilo commented that there will likely be some minor impacts to shipments, specifically, a slight decline in complete pump sales, and an increase in replacement parts to repair pumps. (Wilo, No. 44 at p. 5–6) Given that HI and Wilo expect the impacts to be minor and that no data are available to support changes in total shipments estimates and annual repair estimates, DOE maintained its approach to the shipments analysis in the final rule. DOE updated its projections based on the forecasts of various indicators for each sector in *AEO 2015.* Chapter 9 of the final rule TSD contains more details.

H. National Impact Analysis

The national impact analysis (NIA) evaluates the effects of energy conservation standards from a national perspective. This analysis assesses the net present value (NPV) (future amounts discounted to the present) and the national energy savings (NES) of total commercial consumer costs and savings expected to result from new standards at specific efficiency levels.[45]

The NES refers to cumulative energy savings for the lifetime of pumps shipped from 2020 through 2049. DOE calculated energy savings in each year relative to a no-new-standards case, defined by the current market. DOE calculated net monetary savings in each year relative to the no-new-standards case as the difference between total operating cost savings and increases in total installed cost. DOE accounted for operating cost savings until the year when the equipment installed in 2049 should be retired. Cumulative savings are the sum of the annual NPV over the specified period.

1. Approach

The NES and NPV are a function of the total number of units in use and their efficiencies. Both the NES and NPV depend on annual shipments and equipment lifetime. Both calculations start by using the shipments estimate and the quantity of units in service derived from the shipments model.

DOE used a spreadsheet tool, available on DOE's Web site for pumps,[46] to calculate the energy savings and the national monetary costs and savings from potential new standards. Interested parties can review DOE's analyses by changing various input quantities within the spreadsheet.

Unlike the LCC analysis, the NES spreadsheet does not use distributions for inputs or outputs, but relies on national average equipment costs and energy costs developed from the LCC analysis. DOE projected the energy savings, energy cost savings, equipment costs, and NPV of benefits for equipment sold in each pump class from 2020 through 2049.

a. National Energy Savings

DOE calculated the NES based on the difference between the per-unit energy use under a standards-case scenario and the per-unit energy use in the no-new-standards case. The average energy per unit used by the pumps in service gradually decreases in the standards case relative to the no-new-standards case because more-efficient pumps are expected to gradually replace less-efficient ones.

Unit energy consumption values for each equipment class are taken from the LCC spreadsheet for each efficiency level and weighted based on market efficiency distributions. To estimate the total energy savings for each efficiency level, DOE first calculated the delta unit energy consumption (*i.e.,* the difference between the energy directly consumed by a unit of equipment in operation in the no-new-standards case and the standards case) for each class of pumps for each year of the analysis period. The analysis period begins with the first full year following the estimated compliance date of any new energy conservation standards (*i.e.,* 2020). Second, DOE determined the annual site energy savings by multiplying the stock of each equipment class by vintage (*i.e.,* year of shipment) by the delta unit energy consumption for each vintage (from step one). Third, DOE converted the annual site electricity savings into the annual amount of energy saved at the source of electricity generation (primary energy) using a time series of conversion factors derived from the *AEO 2015* version of EIA's National Energy Modeling System (NEMS). Finally, DOE summed the annual primary energy savings for the lifetime of units shipped over a 30-year period to calculate the total NES. DOE performed these calculations for each efficiency level considered for pumps in this rulemaking.

DOE has historically presented NES in terms of primary energy savings. On August 18, 2011, DOE published a final statement of policy in the **Federal Register** announcing its intention to use full-fuel-cycle (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. After evaluating the approaches discussed in the August 18, 2011 statement, DOE published a statement of amended policy in the **Federal Register** in which DOE explained its determination that NEMS is the most appropriate tool for its FFC analysis and its intention to use NEMS for that purpose. 77 FR 49701 (August 17, 2012). Therefore, DOE used the NEMS model to conduct the FFC analysis. The approach used for this rulemaking, and the FFC multipliers that were applied, are described in appendix 10B of the final rule TSD.

To properly account for national impacts, DOE adjusted the energy use and energy costs developed from the LCC spreadsheet. Specifically, in the LCC, DOE does not account for pumps sold with trimmed impellers or pumps used with VSDs, both of which may reduce the energy savings resulting from pump efficiency improvements.

For the NOPR, DOE reviewed studies on VSD penetration and used an initial

[45] The NIA accounts for impacts in the 50 States and the U.S. territories.

[46] DOE's Web page on pumps can be found at: *www1.eere.energy.gov/buildings/appliance_standards/rulemaking.aspx/ruleid/14.*

penetration of 3.2 percent in 1998 [47] with a 5 percent annual increase.[48] Although these studies are not specific to VFDs, DOE assumed all VSD use was attributable to VFD use, as VFDs are the most common type of VSD in the pumps market.[49] Based on DOE's analysis of VFD users in the consumer subgroup analysis (see section IV.I), DOE assumed VFDs would reduce energy use by 39 percent on average, which also reduces the potential energy savings from higher efficiency. However, DOE assumed based on the difficulties with VFD installation and operation,[50] that the full amount of potential savings would not be realized for all consumers. DOE assumed an ''effectiveness rate'' of 75 percent; in other words DOE assumed that consumers would achieve on average only 75 percent of the 39 percent estimated savings (*i.e.,* 29 percent savings) because of improper installation, operation inconsistent with intended use, or other equipment problems. 80 FR 17826, 17853 (April 2, 2015).

For the NOPR, DOE assumed that for all equipment classes except VTS, 50 percent of pumps not sold with VFDs are sold with impellers trimmed to 85 percent of full impeller. According to the pump affinity laws, which are a set of relationships that can be used to predict the performance of a pump when its speed or impeller diameter is changed, such an impeller trim uses 61 percent of the power of full trim. Accordingly, DOE reduced the energy use for those consumers by 39 percent. For the VTS equipment class, DOE assumed that pumps were not sold with trimmed impellers. A large percentage of these pumps are pressed stainless steel and will never be trimmed; the remainder of these pumps will be significantly less likely to be trimmed than other pump types because variability in the number of stages would be used in place of trimming the impellers. (*Id.*)

DOE used the penetration rate and power reduction values for VFDs and trimmed impellers, as well as the effectiveness rate for VFDs, to create an energy use adjustment factor time series in the NES spreadsheet. (*Id.*)

In response to the NOPR, Wilo commented that the energy savings relative to ''business-as-usual'' are overstated due to the adoption of new technologies, including pumps with VFDs (Wilo, No. 44 at p. 1), and that power reductions associated with VFDs are dependent on the pump application. (Wilo, No. 44 at p. 6) HI stated that maintaining maximum diameter and using continuous controls would result in higher energy savings. (HI, No. 45 at p. 6) Wilo commented that pumps shipped with VFDs do not have a trimmed impeller. (Wilo, No. 44 p. 6)

As stated previously, DOE used a 5 percent annual increase for VFD penetration to account for market adoption of these technologies. Available data do not indicate that DOE's assumption on the VFD penetration growth rate is incorrect. Therefore, DOE has maintained this growth rate in the final rule. DOE acknowledges that power reductions associated with VFDs are dependent on pump application. In the NIA, however, DOE has attempted to capture the national average power reduction. Modeling variability in power reduction across applications is not expected to significantly impact the average assumed reduction.

DOE believes that HI and Wilo's comments regarding maximum diameter and trimmed impellers validate DOE's approach to assuming only trimmed impellers for non-VFD shipments. Therefore, DOE maintains this approach in the final rule.

For more information on VFD penetration, see chapter 9 of the final rule TSD.

In the NOPR, DOE considered whether a rebound effect applies to pumps. A rebound effect occurs when an increase in equipment efficiency leads to increased demand for its service. For example, when a consumer realizes that a more-efficient pump used for cooling will lower the electricity bill, that person may opt for increased comfort in the building by using the equipment more, thereby negating a portion of the energy savings. In commercial buildings, however, the person owning the equipment (*i.e.,* the building owner) is usually not the person operating the equipment (*i.e.,* the renter). Because the operator usually does not own the equipment, that person will not have the operating cost information necessary to influence their operation of the equipment. Therefore, DOE believes that a rebound effect is unlikely to occur in commercial buildings. In the industrial and agricultural sectors, DOE believes that pumps are likely to be operated whenever needed for the required process or irrigation demand, so a rebound effect is also unlikely to occur in the industrial and agricultural sectors. 80 FR 17826, 17853 (April 2, 2015).

In response to the NOPR, HI agreed that a rebound effect is unlikely to occur and does not believe it should be included in the determination of annual energy savings. (HI, No. 45 at p. 5) Consistent with this suggestion, DOE maintained its position and did not incorporate the impact of a rebound effect in the final rule.

b. Net Present Value

To estimate the NPV, DOE calculated the net impact as the difference between total operating cost savings and increases in total installed costs. DOE calculated the NPV of each considered standard level over the life of the equipment using the following three steps.

First, DOE determined the difference between the equipment costs under the standard-level case and the no-new-standards case to obtain the net equipment cost increase resulting from the higher standard level. In the NOPR, DOE used a constant price assumption as the default price forecast. In addition, DOE considered two alternative price trends to investigate the sensitivity of the results to different assumptions regarding equipment price trends. One of these used an exponential fit on the deflated Producer Price Index (PPI) for pump and puming equipment manufacturing, and the other is based on the ''deflator—industrial equipment'' forecast for *AEO 2014.* 80 FR 17826, 17854 (April 2, 2015) Comments on this approach are discussed in section IV.F.2.a, and DOE has maintained the same approach for the final rule with minor updates described in appendix 10B of the final rule TSD.

Second, DOE determined the difference between the no-new-standards case operating costs and the standard-level operating costs to obtain the net operating cost savings from each higher efficiency level.

Third, DOE determined the difference between the net operating cost savings and the net equipment cost increase to obtain the net savings (or expense) for each year. DOE then discounted the annual net savings (or expenses) to 2015 and summed the discounted values to

[47] *United States Industrial Electric Motor Systems Market Opportunities Assessment.* Tech. Washington DC: U.S. Department of Energy's (DOE) Office of Energy Efficiency and Renewable Energy (EERE), 1998. Print.

[48] Almeida, A., Chretien, B., Falkner, H., Reichert, J., West, M., Nielsen, S., and Both, D. *VSDs for Electric Motor Systems.* Tech. N.p.: European Commission Directorate-General for Transport and Energy, SAVE II Programme 2000, n.d. Print.

[49] See for example: *Energy Tips—Motor.* Tech. Washington DC: U.S. Department of Energy's (DOE) Office of Energy Efficiency and Renewable Energy (EERE), 2008, Motor Tip Sheet #11, Print, p. 1. *Variable Frequency Drives.* Tech. Northwest Energy Efficiency Alliance, 2000, Report #00–054, Print, Exhibit 2.1.

[50] See for example: *Variable speed drives: Introducing energy saving opportunities for business.* London: Carbon Trust, 2011.

provide the NPV for a standard at each efficiency level.

In accordance with the Office of Management and Budget's (OMB's) guidelines on regulatory analysis,[51] DOE calculated NPV using both a 7-percent and a 3-percent real discount rate. The 7-percent rate is an estimate of the average before-tax rate of return on private capital in the U.S. economy. DOE used this discount rate to approximate the opportunity cost of capital in the private sector, because recent OMB analysis has found the average rate of return on capital to be near this rate. DOE used the 3-percent rate to capture the potential effects of standards on private consumption (*e.g.,* through higher prices for equipment and reduced purchases of energy). This rate represents the rate at which society discounts future consumption flows to their present value. This rate can be approximated by the real rate of return on long-term government debt (*i.e.,* yield on United States Treasury notes minus annual rate of change in the Consumer Price Index), which has averaged about 3 percent on a pre-tax basis for the past 30 years.

2. No-New-Standards Case and Standards-Case Distribution of Efficiencies

As described in the NOPR, DOE developed a no-new-standards case distribution of efficiency levels for pumps using performance data provided by manufacturers. Because the available evidence suggested that there is no trend toward greater interest in higher pump efficiency, DOE assumed that the no-new-standards case distribution would remain constant over time. Furthermore, DOE had no reason to believe that implementation of standards would lead to an increased demand for more efficient equipment than the minimum available, and therefore did not use an efficiency trend in the standards-case scenarios.

For each efficiency level analyzed, DOE used a ''roll-up'' scenario to establish the market shares by efficiency level for the year that compliance would be required with new standards (*i.e.,* 2020). DOE concluded that equipment efficiencies in the no-new-standards case that were above the standard level under consideration would not be affected. Information from certain manufacturers indicated that for pumps not meeting a potential standard at some of the lower efficiency levels, redesign would likely target an efficiency level higher than the minimum given the level of investment required for a redesign, and the relatively more modest change in investment to design a given pump to a higher level once redesign is already taking place. However, DOE had no data that clearly indicate what percentage of failing pumps would likely be redesigned to a level higher than the minimum, or how high that level would be. In the absence of such data, DOE did not assume that manufacturers would design to a level higher than required, to avoid overestimating the energy savings that would result from the rulemaking. 80 FR 17826, 17855 (April 2, 2015) DOE did not receive comment on this approach and has maintained it for the final rule. The no-new-standards case efficiency distributions for each equipment class are presented in chapter 10 of the final rule TSD.

I. Consumer Subgroup Analysis

For the consumer subgroup analysis, DOE estimated the impacts of the TSLs on the subgroup of consumers who operate their pumps with VFDs.[52] DOE analyzed this subgroup because the lower power typically drawn by operating pumps at reduced speed may reduce the energy and operating cost savings to the consumer that would result from improved efficiency of the pump itself. DOE estimated the average LCC savings and simple PBP for the subgroup compared with the results from the full sample of pump consumers, which did not account for VFD use.

J. Manufacturer Impact Analysis

1. Overview

DOE performed a manufacturer impact analysis (MIA) to calculate the financial impact of energy conservation standards on manufacturers of pumps and to estimate the potential impact of such standards on direct employment and manufacturing capacity.

The MIA has both quantitative and qualitative aspects. The quantitative portion of the MIA primarily relies on the Government Regulatory Impact Model (GRIM), an industry cash-flow model customized for this rulemaking. The key GRIM inputs are data on the industry cost structure, equipment costs, shipments, markups, and conversion expenditures. The key output is the industry net present value (INPV). Different sets of assumptions will produce different results. The qualitative portion of the MIA addresses factors such as equipment characteristics, as well as industry and market trends. Chapter 12 of the TSD describes the complete MIA.

DOE conducted the MIA for this rulemaking in three phases. In Phase 1 of the MIA, DOE prepared a profile of the pumps industry that includes a top-down cost analysis of manufacturers that DOE used to derive preliminary financial inputs for the GRIM (*e.g.,* sales, general, and administration (SG&A) expenses; research and development (R&D) expenses; and tax rates). DOE used public sources of information, including the Securities and Exchange Commission (SEC) 10–K filings;[53] corporate annual reports; the U.S. Census Bureau's Annual Survey of Manufacturers;[54] and Hoovers reports.[55]

In phase 2 of the MIA, DOE prepared an industry cash-flow analysis to quantify the potential impacts of an energy conservation standard. In general, new or amended energy conservation standards can affect manufacturer cash flow in three distinct ways: (1) Create a need for increased investment; (2) raise production costs per unit; and (3) alter revenue due to higher per-unit prices and possible changes in sales volumes.

In phase 3 of the MIA, DOE conducted detailed interviews with a representative cross-section of 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.

Additionally, in phase 3, DOE evaluates subgroups of manufacturers that may be disproportionately impacted by standards or that may not be accurately represented by the average cost assumptions used to develop the industry cash-flow analysis. For example, small manufacturers, niche players, or manufacturers exhibiting a cost structure that largely differs from the industry average could be more negatively affected. For this final rule, DOE analyzed small manufacturers as a subgroup.

The Small Business Administration (SBA) defines a small business under

[51] OMB Circular A–4, section E (Sept. 17, 2003) (Available at: *www.whitehouse.gov/omb/circulars_a004_a-4.*)

[52] In this analysis, DOE is not counting energy savings of switching from throttling a pump to using a VFD, as this is not a design option. DOE is simply analyzing the life-cycle costs of customers that use VFDs with their pumps.

[53] Filings & Forms, Securities and Exchange Commission (2013) (Available at: *http://www.sec.gov/edgar.shtml*) (Last accessed July 2013).

[54] U.S. Census Bureau, Annual Survey of Manufacturers: General Statistics: Statistics for Industry Groups and Industries (2010) (Available at: <*http://www.census.gov/manufacturing/asm/index.html*>) (Last accessed July, 2013).

[55] Hoovers | Company Information | Industry Information | Lists, D&B (2013) (Available at: *http://www.hoovers.com/*) (Last accessed July 2013).

North American Industry Classification System (NAICS) code 333911, ''Pump and Pumping Equipment Manufacturing,'' as one having no more than 500 employees. During its research, DOE identified 25 domestic companies that manufacture equipment covered by this rulemaking and qualify as small businesses under the SBA definition. Consistent with the requirements of the Regulatory Flexibility Act, DOE's analysis of the small business subgroup is discussed in section VII.B of this document and chapter 12 of the TSD.

2. GRIM Analysis

As discussed previously, DOE uses the GRIM to quantify the changes in cash flow that result in a higher or lower industry value due to energy conservation standards. The GRIM analysis uses a discounted cash-flow methodology that incorporates manufacturer costs, markups, shipments, and industry financial information as inputs. The GRIM model changes in MPCs, distributions of shipments, investments, and manufacturer margins that could result from new energy conservation standards. The GRIM spreadsheet uses the inputs to arrive at a series of annual cash flows, beginning in 2015 (the base year of the MIA) and continuing to 2049. DOE calculated INPVs by summing the stream of annual discounted cash flows during this period. DOE applied a discount rate of 11.8 percent, derived from industry financials and then modified according to feedback received during manufacturer interviews.

In the GRIM, DOE calculates cash flows using standard accounting principles and compares changes in INPV between the no-new-standards case and each TSL (the standards case). The difference in INPV between the no-new-standards case and a standards case represents the financial impact of the energy conservation standard on manufacturers. Additional details about the GRIM, the discount rate, and other financial parameters can be found in chapter 12 of the TSD.

a. GRIM Key Inputs

Manufacturer Production Costs

Manufacturer production costs (MPCs) are the cost to the manufacturer to produce a covered pump. The cost includes raw materials and purchased components, production labor, factory overhead, and production equipment depreciation. The changes, if any, in the MPC of the analyzed products can affect revenues, gross margins, and cash flow of the industry. In the MIA, DOE used the MPCs for each efficiency level calculated in the engineering analysis, as described in section IV.C.5 and further detailed in chapter 5 of the TSD. In addition, DOE used information from manufacturer interviews to disaggregate the MPCs into material, labor, and overhead costs.

Shipments Forecast

The GRIM estimates manufacturer revenues based on total unit shipment forecasts and the distribution of shipments by equipment class. For the no-new-standards case analysis, the GRIM uses the NIA no-new-standards case shipments forecasts from 2015 (the base year for the MIA analysis) to 2049 (the last year of the analysis period). In the shipments analysis, DOE estimates the distribution of efficiencies in the no-new-standards case for all equipment classes. See section IV.G for additional details.

For the standards-case shipment forecast, the GRIM uses the NIA standards-case shipment forecasts. The NIA assumes that equipment efficiencies in the no-new-standards case that do not meet the energy conservation standard in the standards case ''roll up'' to meet the standard after the compliance date. See section IV.G for additional details.

Product and Capital Conversion Costs

Energy conservation standards can cause manufacturers to incur conversion costs to make necessary changes to their production facilities and bring 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 equipment class. For the purpose of 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, and marketing, focused on making product designs comply with the energy conservation standard. Capital conversion costs are investments in property, plant, and equipment to adapt or change existing production facilities so that compliant equipment designs can be fabricated and assembled.

In the NOPR, DOE used a bottom-up approach to evaluate the magnitude of the product and capital conversion costs the pump industry would incur to comply with new energy conservation standards. 80 FR 17826, 17845–17846 (April 2, 2015) For this approach, DOE first determined the industry-average cost, per model, to redesign pumps of varying sizes to meet each of the candidate efficiency levels. DOE then modeled the distribution of unique pump models that would require redesign at each efficiency level. For each efficiency level, DOE multiplied each unique failing model by its associated cost to redesign it to comply with the applicable efficiency level and summed the total to reach an estimate of the total product and capital conversion cost for the industry. DOE maintained this approach in this final rule. A more detailed description of this methodology can be found in engineering section IV.C.6.

In general, DOE assumes that all conversion-related investments occur between the year of publication of the final rule and the year by which manufacturers must comply with the standard. The investment figures used in the GRIM can be found in section V.V.B.2 of this document. For additional information on the estimated product conversion and capital conversion costs, see chapters 5 and 12 of the TSD.

b. GRIM Scenarios

Markup Scenarios

As discussed above, MSPs include direct manufacturing production costs (*i.e.,* labor, material, and overhead estimated in DOE's MPCs), all non-production costs (*i.e.,* SG&A, R&D, and interest), and profit. To account for manufacturers' non-production costs and profit margin, DOE applies a non-production cost multiplier (the manufacturer markup) to the full MPC. The resulting MSP is the price at which the manufacturer can recover all production and non-production costs and earn a profit. Modifying these markups in the standards case yields different sets of impacts on manufacturers.

To meet new energy conservation standards, manufacturers must often invest in design changes that result in changes to equipment design and production lines, which can result in changes to MPC and changes to working capital, as well as change to capital expenditures. Depending on the competitive pressures, some or all of the increased costs may be passed from manufacturers to the manufacturers' first consumer (typically a distributor) and eventually to consumers in the form of higher purchase prices. The MSP should be high enough to recover the full cost of the produced equipment (*i.e.,* full production and non-production costs) and yield a profit. The manufacturer markup impacts profitability. A high markup under a standards scenario suggests manufacturers can readily pass along increases in variable costs and some of the capital and product conversion costs (the one-time expenditures) to consumers. A low markup suggests that manufacturers will not be able to recover as much of the necessary investment in plant and equipment.

In the NOPR, industry-average, no-new-standards case manufacturer markups were developed by weighting individual manufacturer markup estimates on a market share basis, as manufacturers with larger market shares more significantly affect the market average. 80 FR 17826, 17846 (April 2, 2015) DOE did not receive any comments on these industry-average markups and used the same markups in this final rule.

In the NOPR, DOE modeled two standards case markup scenarios to represent the uncertainty regarding the potential impacts on prices and profitability for manufacturers following the implementation of new energy conservation standards: (1) A flat markup scenario; and (2) a cost recovery markup scenario. 80 FR 17827, 17847 (April 2, 2015) These scenarios lead to different markup values that, when applied to the MPCs, result in varying revenue and cash flow impacts. DOE used these values to represent the lower and upper bounds of potential markups for manufacturers. DOE did not receive any additional comments on these two cost recovery scenarios. Consequently, DOE has maintained its methodology scenarios, and resulting markups, in the analysis of this final rule. The scenarios are described in further detail in the following paragraphs.

Under the flat markup scenario, DOE maintains the same markup in the no-new-standards case and standards case. This results in no price changes at a given efficiency level for the manufacturer's first consumer. Based on the MSP, component cost, performance, and efficiency data supplied by both individual manufacturers and HI, DOE concluded the non-production cost markup (which includes SG&A expenses, R&D expenses, interest, and profit) to vary by efficiency level. DOE calculated the flat markups as follows:

TABLE IV.5—INDUSTRY AVERAGE FLAT MANUFACTURER MARKUPS

	Baseline	TSL 1	TSL 2	TSL 3	TSL 4	TSL 5
ESCC	1.37	1.38	1.39	1.39	1.39	1.39
ESFM	1.33	1.37	1.38	1.39	1.39	1.39
IL	1.43	1.46	1.47	1.47	1.47	1.47
VT–S	1.37	1.37	1.40	1.40	1.40	1.40

Because this markup scenario assumes that manufacturers would not increase their pricing for a given efficiency level as a result of a standard even as they incur conversion costs, this markup scenario is considered a lower bound.

In the cost recovery markup scenario, manufacturer markups are set so that manufacturers recover their conversion costs, which are investments necessary to comply with the new energy conservation standard, over the analysis period. That cost recovery is enabled by an increase in mark-up, which results in higher manufacturer sales prices for pumps even as manufacturer product costs stay the same. The cost recovery calculation assumes manufacturers raise prices only on models where a redesign is necessitated by the standard. The additional revenue due to the increase in markup results in manufacturers recovering 100% of their conversion costs over the 30-year analysis period, taking into account the time-value of money. DOE's calculated cost recovery markups are as follows:

TABLE IV.6—INDUSTRY AVERAGE COST RECOVERY MANUFACTURER MARKUPS

	Baseline	TSL 1	TSL 2	TSL 3	TSL 4	TSL 5
ESCC	1.37	1.57	1.68	1.74	1.92	2.13
ESFM	1.33	1.45	1.51	1.54	1.61	1.70
IL	1.43	1.53	1.62	1.73	1.88	2.02
VT–S	1.37	1.49	1.47	1.54	1.65	1.77

Because this markup scenario models the maximum level to which manufacturers would increase their pricing as a result of the given standard, this markup scenario is considered an upper bound to markups.

Depending on the equipment class and the standard level being analyzed, the cost-recovery markup results in a simple payback period of 7 to 8 years for the industry. This means the total additional revenues due to a higher markup equal the industry conversion cost within seven to eight years, not taking into account the time value of money. The simple payback period varies at each TSL due to differences in the number of models requiring redesign, the total conversion costs, and the number of units over which costs can be recouped. The simple payback timeframes are as follows:

TABLE IV.7—MANUFACTURER SIMPLE PAYBACK PERIOD

	Baseline	TSL 1	TSL 2	TSL 3	TSL 4	TSL 5
Years	0	8	7	7	7	7

The payback period is greatest at TSL 1 due to the relatively high numbers of models that require redesign as compared to the number of units sold at that level. These payback periods are unchanged from the NOPR analysis.

3. Discussion of MIA Comments

During the NOPR public comment period, interested parties commented on assumptions and results described in the NOPR document and accompanying TSD, addressing several topics related to manufacturer impacts. These include: Conversion costs; industry direct employment; cumulative regulatory burden; and small business impacts.

Conversion Costs

Several commenters requested information about DOE's conversion costs for the pump industry. In response to DOE's request for comment on conversion costs, HI requested further clarification of the sources of DOE's conversion cost data. (HI, No.45 at p.5) Wilo commented that conversion costs at their company would total $125,000 to $300,000 per pump model to reach ''high efficiency''. Wilo also noted that testing could require operational expenditures of $750,000 for their business. (Wilo, No. 44 at p.6–7)

DOE's conversion costs were based on industry survey data provided to the Department by HI, as noted in section IV.C.5 of this document. The industry feedback, which included data from 15 different manufacturers, suggested industry-average conversion costs of approximately $200,000 per model. DOE believes the data provided by HI to be the best dataset available for estimating industry conversion costs. Wilo's range of $125,000 to $300,000 is consistent with DOE's estimates, though DOE recognizes that any single manufacturer's conversion cost may differ from the average. In Wilo's written comments, the company also noted a cost of $750,000 to retest 15,000 unique products. DOE believes that grouping of products into basic models for the purposes of CC&E testing may allow the company to mitigate these costs, as not each unique product requires testing. In response to Wilo's concern, DOE updated its financial models for the final rule to include an expense to industry for testing all basic models. The final pumps test procedure estimated the total cost of testing a pump, including setup, tests, and takedown to range between $161.61 and $430.96 per model. 80 FR 17586 (April 1, 2015). DOE used the upper end estimate of $430.96 per test to develop a conservative expense to industry. Assuming two tests per model and 3,332 basic models in the industry, DOE estimates the cost to test all products in accordance with the DOE test procedure expense will result in an expense of $2.9 million to the industry in both the no-standards case and the standards cases. Additional information about DOE's conversion cost methodology can be found in section IV.C.6 of this document and in Chapter 12 of the TSD.

Direct Employment

HI stated that it disagreed with the statement that ''DOE estimates that in the absence of energy conservation standards, there would be 415 domestic production workers for covered pumps'', and requests to know what data was used to determine this value. HI also believes that the impact will be greater than what is stated by the DOE. HI also believes it is important for DOE to analyze and report the impact on employment throughout the supply and distribution chain. (HI, No.45 at p.5)

In the manufacturer impact analysis, DOE analyzes the impacts on regulated pump manufacturers. DOE's production worker employment estimate includes only workers directly involved in fabricating and assembling the covered product and their line supervisors within the manufacturing facility. Workers performing services that are closely associated with production operations, such as materials handling tasks using forklifts, are also included as production labor. DOE's production worker estimate relies on the domestic pump shipments estimated in the shipments analysis, the labor content per pump estimated using the engineering analysis, and typical production worker wages estimated using labor rate data in the US Census. The complete methodology is explained in detail in section 12.7 of the TSD. DOE's production worker estimate does not include workers in the supply or distribution chain. These workers are accounted for in DOE's analysis of the indirect employment impact, which estimates impacts on the broader economy. These impacts can be found in section V.B.3.c.

Cumulative Regulatory Burden

HI noted that pending regulations on dedicated purpose pool pumps and any additional pump regulations will further tax the limited resources available for redesign, manufacturing, and testing of new products. (HI, No.45 at p. 6) DOE does not list the pool pump rulemaking in its list of cumulative regulations because the rulemaking is in the preliminary stages. Until the rule reaches the NOPR stage, DOE does not have enough detail on the scope of coverage, the effective date, and potential conversion costs. DOE will consider whether to include the regulatory burden of these pump standards in any subsequent analysis of the cumulative regulatory burden of potential standards for dedicated purpose pool pumps.

Small Businesses Impacts

DOE requested comment on the number of small business in the industry. Wilo commented that the number of businesses affected by this rule numbers in the hundreds, including distributors, installers, design-builders, manufacturers and engineers. (Wilo, No.44 at p.8) Consistent with the requirements of the Regulatory Flexibility Act (5 U.S.C. 601, *et seq.*), as amended, the Department analyzes the expected impacts of an energy conservation standard on pump manufacturers directly regulated by DOE's standards. Distributors, installers, design-builders, manufacturers, and engineers that are not pump manufacturers are excluded from analysis.

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 to emissions of all species due to ''upstream'' activities in the fuel production chain. These upstream activities comprise extraction, processing, and transporting fuels to the site of combustion. The associated emissions are referred to as upstream emissions.

The analysis of power sector emissions uses marginal emissions factors that were derived from data in *AEO 2015,* as described in section IV.M. The methodology is described in chapter 13 and 15 of the final rule TSD.

Combustion emissions of CH_4 and N_2O are estimated using emissions intensity factors published by the EPA, GHG Emissions Factors Hub.[56] The FFC upstream emissions are estimated based on the methodology described in chapter 15 of the final rule TSD. The upstream emissions include both emissions from fuel combustion during extraction, processing, and transportation of fuel, and ''fugitive''

[56] Available at: *http://www.epa.gov/climateleadership/inventory/ghg-emissions.html.*

emissions (direct leakage to the atmosphere) of CH_4 and CO_2.

The emissions intensity factors are expressed in terms of physical units per MWh or MMBtu of site energy savings. Total emissions reductions are estimated using the energy savings calculated in the national impact analysis.

For CH_4 and N_2O, DOE calculated emissions reduction in tons and also in terms of units of carbon dioxide equivalent (CO_2eq). Gases are converted to CO_2eq by multiplying each ton of gas by the gas' global warming potential (GWP) over a 100-year time horizon. Based on the Fifth Assessment Report of the Intergovernmental Panel on Climate Change,[57] DOE used GWP values of 28 for CH_4 and 265 for N_2O.

The *AEO* incorporates the projected impacts of existing air quality regulations on emissions. *AEO 2015* generally represents current legislation and environmental regulations, including recent government actions, for which implementing regulations were available as of October 31, 2014. DOE's estimation of impacts accounts for the presence of the emissions control programs discussed in the following paragraphs.

SO_2 emissions from affected electric generating units (EGUs) are subject to nationwide and regional emissions cap-and-trade programs. Title IV of the Clean Air Act sets an annual emissions cap on SO_2 for affected EGUs in the 48 contiguous States and the District of Columbia (DC). (42 U.S.C. 7651 *et seq.*) SO_2 emissions from 28 eastern States and DC were also limited under the Clean Air Interstate Rule (CAIR). 70 FR 25162 (May 12, 2005). CAIR created an allowance-based trading program that operates along with the Title IV program. In 2008, CAIR was remanded to EPA by the U.S. Court of Appeals for the District of Columbia Circuit, but it remained in effect.[58] In 2011, EPA issued a replacement for CAIR, the Cross-State Air Pollution Rule (CSAPR). 76 FR 48208 (August 8, 2011). On August 21, 2012, the D.C. Circuit issued a decision to vacate CSAPR,[59] and the court ordered EPA to continue administering CAIR. On April 29, 2014, the U.S. Supreme Court reversed the judgment of the D.C. Circuit and remanded the case for further proceedings consistent with the Supreme Court's opinion.[60] On October 23, 2014, the D.C. Circuit lifted the stay of CSAPR.[61] Pursuant to this action, CSAPR went into effect (and CAIR ceased to be in effect) as of January 1, 2015.

EIA was not able to incorporate CSAPR into *AEO 2015,* so it assumes implementation of CAIR. Although DOE's analysis used emissions factors that assume that CAIR, not CSAPR, is the regulation in force, the difference between CAIR and CSAPR is not relevant for the purpose of DOE's analysis of emissions impacts from energy conservation standards.

The attainment of emissions caps is typically flexible among EGUs and is enforced through the use of emissions allowances and tradable permits. Under existing EPA regulations, 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 any regulated EGU. In past rulemakings, DOE recognized that there was uncertainty about the effects of efficiency standards on SO_2 emissions covered by the existing cap-and-trade system, but it concluded that negligible reductions in power sector SO_2 emissions would occur as a result of standards.

Beginning in 2016, however, SO_2 emissions will fall as a result of the Mercury and Air Toxics Standards (MATS) for power plants. 77 FR 9304 (Feb. 16, 2012). In the MATS rule, EPA established a standard for hydrogen chloride as a surrogate for acid gas hazardous air pollutants (HAP), and also established a standard for SO_2 (a non-HAP acid gas) as an alternative equivalent surrogate standard for acid gas HAP. The same controls are used to reduce HAP and non-HAP acid gas; thus, SO_2 emissions will be reduced as a result of the control technologies installed on coal-fired power plants to comply with the MATS requirements for acid gas. *AEO 2015* assumes that, in order to continue operating, coal plants must have either flue gas desulfurization or dry sorbent injection systems installed by 2016. Both technologies, which are used to reduce acid gas emissions, also reduce SO_2 emissions. Under the MATS, emissions will be far below the cap established by CAIR, so 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 any regulated EGU.[62] Therefore, DOE believes that energy conservation standards will generally reduce SO_2 emissions in 2016 and beyond.

CAIR established a cap on NO_X emissions in 28 eastern States and the District of Columbia.[63] Energy conservation standards are expected to have little effect on NO_X emissions in those States covered by CAIR because excess NO_X emissions allowances resulting from the lower electricity demand could be used to permit offsetting increases in NO_X emissions from other facilities. However, standards would be expected to reduce NO_X emissions in the States not affected by the caps, so DOE estimated NO_X emissions reductions from the standards considered in this final rule for these States.

The MATS limit mercury emissions from power plants, but they do not include emissions caps and, as such, DOE's energy conservation standards would likely reduce Hg emissions. DOE estimated mercury emissions reduction using emissions factors based on *AEO 2015,* which incorporates the MATS.

L. Monetizing Carbon Dioxide and Other Emissions Impacts

As part of the development of this rulemaking, DOE considered the estimated monetary benefits from the reduced emissions of CO_2 and NO_X that are expected to result from each of the considered efficiency levels. To make

[57] IPCC, 2013: Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA. Chapter 8.

[58] See *North Carolina* v. *EPA,* 550 F.3d 1176 (D.C. Cir. 2008); *North Carolina* v. *EPA,* 531 F.3d 896 (D.C. Cir. 2008).

[59] See *EME Homer City Generation, LP* v. *EPA,* 696 F.3d 7, 38 (D.C. Cir. 2012), *cert. granted,* 81 U.S.L.W. 3567, 81 U.S.L.W. 3696, 81 U.S.L.W. 3702 (U.S. June 24, 2013) (No. 12–1182).

[60] *See EPA* v. *EME Homer City Generation,* 134 S.Ct. 1584, 1610 (U.S. 2014). The Supreme Court held in part that EPA's methodology for quantifying emissions that must be eliminated in certain States due to their impacts in other downwind States was based on a permissible, workable, and equitable interpretation of the Clean Air Act provision that provides statutory authority for CSAPR.

[61] See Georgia v. EPA, Order (D.C. Cir. filed October 23, 2014) (No. 11–1302).

[62] DOE notes that the Supreme Court recently remanded EPA's 2012 rule regarding national emission standards for hazardous air pollutants from certain electric utility steam generating units. See *Michigan* v. *EPA* (Case No. 14–46, 2015). DOE has tentatively determined that the remand of the MATS rule does not change the assumptions regarding the impact of energy efficiency standards on SO_2 emissions. Further, while the remand of the MATS rule may have an impact on the overall amount of mercury emitted by power plants, it does not change the impact of the energy efficiency standards on mercury emissions. DOE will continue to monitor developments related to this case and respond to them as appropriate.

[63] CSAPR also applies to NO_X and it would supersede the regulation of NO_X under CAIR. As stated previously, the current analysis assumes that CAIR, not CSAPR, is the regulation in force. The difference between CAIR and CSAPR with regard to DOE's analysis of NO_X emissions is slight.

this calculation similar to the calculation of the NPV of consumer benefit, DOE considered the reduced emissions expected to result over the lifetime of equipment shipped in the forecast period for each efficiency level. This section summarizes the basis for the monetary values used for CO_2 and NO_X emissions and presents the values considered in this rulemaking.

For this final rule, DOE is relying on a set of values for the social cost of carbon (SCC) that was developed by an interagency process. A summary of the basis for those values is provided in the following subsection, and a more detailed description of the methodologies used is provided as an appendix to chapter 14 of the final rule TSD.

1. Social Cost of Carbon

The SCC is an estimate of the monetized damages associated with an incremental increase in carbon emissions in a given year. It is intended to include (but is not limited to) changes in net agricultural productivity, human health, property damages from increased flood risk, and the value of ecosystem services. Estimates of the SCC are provided in dollars per metric ton of carbon dioxide. A domestic SCC value is meant to reflect the value of damages in the United States resulting from a unit change in carbon dioxide emissions, while a global SCC value is meant to reflect the value of damages worldwide.

Under section 1(b)(6) of Executive Order 12866, ''Regulatory Planning and Review,'' 58 FR 51735, Oct. 4, 1993, agencies must, to the extent permitted by law, assess both the costs and the benefits of the intended regulation and, recognizing that some costs and benefits are difficult to quantify, propose or adopt a regulation only upon a reasoned determination that the benefits of the intended regulation justify its costs. The purpose of the SCC estimates presented here is to allow agencies to incorporate the monetized social benefits of reducing CO_2 emissions into cost-benefit analyses of regulatory actions. The estimates are presented with an acknowledgement of the many uncertainties involved and with a clear understanding that they should be updated over time to reflect increasing knowledge of the science and economics of climate impacts.

As part of the interagency process that developed the SCC estimates, technical experts from numerous agencies met on a regular basis to consider public comments, explore the technical literature in relevant fields, and discuss key model inputs and assumptions. The main objective of this process was to develop a range of SCC values using a defensible set of input assumptions grounded in the existing scientific and economic literatures. In this way, key uncertainties and model differences transparently and consistently inform the range of SCC estimates used in the rulemaking process.

a. Monetizing Carbon Dioxide Emissions

When attempting to assess the incremental economic impacts of carbon dioxide emissions, the analyst faces a number of challenges. A recent report from the National Research Council points out that any assessment will suffer from uncertainty, speculation, and lack of information about: (1) Future emissions of greenhouse gases; (2) the effects of past and future emissions on the climate system; (3) the impact of changes in climate on the physical and biological environment; and (4) the translation of these environmental impacts into economic damages. As a result, any effort to quantify and monetize the harms associated with climate change will raise questions of science, economics, and ethics and should be viewed as provisional.

Despite the limits of both quantification and monetization, SCC estimates can be useful in estimating the social benefits of reducing carbon dioxide emissions. The agency can estimate the benefits from reduced emissions in any future year by multiplying the change in emissions in that year by the SCC value appropriate for that year. The net present value of the benefits can then be calculated by multiplying the future benefits by an appropriate discount factor and summing across all affected years.

It is important to emphasize that the interagency process is committed to updating these estimates as the science and economic understanding of climate change and its impacts on society improves over time. In the meantime, the interagency group will continue to explore the issues raised by this analysis and consider public comments as part of the ongoing interagency process.

b. Development of Social Cost of Carbon Values

In 2009, an interagency process was initiated to offer a preliminary assessment of how best to quantify the benefits from reducing carbon dioxide emissions. To ensure consistency in how benefits are evaluated across agencies, the Administration sought to develop a transparent and defensible method, specifically designed for the rulemaking process, to quantify avoided climate change damages from reduced CO_2 emissions. The interagency group did not undertake any original analysis. Instead, it combined SCC estimates from the existing literature to use as interim values until a more comprehensive analysis could be conducted. The outcome of the preliminary assessment by the interagency group was a set of five interim values: Global SCC estimates for 2007 (in 2006$) of $55, $33, $19, $10, and $5 per metric ton of CO_2. These interim values represented the first sustained interagency effort within the U.S. government to develop an SCC for use in regulatory analysis. The results of this preliminary effort were presented in several proposed and final rules.

c. Current Approach and Key Assumptions

After the release of the interim values, the interagency group reconvened on a regular basis to generate improved SCC estimates. Specifically, the group considered public comments and further explored the technical literature in relevant fields. The interagency group relied on three integrated assessment models commonly used to estimate the SCC: The FUND, DICE, and PAGE models. These models are frequently cited in the peer-reviewed literature and were used in the last assessment of the Intergovernmental Panel on Climate Change. Each model was given equal weight in the SCC values that were developed.

Each model takes a slightly different approach to model how changes in emissions result in changes in economic damages. A key objective of the interagency process was to enable a consistent exploration of the three models while respecting the different approaches to quantifying damages taken by the key modelers in the field. An extensive review of the literature was conducted to select three sets of input parameters for these models: climate sensitivity, socio-economic and emissions trajectories, and discount rates. A probability distribution for climate sensitivity was specified as an input into all three models. In addition, the interagency group used a range of scenarios for the socio-economic parameters and a range of values for the discount rate. All other model features were left unchanged, relying on the model developers' best estimates and judgments.

The interagency group selected four sets of SCC values for use in regulatory analyses. Three sets of values are based on the average SCC from three integrated assessment models, at discount rates of 2.5 percent, 3 percent, and 5 percent. The fourth set, which represents the 95th-percentile SCC estimate across all three models at a 3-percent discount rate, is included to represent higher-than-expected impacts from climate change further out in the tails of the SCC distribution. The values grow in real terms over time. Additionally, the interagency group determined that a range of values from 7 percent to 23 percent should be used to adjust the global SCC to calculate domestic effects, although preference is given to consideration of the global benefits of reducing CO_2 emissions. Table IV.8 presents the values in the 2010 interagency group report,[64] which is reproduced in appendix 14A of the final rule TSD.

TABLE IV.8—ANNUAL SCC VALUES FROM 2010 INTERAGENCY REPORT, 2010–2050

[In 2007 dollars per metric ton CO_2]

Year	Discount Rate %			
	5	3	2.5	3
	Average	Average	Average	95th Percentile
2010	4.7	21.4	35.1	64.9
2015	5.7	23.8	38.4	72.8
2020	6.8	26.3	41.7	80.7
2025	8.2	29.6	45.9	90.4
2030	9.7	32.8	50.0	100.0
2035	11.2	36.0	54.2	109.7
2040	12.7	39.2	58.4	119.3
2045	14.2	42.1	61.7	127.8
2050	15.7	44.9	65.0	136.2

The SCC values used for this document were generated using the most recent versions of the three integrated assessment models that have been published in the peer-reviewed literature, as described in the 2013 update from the interagency working group (revised July 2015).[65] (See appendix 14B of the final rule TSD for further information.) Table IV.9 shows the updated sets of SCC estimates in five year increments from 2010 to 2050. Appendix 14B of the final rule TSD provides the full set of SCC estimates. The central value that emerges is the average SCC across models at the 3 percent discount rate. However, for purposes of capturing the uncertainties involved in regulatory impact analysis, the interagency group emphasizes the importance of including all four sets of SCC values.

TABLE IV.9—ANNUAL SCC VALUES FROM 2013 INTERAGENCY UPDATE [REVISED JULY 2015, 2010–2050

[In 2007 dollars per metric ton CO_2]

Year	Discount Rate %			
	5	3	2.5	3
	Average	Average	Average	95th Percentile
2010	10	31	50	86
2015	11	36	56	105
2020	12	42	62	123
2025	14	46	68	138
2030	16	50	73	152
2035	18	55	78	168
2040	21	60	84	183
2045	23	64	89	197
2050	26	69	95	212

It is important to recognize that a number of key uncertainties remain, and that current SCC estimates should be treated as provisional and revisable since they will evolve with improved scientific and economic understanding. The interagency group also recognizes that the existing models are imperfect and incomplete. The National Research Council report mentioned above points out that there is tension between the goal of producing quantified estimates of the economic damages from an incremental ton of carbon and the limits of existing efforts to model these effects. There are a number of analytical challenges that are being addressed by the research community, including research programs housed in many of the Federal agencies participating in the interagency process to estimate the SCC. The interagency group intends to periodically review and reconsider those estimates to reflect increasing knowledge of the science and economics of climate impacts, as well as improvements in modeling.

[64] *Social Cost of Carbon for Regulatory Impact Analysis Under Executive Order 12866,* Interagency Working Group on Social Cost of Carbon, United States Government (February 2010) (Available at: *www.whitehouse.gov/sites/default/files/omb/inforeg/for-agencies/Social-Cost-of-Carbon-for-RIA.pdf.*

[65] *Technical Update of the Social Cost of Carbon for Regulatory Impact Analysis Under Executive Order 12866,* Interagency Working Group on Social Cost of Carbon, United States Government (May 2013; revised July 2015) (Available at: *www.whitehouse.gov/sites/default/files/omb/inforeg/scc-tsd-final-july-2015.pdf).*

In summary, in considering the potential global benefits resulting from reduced CO_2 emissions, DOE used the values from the 2013 interagency report (revised July 2015), adjusted to 2014$ using the Gross Domestic Product price deflator. For each of the four cases specified, the values used for emissions in 2015 were $12.2, $40.0, $62.3, and $117 per metric ton avoided (values expressed in 2014$). DOE derived values after 2050 using the relevant growth rates for the 2040–2050 period in the interagency update.

DOE multiplied the CO_2 emissions reduction estimated for each year by the SCC value for that year in each of the four cases. 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 SCC values in each case.

In response to the NOPR, the Cato Institute commented that the integrated assessment model (IAM) on which the SCC values are based does not provide reliable guidance and does not signal the order of magnitude of the actual social cost of carbon. Furthermore, the Cato Institute commented that the values are discordant with leading scientific literature on important SCC parameters. (Cato Institute, No. 48 at p. 1) The Associations object to DOE's use of the SCC in the cost-benefit analysis performed in the NOPR and believes that the SCC should not be used in any rulemaking or policymaking until it undergoes a more rigorous notice, review, and comment process. (The Associations, No. 47 at p. 4)

In conducting the interagency process that developed the SCC values, technical experts from numerous agencies met on a regular basis to consider public comments, explore the technical literature in relevant fields, and discuss key model inputs and assumptions. Key uncertainties and model differences transparently and consistently inform the range of SCC estimates. These uncertainties and model differences are discussed in the interagency working group's reports, which are reproduced in appendix 14A and 14B of the final rule TSD, as are the major assumptions. Specifically, uncertainties in the assumptions regarding climate sensitivity, as well as other model inputs such as economic growth and emissions trajectories, are discussed and the reasons for the specific input assumptions chosen are explained. However, the three integrated assessment models used to estimate the SCC are frequently cited in the peer-reviewed literature and were used in the last assessment of the IPCC. In addition, new versions of the models that were used in 2013 to estimate revised SCC values were published in the peer-reviewed literature (see appendix 14B of the final rule TSD for discussion). Although uncertainties remain, the revised estimates used in this final rule are based on the best available scientific information on the impacts of climate change. The current estimates of the SCC have been developed over many years, using the best science available, and with input from the public. In November 2013, OMB announced a new opportunity for public comment on the interagency technical support document underlying the revised SCC estimates. In July 2015 OMB published a detailed summary and formal response to the many comments that were received.[66] It also stated its intention to seek independent expert advice on opportunities to improve the estimates, including many of the approaches suggested by commenters. DOE stands ready to work with OMB and the other members of the interagency working group on further review and revision of the SCC estimates as appropriate.

2. Valuation of Other Emissions Reductions

As noted previously, DOE has estimated how the considered energy conservation standards would reduce site NO_X emissions nationwide and decrease power sector NO_X emissions in those 22 States not affected by the CAIR.

DOE estimated the monetized value of NO_X emissions reductions using benefit per ton estimates from the Regulatory Impact Analysis titled, ''Proposed Carbon Pollution Guidelines for Existing Power Plants and Emission Standards for Modified and Reconstructed Power Plants,'' published in June 2014 by EPA's Office of Air Quality Planning and Standards.[67] The report includes high and low values for NO_X (as $PM_{2.5}$) for 2020, 2025, and 2030 discounted at 3 percent and 7 percent,[68] which are presented in chapter 14 of the final rule TSD. DOE assigned values for 2021–2024 and 2026–2029 using, respectively, the values for 2020 and 2025. DOE assigned values after 2030 using the value for 2030.

DOE multiplied the emissions reduction (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. DOE will continue to evaluate the monetization of avoided NOx emissions and will make any appropriate updates in energy conservation standards rulemakings.

DOE is evaluating appropriate monetization of avoided SO_2 and Hg emissions in energy conservation standards rulemakings. It has not included such monetization in the current analysis.

M. Utility Impact Analysis

The utility impact analysis estimates several effects on the electric power industry that would result from the adoption of new or amended energy conservation standards. The utility impact analysis estimates the changes in installed electrical capacity and generation that would result for each TSL. The analysis is based on published output from the NEMS associated with *AEO 2015*. 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. DOE uses published side cases to estimate the marginal impacts of reduced energy demand on the utility sector. These marginal factors are estimated based on the changes to electricity sector generation, installed capacity, fuel consumption and emissions in the *AEO* 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 new or amended energy conservation standards.

N. Employment Impact Analysis

Employment impacts include direct and indirect impacts. Direct

[66] *https://www.whitehouse.gov/blog/2015/07/02/estimating-benefits-carbon-dioxide-emissions-reductions.*

[67] *http://www3.epa.gov/ttnecas1/regdata/RIAs/111dproposalRIAfinal0602.pdf. See Tables 4–7, 4–8, and 4–9 in the report.*

[68] For the monetized NOx benefits associated with $PM_{2.5}$, the related benefits (derived from benefit-per-ton values) are based on an estimate of premature mortality derived from the ACS study (Krewski et al., 2009), which is the lower of the two EPA central tendencies. Using the lower value is more conservative when making the policy decision concerning whether a particular standard level is economically justified so using the higher value would also be justified. If the benefit-per-ton estimates were based on the Six Cities study (Lepuele et al., 2012), the values would be nearly two-and-a-half times larger. (See chapter 14 of the final rule TSD for further description of the studies mentioned above.)

employment impacts are any changes in the number of employees of manufacturers of the equipment subject to standards; 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 equipment. Indirect employment impacts from standards consist of the jobs created or eliminated in the national economy due to: (1) Reduced spending by end users on energy; (2) reduced spending on new energy supply by the utility industry; (3) increased consumer spending on the purchase of new products; 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).[69] 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.[70] 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, based on the BLS data, net national employment may increase because of shifts in economic activity resulting from new energy conservation standards for pumps.

For the standard levels considered in this final rule, DOE estimated indirect national employment impacts using an input/output model of the U.S. economy called Impact of Sector Energy Technologies version 3.1.1 (ImSET).[71] 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 the 187 sectors. ImSET's national economic I–O structure is based on a 2002 U.S. benchmark table, specially aggregated to the 187 sectors most relevant to industrial, commercial, and residential building energy use. DOE notes that ImSET is not a general equilibrium forecasting model, and understands 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 the final rule, DOE used ImSET only to estimate short-term (through 2024) employment impacts.

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 pumps. It addresses the TSLs examined by DOE, the projected impacts of each of these levels if adopted as energy conservation standards for pumps, 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

1. Trial Standard Level Formulation Process and Criteria

DOE developed six efficiency levels, including a baseline level, for each equipment class analyzed in the LCC, NIA, and MIA. TSL 5 was selected at the max-tech level for these equipment classes, and also represented the highest energy savings, NPV, and net benefit to the nation scenario. TSL 1, TSL 2, TSL 3, and TSL 4 provide intermediate efficiency levels between the baseline efficiency level and TSL 5 and allow for an evaluation of manufacturer impact at each level. As discussed in section IV.A.2.a, for the RSV equipment classes, DOE set the baseline and max-tech levels equal to those established in Europe, but did not develop intermediate efficiency levels or TSLs due to lack of available cost data for this equipment. Moreover, as discussed in section IV.A.2.b, DOE set the baseline and max-tech levels for the VTS.1800 equipment class equal to those for VTS.3600, but did not develop intermediate efficiency levels or TSLs, again due to lack of available data. As a result, for the RSV and VTS.1800 equipment classes, TSLs 1 through 4 map to the baseline efficiency level, EL 0, and TSL 5 maps to the max-tech level, EL 5. Table V.1 shows the mapping between TSLs and efficiency levels for all equipment classes.

TABLE V.1—MAPPING BETWEEN TSLS AND EFFICIENCY LEVELS

Equipment Class	Baseline	TSL 1	TSL 2	TSL 3	TSL 4	TSL 5
ESCC.1800	EL 0	EL 1	EL 2	EL 3	EL 4	EL 5
ESCC.3600	EL 0	EL 1	EL 2	EL 3	EL 4	EL 5
ESFM.1800	EL 0	EL 1	EL 2	EL 3	EL 4	EL 5
ESFM.3600	EL 0	EL 1	EL 2	EL 3	EL 4	EL 5
IL.1800	EL 0	EL 1	EL 2	EL 3	EL 4	EL 5
IL.3600	EL 0	EL 1	EL 2	EL 3	EL 4	EL 5
RSV.1800*	EL 0	EL 0	EL 0	EL 0	EL 0	EL 5
RSV.3600*	EL 0	EL 0	EL 0	EL 0	EL 0	EL 5
VTS.1800*	EL 0	EL 0	EL 0	EL 0	EL 0	EL 5

[69] Data on industry employment, hours, labor compensation, value of production, and the implicit price deflator for output for these industries are available upon request by calling the Division of Industry Productivity Studies (202–691–5618) or by sending a request by email to *dipsweb@bls.gov*.

[70] *See* Bureau of Economic Analysis, ''Regional Multipliers: A User Handbook for the Regional Input-Output Modeling System (RIMS II),'' U.S. Department of Commerce (1992).

[71] M. J. Scott, O. V. Livingston, P. J. Balducci, J. M. Roop, and R. W. Schultz, *ImSET 3.1: Impact of Sector Energy Technologies,* PNNL-18412, Pacific Northwest National Laboratory (2009) (Available at: *www.pnl.gov/main/publications/external/technical_reports/PNNL-18412.pdf*).

TABLE V.1—MAPPING BETWEEN TSLs AND EFFICIENCY LEVELS—Continued

Equipment Class	Baseline	TSL 1	TSL 2	TSL 3	TSL 4	TSL 5
VTS.3600	EL 0	EL 1	EL 2	EL 3	EL 4	EL 5

* Equipment classes not analyzed due to lack of available data (in the case of RSV) or lack of market share (in the case of VTS.1800).

2. Trial Standard Level Equations

Because the efficiency metric, PEI, is a normalized metric targeted to create a standard level of 1.00, DOE has expressed its efficiency levels in terms of C-values. Each C-value represents a normalized efficiency for all size pumps, across the entire equipment class. (See section III.C.1 for more information about C-values and the related equations.) Table V.2 shows the appropriate C-values for each equipment class, at each TSL.

TABLE V.2 C—VALUES AT EACH TSL

Equipment Class	Baseline	TSL 1	TSL 2	TSL 3	TSL 4	TSL 5
ESCC.1800	134.43	131.63	128.47	126.67	125.07	123.71
ESCC.3600	135.94	134.60	130.42	128.92	127.35	125.29
ESFM.1800	134.99	132.95	128.85	127.04	125.12	123.71
ESFM.3600	136.59	134.98	130.99	129.26	127.77	126.07
IL.1800	135.92	133.95	129.30	127.30	126.00	124.45
IL.3600	141.01	138.86	133.84	131.04	129.38	127.35
RSV.1800*	129.63	129.63	129.63	129.63	129.63	124.73
RSV.3600*	133.20	133.20	133.20	133.20	133.20	129.10
VTS.1800*	138.78	138.78	138.78	138.78	138.78	127.15
VTS.3600	138.78	136.92	134.85	131.92	129.25	127.15

* Equipment classes not analyzed due to lack of available data (in the case of RSV) or lack of market share (in the case of VTS.1800).

B. Economic Justification and Energy Savings

1. Economic Impacts on Commercial Consumers

DOE analyzed the economic impacts on pump consumers by looking at the effects potential new standards would have on the LCC and PBP, when compared to the no-new-standards case described in section IV.F.1. DOE also examined the impacts of potential new standards on consumer subgroups. These analyses are discussed below.

a. Life-Cycle Cost and Payback Period

In general, higher-efficiency equipment would affect consumers in two ways: (1) Purchase price would increase over the price of less efficient equipment currently in the market, and (2) annual operating costs would decrease as a result of increased energy savings. Inputs used for calculating the LCC and PBP include total installed costs (*i.e.,* equipment price plus installation costs), and operating costs (*i.e.,* annual energy savings, energy prices, energy price trends, repair costs, and maintenance costs). The LCC calculation also uses equipment lifetime and a discount rate. Chapter 8 of the final rule TSD provides detailed information on the LCC and PBP analyses.

Table V.3 through Table V.16 show the LCC and PBP results for all efficiency levels considered for all analyzed equipment classes. The average costs at each TSL are calculated considering the full sample of consumers that have levels of efficiency in the no-new-standards case equal to or above the given TSL (who are not affected by a standard at that TSL), as well as consumers who had non-compliant pumps in the no-new-standards case and purchase more expensive and efficient redesigned pumps in the standards case. The simple payback and LCC savings are measured relative to the no-new-standards case efficiency distribution in the compliance year (see section IV.F.1 for a description of the no-new-standards case).

TABLE V.3—AVERAGE LCC AND PBP RESULTS BY EFFICIENCY LEVEL FOR ESCC.1800

TSL	Efficiency level	Average costs *(2014$)*				Simple payback (years)	Average lifetime (years)
		Installed cost	First year's operating cost	Lifetime operating cost	LCC		
—	0	$1,661	$2,224	$17,558	$19,219		13
1	1	1,695	2,234	17,482	19,176	3.4	13
2	2	1,728	2,214	17,328	19,056	2.2	13
3	3	1,792	2,196	17,188	18,981	2.7	13
4	4	1,889	2,172	17,008	18,897	3.2	13
5	5	2,054	2,147	16,807	18,861	4.0	13

Note: The results for each TSL are calculated considering all consumers. The PBP is measured relative to the no-new-standards case.

TABLE V.4—AVERAGE LCC SAVINGS RELATIVE TO THE NO-NEW-STANDARDS CASE FOR ESCC.1800

TSL	Efficiency level	Average LCC savings* (2014$)	Percent of consumers that experience net cost
1	1	$43	12
2	2	163	11
3	3	238	24
4	4	322	30
5	5	357	43

* The calculation includes consumers with zero LCC savings (no impact).

TABLE V.5—AVERAGE LCC AND PBP RESULTS BY EFFICIENCY LEVEL FOR ESCC.3600

TSL	Efficiency level	Average costs 2014$				Simple payback *(years)*	Average lifetime *(years)*
		Installed cost	First year's operating cost	Lifetime operating cost	LCC		
—	0	$1,108	$1,574	$9,800	$10,908	—	11
1	1	1,113	1,570	9,777	10,890	1.5	11
2	2	1,126	1,556	9,689	10,816	1.0	11
3	3	1,157	1,546	9,630	10,787	1.8	11
4	4	1,186	1,533	9,544	10,730	1.9	11
5	5	1,233	1,510	9,400	10,633	2.0	11

Note: The results for each TSL are calculated considering all consumers. The PBP is measured relative to the no-new-standards case.

TABLE V.6—AVERAGE LCC SAVINGS RELATIVE TO THE NO-NEW-STANDARDS CASE FOR ESCC.3600

TSL	Efficiency level	Average LCC savings* (2014$)	Percent of consumers that experience net cost
1	1	$17	0.68
2	2	92	1.8
3	3	121	14
4	4	178	14
5	5	275	13

* The calculation includes consumers with zero LCC savings (no impact).

TABLE V.7—AVERAGE LCC AND PBP RESULTS BY EFFICIENCY LEVEL FOR ESFM.1800

TSL	Efficiency level	Average costs (2014$)				Simple payback *years*	Average lifetime *years*
		Installed cost	First year's operating cost	Lifetime operating cost	LCC		
—	0	$1,917	$3,384	$41,409	$43,326	—	23
1	1	1,920	3,383	41,398	43,318	2.5	23
2	2	1,970	3,365	41,182	43,152	2.9	23
3	3	2,032	3,344	40,919	42,950	2.9	23
4	4	2,181	3,302	40,403	42,584	3.2	23
5	5	2,347	3,262	39,908	42,254	3.5	23

Note: The results for each TSL are calculated considering all consumers. The PBP is measured relative to the no-new-standards-case.

TABLE V.8—AVERAGE LCC SAVINGS RELATIVE TO THE NO-NEW-STANDARDS CASE FOR ESFM.1800

TSL	Efficiency level	Average LCC savings* (2014$)	Percent of consumers that experience net cost
1	1	$8.0	0.27
2	2	174	6.6
3	3	376	15
4	4	742	24

TABLE V.8—AVERAGE LCC SAVINGS RELATIVE TO THE NO-NEW-STANDARDS CASE FOR ESFM.1800—Continued

TSL	Efficiency level	Average LCC savings* (2014$)	Percent of consumers that experience net cost
5	5	1,072	26

* The calculation includes consumers with zero LCC savings (no impact).

TABLE V.9—AVERAGE LCC AND PBP RESULTS BY EFFICIENCY LEVEL FOR ESFM.3600

TSL	Efficiency level	Average costs (2014$)				Simple payback (years)	Average lifetime (years)
		Installed cost	First year's operating cost	Lifetime operating cost	LCC		
—	0	$1,367	$5,215	$51,540	$52,907		20
1	1	1,375	5,208	51,473	52,848	1.3	20
2	2	1,415	5,155	50,943	52,358	0.8	20
3	3	1,460	5,109	50,481	51,941	0.9	20
4	4	1,549	5,055	49,940	51,489	1.1	20
5	5	1,670	4,976	49,150	50,820	1.3	20

Note: The results for each TSL are calculated considering all consumers. The PBP is measured relative to the no-new-standards-case.

TABLE V.10—AVERAGE LCC SAVINGS RELATIVE TO THE NO-NEW-STANDARDS CASE FOR ESFM.3600

TSL	Efficiency level	Average LCC savings* (2014$)	Percent of consumers that experience net cost
1	1	$58	0.30
2	2	549	1.9
3	3	966	4.8
4	4	1,418	7.2
5	5	2,087	8.6

* The calculation includes consumers with zero LCC savings (no impact).

TABLE V.11—AVERAGE LCC AND PBP RESULTS BY EFFICIENCY LEVEL FOR IL.1800

TSL	Efficiency level	Average costs (2014$)				Simple payback (years)	Average lifetime (years)
		Installed cost	First year's operating cost	Lifetime operating cost	LCC		
—	0	$2,157	$1,869	$16,817	$18,974		16
1	1	2,175	1,861	16,748	18,923	2.4	16
2	2	2,225	1,846	16,602	18,827	2.9	16
3	3	2,312	1,831	16,465	18,777	4.1	16
4	4	2,466	1,814	16,311	18,776	5.6	16
5	5	2,650	1,790	16,096	18,747	6.2	16

Note: The results for each TSL are calculated considering all consumers. The PBP is measured relative to the no-new-standards-case.

TABLE V.12—AVERAGE LCC SAVINGS RELATIVE TO THE NO-NEW-STANDARDS CASE FOR IL.1800

TSL	Efficiency level	Average LCC savings* (2014$)	Percent of consumers that experience net cost
1	1	$51	1.9
2	2	147	7.3
3	3	197	15
4	4	198	26
5	5	227	36

* The calculation includes consumers with zero LCC savings (no impact).

TABLE V.13—AVERAGE LCC AND PBP RESULTS BY EFFICIENCY LEVEL FOR IL.3600

TSL	Efficiency level	Average costs (2014$)				Simple payback (years)	Average lifetime (years)
		Installed cost	First year's operating cost	Lifetime operating cost	LCC		
—	0	$1,494	$2,021	$14,198	$15,692		13
1	1	1,504	2,013	14,142	15,646	1.4	13
2	2	1,546	1,994	14,008	15,554	2.0	13
3	3	1,600	1,972	13,852	15,452	2.2	13
4	4	1,673	1,955	13,734	15,407	2.8	13
5	5	1,822	1,922	13,497	15,320	3.3	13

Note: The results for each TSL are calculated considering all consumers. The PBP is measured relative to the no-new-standards-case.

TABLE V.14—AVERAGE LCC SAVINGS RELATIVE TO THE NO-NEW-STANDARDS CASE FOR IL.3600

TSL	Efficiency level	Average LCC savings * (2014$)	Percent of consumers that experience net cost
1	1	$45	2.1
2	2	138	13
3	3	239	11
4	4	285	14
5	5	372	20

* The calculation includes consumers with zero LCC savings (no impact).

TABLE V.15—AVERAGE LCC AND PBP RESULTS BY EFFICIENCY LEVEL FOR VTS.3600

TSL	Efficiency level	Average costs (2014$)				Simple payback (years)	Average lifetime (years)
		Installed cost	First year's operating cost	Lifetime operating cost	LCC		
—	0	$706	$1,084	$6,255	$6,961		11
1	1	712	1,080	6,231	6,943	1.3	11
2	2	727	1,077	6,218	6,944	3.1	11
3	3	747	1,061	6,128	6,875	1.8	11
4	4	787	1,044	6,029	6,817	2.0	11
5	5	838	1,028	5,937	6,775	2.4	11

Note: The results for each TSL are calculated considering all consumers. The PBP is measured relative to the no-new-standards-case.

TABLE V.16—AVERAGE LCC SAVINGS RELATIVE TO THE NO-NEW-STANDARDS CASE FOR VTS.3600

TSL	Efficiency level	Average LCC savings * (2014$)	Percent of consumers that experience net cost
1	1	$18	0.51
2	2	17	27
3	3	86	7.4
4	4	144	10
5	5	186	13

* The calculation includes consumers with zero LCC savings (no impact).

b. Consumer Subgroup Analysis

As shown in Table V.17 through Table V.23, the results of the life-cycle cost subgroup analysis indicate that for all equipment classes analyzed, the VFD subgroup fared slightly worse than the average consumer, with the VFD subgroup being expected to have lower LCC savings and longer payback periods than average. This occurs mainly because with power reduction through use of a VFD, consumers use and save less energy from pump efficiency improvements than do consumers who do not use VFDs and so would benefit less from the energy savings.[72] Chapter 11 of the final rule TSD provides more detailed discussion on the LCC subgroup analysis and results.

[72] In this analysis, DOE does not count energy savings of switching from throttling a pump to using a VFD, as this is not a design option. Instead, DOE analyzes the life-cycle costs of consumers who use VFDs with their pumps.

TABLE V.17—COMPARISON OF IMPACTS FOR VFD USERS WITH NON-VFD USERS, ESCC.1800

TSL	Energy efficiency level	LCC savings (2014$) *		Simple payback period (years)	
		VFD-users	Non-VFD users	VFD-users	Non-VFD users
1	1	$9.3	$43	6.0	3.4
2	2	64	163	3.9	2.2
3	3	80	238	4.7	2.7
4	4	88	322	5.5	3.2
5	5	40	357	7.0	4.0

* Parentheses indicate negative values.

TABLE V.18—COMPARISON OF IMPACTS FOR VFD USERS WITH NON-VFD USERS, ESCC.3600

TSL	Energy efficiency level	LCC savings (2014$) *		Simple payback period (years)	
		VFD-users	Non-VFD users	VFD-users	Non-VFD users
1	1	$8.0	$17	2.5	1.5
2	2	48	92	1.7	1.0
3	3	53	121	3.0	1.8
4	4	76	178	3.2	1.9
5	5	116	275	3.3	2.0

* Parentheses indicate negative values.

TABLE V.19—COMPARISON OF IMPACTS FOR VFD USERS WITH NON-VFD USERS, ESFM.1800

TSL	Energy efficiency level	LCC savings (2014$)*		Simple payback period (years)	
		VFD-users	Non-VFD users	VFD-users	Non-VFD users
1	1	$4.0	$8.0	4.2	2.5
2	2	81	175	4.9	2.9
3	3	175	376	4.9	2.9
4	4	334	742	5.5	3.2
5	5	462	1072	6.0	3.5

* Parentheses indicate negative values.

TABLE V.20—COMPARISON OF IMPACTS FOR VFD USERS WITH NON-VFD USERS, ESFM.3600

TSL	Energy efficiency level	LCC savings (2014$)*		Simple payback period (years)	
		VFD-users	Non-VFD users	VFD-users	Non-VFD users
1	1	$32	$58	2.1	1.3
2	2	306	549	1.4	0.8
3	3	533	966	1.5	0.9
4	4	764	1,418	1.9	1.1
5	5	1,110	2,087	2.1	1.3

*Parentheses indicate negative values.

TABLE V.21—COMPARISON OF IMPACTS FOR VFD USERS WITH NON-VFD USERS, IL.1800

TSL	Energy efficiency level	LCC savings (2014$)*		Simple payback period (years)	
		VFD-users	Non-VFD users	VFD-users	Non-VFD users
1	1	$23	$51	3.9	2.4
2	2	61	147	4.8	2.9
3	3	53	197	6.8	4.1
4	4	(11)	198	9.5	5.6
5	5	(71)	227	11	6.2

*Parentheses indicate negative values.

TABLE V.22—COMPARISON OF IMPACTS FOR VFD USERS WITH NON-VFD USERS, IL.3600

TSL	Energy efficiency level	LCC savings (2014$)*		Simple payback period (years)	
		VFD-users	Non-VFD users	VFD-users	Non-VFD users
1	1	$23	$45	2.4	1.4
2	2	61	138	3.3	2.0
3	3	100	239	3.7	2.2
4	4	97	285	4.6	2.8
5	5	88	372	5.6	3.3

*Parentheses indicate negative values.

TABLE V.23—COMPARISON OF IMPACTS FOR VFD USERS WITH NON-VFD USERS, VTS.3600

TSL	Energy efficiency level	LCC savings (2014$)*		Simple payback period (years)	
		VFD-users	Non-VFD users	VFD-users	Non-VFD users
1	1	$9.7	$18	1.9	1.3
2	2	3.8	17	4.7	3.1
3	3	41	86	2.8	1.8
4	4	62	144	3.2	2.0
5	5	69	186	3.7	2.4

*Parentheses indicate negative values.

c. Rebuttable Presumption Payback

As discussed in section III.G.2, EPCA provides a rebuttable presumption that, in essence, 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. However, DOE routinely conducts a full economic analysis that considers the full range of impacts, including those to the consumer, manufacturer, nation, and environment, as required under 42 U.S.C. 6295(o)(2)(B)(i) and 6316(a). The results of this analysis serve as the basis for DOE to evaluate the economic justification for a potential standard level, thereby supporting or rebutting the results of any preliminary determination of economic justification. For comparison with the more detailed analytical results, DOE calculated a rebuttable presumption payback period for each TSL. Table V.24 shows the rebuttable presumption payback periods for the pump equipment classes.

TABLE V.24—REBUTTABLE PRESUMPTION PAYBACK PERIODS FOR PUMP EQUIPMENT CLASSES

Equipment class	Rebuttable presumption payback *(years)*				
	TSL 1	TSL 2	TSL 3	TSL 4	TSL 5
ESCC.1800	3.5	2.2	2.7	3.2	4.0
ESCC.3600	1.5	1.0	1.8	1.9	1.9
ESFM.1800	2.5	2.8	2.9	3.2	3.5
ESFM.3600	1.3	0.8	0.9	1.1	1.3
IL.1800	2.3	2.9	4.1	5.6	6.2
IL.3600	1.4	2.0	2.2	2.7	3.3
VTS.3600	1.3	3.1	1.9	2.1	2.4

2. Economic Impacts on Manufacturers

As noted above, DOE performed an MIA to estimate the impact of energy conservation standards on manufacturers of pumps. The following section summarizes 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

Table V.25 and Table V.26 depict the financial impacts (represented by changes in INPV) of energy standards on manufacturers of pumps, as well as the conversion costs that DOE expects manufacturers would incur for all equipment classes at each TSL. To evaluate the range of cash flow impacts on the CIP industry, DOE modeled two different mark-up scenarios using different assumptions that correspond to the range of anticipated market responses to energy conservation standards: (1) The flat markup scenario; and (2) the cost recovery markup scenario. Each of these scenarios is discussed immediately below.

Under the flat markup scenario, DOE maintains the same markup in the no-new-standards case and standards case. This results in no price change at a given efficiency level for the manufacturer's first consumer. Because this markup scenario assumes that manufacturers would not increase their pricing as a result of a standard even as they incur conversion costs, this markup scenario is the most negative and results in the most negative impacts on INPV.

In the cost recovery markup scenario, manufacturer markups are set so that manufacturers recover their conversion costs over the analysis period. That cost recovery is enabled by an increase in mark-up, which results in higher sales prices for pumps even as manufacturer product costs stay the same. The cost recovery calculation assumes manufacturers raise prices on models where a redesign is necessitates by the standard. This cost recovery scenario results in more positive results than the flat markup scenario.

The set of results below shows potential INPV impacts for pump manufacturers; Table V.25 reflects the lower bound of impacts (*i.e.,* the flat markup scenario), and Table V.26 represents the upper bound (the cost recovery markup scenario).

Each of the modeled 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 that results from the sum of discounted cash flows from the base year 2015 through 2049, the end of the analysis period.

To provide perspective on the short-run cash flow impact, DOE includes in the discussion of the results below a comparison of free cash flow between the no-new-standards case and the standards case at each TSL in the year before new standards would take effect. This figure provides an understanding of the magnitude of the required conversion costs relative to the cash flow generated by the industry in the no-new-standards case.

TABLE V.25—MANUFACTURER IMPACT ANALYSIS FOR PUMPS—FLAT MARKUP SCENARIO*

	Units	No-new-standards case	Trial standard level				
			1	2	3	4	5
INPV	$M	120.0	110.3	80.5	20.9	(86.1)	(229.0)
Change in INPV	$M		(9.7)	(39.5)	(99.1)	(206.1)	(349.0)
	%		(8.1)	(32.9)	(82.6)	(171.8)	(290.9)
Total Conversion Costs	$M		22.8	81.2	177.2	337.9	550.6
Free Cash Flow (2018)	$M	11.8	4.9	(16.6)	(58.3)	(128.2)	(220.6)
Free Cash Flow (2018)	% Decrease		58.7	241.1	594.5	1186.7	1970.3

* Values in parentheses are negative values.

TABLE V.26—MANUFACTURER IMPACT ANALYSIS FOR PUMPS—COST RECOVERY MARKUP SCENARIO

	Units	No-new-standards case	Trial standard level				
			1	2	3	4	5
INPV	$M	120.0	120.4	128.3	124.5	113.0	93.5
Change in INPV	$M		0.5	8.4	4.6	(6.9)	(26.5)
	%		0.4	7.0	3.8	(5.8)	(22.1)
Total Conversion Costs	$M		22.8	81.2	177.2	337.9	550.6
Free Cash Flow (2018)	$M	11.8	4.9	(16.6)	(58.3)	(128.2)	(220.6)
Free Cash Flow (2018)	% Decrease		58.7	241.1	594.5	1186.7	1970.3

* Values in parentheses are negative values.

TSL 1 represents EL 1 for all equipment classes except for RSV.1800, RSV.3600 and VTS.1800 classes, which are set at EL 0. At TSL 1, DOE estimates impacts on INPV for pump manufacturers to range from −8.1 percent to 0.4 percent, or a change in INPV of −$9.7 million to $0.5 million. At this potential standard level, industry free cash flow is estimated to decrease by approximately 58.7 percent to $4.9 million, compared to the no-new-standards case value of $11.8 million in the year before the compliance date (2019). The industry would need to either drop product lines or engage in redesign of approximately 10% of their models. DOE estimates that manufacturers would incur conversion costs totaling $22.8 million, driven by hydraulic redesigns.

TSL 2 represents EL 2 across all equipment classes except for RSV.1800, RSV.3600 and VTS.1800 classes, which are set at EL 0. At TSL 2, DOE estimates impacts on INPV for pump manufacturers to range from −39.5 percent to 8.4 percent, or a change in INPV of −$32.9 million to $7.0 million. At this potential standard level, industry free cash flow is estimated to decrease by approximately 241.1 percent to −$16.6 million, compared to the no-new-standards case value of $11.8 million in the year before the compliance date (2019). Conversion costs for an estimated 25% of model offerings would be approximately $81.2 million for the industry. At TSL 2, the industry's annual free cash flow is estimated to drop below zero in 2018 and 2019, the years where conversion investments are the greatest. The negative free cash flow indicates that at least some manufacturers in the industry would need to access cash reserves or borrow money from capital markets to cover conversion costs.

TSL 3 represents EL 3 for all equipment classes except for RSV.1800, RSV.3600 and VTS.1800 classes, which are set at EL 0. At TSL 3, DOE estimates impacts on INPV for pump manufacturers to range from −82.6 percent to 3.8 percent, or a change in INPV of −$99.1 million to $4.6 million. At TSL 3, industry conversion costs for an estimated 40% of model offerings would be approximately $177.2 million. As conversion costs increase, free cash flow continues to drop in the years before the standard year. This increases the likelihood that manufacturers will need to seek outside capital to support their conversion efforts. Furthermore, as more models require redesign, technical resources for hydraulic redesign could become an industry-wide constraint. Participants in the CIP Working Group noted that the industry as a whole relies on a limited pool of hydraulic redesign engineers and consultants. These specialists can support only a limited number of redesigns per year. Industry representatives stated that TSL 3 could be an upper bound to the number of redesigns possible in the four years between announcement and effective year of the final rule.

TSL 4 represents EL4 across all equipment classes except for RSV.1800, RSV.3600 and VTS.1800 classes, which are set at EL 0. At TSL 4, DOE estimates impacts on INPV for pump manufacturers to range from −171.8 percent to −5.8 percent, or a change in INPV of −$206.1 million to −$6.9 million. At this potential standard level, industry free cash flow is estimated to decrease by approximately 1186.7 percent relative to the no-new-standards case value of $11.8 million in the year before the compliance date (2019). The total industry conversion costs for an estimated 55% of model offerings would be approximately $337.9 million. The 1186.7% drop in free cash flow in 2019 indicates that the conversion costs are a very large investment relative to typical industry operations. As noted above, at TSL 2 and TSL 3, manufacturers may need to access cash reserves or outside capital to finance conversion efforts. Additionally, the industry may not be able to convert all necessary models before the compliance date of the standard.

TSL 5 represents max-tech across all equipment classes. The following economic results reflect all equipment classes except for RSV.1800, RSV.3600 and VTS.1800 classes, for which DOE had insufficient data to conduct the analysis. At TSL 5, DOE estimates impacts on INPV for pump manufacturers to range from −290.9 percent to −22.1 percent, or a change in INPV of −$349.0 million to −$26.5 million. At this potential standard level, industry free cash flow is estimated to decrease by approximately 1970.3 percent relative to the no-new-standards case value of $11.8 million in the year before the compliance date (2019). At max-tech, DOE estimates total industry conversion costs for an estimated 70% of model offerings, would be approximately $550.6 million. The negative impacts related to cash availability, need for outside capital, and technical resources constraints at TSLs 2, 3, and 4 would increase at TSL 5.

In section VI.A, DOE adopts labeling requirements recommended by the CIP Working Group. DOE recognizes that such requirements may result in costs to manufacturers. Costs of updating marketing materials for redesigned pumps in each standards case were included in the conversion costs for the industry and are accounted for in the industry cash-flow analysis results and industry valuation figures presented in this section.

b. Labeling Costs

Section VI.A of this rule discusses the labeling requirements for pumps. Manufacturers would need to update labels and literature that make representations of energy use (PEI) for all covered pumps, including both pumps that are redesigned to meet the standard and pumps that do not require redesign. For pumps that require redesign, the industry provided estimates of the cost to produce all-new marketing materials and labels as a part of their conversion costs feedback. Conversion costs were accounted for in DOE's financial modeling of the industry. For pumps that will not need to be redesigned, a much smaller effort is needed to update literature to include the PEI metric when making representations of energy use. DOE did not receive information on the cost to update labels and literature for equipment models that are already compliant with the energy conservation standard. As a result, these costs are not explicitly included in the analysis. DOE believes the labeling costs for compliant pumps to be significantly less than the certification costs and that those costs would not significantly impact the financial modeling results.

c. Impacts on Direct Employment

To quantitatively assess the impacts of energy conservation standards on direct employment in the pumps industry, DOE used the GRIM to estimate the domestic labor expenditures and number of employees in the no-new-standards case and at each TSL from 2015 through 2049. DOE used statistical data from the U.S. Census Bureau's 2011 Annual Survey of Manufacturers (ASM),[73] the results of the engineering analysis, and interviews with manufacturers to determine the inputs necessary to calculate industry-wide labor expenditures and domestic employment levels. Labor expenditures related to manufacturing of the product are a function of the labor intensity of the product, the sales volume, and an assumption that wages remain fixed in real terms over time. The total labor expenditures in each year are calculated by multiplying the MPCs by the labor percentage of MPCs. Based on feedback from manufacturers, DOE believes that 99% of the covered pumps are produced in the U.S. Therefore, 99% of the total labor expenditures contribute to domestic production employment.

The total domestic 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 (production worker hours multiplied by the labor rate found in the U.S. Census Bureau's 2011 ASM). The estimates of production workers in this section cover workers, including line-supervisors directly involved in fabricating and assembling a product within the manufacturing facility. Workers performing services that are closely associated with production operations, such as materials handling tasks using forklifts, are also included as production labor. DOE's estimates only account for production workers who manufacture the specific products covered by this rulemaking. DOE estimates that in the absence of energy conservation standards, there would be 415 domestic production workers for covered pumps.

In the standards case, DOE estimates an upper and lower bound to the potential changes in employment that result from the standard. Table V.27 shows the range of the impacts of potential energy conservation standards on U.S. production workers of pumps.

[73] ''Annual Survey of Manufactures (ASM),'' U.S. Census Bureau (2011) (Available at: *www.census.gov/manufacturing/asm/*).

TABLE V.27—POTENTIAL CHANGES IN THE TOTAL NUMBER OF PUMP PRODUCTION WORKERS IN 2020 *

	Trial standard level					
	No-new-standards case	1	2	3	4	5
Potential Changes in Domestic Production Workers in 2020 (relative to a no-new-standards case employment of 415).	....	(41) to 0	(104) to 0	(166) to 0	(228) to 0	(290) to 0.

* Parentheses indicate negative values.

Based on the engineering analysis, MPCs and labor expenditures do not vary with efficiency and increasing TSLs. Additionally, the shipments analysis models consistent shipments at all TSLs. As a result, the GRIM predicts no change in employment in the standards case. DOE considers this to be the upper bound for change in employment. For a lower bound, DOE assumes a loss of employment that is directly proportional to the portion of pumps being eliminated from the market. Additional detail can be found in chapter 12 of the final rule TSD.

DOE notes that the direct employment impacts discussed here are independent of the indirect employment impacts to the broader U.S. economy, which are documented in chapter 15 of the final rule TSD.

d. Impacts on Manufacturing Capacity

Based on the engineering analysis, DOE concludes that higher efficiency pumps require similar production facilities, tooling, and labor as baseline efficiency pumps. Based on the engineering analysis and interviews with manufacturers, a new energy conservation standard is unlikely to create production capacity constraints.

However, industry representatives, in interviews and in the CIP Working Group meetings, expressed concern about the industry's ability to complete the necessary number of hydraulic redesigns required to comply with a new standard. (EERE–2013–BT–NOC–0039–0109, pp. 280–283) In the industry, not all companies have the in-house capacity to redesign pumps. Many companies rely on outside consultants for a portion or all of their hydraulic design projects. Manufacturers were concerned that a new standard would create more demand for hydraulic design technical resources than are available in the industry.

The number of pumps that require redesign is directly tied to the adopted standard level. The level adopted today is based on a level that the CIP Working Group considered feasible for the industry.

e. Impacts on Subgroups of Manufacturers

Small manufacturers, niche equipment manufacturers, and manufacturers exhibiting a cost structure substantially different from the industry average could be affected disproportionately. Using average cost assumptions developed for an industry cash-flow estimate is inadequate to assess differential impacts among manufacturer subgroups.

For the CIP industry, DOE identified and evaluated the impact of energy conservation standards on one subgroup—small manufacturers. The SBA defines a ''small business'' as having 500 employees or less for NAICS 333911, ''Pump and Pumping Equipment Manufacturing.'' Based on this definition, DOE identified 39 manufacturers in the CIP industry that qualify as small businesses. For a discussion of the impacts on the small manufacturer subgroup, see the regulatory flexibility analysis in section VII.B of this document and chapter 12 of the final rule TSD.

f. Cumulative Regulatory Burden

While any one regulation may not impose a significant burden on manufacturers, the combined effects of recent or impending regulations may have serious consequences for some manufacturers, groups of manufacturers, or an entire industry. Assessing the impact of a single regulation may overlook this cumulative regulatory burden. In addition to energy conservation standards, other regulations can significantly affect manufacturers' financial operations. Multiple regulations affecting the same manufacturer can strain profits and lead companies to abandon product lines or markets with lower expected future returns than competing products. For these reasons, DOE conducts an analysis of cumulative regulatory burden as part of its rulemakings pertaining to appliance efficiency.

For the cumulative regulatory burden analysis, DOE looks at product-specific Federal regulations that could affect pumps manufacturers and with which compliance is required approximately three years before or after the 2019 compliance date of standard adopted in this document. The Department was not able to identify any additional regulatory burdens that met these criteria.

3. National Impact Analysis

a. Significance of Energy Savings

For each TSL, DOE projected energy savings for pumps purchased in the 30-year period that begins in the year of compliance with new standards (2020–2049). The savings are measured over the entire lifetime of equipment purchased in the 30-year 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 described in section IV.H.2.

Table V.28 presents the estimated primary energy savings and FFC energy savings for each considered TSL. The approach is further described in section IV.H.1.

TABLE V.28—CUMULATIVE NATIONAL ENERGY SAVINGS FOR PUMP TRIAL STANDARD LEVELS FOR UNITS SOLD IN 2020–2049

All equipment classes	Trial standard level (quads)				
	1	2	3	4	5
Primary energy	0.074	0.28	0.53	0.88	1.28
FFC energy	0.077	0.29	0.55	0.91	1.34

Note: Components may not sum to total due to rounding.

OMB Circular A–4 requires agencies to present analytical results, including separate schedules of the monetized benefits and costs that show the type and timing of benefits and costs.[74] 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 nine rather than 30 years of equipment shipments. The choice of a nine-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.[75] The review timeframe established in EPCA is generally not synchronized with the equipment lifetime, product manufacturing cycles, or other factors specific to pumps. Thus, such results are presented for informational purposes only and are not indicative of any change in DOE's analytical methodology. The NES results based on a nine-year analytical period are presented in Table V.29. The impacts are counted over the lifetime of equipment purchased in 2020–2028.

TABLE V.29—CUMULATIVE NATIONAL PRIMARY ENERGY SAVINGS FOR PUMP TRIAL STANDARD LEVELS FOR UNITS SOLD IN 2020–2028

Equipment class	Trial standard level (quads)				
	1	2	3	4	5
Primary energy	0.020	0.074	0.14	0.24	0.35
FFC energy	0.021	0.078	0.15	0.25	0.36

Note: Components may not sum to total 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 pumps. In accordance with OMB's guidelines on regulatory analysis,[76] DOE calculated NPV using both a 7-percent and a 3-percent real discount rate. Table V.30 shows the consumer NPV results for each TSL considered for pumps. In each case, the impacts cover the lifetime of equipment purchased in 2020–2049.

TABLE V.30—CUMULATIVE NET PRESENT VALUE OF CONSUMER BENEFIT FOR PUMP TRIAL STANDARD LEVELS FOR UNITS SOLD IN 2020–2049

Discount rate	Trial standard level (billion 2014$*)				
	1	2	3	4	5
3 percent	0.29	1.1	1.9	3.0	4.2
7 percent	0.11	0.39	0.69	1.1	1.4

* Numbers in parentheses indicate negative NPV.
Note: Components may not sum to total due to rounding.

The NPV results based on the aforementioned nine-year analytical period are presented in Table V.31. The impacts are counted over the lifetime of equipment purchased in 2020–2028. As mentioned previously, this information is presented for informational purposes only and is not indicative of any change in DOE's analytical methodology or decision criteria.

74 U.S. Office of Management and Budget, ''Circular A–4: Regulatory Analysis'' (Sept. 17, 2003) (Available at: *www.whitehouse.gov/omb/circulars_a004_a-4/*).

75 EPCA requires DOE to review its standards at least once every six years, and requires, for certain products, a three-year period after any new standard is promulgated before compliance is required, except that in no case may any new standards be required within six years of the compliance date of the previous standards. (42 U.S.C. 6295(m) and 6313(a)(6)(C)). While adding a six-year review to the three-year compliance period adds up to nine years, DOE notes that it may undertake reviews at any time within the six-year period and that the three-year compliance date may yield to the six-year backstop. A nine-year analysis period may not be appropriate given the variability that occurs in the timing of standards reviews and the fact that for some consumer products, the compliance period is five years rather than three years.

76 OMB Circular A–4, section E (Sept. 17, 2003) (Available at: *www.whitehouse.gov/omb/circulars_a004_a-4*).

TABLE V.31—CUMULATIVE NET PRESENT VALUE OF CONSUMER BENEFIT FOR PUMP TRIAL STANDARD LEVELS FOR UNITS SOLD IN 2020–2028

Discount rate	Trial standard level (billion 2014$*)				
	1	2	3	4	5
3 percent	0.094	0.35	0.63	0.99	1.4
7 percent	0.049	0.18	0.31	0.48	0.64

* Numbers in parentheses indicate negative NPV.
Note: Components may not sum to total due to rounding.

The results presented in this section reflect an assumption of no change in pump prices over the forecast period. In addition, DOE conducted sensitivity analyses using alternative price trends: one in which prices decline over time, and one in which prices increase. These price trends, and the associated NPV results, are described in appendix 10B of the final rule TSD.

c. Indirect Impacts on Employment

DOE expects energy conservation standards for pumps to reduce energy costs for equipment owners, with the resulting net savings being redirected to other forms of economic activity. Those shifts in spending and economic activity could affect the demand for labor. As described in section IV.N, DOE used an input/output model of the U.S. economy to estimate indirect employment impacts of the TSLs that DOE considered in this rulemaking. DOE understands that there are uncertainties involved in projecting employment impacts, especially changes in the later years of the analysis. Therefore, DOE generated results for near-term time frames (2020–2024), where these uncertainties are reduced.

The results suggest that these adopted standards would be likely to have negligible impact on the net demand for labor in the economy. The projected 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 more detailed results about anticipated indirect employment impacts.

4. Impact on Utility or Performance of Equipment

Any technology option expected to lessen the utility or performance of pumps was removed from consideration in the screening analysis. As a result, DOE considered only one design option in this final rule, hydraulic redesign. This design option does not involve geometry changes affecting installation of the pump (*i.e.,* the flanges that connect it to external piping)—hence, there is no utility difference that might affect use of the more-efficient pumps for replacement applications. Further, the design option would not reduce the acceptable performance envelope of the pump (*e.g.,* the combinations of pressure and flow for which the pump can be operated, restrictions to less corrosive environments, restrictions on acceptable operating temperature range). The hydraulic redesign would affect only the required power input, making no change to pump utility or performance.

5. Impact of Any Lessening of Competition

DOE has also considered any lessening of competition that is likely to result from new standards. The Attorney General determines the impact, if any, of any lessening of competition likely to result from a proposed standard, and transmits such determination in writing to the Secretary, together with an analysis of the nature and extent of such impact. (42 U.S.C. 6313(a)(6)(B)(ii)(V) and 6316(a).) DOE transmitted a copy of its proposed rule to the Attorney General with a request that the Department of Justice (DOJ) provide its determination on this issue.

In a letter dated July 10, 2015, DOJ stated that it did not have sufficient information to conclude that the proposed energy conservation standards or test procedure likely will substantially lessen competition in any particular product or geographic market. However, DOJ noted that the possibility exists that the proposed energy conservation standards and test procedure may result in anticompetitive effects in certain pump markets. Specifically in relation to the proposed standards, DOJ expressed concern that ''by design, the bottom quartile of pumps in each class of covered pumps will not meet the new standards. The non-compliance of the bottom quartile of pump models may result in some manufacturers stopping production of pumps altogether and fewer firms producing models that comply with the new standards. At this point, it is not possible to determine the impact on any particular product or geographic market.''

As stated in section III.G.1.e, in all energy conservation standards rulemakings that set new standards or amend standards, a certain percentage of the market is affected by the standard. The percentage of affected pumps is represented by any models below the amended standard, which may have a distribution of efficiencies (*i.e.,* some pump models will be closer to the new or amended standard level than others). It is not unusual for a large fraction of models (sometimes greater than 25%) to be at or near the baseline. As in all rulemakings, manufacturers have a choice between re-designing a non-compliant model to meet the standard and discontinuing it.

The ASRAC working group indicated that between 5 and 10% of models requiring redesign may be dropped because current sales are very low. (Docket No. EERE–2013–BT–NOC–0039, May 28 Pumps Working Group Meeting, p.61–63) Manufacturers indicated that additional models may be dropped where they can be replaced by another existing equivalent model currently made by the same manufacturer, often under an alternative brand. (Docket No. EERE–2013–BT–NOC–0039, April 29 Pumps Working Group Meeting, p.100) In either case, the elimination of these models would not have an adverse impact on the market or overall availability of pumps to serve particular applications.

For these reasons, DOE concludes that the standard levels included in this final rule will not result in adverse impacts on competition within the pump marketplace. The remaining concerns in the DOJ letter regarding the test procedure have been addressed in the parallel test procedure rulemaking (Docket No. EERE–2013–BT–TP–0055). The Attorney General's assessment is available at *http://www.regulations.gov/#!documentDetail;D=EERE-2011-BT-STD-0031-0053.*

6. Need of the Nation To Conserve Energy

An improvement in the energy efficiency of the equipment subject to this rule is likely to improve the security of the nation's energy system by reducing the overall demand for energy. Reduced electricity demand may also improve the reliability of the electricity system. Reductions in national electric generating capacity estimated for each considered TSL are reported in chapter 15 of the final rule TSD.

Energy savings from new standards for the pump equipment classes covered in this rulemaking could also produce environmental benefits in the form of reduced emissions of air pollutants and greenhouse gases associated with electricity production. Table V.32 provides DOE's estimate of cumulative emissions reductions projected to result from the TSLs considered in this rulemaking. The table includes both power sector emissions and upstream emissions. The upstream emissions were calculated using the multipliers discussed in section IV.K. DOE reports annual CO_2, NO_X, and Hg emissions reductions for each TSL in chapter 13 of the final rule TSD. As discussed in section IV.L, DOE did not include NO_X emissions reduction from power plants in States subject to CAIR, because an energy conservation standard would not affect the overall level of NO_X emissions in those States due to the emissions caps mandated by CSAPR.

TABLE V.32—CUMULATIVE EMISSIONS REDUCTION FOR PUMPS SHIPPED IN 2020–2049

	TSL				
	1	2	3	4	5
Power Sector Emissions					
CO_2 *(million metric tons)*	4.4	16	31	52	75
SO_2 (*thousand tons*)	2.5	9.3	18	30	43
NO_X *(thousand tons)*	4.9	18	35	57	84
Hg (*tons*)	0.009	0.035	0.066	0.11	0.16
CH4 (*thousand tons*)	0.36	1.35	2.58	4.28	6.26
N_2O (*thousand tons*)	0.051	0.19	0.36	0.60	0.88
Upstream Emissions					
CO_2 *(million metric tons)*	0.25	0.93	1.78	2.95	4.33
SO_2 (*thousand tons*)	0.05	0.17	0.33	0.55	0.80
NO_X *(thousand tons)*	3.6	13	25	42	62
Hg (*tons*)	0.0001	0.0004	0.0007	0.0012	0.0017
CH4 (*thousand tons*)	20	74	141	234	343
N_2O (*thousand tons*)	0.002	0.008	0.016	0.027	0.040
Total FFC Emissions					
CO_2 *(million metric tons)*	4.6	17	33	54	80
SO_2 (*thousand tons*)	2.6	9.5	18	30	44
NO_X *(thousand tons)*	8.4	31	60	100	146
Hg (*tons*)	0.009	0.035	0.067	0.11	0.16
CH4 (*thousand tons*)	20	75	143	238	349
N_2O (*thousand tons*)	0.054	0.20	0.38	0.63	0.92

As part of the analysis for this rulemaking, DOE estimated monetary benefits likely to result from the reduced emissions of CO_2 and NO_X estimated for each of the TSLs considered for pumps. As discussed in section IV.L, for CO_2, DOE used values for the SCC developed by an interagency process. The interagency group selected four sets of SCC values for use in regulatory analyses. Three sets are based on the average SCC from three integrated assessment models, at discount rates of 2.5 percent, 3 percent, and 5 percent. The fourth set, which represents the 95th-percentile SCC estimate across all three models at a 3-percent discount rate, is included to represent higher-than-expected impacts from temperature change further out in the tails of the SCC distribution. The four sets of SCC values for CO_2 emissions reductions in 2015 resulting from that process (expressed in 2014$) are represented by $12.2/metric ton (the average value from a distribution that uses a 5-percent discount rate), $40.0/metric ton (the average value from a distribution that uses a 3-percent discount rate), $62.3/metric ton (the average value from a distribution that uses a 2.5-percent discount rate), and $117/metric ton (the 95th-percentile value from a distribution that uses a 3-percent discount rate). The values for later years are higher due to increasing damages (public health, economic and environmental) as the projected magnitude of climate change increases.

Table V.33 presents the global value of CO_2 emissions reductions at each TSL. DOE calculated domestic values as a range from 7 percent to 23 percent of the global values, and these results are presented in chapter 14 of the final rule TSD. See Section IV.L. for further details.

TABLE V.33—ESTIMATES OF GLOBAL PRESENT VALUE OF CO_2 EMISSIONS REDUCTION FOR PUMPS SHIPPED IN 2020–2049

TSL	SCC Scenario* (million 2014$)			
	5% discount rate, average	3% discount rate, average	2.5% discount rate, average	3% discount rate, 95th percentile
Power Sector Emissions				
1	29	134	214	410
2	104	492	787	1501
3	199	942	1506	2872
4	329	1559	2494	4753
5	482	2282	3651	6957
Upstream Emissions				
1	1.6	7.6	12	23
2	5.9	28	45	85
3	11	53	86	163
4	19	89	142	270
5	27	130	208	395
Total FFC Emissions				
1	30	142	227	433
2	110	520	832	1586
3	211	995	1592	3035
4	348	1647	2636	5023
5	509	2411	3858	7353

* For each of the four cases, the corresponding SCC value for emissions in 2015 is $12.2, $40.0, $62.3 and $117 per metric ton (2014$).

DOE is well aware that scientific and economic knowledge about the contribution of CO_2 and other greenhouse gas (GHG) emissions to changes in the future global climate and the potential resulting damages to the world economy continues to evolve rapidly. Thus, any value placed in this rulemaking on reducing CO_2 emissions is subject to change. DOE, together with other Federal agencies, will continue to review various 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. However, consistent with DOE's legal obligations, and taking into account the uncertainty involved with this particular issue, DOE has included in this rulemaking the most recent values and analyses resulting from the interagency review process.

DOE also estimated a range for the cumulative monetary value of the economic benefits associated with NO_X emissions reductions anticipated to result from new standards for the pump equipment that is the subject of this rulemaking. The dollar-per-ton values that DOE used are discussed in section IV.L. Table V.34 presents the cumulative present value ranges for NO_X emissions reductions for each TSL calculated using seven-percent and three-percent discount rates. This table presents values that use the low dollar-per-ton values. Results that reflect the range of NO_X dollar-per-ton values are presented in Table V.36.

TABLE V.34—ESTIMATES OF PRESENT VALUE OF NO_X EMISSIONS REDUCTION FOR PUMPS SHIPPED IN 2020–2049

TSL	Million 2014$	
	3% discount rate	7% discount rate
Power Sector Emissions		
1	15	5.8
2	55	21
3	104	40
4	172	65
5	252	95
Upstream Emissions		
1	11	4.1
2	40	15
3	76	28
4	125	46
5	183	67
Total FFC Emissions		
1	26	9.9
2	94	35
3	180	67
4	297	111
5	435	162

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)(VI) and 6316(a).) In developing the proposed standard, DOE considered the term sheet of recommendations voted on by the CIP Working Group and approved by the ASRAC. (See EERE–2013–BT–NOC–0039–0092.) DOE weighed the value of such negotiation in establishing the standards proposed in in the NOPR. DOE encouraged the negotiation of proposed standard levels, in accordance with the FACA and the NRA, as a means for interested parties, representing diverse points of view, to analyze and recommend energy conservation standards to DOE. Such negotiations may often expedite the rulemaking process. In addition, standard levels recommended through a negotiation may increase the likelihood for regulatory compliance, while decreasing the risk of litigation. The standards adopted in this final rule reflect the proposed standards and therefore the term sheet of recommendations voted on by the CIP Working Group and approved by the ASRAC.

8. Summary of National Economic Impacts

The NPV of the monetized benefits associated with emissions reductions can be viewed as a complement to the NPV of the consumer savings calculated for each TSL considered in this rulemaking. Table V.35 presents the NPV values that result from adding the estimates of the potential economic benefits resulting from reduced CO_2 and NO_X emissions in each of four valuation scenarios to the NPV of consumer savings calculated for each TSL considered in this rulemaking, at both a seven-percent and a three-percent discount rate. The CO_2 values used in the columns of each table correspond to the four scenarios for the valuation of CO_2 emission reductions discussed above.

TABLE V.35—NET PRESENT VALUE OF CONSUMER SAVINGS COMBINED WITH NET PRESENT VALUE OF MONETIZED BENEFITS FROM CO_2 AND NO_X EMISSIONS REDUCTIONS

[Billion 2014$]

TSL	Consumer NPV at 3% Discount Rate added with:			
	SCC Value of \$12.2/metric ton CO_2 and 3% Low Value for NO_X	SCC Value of \$40.0/metric ton CO_2 and 3% Low Value for NO_X	SCC Value of \$62.3/metric ton CO_2 and 3% Low Value for NO_X	SCC Value of \$117/metric ton CO_2 and 3% Low Value for NO_X
1	0.3	0.5	0.5	0.7
2	1.3	1.7	2.0	2.7
3	2.3	3.1	3.7	5.2
4	3.7	5.0	6.0	8.4
5	5.2	7.1	8.5	12
TSL	Consumer NPV at 7% Discount Rate added with:			
	SCC Value of \$12.2/metric ton CO_2 and 7% Low Value for NO_X	SCC Value of \$40.0/metric ton CO_2 and 7% Low Value for NO_X	SCC Value of \$62.3/metric ton CO_2 and 7% Low Value for NO_X	SCC Value of \$117/metric ton CO_2 and 7% Low Value for NO_X
1	0.1	0.3	0.3	0.6
2	0.5	0.9	1.3	2.0
3	1.0	1.8	2.3	3.8
4	1.5	2.8	3.8	6.2
5	2.1	4.0	5.4	8.9

Note: These label values represent the global SCC in 2015, in 2014$.

In considering the above results, two issues are relevant. First, the national operating cost savings are domestic U.S. monetary savings that occur as a result of market transactions, while the value of CO_2 reductions is based on a global value. Second, the assessments of operating cost savings and the SCC are performed with different methods that use different time frames for analysis. The national operating cost savings is measured for the lifetime of products shipped in 2020 to 2049. Because CO_2 emissions have a very long residence time in the atmosphere,[77] the SCC values in future years reflect future climate-related impacts that continue beyond 2100.

[77] The atmospheric lifetime of CO_2 is estimated of the order of 30–95 years. Jacobson, MZ, ''Correction to 'Control of fossil-fuel particulate black carbon and organic matter, possibly the most effective method of slowing global warming,''' *J. Geophys. Res.* 110. pp. D14105 (2005).

C. Conclusion

When considering standards, the new or amended energy conservation standard that DOE adopts for any type (or class) of covered equipment shall 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) and 6316(a)). In determining whether a standard is economically justified, the Secretary must determine whether the benefits of the standard exceed its burdens, considering, to the greatest extent practicable, the seven statutory factors discussed previously. (42 U.S.C. 6295(o)(2)(B)(i) and 6316(a)). The new or amended standard must also ''result in significant conservation of energy.'' (42 U.S.C. 6295(o)(3)(B) and 6316(a)).

For this final rule, DOE considered the impacts of new standards for pumps 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 in understanding the benefits and/or burdens of each TSL, tables in this section summarize the quantitative analytical results for each TSL, based on the assumptions and methodology discussed herein. The efficiency levels contained in each TSL are described in section I.A. 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. Section V.B.1.b presents the estimated impacts of each TSL for these subgroups. DOE discusses the impacts on direct employment in pump manufacturing in section 0, and the indirect employment impacts in section V.B.3.c.

1. Benefits and Burdens of Trial Standard Levels Considered for Pumps Standards

Table V.36 and Table V.37 summarize the quantitative impacts estimated for each TSL for pumps. The national impacts are measured over the lifetime of pumps purchased in the 30-year period that begins in the year of compliance with new standards (2020–2049). The energy savings, emissions reductions, and value of emissions reductions refer to full-fuel-cycle results.

TABLE V.36—SUMMARY OF ANALYTICAL RESULTS FOR PUMPS: NATIONAL IMPACTS

Category	TSL 1	TSL 2	TSL 3	TSL 4	TSL 5
National FFC Energy Savings quads	0.077	0.29	0.55	0.91	1.34.
NPV of Consumer Benefits (2014$ billion)					
3% discount rate	0.29	1.1	1.9	3.0	4.2.
7% discount rate	0.11	0.39	0.69	1.1	1.4.
Cumulative FFC Emissions Reduction					
CO_2 *(million metric tons)*	4.6	17	33	54	80.
SO_2 (*thousand tons*)	2.6	9.5	18	30	44.
NO_X *(thousand tons)*	8.4	31	60	100	146.
Hg (*tons)*	0.009	0.035	0.067	0.11	0.16.
CH_4 (*thousand tons*)	20	75	143	238	349.
N_2O (*thousand tons*)	0.054	0.20	0.38	0.63	0.92.
Value of Emissions Reduction					
CO_2 (2014$ million) *	30 to 433	110 to 1586	211 to 3035	348 to 5023	509 to 7353.
NO_X—3% discount rate (*2014$ million*)	26 to 57	94 to 208	180 to 398	297 to 658	435 to 963.
NO_X—7% discount rate (*2014$ million*)	10 to 22	35 to 79	67 to 151	111 to 248	162 to 362.

* Range of the economic value of CO_2 reductions is based on estimates of the global benefit of reduced CO_2 emissions.
Note: Parentheses indicate negative values.

TABLE V.37—SUMMARY OF ANALYTICAL RESULTS FOR PUMPS: MANUFACTURER AND CONSUMER IMPACTS

	TSL 1	TSL 2	TSL 3	TSL 4	TSL 5
Manufacturer Impacts					
Industry NPV relative to a no-new-standards case value of 120.0 (2014$ million).	110.3 to 120.4	80.5 to 128.3	20.9 to 124.5	(86.1) to 113.0	(229.0) to 93.5
Industry NPV (% change)	(8.1) to 0.4	(32.9) to 7.0	(82.6) to 3.8	(171.8) to (5.8)	(290.9) to (22.1)
Consumer Mean LCC Savings (2014$)					
ESCC.1800	$43	$163	$238	$322	$357
ESCC.3600	$17	$92	$121	$178	$275
ESFM.1800	$8.0	$174	$376	$742	$1,072
ESFM.3600	$58	$549	$966	$1,418	$2,087
IL.1800	$51	$147	$197	$198	$227
IL.3600	$45	$138	$239	$285	$372
VTS.3600	$18	$17	$86	$144	$186
Consumer Simple PBP (years)					
ESCC.1800	3.4	2.2	2.7	3.2	4.0
ESCC.3600	1.5	1.0	1.8	1.9	2.0
ESFM.1800	2.5	2.9	2.9	3.2	3.5
ESFM.3600	1.3	0.8	0.9	1.1	1.3
IL.1800	2.4	2.9	4.1	5.6	6.2
IL.3600	1.4	2.0	2.2	2.8	3.3
VTS.3600	1.3	3.1	1.8	2.0	2.4
Percent Consumers with Net Cost (%)					
ESCC.1800	12	11	24	30	43
ESCC.3600	0.68	1.8	14	14	13
ESFM.1800	0.27	6.6	15	24	26
ESFM.3600	0.30	1.9	4.8	7.2	8.6
IL.1800	1.9	7.3	15	26	36
IL.3600	2.1	13	11	14	20

TABLE V.37—SUMMARY OF ANALYTICAL RESULTS FOR PUMPS: MANUFACTURER AND CONSUMER IMPACTS—Continued

	TSL 1	TSL 2	TSL 3	TSL 4	TSL 5
VTS.3600	0.51	27	7.4	10	13

Note: Parentheses indicate negative values.

First, DOE considered TSL 5, which would save an estimated total of 1.34 quads of energy, an amount DOE considers significant. TSL 5 has an estimated NPV of consumer benefit of $1.4 billion using a 7-percent discount rate, and $4.2 billion using a 3-percent discount rate. The cumulative emissions reductions at TSL 5 are 80 million metric tons of CO_2, 146 thousand tons of NO_X, and 0.16 tons of Hg. The estimated monetary value of the CO_2 emissions reductions at TSL 5 ranges from $509 million to $7,353 million. At TSL 5, the average LCC savings ranges from $186 to $2,087 depending on equipment class. The fraction of consumers with negative LCC impacts ranges from 8.6 percent to 43 percent depending on equipment class. At TSL 5, the projected change in INPV ranges from a decrease of $349.0 million to a decrease of $26.5 million. At TSL 5, DOE recognizes the risk of negative impacts if manufacturers' expectations concerning reduced profit margins are realized. If the lower bound of the range of impacts is reached, TSL 5 could result in a net loss of up to 290.9 percent in INPV for manufacturers.

Accordingly, the Secretary concludes that, at TSL 5 for pumps, the benefits of energy savings, national net present value of consumer benefit, LCC savings, emission reductions, and the estimated monetary value of the CO_2 emissions reductions would be outweighed by the fraction of consumers with negative LCC impacts and the significant burden on the industry. Consequently, DOE has concluded that TSL 5 is not economically justified.

Next, DOE considered TSL 4, which would save an estimated total of 0.91 quads of energy, an amount DOE considers significant. TSL 4 has an estimated NPV of consumer benefit of $1.1 billion using a 7-percent discount rate, and $3.0 billion using a 3-percent discount rate. The cumulative emissions reductions at TSL 4 are 54 million metric tons of CO_2, 100 thousand tons of NO_X, and 0.11 tons of Hg. The estimated monetary value of the CO_2 emissions reductions at TSL 4 ranges from $348 million to $5,023 million. At TSL 4, the average LCC savings ranges from $144 to $1,418 depending on equipment class. The fraction of consumers with negative LCC impacts ranges from 7.2 percent to 30 percent depending on equipment class. At TSL 4, the projected change in INPV ranges from a decrease of $206.1 million to a decrease of $6.9 million. At TSL 4, DOE recognizes the risk of negative impacts if manufacturers' expectations concerning reduced profit margins are realized. If the lower bound of the range of impacts is reached, TSL 4 could result in a net loss of up to 171.8 percent in INPV for manufacturers.

Accordingly, the Secretary concludes that at TSL 4 for pumps, the benefits of energy savings, national net present value of consumer benefit, LCC savings, emission reductions, and the estimated monetary value of the CO_2 emissions reductions would be outweighed by the fraction of consumers with negative LCC impacts and the significant burden on the industry. Consequently, DOE has concluded that TSL 4 is not economically justified.

Next, DOE considered TSL 3, which would save an estimated total of 0.55 quads of energy, an amount DOE considers significant. TSL 3 has an estimated NPV of consumer benefit of $0.69 billion using a 7-percent discount rate, and $1.9 billion using a 3-percent discount rate. The cumulative emissions reductions at TSL 3 are 33 million metric tons of CO_2, 60 thousand tons of NO_X, and 0.07 tons of Hg. The estimated monetary value of the CO_2 emissions reductions at TSL 3 ranges from $211 million to $3,035 million. At TSL 3, the average LCC savings range from $86 to $966 depending on equipment class. The fraction of consumers with negative LCC impacts ranges from 4.8 percent to 24 percent depending on equipment class. At TSL 3, the projected change in INPV ranges from a decrease of $99.1 million to an increase of $4.6 million. If the lower bound of the range of impacts is reached, TSL 3 could result in a net loss of up to 82.6 percent in INPV for manufacturers.

Accordingly, the Secretary concludes that at TSL 3 for pumps, the benefits of energy savings, national net present value of consumer benefit, LCC savings, emission reductions, and the estimated monetary value of the CO_2 emissions reductions would be outweighed by the fraction of consumers with negative LCC impacts and the significant burden on the industry. Consequently, DOE has concluded that TSL 3 is not economically justified.

Next, DOE considered TSL 2, which would save an estimated total of 0.29 quads of energy, an amount DOE considers significant. TSL 2 has an estimated NPV of consumer benefit of $0.39 billion using a 7-percent discount rate, and $1.1 billion using a 3-percent discount rate. The cumulative emissions reductions at TSL 2 are 17 million metric tons of CO_2, 31 thousand tons of NO_X, and 0.035 tons of Hg. The estimated monetary value of the CO_2 emissions reductions at TSL 3 ranges from $110 million to $1,586 million. At TSL 2, the average LCC savings range from $17 to $549 depending on equipment class. The fraction of consumers with negative LCC impacts ranges from 1.8 percent to 27 percent depending on equipment class. At TSL 2, the projected change in INPV ranges from a decrease of $39.5 million to an increase of $8.4 million. If the lower bound of the range of impacts is reached, TSL 2 could result in a net loss of up to 32.9 percent in INPV for manufacturers.

After considering the analysis and weighing the benefits and the burdens, DOE has concluded that at TSL 2 for pumps, the benefits of energy savings, positive NPV of consumer benefit, positive average consumer LCC savings, emission reductions, and the estimated monetary value of the emissions reductions would outweigh the fraction of consumers with negative LCC impacts and the potential reduction in INPV for manufacturers.

In addition, TSL 2 is consistent with the recommendations voted on by the CIP Working Group and approved by the ASRAC. (See EERE–2013–BT–NOC–0039–0092.) DOE has encouraged the negotiation of new standard levels, in accordance with the FACA and the NRA, as a means for interested parties, representing diverse points of view, to analyze and recommend energy conservation standards to DOE. Such negotiations may often expedite the rulemaking process. In addition, standard levels recommended through a negotiation may increase the likelihood for regulatory compliance, while decreasing the risk of litigation.

The Secretary of Energy has concluded that TSL 2 would save a significant amount of energy and is technologically feasible and economically justified. Therefore, DOE adopts the energy conservation standards for pumps at TSL 2. Table V.38 presents the new energy conservation standards for pumps.

TABLE V.38—NEW ENERGY CONSERVATION STANDARDS FOR PUMPS

Equipment class	Adopted standard level *	Adopted C-value
ESCC.1800.CL	1.00	128.47
ESCC.3600.CL	1.00	130.42
ESCC.1800.VL	1.00	128.47
ESCC.3600.VL	1.00	130.42
ESFM.1800.CL	1.00	128.85
ESFM.3600.CL	1.00	130.99
ESFM.1800.VL	1.00	128.85
ESFM.3600.VL	1.00	130.99
IL.1800.CL	1.00	129.30
IL.3600.CL	1.00	133.84
IL.1800.VL	1.00	129.30
IL.3600.VL	1.00	133.84
RSV.1800.CL	1.00	129.63
RSV.3600.CL	1.00	133.20
RSV.1800.VL	1.00	129.63
RSV.3600.VL	1.00	133.20
VTS.1800.CL	1.00	138.78
VTS.3600.CL	1.00	134.85
VTS.1800.VL	1.00	138.78
VTS.3600.VL	1.00	134.85

* A pump model is compliant if its PEI rating is less than or equal to the adopted standard.

2. Summary of Annualized Benefits and Costs of the Adopted Standards

The benefits and costs of these adopted standards can also be expressed in terms of annualized values. The annualized monetary values are the sum of: (1) The annualized national economic value, expressed in 2014$, of the benefits from operating equipment that meets the adopted standards (consisting primarily of operating cost savings from using less energy, minus increases in equipment purchase costs, which is another way of representing consumer NPV), and (2) the monetary value of the benefits of emission reductions, including CO_2 emission reductions.[78] The value of the CO_2 reductions (*i.e.,* SCC), is calculated using a range of values per metric ton of CO_2 developed by a recent interagency process. See section IV.L.

Although combining the values of operating savings and CO_2 reductions provides a useful perspective, two issues should be considered. First, the national operating savings are domestic U.S. consumer monetary savings that occur as a result of market transactions, while the value of CO_2 reductions is based on a global value. Second, the assessments of operating cost savings and SCC are performed with different methods that use different time frames for analysis. The national operating cost savings is measured for the lifetime of equipment shipped in 2020–2049. The SCC values, on the other hand, reflect the present value of future climate-related impacts resulting from the emission of one metric ton of CO_2 in each year. These impacts continue well beyond 2100.

Table V.39 shows the annualized values for the adopted standards for pumps. The results under the primary estimate are as follows. Using a 7-percent discount rate for benefits and costs other than CO_2 reduction, for which DOE used a 3-percent discount rate along with the average SCC series that has a value of $40.0/t in 2015, the cost of the standards adopted in this rule is $17 million per year in increased equipment costs, while the benefits are $58 million per year in reduced equipment operating costs, $30 million in CO_2 reductions, and $3.7 million in reduced NO_X emissions. In this case, the net benefit amounts to $74 million per year. Using a 3-percent discount rate for all benefits and costs and the average SCC series that has a value of $40.0/t in 2015, the cost of the standards adopted in this rule is $17 million per year in increased equipment costs, while the benefits are $78 million per year in reduced operating costs, $30 million in CO_2 reductions, and $5.4 million in reduced NO_X emissions. In this case, the net benefit amounts to $96 million per year.

TABLE V.39—ANNUALIZED BENEFITS AND COSTS OF ADOPTED ENERGY CONSERVATION STANDARDS FOR PUMPS *

	Discount rate	Million 2014$/year		
		Primary estimate	Low net benefits estimate	High net benefits estimate
Benefits				
Consumer Operating Cost Savings	7%	58	52	68.
	3%	78	70	94.
CO_2 Reduction Value ($12.2/t case) **	5%	8.7	8.1	9.5.
CO_2 Reduction Value ($40.0/t case) **	3%	30	28	33.
CO_2 Reduction Value ($62.3/t case) **	2.5%	44	41	48.
CO_2 Reduction Value ($117/t case) **	3%	91	84	99.
NO_X Reduction Value †	7%	3.7	3.5	9.0.
	3%	5.4	5.0	13.
Total Benefits ††	7% plus CO_2 range	70 to 152	64 to 140	86 to 176.
	7%	91	83	109.
	3% plus CO_2 range	92 to 174	83 to 159	116 to 206.
	3%	113	102	139.
Costs				
Consumer Incremental Equipment Costs	7%	17	19	17.
	3%	17	20	18.
Net Benefits				
Total ††	7% plus CO_2 range	53 to 136	45 to 121	69 to 159.

[78] To convert the time-series of costs and benefits into annualized values, DOE calculated a present value in 2014, 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 (2020, 2030, *etc.*), and then discounted the present value from each year to 2015. The calculation uses discount rates of 3 and 7 percent for all costs and benefits except for the value of CO_2 reductions, for which DOE used case-specific discount rates. 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 V.39—ANNUALIZED BENEFITS AND COSTS OF ADOPTED ENERGY CONSERVATION STANDARDS FOR PUMPS *—Continued

	Discount rate	Million 2014$/year		
		Primary estimate	Low net benefits estimate	High net benefits estimate
	7%	74	65	92.
	3% plus CO_2 range	75 to 157	63 to 139	99 to 189.
	3%	96	83	122.

* This table presents the annualized costs and benefits associated with pumps shipped in 2020–2049. These results include benefits to consumers which accrue after 2049 from the pumps purchased from 2020–2049. The results account for the incremental variable and fixed costs incurred by manufacturers due to the standard, some of which may be incurred in preparation for the rule. The Primary, Low Benefits, and High Benefits Estimates utilize projections of energy prices and shipments from the *AEO 2015* Reference case, Low Economic Growth case, and High Economic Growth case, respectively. In addition, incremental equipment costs reflect constant real prices in the Primary Estimate, an increase in the Low Benefits Estimate, and a decrease in the High Benefits Estimate. The methods used to derive projected price trends are explained in IV.F.2.a.

** The CO_2 values represent global monetized values of the SCC, in 2014$, in 2015 under several scenarios of the updated SCC values. The first three cases use the averages of SCC distributions calculated using 5%, 3%, and 2.5% discount rates, respectively. The fourth case represents the 95th percentile of the SCC distribution calculated using a 3% discount rate. The SCC time series incorporate an escalation factor.

† The $/ton values used for NO_X are described in section IV.L.2. DOE estimated the monetized value of NO_X emissions reductions using benefit per ton estimates from the Regulatory Impact Analysis titled, "Proposed Carbon Pollution Guidelines for Existing Power Plants and Emission Standards for Modified and Reconstructed Power Plants," published in June 2014 by EPA's Office of Air Quality Planning and Standards. (Available at: *http://www3.epa.gov/ttnecas1/regdata/RIAs/111dproposalRIAfinal0602.pdf*.) See section IV.L.2 for further discussion. For DOE's Primary Estimate and Low Net Benefits Estimate, the agency is presenting a national benefit-per-ton estimate for particulate matter emitted from the Electric Generating Unit sector based on an estimate of premature mortality derived from the ACS study (Krewski et al., 2009). For DOE's High Net Benefits Estimate, the benefit-per-ton estimates were based on the Six Cities study (Lepuele et al., 2011), which are nearly two-and-a-half times larger than those from the ACS study. Because of the sensitivity of the benefit-per-ton estimate to the geographical considerations of sources and receptors of emission, DOE intends to investigate refinements to the agency's current approach of one national estimate by assessing the regional approach taken by EPA's Regulatory Impact Analysis for the Clean Power Plan Final Rule.

†† Total Benefits for both the 3% and 7% cases are derived using the series corresponding to the average SCC with 3-percent discount rate ($40.0/t case). In the rows labeled "7% plus CO_2 range" and "3% plus CO_2 range," the operating cost and NO_X benefits are calculated using the labeled discount rate, and those values are added to the full range of CO_2 values.

VI. Labeling and Certification Requirements

A. Labeling

EPCA includes provisions for labeling. (42 U.S.C. 6315). EPCA authorizes DOE to establish labeling requirements only if certain criteria are met. Specifically, DOE must determine that: (1) Labeling in accordance with section 6315 is technologically and economically feasible with respect to any particular equipment class; (2) significant energy savings will likely result from such labeling; and (3) labeling in accordance with section 6315 is likely to assist consumers in making purchasing decisions. (42 U.S.C. 6315(h)).

If these criteria are met, EPCA specifies certain aspects of equipment labeling that DOE must consider in any rulemaking establishing labeling requirements for covered equipment. At a minimum, such labels must include the energy efficiency of the affected equipment, as tested under the prescribed DOE test procedure. The labeling provisions may also consider the addition of other requirements, including: Directions for the display of the label; a requirement to display on the label additional information related to energy efficiency or energy consumption, which may include instructions for maintenance and repair of the covered equipment, as necessary to provide adequate information to purchasers; and requirements that printed matter displayed or distributed with the equipment at the point of sale also include the information required to be placed on the label. (42 U.S.C. 6315(b) and 42 U.S.C. 6315(c)).

The CIP Working Group recommended labeling requirements in the term sheet. (See EERE–2013–BT–NOC–0039–0092, recommendation #12.) Specifically, the working group recommended that pumps be labeled based on the configuration in which they are sold. Table VI.1 shows the information that the CIP Working Group recommended be included on a pump nameplate. (See EERE–2013–BT–NOC–0039–0092, recommendation #12.)

TABLE VI.1—LABELING REQUIREMENTS FOR PUMP NAMEPLATE

Bare pump	Bare pump + motor	Bare pump + motor + controls
PEI_{CL}	PEI_{CL}	PEI_{VL}
Model number	Model number	Model number
Impeller diameter for each unit	Impeller diameter for each unit	Impeller diameter for each unit

Note: The impeller diameter referenced is the actual diameter of each unit as sold, not the full impeller diameter at which the pump is rated.

DOE reviewed the recommendations of the working group with respect to the three requirements that must be met for DOE to promulgate labeling rules. (42 U.S.C. 6315(h)). In the NOPR, DOE determined that all three criteria had been met and proposed the labeling requirements as recommended by the working group. 80 FR 17826, 17882 (April 2, 2015) In response to the NOPR, HI agreed with the labeling requirements proposed. (HI, No. 45 at p. 6). The Advocates and the CA IOUs agreed that requiring labels may increase demand for more efficient pumps and facilitate comparison of expected performance of bare pumps and pumps with controls for consumers. (The Advocates, No. 49 at p. 1; CA IOUs, No. 50 at p. 1–2)

The changes made in this final rule, as described in the methodology sections, did not significantly impact DOE's analysis of the labeling proposals.

For these reasons, DOE is adopting the labeling requirements recommended by the CIP Working Group, and proposed in the NOPR, as shown in Table VI.1. Additionally, DOE requires the same labeling requirements for marketing materials as for the pump nameplate. See 42 U.S.C. 6315(c)(3).

DOE adopts the following requirements for display of information: All orientation, spacing, type sizes, typefaces, and line widths to display this required information must be the same as or similar to the display of the other performance data on the pump's permanent nameplate. The PEI_{CL} or PEI_{VL}, as appropriate to a given pump model, must be identified in the form ''PEI_{CL} [certified value of PEI_{CL}]'' or ''PEI_{VL} [certified value of PEI_{VL}].'' The model number shall be in one of the following forms: ''Model [model number]'' or ''Model number [model number]'' or ''Model No. [model number].'' The unit's impeller diameter must be in the form either ''Imp. Dia. [actual diameter] (in.).'' or ''Imp. Dia.__ (in.)'' as discussed below.

DOE is aware that when pump manufacturers sell a bare pump to a distributor, the distributor may trim the impeller prior to selling the pump to a customer. In response to the NOPR, Wilo commented that the labeling of the impeller diameter should be filled in by the final distributor. (Wilo, No. 44 at pp. 7–8) Similarly, HI commented that the impeller diameter field should be left blank and filled in by the final distributor or manufacturer. (HI, No. 45 at p. 6; NOPR public meeting transcript, Mark Handzel, on behalf of HI, No. 51 at pp. 52–55) HI's comments indicate that in some cases the pump manufacturer will act as the ''final distributor,'' and sell directly to the end-user. DOE agrees with HI's indication that most, but not all, pumps are sold through distributors. Consequently, in this final rule, DOE adopts the requirement that manufacturers must mark each pump's actual impeller diameter on the label, if distributed in commerce directly to end-user; otherwise this field must be left blank. DOE has concluded that this requirement meets the original intent of the CIP working group, while also addressing the concerns voiced HI and Wilo.

B. Certification Requirements

In the NOPR, DOE proposed to adopt the reporting requirements in a new § 429.59 within subpart B of 10 CFR part 429. This section also includes sampling requirements, which are discussed in the test procedure final rule. Consistent with other types of covered products and equipment, the proposed section (10 CFR 429.59) would specify that the general certification report requirements contained in 10 CFR 429.12 apply to pumps. The additional requirements proposed in 10 CFR 429.59 would require manufacturers to supply certain additional information to DOE in certification reports for pumps to demonstrate compliance with any energy conservation standards established as a result of this rulemaking.

The CIP Working Group recommended that the following data be included in the certification reports:

- Manufacturer name;
- Model number(s);
- Equipment class;
- PEI_{CL} or PEI_{VL} as applicable;
- BEP flow rate and head;
- Rated speed;
- Number of stages tested;
- Full impeller diameter (in.);
- Whether the PEI_{CL} or PEI_{VL} is calculated or tested; and
- Input power to the pump at each load point *i* (P_{ini}).

(See EERE–2013–BT–NOC–0039–0092, recommendation No. 13.)

In the NOPR, DOE proposed some modifications and additions to the certification report for clarity and to assist with verification. The proposed items included:

- Manufacturer name;
- Model number(s);
- Equipment class;
- PEI_{CL} or PEI_{VL} as applicable;
- BEP flow rate in gallons per minute (gpm) and head in feet when operating at nominal speed;
- Rated (tested) speed in revolutions per minute (rpm) at the BEP of the pump;
- Number of stages tested;
- Full impeller diameter (in.);
- Whether the PEI_{CL} or PEI_{VL} is calculated or tested;
- Driver power input at each required load point *i* (P_{ini}), corrected to nominal speed, in horsepower (hp);
- Nominal speed for certification in revolutions per minute (rpm);
- The configuration in which the pump is being rated (*i.e.,* bare pump, a pump sold with a motor, or a pump sold with a motor and continuous or non-continuous controls);
- For pumps sold with electric motors regulated by DOE's energy conservation standards for electric motors at § 431.25 other single-phase induction motors (with or without controls): Motor horsepower (hp) and nominal motor efficiency, in percent (%);
- PER_{CL} or PER_{VL}, as applicable;
- Pump efficiency at BEP; and
- For VTS pumps, the bowl diameter in inches (in.).

(80 FR 17826, 17891 (April 2, 2015))

In reviewing the certification report requirements for the final rule, DOE has determined that the requirements of § 429.12(b) already require reporting of manufacturer name, model number(s), and equipment class for all covered products and equipment. For these reasons, DOE is withdrawing its proposal to include these requirements in § 429.59. With respect to the certification requirements, the equipment class reported refers to those listed in the table in § 431.465(b); *e.g.,* ESCC.1800.CL, ESCC.1800.VL, IL.1800.CL, etc.

With respect to reporting model number(s), a certification report must include a basic model number and the manufacturer's (individual) model number(s). A manufacturer's model number (individual model number) is the identifier used by a manufacturer to uniquely identify what is commonly considered a ''model'' in industry—all units of a particular design. The manufacturer's (individual) model number typically appears on the product nameplate, in product catalogs and in other product advertising literature. In contrast, the basic model number is a number used by the manufacturer to indicate to DOE how the manufacturer has grouped its individual models for the purposes of testing and rating; many manufacturers choose to use a model number that is similar to the individual model numbers in the basic model, but that is not required. The manufacturer's individual model number(s) in each basic model must reference not only the bare pump, but also any motor and controls with which the pump is being rated. This may be accomplished in one of two ways, depending on the manufacturer's normal business practices. Specifically: (1) Pumps distributed in commerce as a bare pump require the bare pump individual model number reported; (2) pumps distributed in commerce as a bare pump with driver require the bare pump and driver individual model numbers reported; and (3) pumps distributed in commerce as a bare pump with driver and controls require the bare pump, driver, and controls individual model numbers reported. Alternatively, the manufacturer may specify a single manufacturer individual model number for the bare pump with driver and/or controls if the manufacturer routinely uses that model number in marketing materials and on the product to indicate a particular combination of bare pump and driver or bare pump, driver and controls. For example, one manufacturer may certify basic model ABC as including individual model ABC + EZB12 + AC2, where ABC is the bare pump model number, EZB12 is the driver model number, and AC2 is the control model number. Another manufacturer may certify basic model DEF as including individual model number DEF12DQ45Z, which is the model number the manufacturer routinely uses to indicate the bare pump DEF with a particular driver and set of controls.

After further review, DOE has also determined that the use of the term ''rated speed'' in the CIP working group term sheet was ambiguous. In the NOPR, DOE interpreted this to mean tested speed, and also added an additional requirement for nominal speed, as discussed previously. After reviewing the transcripts of the working group meetings, DOE has determined that it is unclear whether the CIP Working Group actually intended to refer to tested or nominal speed of the pump. DOE has determined that reporting tested speed is not necessary as no two pumps in a sample are likely to be tested at exactly the same speed. Therefore, DOE does not require reporting of ''rated (tested) speed''. However, DOE does require reporting of nominal speed.

In response to the NOPR, HI and Wilo commented against the inclusion of pump efficiency at BEP in certification reports. (HI, No. 45 at p. 7; Wilo, No. 44 at p. 8) HI agreed with only the certification reporting requirements agreed to by the ASRAC CIP working group. Conversely, EEI requested additional data, such as watts per gpm or annual kWh per gpm, to help the public better understand the relative efficiencies of pumps. (EEI, No. 46 ¶ at p. 2)

DOE notes that in the NOPR, six requirements were added beyond those agreed to by the CIP working group. Of these, four were added in order for DOE to conduct verification (*i.e.,* nominal speed; configuration; electric motor information; and for VTS pumps, bowl diameter). As noted previously, DOE has determined that nominal speed was a duplicative requirement and has withdrawn that proposal. However, DOE does require configuration, electric motor information, and bowl diameter to conduct verification. DOE maintains these three requirements in the final rule; however, DOE will not post this information on its Web site.

In response to HI and Wilo's comments, DOE is adopting a reporting option for PER and pump efficiency at BEP, the two reporting requirements that are not required for DOE to conduct enforcement testing and were not recommended by the CIP Working Group. DOE does not add the information requested by EEI, because consumers of pumps in the scope of this rulemaking typically rely on more sophisticated information, and the suggested metrics may be more relevant to commodity-type pumps in the residential sector.

In summary, DOE is modifying required data for certification reports in this final rule based on feedback from interested parties and review of its requirements. The following data is required for certification reports and will be made public on DOE's Web site:

- PEI_{CL} or PEI_{VL} as applicable;
- Number of stages tested;
- Full impeller diameter (in);
- Whether the PEI_{CL} or PEI_{VL} is calculated or tested;
- BEP flow rate in gallons per minute (gpm) and head in feet when operating at nominal speed;
- Nominal speed of rotation in revolutions per minute (rpm); and
- Driver power input at each required load point *i* (P^{in}_i), corrected to nominal speed, in horsepower (hp).

The following data will be required, but will not be posted on DOE's Web site:

- The configuration in which the pump is being rated (*i.e.,* bare pump, a pump sold with a motor, or a pump sold with a motor and continuous or non-continuous controls);
- For pumps sold with electric motors regulated by DOE's energy conservation standards for electric motors at § 431.25 (with or without controls): Motor horsepower (hp) and nominal motor efficiency, in percent (%);
- For pumps sold with submersible motors (with or without controls): Motor horsepower (hp); and
- For VTS pumps, bowl diameter in inches (in.).

Additionally, the following data will be optional for inclusion in certification reports, and if provided, will be public:

- PER_{CL} or PER_{VL}, as applicable; and
- Pump efficiency at BEP.

In response to the NOPR, the Advocates and the CA IOUs requested that DOE set up the certification database early for voluntary certification in order for utilities to gather data and incentivize high efficiency pumps. (Advocates, No. 49 at p. 1–2; CA IOUs, No. 50 at p. 2) DOE typically provides templates for certification early and allows for early voluntary certification.

C. Representations

In response to the NOPR, HI expressed concern with the general language around 42 U.S.C. 6314(d) prohibited representation. HI suggested that pump manufacturers be allowed to continue using pre-existing efficiency curves and sizing software that is used directly by end users and distributors to purchase pumps. HI requested that DOE clearly state in the final rule that prohibited representation only applies to PEI and PER representation. (HI, No. 45 at p. 2) As representations are explicitly discussed in the pumps test procedure rulemaking, DOE has addressed these comments in the test procedure final rule. (See EERE–2013–BT–TP–0055)

VII. Procedural Issues and Regulatory Review

A. Review Under Executive Orders 12866 and 13563

Section 1(b)(1) of Executive Order 12866, ''Regulatory Planning and Review,'' 58 FR 51735, Oct. 4, 1993, requires each agency to identify the problem that it intends to address, including, where applicable, the failures of private markets or public institutions that warrant new agency action, as well as to assess the significance of that problem. The problems that the adopted standards for pumps address are as follows:

(1) Insufficient information and the high costs of gathering and analyzing relevant information leads some consumers to miss opportunities to make cost-effective investments in energy efficiency.

(2) In some cases the benefits of more efficient equipment are not realized due to misaligned incentives between purchasers and users. An example of such a case is when the equipment purchase decision is made by a building contractor or building owner who does not pay the energy costs.

(3) There are external benefits resulting from improved energy efficiency of equipment that are not captured by the users of such equipment. These benefits include externalities related to public health, environmental protection and national energy security that are not reflected in energy prices, such as reduced emissions of air pollutants and greenhouse gases that impact human health and global warming. DOE attempts to qualify some of the external benefits through the use of social cost of carbon values.

The Administrator of the Office of Information and Regulatory Affairs (OIRA) in the OMB has determined that the proposed regulatory action is a significant regulatory action under section (3)(f) of Executive Order 12866.

Accordingly, pursuant to section 6(a)(3)(B) of the Order, DOE has provided to OIRA: (i) The text of the draft regulatory action, together with a reasonably detailed description of the need for the regulatory action and an explanation of how the regulatory action will meet that need; and (ii) an assessment of the potential costs and benefits of the regulatory action, including an explanation of the manner in which the regulatory action is consistent with a statutory mandate. DOE has included these documents in the rulemaking record.

In addition, the Administrator of OIRA has determined that the proposed regulatory action is an ''economically'' significant regulatory action under section (3)(f)(1) of Executive Order 12866. Accordingly, pursuant to section 6(a)(3)(C) of the Order, DOE has provided to OIRA an assessment, including the underlying analysis, of benefits and costs anticipated from the 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 can be found in the technical support document for this rulemaking.

DOE has also reviewed this regulation pursuant to Executive Order 13563, issued on January 18, 2011. (76 FR 3281, Jan. 21, 2011) EO 13563 is supplemental to and explicitly reaffirms the principles, structures, and definitions governing regulatory review established in Executive Order 12866. To the extent permitted by law, agencies are required by Executive Order 13563 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 Executive Order 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, OIRA has emphasized that such techniques may include identifying changing future compliance costs that might result from technological innovation or anticipated behavioral changes. For the reasons stated in the preamble, DOE believes that this final rule is consistent with these principles, including the requirement that, to the extent permitted by law, benefits justify costs and that net benefits are maximized.

B. Review Under the Regulatory Flexibility Act

The Regulatory Flexibility Act (5 U.S.C. 601 *et seq.*) requires preparation of 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 Executive Order 13272, ''Proper Consideration of Small Entities in Agency Rulemaking,'' 67 FR 53461 (August 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 Web site (*http://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 pumps, the Small Business Administration (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/sites/default/files/files/Size_Standards_Table.pdf*. Manufacturing of pumps is classified under NAICS 333911, ''Pump and Pumping Equipment Manufacturing.'' The SBA sets a threshold of 500 employees or less for an entity to be considered as a small business for this category.

1. Description on Estimated Number of Small Entities Regulated

To estimate the number of small business manufacturers of equipment covered by this rulemaking, DOE conducted a market survey using available public information to identify potential small manufacturers. DOE's research involved industry trade association membership directories (including HI), industry conference exhibitor lists, individual company and buyer guide Web sites, and market research tools (*e.g.,* Hoovers reports) to create a list of companies that manufacture products covered by this rulemaking. DOE presented its list to manufacturers in MIA interviews and asked industry representatives if they were aware of any other small manufacturers during manufacturer interviews and at DOE public meetings. DOE reviewed publicly-available data and contacted select companies on its list, as necessary, to determine whether they met the SBA's definition of a small business manufacturer of pumps that would be regulated by the adopted standards. DOE screened out companies that do not offer products covered by this rulemaking, do not meet the definition of a ''small business,'' or are foreign-owned and operated.

DOE identified 86 manufacturers of covered pump products sold in the U.S. Thirty-eight of these manufacturers met the 500-employee threshold defined by the SBA to qualify as a small business, but only 25 were domestic companies. DOE notes that manufacturers interviewed stated that there are potentially a large number of small pumps manufacturers that serve small regional markets. These unidentified small manufacturers are not members of HI and typically have a limited marketing presence. The interviewed manufacturers and CIP Working Group participants were not able to name these smaller players, and no commenters to the proposed rule provided information on any other potential small manufacturers.

Two small business manufacturers of pumps responded to DOE's request for an interview prior to publication of the proposed standard. These manufacturers provided extensive data on product availability, product efficiency, and product pricing. This content was critical to the modeling of the industry and was used to estimate impacts on small businesses.

DOE also obtained qualitative information about small business impacts while interviewing large manufacturers. Specifically, DOE discussed with large manufacturers the extent to which new standards might require small businesses to acquire new equipment or cause manufacturing process changes that could destabilize their business. Responses and information provided by small and large manufacturers informed DOE's description and estimate of compliance requirements, which are presented in section VII.B.2.

DOE's final standards reflect the recommendation of the CIP Working Group, which consisted of 16 members, including one small manufacturer. DOE selected the 16 members of the working group after issuing a notice of intent to establish a CIP Working Group (78 FR 44036) and receiving 19 nominations for membership. DOE notes that the three nominated parties who were not selected for the working group did not represent small businesses. Prior to the formation of the CIP Working Group, DOE issued an RFI (76 FR 34192), a Framework Document (78 FR 7304), and held a public meeting on February 20, 2013, to discuss the Framework Document in detail—all of which publicly laid out DOE's efforts to set out standards for pumps. The leading industry trade association, HI, was engaged in each of these stages and helped spread awareness of the rulemaking process to all of its members, which includes both small and large manufacturers.[79]

DOE made key assumptions about the market share and product offerings of small manufacturers in its analysis and requested comment in the NOPR. Specifically, DOE estimated that small manufacturers accounted for approximately 36% of the total industry model offerings. The Department did not receive feedback on this assumption, which was based on product listing data.

2. Description and Estimate of Compliance Requirements

At TSL 2, the level adopted in this document, DOE estimates total conversion costs of $0.8 million for an average small manufacturer, compared to total conversion costs of $1.4 million for an average large manufacturer. DOE notes that it estimates a lower total conversion cost for small manufacturers, because of the previous assumption that small manufacturers offer fewer models than their larger competitors, which means small manufacturers would likely have fewer product models to redesign. DOE's conversion cost estimates were based on industry data collected by HI (see section IV.C.5 for more information on the derivation of industry conversion costs). DOE applied the same per-model product conversion costs for both large and small manufacturers. Table VII.1 below shows the relative impacts of conversion costs on small manufacturers relative to large manufacturers over the four-year conversion period between the announcement year and the effective year of the adopted standard.

TABLE VII.1—IMPACTS OF CONVERSION COSTS ON A MANUFACTURERS AT THE ADOPTED STANDARD

	Capital conversion cost/conversion period CapEx	Product conversion cost/conversion period R&D expense	Total conversion cost/conversion period revenue (%)	Total conversion cost/conversion period EBIT (%)
Average large manufacturer	76	405	8	149
Average small Manufacturer	94	260	6	118

The total conversion costs are approximately 6% of revenue and 118% of earnings before interest and tax (EBIT) for a small manufacturer over the four year conversion period. For large manufacturers, the total conversion costs are approximately 8% of revenue and 149% of EBIT over the conversion period. These initial findings indicate that small manufacturers face conversion costs that are proportionate relative to larger competitors.

However, as noted in section V.B.2.a, the GRIM free cash flow results in 2019 indicated that some manufacturers may need to access the capital markets in order to fund conversion costs directly related to the adopted standard. Given that small manufacturers have a greater difficulty securing outside capital[80] and that the necessary conversion costs are not insignificant to the size of a small business, it is possible the small manufacturers will be forced to retire a greater portion of product models than large competitors. Also, smaller companies often have a higher cost of borrowing due to higher risk on the part of investors, largely attributed to lower cash flows and lower per unit profitability. In these cases, small manufacturers may observe higher costs of debt than larger manufacturers.

Though conversion costs are similar in magnitude for small and large manufacturers, small manufacturers may not have the same resources to make the required conversions. For example, some small pump manufacturers may not have the technical expertise to perform hydraulic redesigns in-house. These small manufacturers would need to hire outside consultants to support their re-design efforts. This could be a disadvantage relative to companies that have internal resources and personnel for the redesign process.

3. Duplication, Overlap, and Conflict With Other Rules and Regulations

DOE is unaware of any rules or regulations that duplicate, overlap, or conflict with the rule being considered today.

4. Significant Alternatives to the Rule

The discussion in the previous section analyzes impacts on small businesses that would result from DOE's proposed rule, TSL 2. In reviewing alternatives to the proposed rule, DOE examined energy conservation standards set at a lower efficiency level. While TSL 1 would reduce the impacts on small business manufacturers, it would come at the expense of a reduction in energy savings. TSL 1 achieves 73 percent lower energy

[79] Though as noted above, some small businesses may not be members of HI, HI membership includes 48 manufacturers of product within the scope of this rulemaking, of which 10 are small domestic manufacturers.

[80] Simon, Ruth, and Angus Loten, ''Small-Business Lending Is Slow to Recover,'' *Wall Street Journal,* August 14, 2014. Accessed August 2014, available at *http://online.wsj.com/articles/small-business-lending-is-slow-to-recover-1408329562.*

savings compared to the energy savings at TSL 2.

DOE believes that establishing standards at TSL 2 balances the benefits of the energy savings at TSL 2 with the potential burdens placed on pumps manufacturers, including small business manufacturers. Accordingly, DOE is declining to adopt one of the other TSLs considered in the analysis, or the other policy alternatives detailed as part of the regulatory impacts analysis included in chapter 17 of the final rule TSD.

Additional compliance flexibilities may be available through other means. For example, individual manufacturers may petition for a waiver of the applicable test procedure (see 10 CFR 431.401). Further, 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. Additionally, Section 504 of the Department of Energy Organization Act, 42 U.S.C. 7194, provides authority for the Secretary to adjust a rule issued under EPCA in order to prevent ''special hardship, inequity, or unfair distribution of burdens'' that may be imposed on that manufacturer as a result of such rule. Manufacturers should refer to 10 CFR part 430, subpart E, and part 1003 for additional details.

C. Review Under the Paperwork Reduction Act

Pump manufacturers must certify to DOE that their products comply with any applicable energy conservation standards as of the compliance date for standards. In certifying compliance, manufacturers must test their products according to the applicable DOE test procedures for pumps that DOE adopts to measure the energy efficiency of this equipment, 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 pumps. *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 for pumps under OMB control number 1910–1400. Public reporting burden for the certification is estimated to average 30 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 (NEPA) of 1969, DOE has determined that the rule fits within the category of actions included in Categorical Exclusion (CX) B5.1 and otherwise meets the requirements for application of a CX. See 10 CFR part 1021, app. B, B5.1(b); § 1021.410(b) and app. B, B(1)-(5). The rule fits within this category of actions because it is a rulemaking that establishes energy conservation standards for consumer products or industrial equipment, and for which none of the exceptions identified in CX B5.1(b) apply. Therefore, DOE has made a CX determination for this rulemaking, and DOE does not need to prepare an Environmental Assessment or Environmental Impact Statement for this rule. DOE's CX determination for this rule is available at *http://energy.gov/nepa/categorical-exclusion-cx-determinations-cx.*

E. Review Under Executive Order 13132

Executive Order 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 Executive Order 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 Executive Order 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 Executive Order 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 Executive Order 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 *http://energy.gov/sites/prod/files/gcprod/documents/umra_97.pdf*.

This final rule does not contain a Federal intergovernmental mandate, nor is it expected to require expenditures of $100 million or more in any one year on the private sector. (Such expenditures may include: (1) Investment in research and development and in capital expenditures by 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 equipment.) As a result, the analytical requirements of UMRA do not apply.

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 Executive Order 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

Pursuant to Executive Order 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.

K. Review Under Executive Order 13211

Executive Order 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 energy conservation standards for pumps, 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. Review Under the Information Quality Bulletin for Peer Review

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.'' Id at FR 2667.

In response to OMB's Bulletin, DOE conducted formal in-progress peer reviews of the energy conservation standards development process and analyses and has prepared a Peer Review Report pertaining to the energy conservation standards rulemaking analyses. 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. The ''Energy Conservation Standards Rulemaking Peer Review Report'' dated February 2007 has been disseminated and is available at the following Web site: *www1.eere.energy.gov/buildings/appliance_standards/peer_review.html*.

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).

VIII. 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, Imports, Intergovernmental relations, Small businesses.

10 CFR Part 431

Administrative practice and procedure, Confidential business information, Energy conservation, Imports, Intergovernmental relations, Small businesses.

Issued in Washington, DC, on December 31, 2015.

David T. Danielson,

Assistant Secretary, Energy Efficiency and Renewable Energy.

For the reasons set forth in the preamble, DOE amends parts 429 and 431 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.

■ 2. Section 429.12 is amended by revising paragraphs (b)(13) and (d) to read as follows:

§ 429.12 General requirements applicable to certification reports.

* * * * *

(b) * * *

(13) Product specific information listed in §§ 429.14 through 429.60 of this chapter.

* * * * *

(d) *Annual filing.* All data required by paragraphs (a) through (c) of this section shall be submitted to DOE annually, on or before the following dates:

Product category	Deadline for data submission
Fluorescent lamp ballasts, Medium base compact fluorescent lamps, Incandescent reflector lamps, General service fluorescent lamps, General service incandescent lamps, Intermediate base incandescent lamps, Candelabra base incandescent lamps, Residential ceiling fans, Residential ceiling fan light kits, Residential showerheads, Residential faucets, Residential water closets, and Residential urinals.	Mar. 1.
Residential water heater, Residential furnaces, Residential boilers, Residential pool heaters, Commercial water heaters, Commercial hot water supply boilers, Commercial unfired hot water storage tanks, Commercial packaged boilers, Commercial warm air furnaces, Commercial unit heaters and Residential furnace fans.	May 1.
Residential dishwashers, Commercial prerinse spray valves, Illuminated exit signs, Traffic signal modules, Pedestrian modules, and Distribution transformers.	June 1.
Room air conditioners, Residential central air conditioners, Residential central heat pumps, Small duct high velocity system, Space constrained products, Commercial package air-conditioning and heating equipment, Packaged terminal air conditioners, Packaged terminal heat pumps, and Single package vertical units.	July 1.
Residential refrigerators, Residential refrigerators-freezers, Residential freezers, Commercial refrigerator, freezer, and refrigerator-freezer, Automatic commercial automatic ice makers, Refrigerated bottled or canned beverage vending machine, Walk-in coolers, and Walk-in freezers.	Aug. 1.
Torchieres, Residential dehumidifiers, Metal halide lamp fixtures, External power supplies, and Pumps	Sept. 1.
Residential clothes washers, Residential clothes dryers, Residential direct heating equipment, Residential cooking products, and Commercial clothes washers.	Oct. 1.

* * * * *

■ 3. Section 429.59 is amended by adding paragraphs (b) and (c) to read as follows:

§ 429.59 Pumps.

* * * * *

(b) *Certification reports.* (1) The requirements of § 429.12 are applicable to pumps; and

(2) Pursuant to § 429.12(b)(13), a certification report must include the following public product-specific information:

(i) For a pump subject to the test methods prescribed in section III of appendix A to subpart Y of part 431 of this chapter: PEI_{CL}; pump total head in feet (ft.) at BEP and nominal speed; volume per unit time (flow rate) in gallons per minute (gpm) at BEP and nominal speed; the nominal speed of rotation in revolutions per minute (rpm); calculated driver power input at each load point *i* (P^{in}_i), corrected to nominal speed, in horsepower (hp); full impeller diameter in inches (in.); and for RSV and ST pumps, the number of stages tested.

(ii) For a pump subject to the test methods prescribed in section IV or V of appendix A to subpart Y of part 431 of this chapter: PEI_{CL}; pump total head in feet (ft.) at BEP and nominal speed; volume per unit time (flow rate) in gallons per minute (gpm) at BEP and nominal speed; the nominal speed of rotation in revolutions per minute (rpm); driver power input at each load point *i* (P^{in}_i), corrected to nominal speed, in horsepower (hp); full impeller diameter in inches (in.); whether the PEI_{CL} is calculated or tested; and for RSV and ST pumps, number of stages tested.

(iii) For a pump subject to the test methods prescribed in section VI or VII of appendix A to subpart Y of part 431 of this chapter: PEI_{VL}; pump total head in feet (ft.) at BEP and nominal speed; volume per unit time (flow rate) in gallons per minute (gpm) at BEP and nominal speed; the nominal speed of rotation in revolutions per minute (rpm); driver power input (measured as the input power to the driver and controls) at each load point *i* (P^{in}_i), corrected to nominal speed, in horsepower (hp); full impeller diameter in inches (in.); whether the PEI_{VL} is calculated or tested; and for RSV and ST pumps, the number of stages tested.

(3) Pursuant to § 429.12(b)(13), a certification report may include the following public product-specific information:

(i) For a pump subject to the test methods prescribed in section III of appendix A to subpart Y of part 431 of this chapter: Pump efficiency at BEP in percent (%) and PER_{CL}.

(ii) For a pump subject to the test methods prescribed in section IV or V of appendix A to subpart Y of part 431 of this chapter: Pump efficiency at BEP in percent (%) and PER_{CL}.

(iii) For a pump subject to the test methods prescribed in section VI or VII of appendix A to subpart Y of part 431 of this chapter: Pump efficiency at BEP in percent (%) and PER_{VL}.

(4) Pursuant to § 429.12(b)(13), a certification report will include the following product-specific information:

(i) For a pump subject to the test methods prescribed in section III of appendix A to subpart Y of part 431 of this chapter: The pump configuration (*i.e.,* bare pump); and for ST pumps, the bowl diameter in inches (in.).

(ii) For a pump subject to the test methods prescribed in section IV or V of appendix A to subpart Y of part 431 of this chapter: The pump configuration (*i.e.,* pump sold with an electric motor); for pumps sold with electric motors regulated by DOE's energy conservation standards for electric motors at § 431.25, the nominal motor efficiency in percent (%) and the motor horsepower (hp) for the motor with which the pump is being rated; and for ST pumps, the bowl diameter in inches (in.).

(iii) For a pump subject to the test methods prescribed in section VI or VII of appendix A to subpart Y of part 431 of this chapter: The pump configuration (*i.e.,* pump sold with a motor and continuous or non-continuous controls); for pumps sold with electric motors regulated by DOE's energy conservation standards for electric motors at § 431.25, the nominal motor efficiency in percent (%) and the motor horsepower (hp) for the motor with which the pump is being rated; and for ST pumps, the bowl diameter in inches (in.).

(c) *Individual model numbers.* (1) Each individual model number required to be reported pursuant to § 429.12(b)(6) must consist of the following:

Equipment configuration (as distributed in commerce)	Basic model number	Individual model number(s)		
		1	2	3
Bare pump	Number unique to the basic model	Bare Pump	N/A	N/A.
Bare pump with driver	Number unique to the basic model	Bare Pump	Driver	N/A.
Bare pump with driver and controls	Number unique to the basic model	Bare Pump	Driver	Controls.

(2) Or must otherwise provide sufficient information to identify the specific driver model and/or controls model(s) with which a bare pump is distributed.

PART 431—ENERGY EFFICIENCY PROGRAM FOR CERTAIN COMMERCIAL AND INDUSTRIAL EQUIPMENT

■ 4. The authority citation for part 431 continues to read as follows:

Authority: 42 U.S.C. 6291–6317.

■ 5. Section 431.465 is added to read as follows:

§ 431.465 Pumps energy conservation standards and their compliance dates.

(a) For the purposes of paragraph (b) of this section, ''PEI_{CL}'' means the constant load pump energy index and ''PEI_{VL}'' means the variable load pump energy index, both as determined in accordance with the test procedure in § 431.464. For the purposes of paragraph (c) of this section, ''BEP'' means the best efficiency point as determined in accordance with the test procedure in § 431.464.

(b) Each pump that is manufactured starting on January 27, 2020 and that:

(1) Is in one of the equipment classes listed in the table in paragraph (b)(4) of this section;

(2) Meets the definition of a clean water pump in § 431.462;

(3) Is not listed in paragraph (c) of this section; and

(4) Conforms to the characteristics listed in paragraph (d) of this section must have a PEI_{CL} or PEI_{VL} rating of not more than 1.00 using the appropriate C-value in the table in this paragraph (b)(4):

Equipment class [1]	Maximum PEI [2]	C-value [3]
ESCC.1800.CL	1.00	128.47
ESCC.3600.CL	1.00	130.42
ESCC.1800.VL	1.00	128.47
ESCC.3600.VL	1.00	130.42
ESFM.1800.CL	1.00	128.85
ESFM.3600.CL	1.00	130.99
ESFM.1800.VL	1.00	128.85
ESFM.3600.VL	1.00	130.99
IL.1800.CL	1.00	129.30
IL.3600.CL	1.00	133.84
IL.1800.VL	1.00	129.30
IL.3600.VL	1.00	133.84
RSV.1800.CL	1.00	129.63
RSV.3600.CL	1.00	133.20
RSV.1800.VL	1.00	129.63
RSV.3600.VL	1.00	133.20
ST.1800.CL	1.00	138.78
ST.3600.CL	1.00	134.85
ST.1800.VL	1.00	138.78
ST.3600.VL	1.00	134.85

[1] Equipment class designations consist of a combination (in sequential order separated by periods) of: (1) An equipment family (ESCC = end suction close-coupled, ESFM = end suction frame mounted/own bearing, IL = in-line, RSV = radially split, multi-stage, vertical, in-line diffuser casing, ST = submersible turbine; all as defined in § 431.462); (2) nominal speed of rotation (1800 = 1800 rpm, 3600 = 3600 rpm); and (3) an operating mode (CL = constant load, VL = variable load). Determination of the operating mode is determined using the test procedure in appendix A to this subpart.

[2] For equipment classes ending in .CL, the relevant PEI is PEI_{CL}. For equipment classes ending in .VL, the relevant PEI is PEI_{VL}.

[3] The C-values shown in this table must be used in the equation for PER_{STD} when calculating PEI_{CL} or PEI_{VL}, as described in section II.B of appendix A to this subpart.

(c) The energy efficiency standards in paragraph (b) of this section do not apply to the following pumps:

(1) Fire pumps;

(2) Self-priming pumps;

(3) Prime-assist pumps;

(4) Magnet driven pumps;

(5) Pumps designed to be used in a nuclear facility subject to 10 CFR part 50, ''Domestic Licensing of Production and Utilization Facilities'';

(6) Pumps meeting the design and construction requirements set forth in Military Specification MIL–P–17639F, ''Pumps, Centrifugal, Miscellaneous Service, Naval Shipboard Use'' (as amended); MIL–P–17881D, ''Pumps,

Centrifugal, Boiler Feed, (Multi-Stage)'' (as amended); MIL–P–17840C, ''Pumps, Centrifugal, Close-Coupled, Navy Standard (For Surface Ship Application)'' (as amended); MIL–P–18682D, ''Pump, Centrifugal, Main Condenser Circulating, Naval Shipboard'' (as amended); MIL–P–18472G, ''Pumps, Centrifugal, Condensate, Feed Booster, Waste Heat Boiler, And Distilling Plant'' (as amended). Military specifications and standards are available for review at *http://everyspec.com/MIL-SPECS*.

(d) The energy conservation standards in paragraph (b) of this section apply only to pumps that have the following characteristics:

(1) Flow rate of 25 gpm or greater at BEP at full impeller diameter;

(2) Maximum head of 459 feet at BEP at full impeller diameter and the number of stages required for testing;

(3) Design temperature range from 14 to 248 °F;

(4) Designed to operate with either:

(i) A 2- or 4-pole induction motor; or

(ii) A non-induction motor with a speed of rotation operating range that includes speeds of rotation between 2,880 and 4,320 revolutions per minute and/or 1,440 and 2,160 revolutions per minute; and

(iii) In either case, the driver and impeller must rotate at the same speed;

(5) For ST pumps, a 6-inch or smaller bowl diameter; and

(6) For ESCC and ESFM pumps, specific speed less than or equal to 5,000 when calculated using U.S. customary units.

■ 6. Section 431.466 is added to read as follows:

§ 431.466 Pumps labeling requirements.

(a) *Pump nameplate*—(1) *Required information.* The permanent nameplate of a pump for which standards are prescribed in § 431.465 must be marked clearly with the following information:

(i) For bare pumps and pumps sold with electric motors but not continuous or non-continuous controls, the rated pump energy index—constant load (PEI_{CL}), and for pumps sold with motors and continuous or non-continuous controls, the rated pump energy index—variable load (PEI_{VL});

(ii) The bare pump model number; and

(iii) If transferred directly to an end-user, the unit's impeller diameter, as distributed in commerce. Otherwise, a space must be provided for the impeller diameter to be filled in.

(2) *Display of required information.* All orientation, spacing, type sizes, typefaces, and line widths to display this required information must be the same as or similar to the display of the other performance data on the pump's permanent nameplate. The PEI_{CL} or $PEI_{VL,}$ as appropriate to a given pump model, must be identified in the form ''PEI_{CL} ____'' or ''PEI_{VL} ____.'' The model number must be in one of the following forms: ''Model ____'' or ''Model number ____'' or ''Model No. ____.'' The unit's impeller diameter must be in the form ''Imp. Dia. ____ (in.).''

(b) *Disclosure of efficiency information in marketing materials.* (1) The same information that must appear on a pump's permanent nameplate pursuant to paragraph (a)(1) of this section, must also be prominently displayed:

(i) On each page of a catalog that lists the pump; and

(ii) In other materials used to market the pump.

(2) [Reserved]

Note: The following letter will not appear in the Code of Federal Regulations.

U.S. Department of Justice
Antitrust Division
William J. Baer
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(202)514–2401/(202)616–2645 (Fax)

July 10, 2015

Anne Harkavy
Deputy General Counsel for Litigation, Regulation and Enforcement
U.S. Department of Energy
1000 Independence Ave, S.W.
Washington, DC 20585

Dear Deputy General Counsel Harkavy:

I am responding to your April 2, 2015 letters seeking the views of the Attorney General about the potential impact on competition of proposed energy conservation standards for pumps and a test procedure to be utilized in connection with the new standards.

Your request relating to the proposed energy conservation standards 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), 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. Your request relating to the test procedure was submitted under Section 32(c) of the Federal Energy Administration Act of 1974, as amended by the Federal Energy Administration Authorization Act of 1977, and codified at 15 U.S.C. 788(c), which requires DOE to consult with the Attorney General concerning the impact of proposed test procedures on competition. 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).

In conducting its analysis, the Antitrust Division examines whether a proposed standard or test procedure 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 energy conservation standards contained in the Notice of Proposed Rulemaking (80 Fed. Reg. 17825, April 2, 2015) and the related Technical Support Document as well as the proposed test procedure contained in the Notice of Proposed Rulemaking (80 Fed. Reg. 17585, April 1, 2015). We have also interviewed industry participants, reviewed information provided by industry participants, and attended the public meetings held on the proposed standards and test procedure on April 29, 2015. We further reviewed additional information provided by the Department of Energy.

Based on our review, we do not have sufficient information to conclude that the proposed energy conservation standards or test procedure likely will substantially lessen competition in any particular product or geographic market. However, the possibility exists that the proposed energy conservation standards and test procedure—which will apply to a broad range of pumps—may result in anticompetitive effects in certain pump markets. As explained below, the standards and test procedure could cause some manufacturers to halt production, reduce the number of manufacturers of pumps covered by the new standards, and deter companies who do not currently manufacture pumps covered by the new standards from entering the market.

Regarding the proposed standards, by design, the bottom quartile of pumps in each class of covered pumps will not meet the new standards. The non-compliance of the bottom quartile of pump models may result in some manufacturers stopping production of pumps altogether and fewer firms producing models that comply with the new standards. At this point, it is not possible to determine the impact on any particular product or geographic market.

As for the proposed test procedure, we are concerned about the possibility of anticompetitive effects resulting from the burden and expense of compliance. The Department of Energy has estimated it will cost manufacturers as much as $277,000 to construct a facility capable of performing the test procedure for all covered classes of pumps. Some industry participants have estimated that their actual costs of building such a facility will be significantly higher, largely due to the test procedure's requirements related to data collection and power supply characteristics.

The Department of Energy has suggested that manufacturers can test their pumps at third-party facilities at lower expense rather than constructing their own facilities. However, pump manufacturers are concerned that third-party facilities do not currently meet the proposed test procedure requirements, and they question whether, when, and how many third-party facilities will meet the requirements. It is also uncertain whether third-party facilities that meet the test procedure requirements will test all—or only some—of the pumps covered by the proposed standards. Thus, the proposed test procedure could cause a significant number of manufacturers of covered pumps to exit the business or stop producing certain models of pumps and deter companies who do not currently manufacture pumps covered by the proposed standards from making such pumps. At this point, we cannot determine whether pump manufacturers can expect vigorous competition, and affordable prices, for third-party testing services.

By the time the proposed test procedure is required, manufacturers may be able to test at least some pumps covered by the proposed standards at third-party facilities. Additionally, the Department of Energy stated at the April 29, 2015 public meetings that it may reconsider certain requirements of the proposed test procedure to ease the burden on pump manufacturers who choose to test their products themselves. If the burden and expense of constructing a facility capable of performing the test procedure was reduced by changing the requirements related to data collection and power supply characteristics, or if using third-party test facilities proved to be a feasible alternative, our concerns would be lessened.

We ask that the Department of Energy take these concerns into account in determining its final energy conservation standards and test procedure.

Sincerely,

William J. Baer

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