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Part II

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10 CFR Parts 429 and 431
Energy Conservation Program: Energy Conservation Standards for Pumps; Proposed Rules

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: Notice of proposed rulemaking (NOPR) and public meeting.

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, which for editorial reasons was re-designated as Part A–1 upon incorporation into the U.S. Code, establishes the ''Energy Conservation Program for Certain Industrial Equipment.'' The covered equipment includes pumps. In this document, DOE proposes to establish new energy conservation standards for pumps and announces a public meeting to receive comment on these proposed standards and associated analyses and results.

DATES:

Meeting: DOE will hold a public meeting on Wednesday, April 29, 2015, from 2 p.m. to 5 p.m., in Washington, DC. The meeting will also be broadcast as a webinar. See section VIII Public Participation for webinar registration information, participant instructions, and information about the capabilities available to webinar participants.

Comments: DOE will accept comments, data, and information regarding this notice of proposed rulemaking (NOPR) before and after the public meeting, but no later than June 1, 2015. See section VIII Public Participation for details.

ADDRESSES: The public meeting will be held at the U.S. Department of Energy, Forrestal Building, Room 8E–089, 1000 Independence Avenue SW., Washington, DC 20585. To attend, please notify Ms. Brenda Edwards at (202) 586–2945. Persons can attend the public meeting via webinar. For more information, refer to the Public Participation section near the end of this NOPR.

Any comments submitted must identify the NOPR for Energy Conservation Standards for pumps, and provide docket number EE–2011–BT–STD–0031 and/or regulatory information number (RIN) number 1904–AC54. Comments may be submitted using any of the following methods:

1. *Federal eRulemaking Portal: www.regulations.gov.* Follow the instructions for submitting comments.
2. *Email: Pumps2011STD0031@ee.doe.gov* . Include the docket number and/or RIN in the subject line of the message.
3. *Mail:* Ms. Brenda Edwards, U.S. Department of Energy, Building Technologies Program, Mailstop EE–2J, 1000 Independence Avenue SW., Washington, DC, 20585–0121. If possible, please submit all items on a CD. It is not necessary to include printed copies.
4. *Hand Delivery/Courier:* Ms. Brenda Edwards, U.S. Department of Energy, Building Technologies Program, 950 L'Enfant Plaza SW., Suite 600, Washington, DC, 20024. Telephone: (202) 586–2945. If possible, please submit all items on a CD, in which case it is not necessary to include printed copies.

Written comments regarding the burden-hour estimates or other aspects of the collection-of-information requirements contained in this proposed rule may be submitted to Office of Energy Efficiency and Renewable Energy through the methods listed above and by email to *Chad_S_Whiteman@omb.eop.gov.*

For detailed instructions on submitting comments and additional information on the rulemaking process, see section VIII of this document (Public Participation).

Docket: The docket, which includes **Federal Register** notices, public meeting attendee lists and transcripts, comments, and other supporting documents/materials, is available for review at regulations.gov. All documents in the docket are listed in the 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.* This Web page will contain a link to the docket for this NOPR on the regulations.gov site. The regulations.gov Web page will contain simple instructions on how to access all documents, including public comments, in the docket. See section VIII for further information on how to submit comments through *www.regulations.gov.*

For further information on how to submit a comment, review other public comments and the docket, or participate in the public meeting, contact Ms. Brenda Edwards at (202) 586–2945 or by email: *Brenda.Edwards@ee.doe.gov.*

FOR FURTHER INFORMATION CONTACT: John Cymbalsky, U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, Building Technologies Program, EE–5B, 1000 Independence Avenue SW., Washington, DC, 20585–0121. Telephone: (202) 287–1692. Email: *pumps@ee.doe.gov.*

Elizabeth Kohl, U.S. Department of Energy, Office of the General Counsel, GC–33, 1000 Independence Avenue SW., Washington, DC, 20585–0121. Telephone: (202) 586–9507. Email: *Elizabeth.Kohl@hq.doe.gov.*

SUPPLEMENTARY INFORMATION:

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I. Summary of the Proposed Rule

The proposed standards for pumps (collectively, ''pumps'') set forth in today's rule 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. 2; 5 U.S.C. 561–570, Pub. L. 104–320.) 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.

DOE's proposed standards, which are consistent with the working group recommendations, are shown in Table I.1 and consist of pump energy index (PEI) values. Under the proposed standards, a pump model would be compliant if its PEI rating is less than or equal to the proposed 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).

The minimally compliant PER is unique to each pump model and is a function of specific speed (a dimensionless index describing the geometry of the pump) and each pump model's flow at best efficiency point (BEP), as well as 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 proposed 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 proposed by DOE in Table I.1 correspond to the lower 25th percentile of efficiency for End Suction Close-Coupled (ESCC), End Suction Frame Mounted/Own Bearings (ESFM), In-line (IL), and Vertical Turbine Submersible (VTS) equipment classes. The C-values for the radially split, multi-stage, vertical, in-line, diffuser casing (RSV) equipment class were targeted to harmonize with the standards recently enacted in the European Union,[1] as 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.[2] Section III.D describes the PEI metric in further detail.

These proposed standards, if adopted, would apply to all equipment listed in Table I.1 and manufactured in, or imported into, the United States on or after the date four years after the publication of any final rule for this rulemaking.

TABLE I.1—PROPOSED ENERGY CONSERVATION STANDARDS FOR PUMPS

Equipment class *	Proposed standard level ** (PEI)	Efficiency percentile	Proposed 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	25	134.13
VTS.3600.CL	1.00	25	134.13
VTS.1800.VL	1.00	25	134.13
VTS.3600.VL	1.00	25	134.13

* 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, IL = inline, RSV = radially split, multi-stage, vertical, in-line, diffuser casing, VTS = vertical turbine submersible); (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 NOPR 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 proposed 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.

A. Benefits and Costs to Consumers

Table I.2 presents DOE's evaluation of the economic impacts of the proposed standards on consumers of pumps, as measured by the average life-cycle cost (LCC) savings and the simple payback period (PBP).[3] The average LCC savings are positive for all equipment classes for which consumers would be impacted by the proposed standards[4] 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 PROPOSED ENERGY CONSERVATION STANDARDS ON CONSUMERS OF PUMPS

Equipment class	Average LCC savings (2013$)	Simple payback period (years)
ESCC.1800	$164	2.2
ESCC.3600	92	1.0
ESFM.1800	173	2.8
ESFM.3600	547	0.8

[1] 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.

[2] 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.

[3] The average LCC savings are measured relative to the base-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).

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

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

Equipment class	Average LCC savings (2013$)	Simple payback period (years)
IL.1800	149	2.8
IL.3600	139	1.9
RSV.1800	N/A	N/A
RSV.3600	N/A	N/A
VTS.1800	N/A	N/A
VTS.3600	7.2	4.2

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 proposing identical standards for both CL and VL equipment classes. Economic results are not presented for RSV classes because the proposed standard is at the baseline. For the VTS.1800 class, which has a small market share, DOE [did not conduct a separate analysis for this class and is instead proposing to adopt the same levels as for the VTS.3600 class.

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 of the manufacturer impacts analysis through the end of the analysis period (2015 to 2049). Using a real discount rate of 11.8 percent,[5] DOE estimates that INPV for manufacturers of pumps is $121.4 million in 2013$ for the base case. Under the proposed standards, DOE expects that INPV will change by −32.5 percent to 6.9 percent. Industry conversion costs total $78.4 million.

C. National Benefits[6]

DOE's analyses indicate that the proposed standards would save a significant amount of energy. The lifetime savings for pumps purchased in the 30-year period that begins in the first full year of compliance[7] with new standards (2020–2049) amount to 0.28 quadrillion Btu (quads).[8] This is a savings of one percent relative to the energy use of this equipment in the base case without new standards.

The cumulative net present value (NPV) of total consumer costs and savings of the proposed standards for pumps ranges from $0.41 billion (at a 7-percent discount rate) to $1.11 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 equipment purchased in 2020–2049.

In addition, the proposed standards would have significant environmental benefits. The energy savings would result in cumulative emission reductions of 16 million metric tons (Mt)[9] of carbon dioxide (CO_2), 77 thousand tons of methane (CH_4), 13 thousand tons of sulfur dioxide (SO_2), 25 thousand tons of nitrogen oxides (NO_X), 0.23 thousand tons of nitrous oxide (N_2O), and 0.04 tons of mercury (Hg).[10] The cumulative reduction in CO_2 emissions through 2030 amounts to 2.5 Mt, which is equivalent to the emissions associated with the annual electricity use of 0.36 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.[11] The derivation of the SCC values is discussed in section IV.L. Using discount rates appropriate for each set of SCC values, DOE estimates the present monetary value of the CO_2 emissions reduction is between $0.11 billion and $1.6 billion. DOE also estimates the present monetary value of the NO_X emissions reduction, is $13 million at a 7-percent discount rate and $30 million at a 3-percent discount rate.[12]

Table 1.3 summarizes the national economic costs and benefits expected to result from the proposed standards for pumps.

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

Category	Present value (billion 2013$)	Discount rate (%)
Benefits		
Operating Cost Savings	0.6	7
	1.4	3
CO_2 Reduction Monetized Value ($12.0/t case) **	0.1	5
CO_2 Reduction Monetized Value ($40.5/t case) **	0.5	3
CO_2 Reduction Monetized Value ($62.4/t case) **	0.8	2.5
CO_2 Reduction Monetized Value ($119/t case) **	1.6	3

[5] 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.

[6] All monetary values in this section are expressed in 2013 dollars and are discounted to 2015.

[7] In this case, the compliance date of any final standards is estimated to be very late 2019, so the analysis period begins in 2020.

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

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

[10] DOE calculated emissions reductions relative to the *Annual Energy Outlook 2014* (*AEO 2014*) Reference case, which generally represents current legislation and environmental regulations for which implementing regulations were available as of October 31, 2013.

[11] *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 November 2013. *http://www.whitehouse.gov/sites/default/files/omb/assets/inforeg/technical-update-social-cost-of-carbon-for-regulator-impact-analysis.pdf.*

[12] DOE is currently investigating valuation of avoided Hg and SO_2 emissions.

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

Category	Present value (billion 2013$)	Discount rate (%)
NO_X Reduction Monetized Value (at $2,684/ton) **	0.01 0.03	7 3
Total Benefits †	1.1 1.9	7 3
Costs		
Incremental Installed Costs	0.2 0.3	7 3
Total Net Benefits		
Including Emissions Reduction Monetized Value †	0.9 1.6	7 3

* This table presents the costs and benefits associated with pumps shipped in 2020–2049. These results include benefits to consumers accruing after 2049 from equipment purchased in 2020–2049. The results account for the incremental variable and fixed costs incurred by manufacturers from 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 2013$, 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.

† Total Benefits for both the 3% and 7% cases are derived using the series corresponding to average SCC with 3-percent discount rate ($40.5/t case).

The benefits and costs of today's proposed standards, for equipment sold in 2020–2049, can also be expressed in terms of annualized values. The annualized monetary values are the sum of (1) the annualized national economic value of the benefits from consumer operation of equipment that meets the new or amended standards (consisting primarily of operating cost savings from using less energy, minus increases in equipment purchase and installation costs, which is another way of representing consumer NPV), and (2) the annualized monetary value of the benefits of emission reductions, including CO_2 emission reductions.[13]

Although combining the values of operating savings and CO_2 emission 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, 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 is measured for the lifetime of pumps shipped in 2020–2049. The SCC values, on the other hand, reflect the present value of some future climate-related impacts resulting from the emission of one ton of carbon dioxide in each year. These impacts continue well beyond 2100.

Estimates of annualized benefits and costs of the proposed 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 average SCC series that has a value of $40.5/t in 2015, the cost of the standards proposed in today's rule is $16.9 million per year in increased equipment costs, while the benefits are $60 million per year in reduced equipment operating costs, $29 million in CO_2 reductions, and $1.3 million in reduced NO_X emissions. In this case, the net benefit amounts to $73 million per year. Using a 3-percent discount rate for all benefits and costs and the average SCC series that has a value of $40.5/t in 2015, the cost of the standards proposed in today's rule is $17.5 million per year in increased equipment costs, while the benefits are $81 million per year in reduced operating costs, $29 million in CO_2 reductions, and $1.7 million in reduced NO_X emissions. In this case, the net benefit amounts to $94 million per year.

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

	Discount rate	Million 2013$/year		
		Primary estimate *	Low net benefits estimate *	High net benefits estimate *
Benefits				
Operating Cost Savings	7%	60	54	67.
	3%	81	72	93.
CO_2 Reduction Monetized Value ($12.0/t case) *	5%	8	8	9.

[13] 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 customer 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.

TABLE I.4—ANNUALIZED BENEFITS AND COSTS OF PROPOSED ENERGY CONSERVATION STANDARDS FOR PUMPS—Continued

	Discount rate	Million 2013$/year		
		Primary estimate *	Low net benefits estimate *	High net benefits estimate *
CO_2 Reduction Monetized Value ($40.5/t case) *	3%	29	27	31.
CO_2 Reduction Monetized Value ($62.4/t case) *	2.5%	42	39	46.
CO_2 Reduction Monetized Value ($119/t case) *	3%	89	83	97.
NO_X Reduction Monetized Value (at $2,684/ton) **	7%	1.3	1.3	1.4.
	3%	1.7	1.6	1.9.
Total Benefits †	7% plus CO_2 range	69 to 150	63 to 138	78 to 166.
	7%	90	82	100.
	3% plus CO_2 range	91 to 172	81 to 156	104 to 192.
	3%	112	100	126.
Costs				
Consumer Incremental Equipment Costs	7%	16.9	18.6	17.2.
	3%	17.5	19.5	17.7.
Net Benefits				
Total †	7% plus CO_2 range	53 to 133	44 to 119	61 to 148.
	7%	73	63	83.
	3% plus CO_2 range	74 to 155	62 to 136	86 to 174.
	3%	94	80	108.

* 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 products purchased in 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 from the *AEO 2014* Reference case, Low Estimate, and High Estimate, respectively. In addition, incremental equipment costs reflect a constant rate in the Primary Estimate, an increase rate in the Low Benefits Estimate, and a decline rate in the High Benefits Estimate. The methods used to derive projected price trends are explained in section IV.F.2.a.

** The CO_2 values represent global monetized values of the SCC, in 2013$, 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.

† Total Benefits for both the 3% and 7% cases are derived using the series corresponding to the average SCC with 3-percent discount rate ($40.5/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 has tentatively concluded that the proposed standards represent the maximum improvement in energy efficiency that is technologically feasible and economically justified, and would result in the significant conservation of energy. DOE further notes that equipment achieving these standard levels is already commercially available for all equipment classes covered by today's proposal. Based on the analyses described above, DOE has tentatively concluded that the benefits of the proposed standards to the nation (energy savings, positive NPV of consumer benefits, consumer LCC savings, and emission reductions) would outweigh the burdens (loss of INPV for manufacturers and LCC increases for some consumers).

DOE also considered higher and lower energy efficiency levels as trial standard levels, and is still considering them in this rulemaking. However, DOE has tentatively concluded that the potential burdens of these energy efficiency levels would outweigh the projected benefits. Based on consideration of the public comments DOE receives in response to this notice and related information collected and analyzed during the course of this rulemaking, DOE may adopt energy efficiency levels presented in this notice that are either higher or lower than the proposed standards, or some combination of level(s) that incorporate the proposed standards in part.

II. Introduction

The following section briefly discusses the statutory authority underlying today's proposal, 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. 6311–6317, as codified), establishes the ''Energy Conservation Program for Certain Industrial Equipment.'' The covered equipment includes pumps, the subject of today's notice. (42 U.S.C. 6311(1)(A).)[14] There are currently no energy conservation standards for pumps.

Pursuant to EPCA, any new or amended energy conservation standard must be designed to achieve the maximum improvement in energy efficiency that is technologically feasible and economically justified. (42 U.S.C. 6295(o)(2)(A) and 6316(a).) Furthermore, the new or amended standard must result in a significant conservation of energy. (42 U.S.C. 6295(o)(3)(B) and 6316(a).)

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

[14] All references to EPCA in this document refer to the statute as amended through the American Energy Manufacturing Technical Corrections Act of 2012, Public Law 112–210 (Dec. 18, 2012).

estimated annual operating cost of each covered product. (42 U.S.C. 6314.) Manufacturers of covered equipment must use the prescribed DOE test procedure as the basis for certifying to DOE that their equipment comply with the applicable energy conservation standards adopted under EPCA and when making representations to the public regarding the energy use or efficiency of those products. (42 U.S.C. 6314(d).) Similarly, DOE must use these test procedures to determine whether the products comply with standards adopted pursuant to EPCA. *Id.* DOE has proposed a test procedure for pumps through a separate rulemaking. Any final test procedures would appear at title 10 of the Code of Federal Regulations (CFR) part 431.

When setting standards for the equipment addressed by today's notice, EPCA prescribes specific statutory criteria for DOE to consider. See generally 42 U.S.C. 6313(a)(6)(A)–(C), 6295(o), and 6316(a). As indicated previously, any new or amended standard for covered equipment must be designed to achieve the maximum improvement in energy efficiency that is technologically feasible and economically justified. Furthermore, DOE may not adopt any standard that would not result in the significant conservation of energy. Moreover, DOE may not prescribe a standard: (1) For certain equipment, including pumps, if no test procedure has been established for the equipment, or (2) if DOE determines by rule that the proposed standard is not technologically feasible or economically justified. 42 U.S.C. 6295(o); 6316(a). In considering 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 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 equipment 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 imposition of the standard;

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

4. Any lessening of the utility or the performance of the covered equipment likely to result from the imposition of 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 imposition of 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) through (VII) and 6316(a).)

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 of any covered product- or equipment-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).)

There is a rebuttable presumption that a standard is economically justified if the Secretary finds that the additional cost to the consumer of purchasing equipment 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).)

Additionally, EPCA specifies requirements when promulgating a standard for a type or class of covered equipment that has two or more subcategories. DOE must specify a different standard level than that which applies generally to such type or class of equipment for any group of covered equipment that have 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 the feature and other factors DOE deems appropriate. 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) through (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

DOE does not currently have a test procedure or 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 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 notice 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.

These comments are discussed in subsequent sections of this notice.

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. 2; 5 U.S.C. 561–570, Pub. L. 104–320.) 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 1 member from the ASRAC and 1 DOE representative. (See Table II.1) The working group met in-person during 7 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 today's NOPR, 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 proposed energy conservation standards.

C. Relevant Industry Sectors

The energy conservation standards proposed in this NOPR 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 proposed rule, with 56 of those being domestic manufacturers. The leading U.S. industry association for the pumps covered under this proposed rule is the Hydraulic Institute (HI).

III. General Discussion

In developing this NOPR, DOE reviewed the recommendations in the term sheet produced by the CIP Working Group, as well as the 13 comments it received in response to the February 2013 Framework Document. Commenters included: Engineered Software, Inc.; Richard Shaw; Grundfos Pumps Corporation; the Hydraulic Institute (HI); Pacific Gas and Electric Company, San Diego Gas and Electric, Southern California Gas Company, and Southern California Edison (the preceding four commenters hereafter referred to collectively as the CA IOUs); National Fire Protection Association (NFPA); Air-Conditioning, Heating, and Refrigeration Institute (AHRI); Colombia Engineering; Earthjustice; Edison Electric Institute (EEI); The Appliance Standards Awareness Project (ASAP), Alliance to Save Energy (ASE), American Council for an Energy Efficient Economy (ACEEE), Earthjustice, and Natural Resources Defense Council (NRDC) (the preceding five commenters hereafter referred to collectively as the Advocates); and the Northwest Energy Efficiency Alliance and the Northwest Power and Conservation Council (hereafter referred to as NEEA/NPCC). DOE addressed all relevant stakeholder comments and requests throughout this NOPR. DOE notes that comments addressed in this NOPR reflect the views of the stakeholders at the close of the framework comment period in May 2013. DOE recognizes that the working group's ASRAC-approved term sheet may represent views that have progressed since the time of the framework comments. As such, when addressing comments, DOE has noted where stakeholder views have changed.

A. Rulemaking Approach

1. Harmonization

In response to the Framework Document, HI and Grundfos recommended that DOE harmonize its efforts with the approach followed by the European Union (EU). (HI, No. 25 at p. 2; Grundfos, No. 24 at p. 2.) HI noted that harmonizing with the EU provides a logical and consistent path forward for U.S. manufacturers who have international operations and who export equipment from the U.S. to markets worldwide. *Id.* Grundfos also suggested that DOE should harmonize with the EU on specific issues, including: (1) nomenclature and definitions, (2) test procedures, and (3) use of the Minimum Efficiency Index (MEI), including the applicable equation and constants. Grundfos also suggested limiting this initial rulemaking to address 1 potential standards for clean water pumps (as opposed to expanding the scope to include other pump types). *Id.* DOE notes that throughout the course of negotiations, the CIP Working Group members, including HI and Grundfos, made recommendations that in many cases did not completely harmonize with the EU approach. The level of harmonization reflected in this NOPR and the associated test procedure NOPR directly results from these working group recommendations. This is discussed with more specificity in the applicable sections of the preamble.

2. Regulatory Options

In the Framework Document, DOE considered the following options for regulation:

1. Defining and establishing standards for the pump exclusive of the motor (*i.e.,* the bare pump), except possibly for submersible pumps. This option follows the current EU approach for clean water pumps.

2. Defining and establishing standards for the pump inclusive of the motor and controls, if the pump is sold with them. Using this approach, each pump equipment class would be sub-divided into two categories: (1) Without variable-speed drive (VSD) (pump is sold with or without a motor), and (2) with VSD (VSD included only if the pump is sold with a motor).[15]

3. Defining and establishing standards for the pump inclusive of the motor, if the pump is sold with a motor, and considering the VSD as a design option to improve the efficiency of pumps sold with motors. Each pump equipment class could be divided into two further categories: (1) without motor (or VSD), and (2) with motor (with or without VSD). (EERE–2011–BT–0031–0013)

DOE also discussed the metrics it was considering for each option, shown in Table III.1.

TABLE III.1—TENTATIVE METRICS FOR PUMP REGULATORY OPTIONS AS PROPOSED IN FRAMEWORK DOCUMENT

Regulatory option	Equipment class set	Metric
1. Bare Pumps	N/A	Pump efficiency at three points.
2. Pumps inclusive of motor and VSD	Pumps Without VSD (with or without motor)	Pump efficiency at three points.
	Pumps With VSD	Overall efficiency at three points.
3. Pumps inclusive of motor, with VSD as a design option for all pumps sold with motors.	Pumps Without Motor	Pump efficiency at three points.
	Pumps With Motor (with or without VSD)	Potentially based on motor/VSD input power at multiple load points.*

* DOE stated that it may also consider the use of pump efficiency as an additional labeling requirement.

In response, commenters recommended various approaches for dealing with pumps inclusive of the motor and/or controls:

- The Advocates, NEEA/NPCC, and the CA IOUs recommended a modified regulatory option 3, in which pumps sold with motors below a certain horsepower (hp) limit might be required to be sold with VSDs. (Advocates, No. 32 at pp. 5–6; NEEA/NPVCC, No. 33 at p. 2; CA IOUs, No. 26 at p. 3.) The CA IOUs did not see the value in having an equipment class just for pump+motor+VSD (as in regulatory option 2). (CA IOUs, No. 26 at p. 3.)
- HI and Grundfos both supported an approach where the pump would be regulated inclusive of the motor and controls, which would, in their view, be likely to achieve significantly greater savings than an approach based only on the bare pump. (Grundfos, No. 24 at p. 1; HI, No. 25 at p. 2.) HI believes that a large majority of systems can benefit from VSDs. (HI, No. 25 at p. 28.) HI and Grundfos agreed that system feedback control is necessary in this approach. (Grundfos, No. 24 at p. 9; HI, No. 25 at p. 27.) Specifically, HI and Grundfos proposed a two-prong approach: that all pumps be required to meet the MEI (Minimum Efficiency Index, based on the metric of pump efficiency), while pumps sold with motors and VSDs would also have another electric input power-based metric as a label or standard. (HI, No. 25 at p. 2; Grundfos, No. 24 at p.10.) The HI and Grundfos (European) approaches are similar but not identical.
- EEI stated that analyzing energy (and setting standards) on the basis of pumps including their motors is the preferred approach, although EEI was not opposed to establishing pump standards based on 'pump only' performance characteristics. EEI did not support establishing standards based on pump performance with a VSD controller, as pumps are used in a variety of applications and not all are a good fit with VSDs. EEI also noted that it was unaware of any other DOE rulemaking where an optional, external component has been proposed as part of the test procedure or standard. (EEI, No. 31 at p. 3.)
- AHRI noted that unless DOE develops coverage of all possible combinations of pumps inclusive of the motor and controls, a regulatory regime may inadvertently cover only 10 percent of the possible combinations that are in use. (AHRI, No. 28 at pp.1–2.)

The CIP Working Group ultimately recommended an alternative regulatory option that considers pumps inclusive of motors and controls, but applies essentially the same metric to all pumps, regardless of how they are sold. (EERE–2013–BT–NOC–0039–0092; Recommendations Nos. 1, 9, and 11.) DOE's proposal is consistent with the recommendation of the working group. The details of the proposed regulatory structure are discussed in the remainder of this NOPR.

DOE recognizes that some pumps, particularly in the agricultural sector, may be sold and operated with non-electric drivers, such as engines, steam turbines, or generators. The CIP Working Group recommended that pumps sold with non-electric drivers be rated as a bare pump, excluding the energy performance of the non-electric driver. (Docket No. EERE–2013–BT–NOC–0039, No. 92, Recommendation #3 at p. 2) DOE believes that there is insufficient technical merit or potential for additional energy savings to justify the additional burden associated with rating and certifying pumps sold with non-electric drivers inclusive of those drivers. This is described in more detail in the test procedure NOPR.

B. 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 NOPR, DOE proposed a definition for ''pump'' clarify what would constitute the

[15] For the purposes of this rulemaking, ''VSD'' will be used when discussing speed control of pumps in general. Variable frequency drive (VFD) will be used when specifically discussing continuous control of AC induction motors.

covered equipment. The definition reflects the consensus reached by the CIP Working Group in its negotiations: ''Pump'' means equipment designed to moves 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 NOPR, DOE also proposed definitions for ''bare pump,'' ''mechanical equipment,'' ''driver,'' and ''controls,'' as recommended by the CIP Working Group.

C. Scope of the Energy Conservation Standards in this Rulemaking

DOE is considering applying a bifurcated approach that would set out the scope of the types of pumps that would be subject to the test procedure and energy conservation standards, along with potential energy conservation standards that would apply to these pumps. The pumps for which DOE is proposing to set energy conservation standards for in this rulemaking are consistent with the CIP Working Group's recommendations as well as the proposals in the test procedure NOPR, and consist of the following categories:

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

DOE proposed definitions for these pumps in the test procedure NOPR.

For the equipment categories included in this rulemaking, DOE proposes to consider energy conservation standards only for clean water pumps. In the test procedure, DOE proposed to define ''clean water pump'' as a pump that is designed for use in pumping water with a maximum non-absorbent free solid content of 0.25 kilograms per cubic meter, and with a maximum dissolved solid content of 50 kilograms per cubic meter, 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 −10 °C.

In the test procedure NOPR, DOE also proposed to define several kinds of pumps that are clean water pumps, as defined, but would not be subject to the proposed test procedure, in accordance with CIP Working Group recommendations. DOE proposes that these pumps would also not be subject to the proposed energy conservation standards:

(a) Fire pumps;
(b) Self-priming pumps;
(c) Prime-assist pumps;
(d) Sealless 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).

The test procedure NOPR included further definitions for ''fire pump,'' ''self-priming pump,'' ''prime-assist pump,'' and ''sealless pump.''

For pumps meeting the definition of a clean water pump, with certain exceptions as noted above, DOE proposes to set energy conservation standards only for pumps with the following characteristics, which are identical to those for which DOE proposed the test procedure apply and are in accordance with CIP Working Group recommendations:

- 1–200 hp (shaft power at BEP at full impeller diameter for the number of stages required for testing to the standard);
- 25 gallons/minute and greater (at BEP at full impeller diameter);
- 459 feet of head maximum (at BEP at full impeller diameter);
- Design temperature range from −10 to 120 degrees C;
- 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; [16] and
- 6 inch or smaller bowl diameter (VTS/HI VS0).

DOE also proposed in the test procedure 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.) [17] DOE proposed a definition for full impeller in its test procedure NOPR.

D. Test Procedure and Metric

DOE is currently conducting a rulemaking to establish a uniform test procedure for determining the energy efficiency of pumps, as well as sampling plans for the purposes of demonstrating compliance with any energy conservation standards for this equipment that DOE adopts. In the test procedure NOPR, DOE proposed to prescribe test methods for measuring the efficiency 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 proposed 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 proposed additions to HI 40.6–2014 to account for the energy performance of motors and/or controls, which is not addressed in the scope of HI 40.6–2014.

The test procedure NOPR proposes 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.D.1) without controls. The metrics are defined as follows:

[16] 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 NOPR contains additional details.

[17] 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.

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

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

Eq. 1

Where:

- PER_{CL} is 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 would specify the default motor loss values to use in the calculations of driver input.
- PER_{VL} is 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} is the PER rating of a minimally compliant pump (as defined in section III.D.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 would indicate that the pump is less efficient than DOE's energy conservation standard and does not comply, while a value less than 1.00 would indicate that the pump is more efficient than the standard requires.

1. PER Rating of a Minimally Compliant Pump

DOE is considering 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 minimally compliant pump would be defined as a function of certain physical properties of the bare pump, such as flow at BEP and specific speed (Ns), as used in the EU MEI approach. In the MEI approach, a single polynomial equation defines a three-dimensional surface over which minimum efficiency varies across a range of both flow and Ns. The EU uses the same equation for all equipment classes, changing only one value—the C-value—to raise or lower the surface along a vertical axis to cut off a certain percentage of pumps, but without adjusting any variables that would change the shape of the efficiency surface. HI and Grundfos supported the EU MEI approach, which eliminates the least efficient pumps by type category. (HI, No. 25 at p. 2; Grundfos, No. 24 at p. 14.) HI added that Ns versus flow rate is the most practical approach to use when predicting efficiency for a particular class of pump types. (HI, No. 25 at p. 37.)

Grundfos recommended use of the EU equation as well as the same C-values used in the EU, which would result in exact harmonization. (Grundfos, No. 24 at p. 14.) However, HI recommended DOE use the EU equation but with an updated C-value. HI added that although a better data fit could be obtained by changing other coefficients, such complexity is not warranted. (HI, No. 25 at pp. 4–5, 32, 40.)

After reviewing stakeholder comments, as well as discussions of the CIP Working Group, DOE is proposing to base its PER rating using the EU's equation, but modifying the C-values as suggested by HI to better reflect the U.S. market. Specifically, DOE proposes to use the same equation used by the EU to develop its standard (*i.e.,* to determine the shape of the efficiency surface), translated to 60 Hz electrical input power and English units [18] as shown in equation 2, to determine the efficiency of a minimally compliant pump:

$$\eta_{pump,STD} = -0.85 * \ln(Q)^2 - 0.38 * \ln(Ns) * \ln(Q) - 11.48 * \ln(Ns)^2 + 13.46 * \ln(Q) + 179.80 * \ln(Ns) - (C - 555.6)$$

Eq. 2

Where:

Q = flow at BEP in gallons per minute at 60 Hz,
Ns = specific speed at 60 Hz, and
C = an intercept that is set for the surface based on the speed of rotation and equipment category of the pump model.

The C-value is the translational component of the three-dimensional polynomial equation. Adjusting the C-value increases or decreases the pump efficiency of a minimally compliant pump.

The calculated efficiency of the minimally compliant pump is reflective of the pump efficiency at BEP. 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, as shown in equation 3:

[18] 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/hr 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 English units.

$$PER_{STD} = \omega_{75\%}\left(\frac{P_{Hydro,75\%}}{0.947 * \eta_{pump,STD}} + L_{75\%}\right) + \omega_{100\%}\left(\frac{P_{Hydro,100\%}}{\eta_{pump,STD}} + L_{100\%}\right) + \omega_{110\%}\left(\frac{P_{Hydro,110\%}}{0.985 * \eta_{pump,STD}} + L_{110\%}\right) \quad \textbf{Eq. 3}$$

Where:

ω_i = weighting at each rating point (equal weighting—0.3333);

$P_{Hydro,i}$ = the pump power output at rating point i of the tested pump;

$\eta_{pump,STD}$ = the minimally compliant pump efficiency, as determined in accordance with equation 52;

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

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

Equation 3 also demonstrates how a ratio of the minimally compliant pump efficiency and the hydraulic output power for the rated pump is used to determine the input power to a minimally compliant pump at each load point. Note that the pump hydraulic output power for the minimally compliant pump is the same as that for the particular pump being evaluated. The calculated shaft input power for the minimally compliant pump at each load point would then be combined with a minimally compliant motor for that default motor construction and horsepower and the default part-load loss curve, described in the proposed DOE test procedure, to determine the input power to the motor at each load point. Under this proposal, 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 existing 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 proposal. 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 proposed rule. See section IV.C.4 for a complete examination of the efficiency levels analyzed in this rulemaking.

E. Compliance Date

Consistent with the recommendations of the CIP Working Group, see EERE–2013–BT–NOC–0039–0092, p. 4, Recommendation No. 9, DOE proposes to require that its standards would apply to equipment manufactured beginning on the date four years after the publication date of the final rule. DOE estimates that any final rule would publish in late 2015, resulting in a compliance date for the standards in late 2019. In its analysis, DOE used an analysis period of 2020 through 2049.

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

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) through (iv).) Section IV.B of this NOPR 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 proposed rulemaking. For further details on the screening analysis for this rulemaking, see chapter 4 of the NOPR TSD.

2. Maximum Technologically Feasible Levels

When DOE proposes to adopt 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 product. (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.

G. Energy Savings

1. Determination of Savings

EPCA provides that any new or amended energy conservation standard that DOE prescribes shall be designed to achieve the maximum improvement in energy efficiency that DOE determines is economically justified. (42 U.S.C. 6295(o)(2)(A) and (B) and 6316(a).) In addition, in determining whether such standard is technologically feasible and economically justified, DOE may not prescribe standards for certain types or classes of pumps if such standards would not result in significant energy savings. (42 U.S.C. 6295(o)(3)(B) and 6316(a).)

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).[19] 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 base case. The base 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 base case, DOE used data provided

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

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 notice) 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) most recent *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 covered equipment. For more information on FFC energy savings, see section IV.H.1.a.

2. Significance of Savings

As noted above, EPCA prohibits DOE from adopting a standard for a covered product unless such standard 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), opined that Congress intended ''significant'' energy savings in the context of EPCA to be savings that were not ''genuinely trivial.'' The energy savings for today's proposed standards (presented in section V.B.3.a) are nontrivial and, therefore, DOE considers them ''significant'' within the meaning of section 325 of EPCA.

H. Economic Justification

1. Specific Criteria

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 industry net present value (INPV), which values the industry on the basis of expected future cash flows; cash flows by year; changes in revenue and income; and 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 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

EPCA requires DOE to consider the savings in operating costs throughout the estimated average life of the covered equipment that are likely to result from the 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 piece of equipment (including its installation) and the operating expense (including energy, maintenance, and repair expenditures) discounted over the lifetime of the equipment. The LCC analysis requires a variety of inputs, such as equipment prices, equipment energy consumption, energy prices, maintenance and repair costs, equipment lifetime, and consumer discount rates. To account for uncertainty and variability in specific inputs, such as equipment lifetime and discount rate, DOE uses a distribution of values, with probabilities attached to each value. For its analysis, DOE assumes that consumers will purchase the covered equipment in the first year of compliance with new standards.

The LCC savings for the efficiency levels considered in today's NOPR are calculated relative to a base case that reflects projected market trends in the absence of new standards. DOE identifies the percentage of consumers estimated to receive LCC savings or experience an LCC increase, in addition to the average LCC savings associated with a particular standard level. 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 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 proposed in today's notice would not reduce the utility or performance of the products under consideration in this rulemaking.

e. Impact of Any Lessening of Competition

EPCA directs DOE to consider the impact of any lessening of competition, as determined in writing by the Attorney General, that is likely to result from a proposed 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 proposed 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 will transmit a copy of this proposed rule to the Attorney General with a request that the Department of Justice (DOJ) provide its determination on this issue. DOE will respond to the Attorney General's determination in the final rule.

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 new or amended 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.

New or amended 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. DOE reports the emissions impacts from the proposed standards, and from each TSL it considered, in section V.B.6 of this notice. DOE also reports estimates of 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).) In developing the proposed standard, DOE has also 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 has weighed the value of such negotiation in establishing the standards proposed in today's rule. DOE has 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.

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 effects that proposed energy conservation standards would have on the payback period for consumers. These analyses include, but are not limited to, the three-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 calculation is discussed in section V.B.1.c of this proposed rule.

IV. Methodology and Discussion of Comments

DOE used four analytical tools to estimate the impact of today's proposed standards. 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 forecasts 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. 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 NOPR 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 or by capacity or other performance-related features that would justify a different standard from that which would apply to other equipment classes. DOE proposes dividing pumps into equipment classes based on the following three factors:

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

DOE notes 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 NOPR, DOE proposed that any pump sold with, or for use with, a driver other than an electric motor would be rated as a bare pump.[20] Therefore, DOE did not

[20] Such a rating would include the hydraulic efficiency of the bare pump as well as the efficiency

Continued

disaggregate equipment classes by fuel type.

As discussed in section III.C, the five pump equipment types considered in this rulemaking, each of which DOE proposes would form the basis for an individual equipment class, include:

- End suction close coupled (ESCC);
- End suction frame mounted/own bearings (ESFM);
- In-line (IL);
- Radially split, multi-stage, vertical, in-line, diffuser casing (RSV); and
- Vertical turbine submersible (VTS).

A pump's configuration is defined 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 NOPR), 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).[21]

In the Framework Document, DOE requested comment on the use of pump design speed as a feature that distinguishes equipment classes as well as the burden associated with testing under multiple speeds. HI reported that often a manufacturer will need to make modifications to pumps that will be run at higher speed to allow for greater bearing loads. These may include changing the bearing frame size or modifying the axial thrust balancing device, which will impact pump efficiency. These potential modifications will vary by equipment class. (HI, No. 25 at p. 37–38.) Grundfos also added that speed is considered during the design of the pump, specifically as it relates to the design of the shaft and bearings. (Grundfos, No.24 at p. 23.) HI noted that pumps designed for different speeds are normally tested over the range of speeds for which the pumps will be offered for sale. A pump manufacturer offering the same pump at different speeds will have to account for any speed-related effects on efficiency and determine if the pump is compliant with the required MEI level at all offered speeds. (HI, No.25 at p. 38.) Both HI and Grundfos recommended harmonizing equipment classes with the EU, which regulates pumps designed for two- and four-pole nominal driver speeds separately, but at 60 Hz frequency. (Grundfos, No. 24 at p. 22; HI, No. 25 at p. 38.)

The CIP Working Group also recommended separate energy efficiency standards for equipment types at the nominal speeds for two- and four-pole motors. (See EERE–2013–BT–NOC–0039–0092, p. 4, Recommendation No. 9.) In its analysis, DOE found that across the market, pumps at each nominal speed demonstrate distinctly different performance. To account for this variability, DOE proposes that for both constant load and variable load pumps, the equipment classes should also be differentiated on the basis of nominal design speed. Within the scope of this proposed rule, pumps may 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 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 type, nominal design speed, and configuration, DOE proposes the following twenty equipment classes for the types of pumps to be addressed by this rulemaking:

- 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.

Chapter 3 of the NOPR TSD provides further detail on the definition of equipment classes.

As noted in section III.D, as proposed in the test procedure NOPR, CL equipment classes would be rated with the PEI_{CL} metric, and VL equipment classes would be rated with the PEI_{VL} metric. For today's NOPR, however, DOE relied on available data for bare pumps. Therefore, DOE's analysis is based on equipment type and nominal design speed only—reported results do not use a ''.CL'' or ''.VL'' designation. DOE is proposing identical standards for both CL and VL equipment classes.

2. Scope of Analysis and Data Availability

DOE collected data to conduct all NOPR analyses for the following equipment classes directly:

- 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:

- RSV.1800;
- RSV.3600; and
- VTS.1800.

a. Radially Split, Multi-Stage, Vertical, In-Line, Diffuser Casing (RSV)

DOE used available information to identify baseline and the maximum technologically feasible (''max-tech'') efficiency levels for this class. Specifically DOE's contractors used market research and confidential manufacturer information to establish a database of RSV models. The DOE contractor database represented models offered for sale in the United States by three major manufacturers of RSV pumps. DOE reviewed the efficiency data for these RSV pumps and found no models to be less efficient than the European Union's MEI 40 standard level, which took effect on January 1, 2015[22]. 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. As such, DOE presented this conclusion to the CIP Working Group for consideration, where it was supported and reaffirmed on numerous occasions (See, *e.g.* EERE–

of a minimally-compliant electric motor, as described in section III.D.1.

[21] In the Framework Document, DOE explored identifying specific equipment types that would always be used in a variable load application. In response, HI and Grundfos reported that application, rather than pump type or equipment class, controls whether the pump can be used in a variable load application. (Grundfos, No. 24 at p. 21; HI, No. 25 at p. 37).) The proposal is based on the assumption that a pump sold with speed controls is intended for a variable load application.

[22] 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.

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.)

As a result of the conclusion that RSV models sold in the United States market are global platforms with hydraulic designs equivalent to those in the European market, DOE proposes to set the baseline and max-tech levels equal to those established in Europe. Specifically, the baseline would be the European minimum efficiency standard,[23] and the max-tech level would be the European level referred to as ''the indicative benchmark for the best available technology.'' [24]

Although DOE was able to establish a baseline and max-tech level using aspects of what has already been adopted for the European market, DOE was unable to develop a cost-efficiency relationship or additional efficiency levels for RSV, due to lack of available cost data for this equipment. As a result, DOE has proposed 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 NOPR TSD provides complete details on RSV data availability and the development of the baseline efficiency level.

DOE seeks comment on its assumption that all RSV models sold in the United States are based on a global platform. This is identified as Issue 1 in section VIII.E, ''Issues on Which DOE Seeks Comment.''

b. Vertical Turbine Submersible (VTS).1800

Market research, confidential manufacturer data, and direct input from the CIP Working Group indicate that the 4-pole electric motor-driven submersible vertical turbine (VTS.1800) is a very uncommon pump configuration in the marketplace. Existing models are hydraulically identical to the 2-pole-based model, with the only differences being in the type of motor used. This means that every 4-pole-based model is constructed from a bare pump that was originally designed for use with a 2-pole motor. Total shipments for this equipment class are estimated to be less than 1 percent of the VTS.3600 equipment class. On the recommendation of the CIP Working Group (See EERE–2013–BT–NOC–0039–0105 at pp. 300–308; EERE–2013–BT–NOC–0039–0106 at pp. 38–40, 62–67, 88–95), DOE proposes efficiency levels for VTS.1800 equal to that of the VTS.3600 equipment class. Chapter 5 of NOPR TSD provides complete details on the development of the VTS.1800 efficiency levels.

DOE seeks 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. This issue is identified as Issue 2 in section VIII.E, ''Issues on Which DOE Seeks Comment.''

3. Technology Assessment

In the Framework Document, DOE listed the following technologies that can improve pump efficiency:

- 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.

Chapter 3 of the NOPR TSD details each of these technology options. DOE solicited and received numerous stakeholder comments regarding these options in the Framework Document. The following sections summarize the stakeholder comments.

a. General Discussion of Technology Options

In the Framework Document, DOE requested comment on the applicability of the technology options presented and the accuracy of the potential efficiency gains listed. HI agreed that the presented technology options are applicable to the types of pumps being discussed, but it emphasized that DOE's estimates of potential efficiency gains are representative of the differences between the very worst and very best in class pump designs. HI also stated that the estimated efficiency gains listed by DOE in the Framework document are likely to be larger than the gains that would be realized for pumps that would be subject to an efficiency standard. (HI, Framework Public Meeting Transcript at pp. 297–298; HI, No. 25 at p. 9; HI, No. 25 at p. 39.)

Grundfos also commented on the applicability of the technology options. They suggested that certain design options are interrelated, noting that optimizing components such as the impeller (*i.e.,* the primary rotating component of a centrifugal pump) and volute (*i.e.,* the primary static component of a centrifugal pump) can reduce volumetric losses and improve efficiency. (Grundfos, No. 24 at p. 25.) Grundfos suggested that using combinations of options, such as hydraulic redesign, reduced running clearance, and reduced volumetric losses, may all be incorporated into the design of the pump to optimize the desired characteristics. (*Id.*)

DOE has incorporated both of these suggestions into its market and technology, screening, and engineering analyses.

b. Additional Technology Options

The CA IOUs recommended that DOE evaluate technology options that facilitate maintenance or improve average performance over a pump's lifetime. These include wear rings, flange taps, and compression sleeves. (CA IOUs, No. 26 at pp. 3, 4.) DOE evaluated all available technology options related to pump performance and efficiency, as defined by the proposed PEI metric and test procedure. While the technology options proposed by the CA IOUs may improve maintainability and average performance over a pump's lifetime, they were not found to have a significant impact on pump efficiency (as defined by the test procedure) as stand-alone technology options and, thus, were not considered in the analysis.

c. Applicability of Technology Options to Reduced Diameter Impellers

In the Framework Document, DOE also solicited comments on how the technology options might impact pumps with reduced diameter impellers. In response, HI observed that pursuing efficiency improvements specific to only trimmed impellers would prove costly and result in only minor efficiency gains. (HI, No. 25 at p. 39.) Grundfos noted that modifications in the pump design to achieve improved

[23] Note that this NOPR 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.

[24] 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.

performance are not specific to the impeller trim, but to the design of all components as a whole. (Grundfos, No. 24 at p. 26.)

DOE is proposing to set 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. As such, DOE's analyses of technology options have been made with respect to the full diameter model. In proposing to set 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.

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

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 being considered for coverage or does not significantly improve efficiency across the entire scope of each equipment class; and (c) efficiency improvements from the technology degrade quickly.

DOE found that most of the technology options identified in the Framework Document 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 discusses the elimination of all of these technologies in section III.B.

B. Screening Analysis

DOE generally uses four screening factors to determine which technology options are suitable for further consideration in a standards rulemaking. If a technology option fails to meet any one of the factors, it is 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

Improved Surface Finish on Wetted Components

Grundfos suggested that smoothing the surface finish of pump components is a time consuming manual activity that should not be considered to be a practical manufacturing process. (Grundfos, No. 24 at pp. 25–26.) Additionally, HI responded to DOE's initial estimates of available efficiency improvement by noting that its experience has shown that smoothing and surface finish have very little effect at higher specific speeds and for the range of pumps that are commonly in service. (HI, No. 25 at p. 39.) HI, Grundfos, and ACEEE all suggested that gains in efficiency from improved surface finish and smoothing are non-persistent, with the surface finish quickly being degraded in most applications. (HI, No.25 at pp. 9, 39; Grundfos, No. 24 at p. 25; ACEEE, Framework Public Meeting Transcript at p. 299.) Based on these comments, the agreement of the CIP Working Group (EERE–2013–BT–NOC–0039–0109 at pp. 91–97 pp. 46–50), and the information obtained from manufacturer interviews, DOE observed that, at this time, 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. Consequently, 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 DOE is currently examining. Consequently, DOE screened this technology option out. Chapters 3 and 4 of NOPR 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 NOPR TSD provide further details on these methods for surface finish improvement, and justification for screening out.

Reduced Running Clearances

Grundfos stated that reducing running clearances is a method used by most manufacturers in the design of the individual components with the use of wear rings. (Grundfos, No. 24 at p.25.) HI suggested that the reduction in running clearances may improve efficiency in some applications, depending on specific speed, but it noted that reduced running clearances may also lead to mechanical reliability problems leading to the added expense of larger (stiffer) shafts, larger bearings, and advanced or more costly wear ring materials. (HI, No. 25 at p. 39.) HI and ACEEE also suggest that the efficiency improvements from tightened running clearances degrade quickly. (HI, Framework Public Meeting Transcript at p. 329; ACEEE, Framework Public Meeting Transcript at p. 299.)

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 proposes to eliminate this technology option because of the reliability concerns highlighted by HI and the concerns of quickly degrading efficiency improvements highlighted by HI and ACEEE. For additional details on the screening of reduced running clearances, see chapter 4 of the NOPR 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 NOPR 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 NOPR TSD.

Addition of a Variable Speed Drive (VSD)

Grundfos suggested that variable speed drives are a proven method to optimize pump operation and reduce energy consumption. (Grundfos, No. 24 at p. 25.) DOE agrees that variable speed drives are a proven method to optimize pump operation, but only for certain pump applications for which standards are being considered. DOE's analysis has shown that there are many applications for these types of pumps that will not benefit from a VSD. For common applications, such as systems that have unvarying flow and head requirements (constant load), on/off operation, or high percentages of static head,[25] VFDs may not save energy and may even increase energy consumption when factoring in the efficiency of the VFD unit. EEI reported that technologies that reduce power factor below 85 percent should be screened out because of deleterious impacts on the electric grid but that most VSDs will not reduce power factors to levels that would create extra costs for consumers. (EEI, No. 31 at p. 4.)

[25] Static head is the component of total dynamic head that results from the fluid being lifted a certain height above the pump. Unlike dynamic head, static head requirements stay constant across the system curve, even at zero flow.

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 has eliminated the use of VSDs from the list of technology options. For additional details, see chapters 3 and 4 of the NOPR TSD.

Improvement of VSD Efficiency

Grundfos stated that proper selection, operation and integration of a VSD with a pump and motor are more important than improving the efficiency of the VSD alone. (Grundfos, No. 24 at p. 25.) Because DOE has eliminated the use of VSDs as a technology option, improvement of VSD efficiency will also not be considered as technology option. For additional details, see chapters 3 and 4 of the NOPR TSD.

Reduced VSD Standby and Off Mode Power Usage

Grundfos stated that reducing VSD standby and off mode power usage has a minor impact on energy efficiency, but can add to the efficiency of the control strategy. (Grundfos, No. 24 at p. 25.) Available information supports Grundfos' characterization of the relative benefits of improved VSD efficiency and reduced standby and off mode power usage. Although improving VSD efficiency and standby/off mode power may help improve overall pump efficiency, DOE has concluded that not all pumps for which DOE is considering standards in this rule would benefit from the use of a VSD. In addition, VSD standby and off model power usage would not impact the PEI rating of equipment as tested under the DOE test procedure. As such, DOE is not considering 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 NOPR TSD.

2. Remaining Technologies

DOE found that only improved hydraulic design met all four screening criteria to be examined further in DOE's analysis. HI commented that hydraulic redesign will be the most prominent method used to improve efficiency because many of the easy to implement efficiency gains, such as tighter clearances, have already been explored by manufacturers. (HI, Framework Public Meeting Transcript at p. 328.) The results of DOE's screening analysis support HI's comment.

Improved hydraulic design is technologically feasible, as there is equipment on the market that has utilized this technology option. DOE also finds that improved hydraulic design meets the other screening criteria (*i.e.,* practicable to manufacture, install, and service and no adverse impacts on consumer utility, product availability, health, or safety). As such, DOE considered hydraulic redesign as a design option in the engineering analysis. For additional details, see chapter 4 of the NOPR 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 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 NOPR TSD.

1. Representative Equipment for Analysis

a. Representative Configuration Selection

For the engineering analysis, DOE directly analyzed the cost-efficiency relationship for all equipment classes specified in in section IV.A.1, 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. This method addresses the concerns of both EEI and HI that the equipment classes considered by DOE encompass too much variation to effectively be characterized by one representative unit. (EEI, Framework Public Meeting Transcript at pp. 275–276; HI, Framework Public Meeting Transcript at p. 286.)

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. 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. Because DOE directly analyzed the cost-efficiency relationship over the full range of sizes, 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.

DOE established baseline configurations by reviewing available manufacturer performance and sales data for equipment manufactured at the time of the analysis. Chapter 5 of the NOPR 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 and removing from consideration technologies that did not warrant inclusion on technical grounds, DOE considered hydraulic redesign as a design option in the NOPR engineering analysis.

3. Available Energy Efficiency Improvements

For each equipment class, DOE assessed the available energy efficiency improvements resulting from a hydraulic redesign. 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. Section IV.C.7 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. Each level consists of a specific C-value, as shown in Table IV.1. (See section III.D.1 for more information about C-values and the related equations.)

TABLE IV.1—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	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.

a. Maximum Technologically Feasible Levels

Efficiency level five (EL5), as shown in Table IV.1, represents the maximum technologically feasible (''max-tech'') efficiency level for the ESCC, ESFM, IL, and VTS equipment classes. EL1 represents max-tech for the RSV 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.

In the case of pumps, DOE determined, 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.[26] 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. The analysis resulted in the 70th efficiency percentile being consider max-tech for each equipment class. A preliminary version of this analysis was provided to the CIP Working Group during the April 29–30, 2014 meetings. (EERE–2013–BT–NOC–0039–0051, pp. 17–32) This analysis proposed the 70th efficiency percentile as the max-tech level and solicited feedback on alternative opinions. Ultimately no alternative feedback on max-tech was received, and the CIP Working Group implicitly agreed with DOE's proposal, and incorporated the 70th efficiency percentile as the highest TSL level evaluated. Chapter 5 of NOPR TSD provides complete details on DOE's market-based max-tech analysis and results.

DOE's market-based approach directly addresses Grundfos' concerns (in response to the Framework Document) that it is difficult to accurately predict maximum efficiency levels using theoretical models. (Grundfos, No. 24 at p. 28).

In response to the CA IOUs concerns that manufacturers might not be currently making the most efficient pumps possible in all segments of the market. See CA IOUs, Framework Public Meeting Transcript at p. 331, DOE notes that the maximum available efficiency level was determined using a regression analysis across pumps of all sizes within each equipment class. As such, a broadly applicable max-tech/max-available level was developed, which does not provide any advantage or disadvantage to current low efficiency sub-segments of the market.

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

5. Manufacturers Production Cost Assessment Methodology

a. Changes in MPC Associated With Hydraulic Redesign

DOE performed an analysis for each equipment class to determine the change in manufacturer production cost (MPC), if any, associated with a hydraulic redesign. 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.[27] 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.

DOE acknowledges 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. Chapter 5 of the NOPR TSD provides complete details on DOE's MPC-efficiency analysis and results.

b. Manufacturer Production Cost (MPC) Model

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.

[27] 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).

The DOE MPC model was developed using data supplied by both HI and individual manufacturers. This data set includes information on the MSP, manufacturer markup, shipments volumes, model performance and efficiency, and various other parameters. Chapter 5 of the NOPR 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.

To evaluate the magnitude of the product and capital conversion costs the pump industry would incur to comply with new energy conservation standards, DOE used a bottom-up approach. 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 [28] was used to augment the HI survey data and scale costs to various efficiency levels above and below the 40th percentile.

During the framework meeting, CA IOUs recommended that DOE use mature market estimates to determine costs associated with efficiency improvements rather than an approach based on the current market. (CA IOUs, Framework Public Meeting Transcript, No. 19, at pp. 324, 345.) In previous rules, the CA IOUs commented that the cost to improve efficiency has been overestimated. DOE recognizes the concerns of the CA IOUs and notes that hydraulic redesigns are a mature technology option and as such, the redesign costs used in the NOPR analysis represent the mature market cost of the technology option.

DOE used a pump model database, developed by its contractors, containing various performance parameters, to model the distribution of unique pump models that would require redesign at each efficiency level. The DOE contractor database is comprised of a combination of data supplied by HI and data collected independently from manufacturers by the DOE. For the ESCC, ESFM, IL, and VT equipment classes, the database is of suitable size to be representative of the industry as a whole. Table IV.2 presents the resulting product and capital conversion costs for each equipment class, at each efficiency level. Complete details on the calculation of industry aggregate product and capital conversion costs are found in chapter 5 of the NOPR TSD.

TABLE IV.2—TOTAL CONVERSION COST AT EACH EFFICIENCY LEVEL

All values in millions of dollars	EL 0	EL 1	EL 2	EL 3	EL 4	EL 5
ESCC/ESFM *	$0	$12.4	$49.4	$110.6	$210.4	$344.7.
IL	0	5.1	20.0	45.3	88.2	144.0.
VTS	0	2.5	9.3	19.2	37.8	61.3.
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.

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 proposed 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.

DOE developed initial estimates of the base case manufacturer markups based on corporate annual reports, Securities and Exchange Commission (SEC) 10–K filings, confidential manufacturer data, and comments made publicly during the CIP Working Group negotiations.

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

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.

b. Individual Manufacturer Markup Structures

Using data and information gathered during the manufacturer interviews, DOE concluded that within an equipment class, each manufacturer maintains a flat markup. 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.

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 that when analyzed as whole, the industry exhibits a relationship between manufacturer markup and efficiency. 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 private interviews and public working group comments, manufacturers held the view that efficiency is not currently the primary selling point or cost driver for the

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

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 the development of the markup-efficiency relationship was based on data from the IL equipment class. DOE, with support of the CIP Working Group, concludes that the markup structure of the IL equipment class is representative of the ESCC, ESFM, and VTS equipment classes.[29] DOE applied the IL markup-efficiency relationship to these equipment classes, for use in the analyses presented in this NOPR. Chapter 5 of the NOPR 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 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. 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.

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.[30]

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 Framework Document, DOE presented initial information regarding the distribution channels for pumps. DOE revised these channels and their assigned market share in response to manufacturer interviews and discussions in the CIP Working Group. (See, *e.g.,* EERE–2013–BT–NOC–0039–0072, pp. 327–330.) Based on this information, DOE proposes to use 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).

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)[31] 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*[32] to develop distributor markups; and (3) 2013 RS Means *Electrical Cost Data*[33] to develop mechanical contractor markups.

In addition to the markups, DOE derived State and local taxes from data provided by the Sales Tax Clearinghouse.[34] 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.

In the Framework Document, DOE also considered accounting for shipping costs in its markups analysis. In response to the Framework Document,

[29] 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.

[30] The cost recovery pricing scenario is the most conservative case (*ie*,i.e., resulting in the fewest benefits) for consumers and the most positive case for manufacturers (ie,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.

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

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

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

[34] 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.*

Grundfos noted that transportation and shipping costs from freight companies and package delivery companies are based on size, weight and transit time requirements. (Grundfos, No. 24 at p. 31.) DOE's understanding is that pump size and weight do not change with efficiency level; therefore, DOE did not account for shipping costs in this analysis.

Chapter 6 of the NOPR TSD provides further detail on the estimation of markups.

Because the identified market channels are complex and their characterization required a number of assumptions, DOE seeks input on its analysis of market channels for the above equipment classes, particularly related to whether the channels include all necessary intermediate steps, and the estimated market share of each channel. DOE identified this as Issue 3 under ''Issues on Which DOE Seeks Comment'' in section VIII.E of this NOPR.

E. Energy Use Analysis

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

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.

2. Pump Sizing

In the Framework Document, DOE requested information on pump sizing. Grundfos noted that the general selection guidelines and other resources are available from HI and specific professional or trade associations such as ASHRAE.[35] (Grundfos, No. 24 at p. 32.) 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 this analysis, the BEP offset is assumed to be uniformly distributed between −0.25 (*i.e.,* 25% less than BEP flow) and 0.1 (10% more than BEP flow).

3. Operating Hours

DOE estimated average annual operating hours by application based on inputs from a market expert and feedback from the CIP Working Group.[36] DOE developed statistical distributions to use in its energy use analysis.

DOE requests information and data on average annual operating hours for the pump types and applications in the scope of this rulemaking. This is identified as Issue 4 in section VIII.E, ''Issues on Which DOE Seeks Comment.''

4. Load Profiles

Information on typical load profiles for pumps is not available in the public domain. DOE requested information on load profiles in the Framework Document. Grundfos responded that available public data related to the use of pumps is very limited and provided a reference that may be considered for heating, cooling, and hot water load profiles: California's 2013 Title 24 Nonresidential Alternative Calculation Method (ACM) Reference Manual, Appendix 5.4B. (Grundfos, No. 24 at p. 32.) Grundfos also noted that general selection guidelines and other resources are available from HI and suggested that DOE review EU Commission Regulation No 547/2012 and the work being considered under the Ecodesign Preparatory Study (ENER Lot 29). (Grundfos, No. 24 at p. 34.) HI mentioned that application-specific duty profiles could lead to confusion for pumps with motors and/or controls serving multiple applications and suggested that a single duty profile, consisting of equally weighted time intervals at 100 percent, 75 percent, 50 percent, and 25 percent of the BEP flow, be used to evaluate pump efficiency. (HI, No. 25 at p. 43.)

DOE reviewed the resources suggested by Grundfos, as well as other information on pump load profiles, such as building simulation files. DOE concluded, however, that these load profiles were not sufficiently representative of the variability expected in the field for commercial applications. In addition, DOE did not identify any similar information for other sectors, including the industrial, agricultural, and municipal sectors. However, DOE believed it would be appropriate to analyze more than one duty profile. Considering the range of all applications of the pump equipment classes for which DOE is considering standards, 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. During the CIP Working Group negotiations, DOE initially proposed that each of these load profiles would be weighted equally in the consumer sample. However, a stakeholder commented that pumps generally operated on the pump curve to the left of the BEP (*i.e.,* pumps generally require less flow than that provided at BEP) as opposed to beyond the BEP. (Charles Cappellino, ITT, EERE–2013–BT–NOC–0039–0072, p. 356.) This indicates that pumps are generally oversized rather than undersized. Therefore, 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. DOE notes that changes in weighting across the load profiles have very little impact on energy use results.

DOE requests information and data on typical load profiles for the pump types and applications in the scope of this

[35] ASHRAE was formerly known as the American Society of Heating, Refrigerating and Air-Conditioning Engineers.

[36] 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–XXXX0109, pp. 128–140139–152.

rulemaking. This is identified as Issue 5 in section VIII.E, ''Issues on Which DOE Seeks Comment.''

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.

5. Equipment Losses

Using the duty point, load profile, and operational 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. DOE takes 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.

In the Framework Document, DOE requested information on motor losses Grundfos noted that existing motor efficiency standards based on prior requirements set by the Energy Policy Act of 1992 (Pub. L. 102–486, Oct. 24 1992) and the Energy Independence and Security Act of 2007 (Pub. L. 110–140, Dec. 19, 2007) can be utilized as minimum efficiency levels. (Grundfos, No. 24 at p. 34) DOE used existing minimum motor efficiency standards in calculating annual energy use.

In the Framework Document, DOE also requested information on variable frequency drive (VFD) efficiency. VFDs are the most common type of VSD used in the pump market; they automatically control the speed of a pump by adjusting frequency in response to system feedback. In this way, pumps can deliver the appropriate amount of flow required by the system with less head and power compared to reducing flow at full speed by closing a throttling valve. Grundfos noted that the efficiencies of a VFD vary by manufacturer and suggested that a sampling of these efficiencies can be obtained from the members of the Adjustable Speed Drive Systems group of the Industrial Automation section of the National Electrical Manufacturers Association (NEMA). (Grundfos, No. 24 at p. 34.) DOE has reviewed all available VFD efficiency information in developing the test procedure NOPR. However, DOE estimates that very few pump users operate their pumps with VFDs. (See section IV.H.1.a, the life-cycle cost analysis is not meant to represent national impacts, DOE's energy use analysis assumes that all users with variable loads throttled their pumps and therefore did not include VFD efficiency. This assumption allows for the analysis of impacts to the largest group of customers in the market (*i.e.,* those that throttle their pumps). However, DOE considered use of VFDs—in the life-cycle cost customer subgroup and national impact analyses. (See section IV.I and IV.H.1.a, respectively.)

As noted previously, 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 estimated, based on information from consultants and the CIP Working Group, that only 1–2% of pumps in scope are driven by non-electric drivers. Therefore DOE accounted for the energy use of all pumps as electricity use and chose not to account for fuel use in its analysis.

DOE requests 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. This is identified as Issue 6 in section VIII.E, ''Issues on Which DOE Seeks Comment.''

F. Life-Cycle Cost and Payback Period Analysis

DOE conducted the life-cycle cost (LCC) and payback period (PBP) analysis to estimate the economic impacts of potential 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 the standard takes effect. 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 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.[37] 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 NOPR 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 proposed 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

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

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 base 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 base case also includes an estimate of the distribution of equipment efficiencies. DOE developed a base-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. Out of this distribution, DOE assigns a pump efficiency based on the relative weighting of different efficiencies. Chapter 8 of the NOPR TSD contains details regarding the base case efficiency distribution.

At each efficiency level, the pump assigned in the base 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 base case and the standard does not impact that user. If the pump would not meet the standard at a given efficiency level, the base 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 base 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 base 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 representative unit based on the proportion of total revenues generated by that unit in the base 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 base 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 base 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 base 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.3 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.3—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.

TABLE IV.3—SUMMARY OF INPUTS AND KEY ASSUMPTIONS USED IN THE LCC AND PBP ANALYSES—Continued

Inputs	Description
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 2014 (AEO 2014).[38]
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.[39]
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.
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.

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 NOPR TSDprovides 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.[40] 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 are equal to the 2012 values for each efficiency level in each equipment class. Appendix 8A of the NOPR TSD describes the historical data that were considered.

DOE requests comments on the most appropriate trend to use for real (inflation-adjusted) pump prices. This is identified as Issue 7 in section VIII.E, ''Issues on Which DOE Seeks Comment.''

b. Installation Costs

In the Framework Document, DOE requested information on whether installation costs would be expected to change with efficiency. Grundfos responded that this was not expected to occur for new installations, but noted that for existing installations, there may be additional costs to replace existing equipment with higher efficiency equipment for piping, electrical modifications, base and foundations, and code requirements for equipment rooms. (Grundfos, No. 24 at p. 34.) In the CIP Working Group, Grundfos and ITT Corporation also noted that the assumption of targeting identical flange or feet dimensions during redesign is reasonable, but that, as one drives to higher efficiency one may have to stretch the pump (*i.e.,* change the dimensions from the base design) and change configurations. (See EERE–2013–BT–NOC–0039–0109, pp.240–242), Grundfos stated that at some point within the range of efficiency levels under consideration, whether at PER 40 or 70 or some other point, the installation cost might change. In the absence of data to indicate at what efficiency level DOE may need to consider an increase in installation costs, DOE has not estimated installation costs for this analysis. DOE requests comment on whether any of the efficiency levels considered in this

[38] U.S. Energy Information Administration. *Annual Energy Outlook 2014* (2014) DOE/EIA–0383(2014). (Last Accessed August 8, 2014) (Available at: *http://www.eia.gov/forecasts/aeo/*).

[39] See for example, Docket No. EERE–2013–BT–NOC–0039–0073, p. 153.

[40] Series ID PCU333911333911; *http://www.bls.gov/ppi/*.

NOPR might lead to an increase in installation costs and, if so, data regarding the magnitude of the increased cost for each relevant efficiency level. This is identified as Issue 8 in section VIII.E, ''Issues on Which DOE Seeks Comment.''

c. Annual Energy Use

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 NOPR TSD.

d. Electricity Prices

Electricity prices are used to convert changes in the electric consumption from higher-efficiency equipment into energy cost savings. 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.

In response to the Framework Document and during the CIP Working Group meetings, EEI and the CA IOUs discussed consideration of reactive power prices in the analyses. Specifically, the CA IOUs recommended that DOE consider costs and value of power factor and reactive power.[41] (CA IOUs, No. 26 at p. 4, EERE–2013–BT–NOC–0039–0072, p. 341.) On the other hand, EEI stated that it may not be necessary to consider reactive power prices because most pumps, motors, and VSDs will not reduce power factors to levels that would create extra costs for consumers. (EEI, No. 31 at p. 4.) DOE is not considering motors or VSDs as technology options and concludes that any changes in pump efficiency would have very small impacts on power factor. As a result, DOE did not include reactive power prices in its analyses.

e. Maintenance Costs

During the CIP Working Group meetings, DOE indicated that its analysis assumed that maintenance costs would not change with efficiency level. (EERE–2013–BT–NOC–0039–0073, p. 135.) DOE did not receive any negative comments on this assumption, so DOE has not estimated a maintenance cost for this analysis.

f. Repair Costs

DOE received information in response to the Framework Document (Grundfos, No. 24 at p. 35) and from the CIP Working Group that repair costs are not expected to change with efficiency level. Therefore, DOE has not estimated a repair cost for this analysis.

g. Equipment Lifetime

DOE defines ''equipment lifetime'' as the age when a given commercial or industrial pump is retired from service. DOE consulted with market experts to establish typical equipment lifetimes, which included estimates of minimum and maximum lifetime. Consequently, DOE developed distributions of lifetimes that vary by equipment class. The average across all equipment classes is 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 (see, *e.g.,* Docket No. EERE–2013–BT–NOC–0039–0073, p. 153), DOE introduced lifetime variation by pump speed—pumps running faster tend to have a shorter lifetime. Chapter 8 of the NOPR 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. For all but the municipal sector, DOE uses the capital asset pricing model to calculate the equity capital component, and financial data sources, primarily the Damodaran Online Web site,[42] to calculate the cost of debt financing. DOE derived the discount rates by estimating the cost of capital of companies that purchase pumping equipment.

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.

More details regarding DOE's estimates of consumer discount rates are provided in chapter 8 of the NOPR 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 NOPR 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 amended 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 Framework Document, DOE considered using the shipment data available from the U.S. Census Bureau.

[41] Power factor is the ratio of real power flowing to the load to the apparent power in the circuit. Reactive power is power that is not transferred to the load but is required for electric motors to start.

[42] 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).

In response, Grundfos and HI expressed concern that the Census descriptions did not match HI nomenclature. (Grundfos, No. 24 at p. 20; HI, No. 25 at p. 36.) HI further added that they did not find the Census data to be reliable (Id.) During the course of the CIP Working Group meetings, HI provided DOE with shipment estimates collected directly from its members (EERE–2013–BT–NOC–0039–0068).

To develop the shipments model, DOE started with the 2012 shipment estimates by equipment type from HI. 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 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 base case. Chapter 9 of the TSD contains more details. DOE seeks comment on whether new standards would be likely to affect shipments. This is identified as Issue 9 under ''Issues on Which DOE Seeks Comment'' in section VIII.E of this NOPR.

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.

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 base case, defined by the current market. DOE calculated net monetary savings in each year relative to the base 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,[43] to calculate the energy savings and the national monetary costs and savings from potential 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 base case. The average energy per unit used by the pumps in service gradually decreases in the standards case relative to the base 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 base 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 2014 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 notice, 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 NOPR, and the FFC multipliers that were applied, are described in appendix 10B of the NOPR 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.

In response to the Framework Document, HI mentioned that the penetration of VSDs is increasing in the

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

market place and recommended that DOE explore the issue (HI, No. 25 at p. 43). DOE reviewed studies on VSD penetration and used an initial penetration of 3.2 percent in 1998[44] with a 5 percent annual increase.[45] For more information on VSD penetration, see chapter 9 of the NOPR TSD. 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.[46] 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,[47] that the full amount of potential savings would not be realized for all consumers. DOE is currently assuming an ''effectiveness rate'' of 75 percent; in other words DOE is assuming that consumers will 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.

In the CIP Working Group meetings, one stakeholder stated that half of pumps sold by manufacturers are trimmed (*i.e.,* have impellers trimmed to meet customer needs) (Louis Starr, EERE–2013–BT–NOC–0039–0072, p. 345), while another stated that the vast majority of pumps sold by manufacturers are trimmed (Al Huber, EERE–2013–BT–NOC–0039–0009, p. 168). DOE also consulted a market expert who agreed that a majority of pumps are trimmed, and that the average trim is between 10 to 20 percent. In the NIA, 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 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.

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. DOE seeks comment on the components of this adjustment. This matter is identified as Issue 10 under ''Issues on Which DOE Seeks Comment'' in section VIII.E of this 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. DOE seeks comment on whether a rebound effect should be included in the determination of annual energy savings. If a rebound effect should be included, DOE seeks data to assist in calculating the rebound effect. This matter is identified as Issue 11 under ''Issues on Which DOE Seeks Comment'' in section VIII.E of this NOPR.

DOE also considered whether there would be any spill-over effects related to an energy conservation standard for clean water pumps. Specifically, in the Framework Document, DOE requested information on whether design changes to clean water pumps would also be reflected in the design of pumps used in other processes and applications, thus saving additional energy not accounted for in the analysis of clean water pumps only. In response, Grundfos expected that design changes to clean water pumps would spill over, while HI believed that spillover was possible for a small number of design changes by pump manufacturers with modular designs. Grundfos and HI noted, however, that designs in alternate applications are very dependent on requirements for safety and reliability. (Grundfos, No. 24 at p. 4; HI No. 25 at p. 14.) Because DOE did not obtain any data indicating how much spillover might occur, DOE has not accounted for spillover effects in the NOPR analysis.

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 base case to obtain the net equipment cost increase resulting from the higher standard level. As noted in section IV.F.2.a, 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.* The derivation of these price trends is described in appendix 10B of the NOPR TSD.

Second, DOE determined the difference between the base-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

[44] *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.

[45] 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.

[46] 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.

[47] 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,[48] 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. Base-Case and Standards-Case Distribution of Efficiencies

As described in section IV.F.1, DOE developed a base-case distribution of efficiency levels for pumps using performance data provided by manufacturers. Because the available evidence suggests that there is no trend toward greater interest in higher pump efficiency, DOE assumed that the base case distribution would remain constant over time. The base-case efficiency distributions for each equipment class are presented in chapter 10 of the NOPR TSD. Furthermore, DOE has no reason to believe that implementation of standards would lead to an increased demand for more efficient equipment than the minimum available, and therefore does 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 concludes that equipment efficiencies in the base case that were above the standard level under consideration would not be affected. Information from certain manufacturers indicates 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 has 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 does not assume that manufacturers would design to a level higher than required, to avoid overestimating the energy savings that would result from the rule.

In response to the Framework Document, EEI commented that the federal regulations on motor efficiency and the requirements in the most recent building codes should be considered in the energy efficiency base case in the analyses. (EEI, No. 31 at p. 2.) DOE notes that its analysis incorporates the federal motor efficiency standards in its analysis but does not consider the use of motors more efficient than those standards. DOE also reviewed the relevant building codes and found that they do not place any requirements on pump efficiency.

I. Consumer Subgroup Analysis

In the Framework Document, DOE requested input on any consumer subgroups that should be analyzed separately. Grundfos suggested that consumer subgroups should include commercial buildings, water utilities, and irrigation. (Grundfos, No. 24 at p. 36.) While DOE is not analyzing these different groups as part of its consumer subgroup analysis, it has considered these groups as part of the LCC analysis.

For the consumer subgroup analysis, DOE estimated the impacts of the TSLs on the subgroup of consumers who operate their pumps with VFDs.[49] 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 estimate the financial impact of energy conservation standards on manufacturers of pumps and to calculate 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 NOPR 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[50]; corporate annual reports; the U.S. Census Bureau's Annual Survey of Manufacturers[51]; and Hoovers reports.[52]

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

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

[49] 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.

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

[51] 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).

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

manufacturers. During these interviews, DOE discussed engineering, manufacturing, procurement, and financial topics to validate assumptions used in the GRIM and to identify key issues or concerns. See section IV.I.3 for a description of the key issues manufacturers raised during the interviews.

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 today's NOPR, DOE analyzed small manufacturers as a subgroup.

The Small Business Administration (SBA) defines a small business under 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 NOPR and chapter 12 of the NOPR 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 models 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 analysis) 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 base case and each TSL (the standards case). The difference in INPV between the base 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 NOPR 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 NOPR 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 base-case analysis, the GRIM uses the NIA base-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 base 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 base 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.

To evaluate the magnitude of the product and capital conversion costs the pump industry would incur to comply with new energy conservation standards, DOE used a bottom-up approach. 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 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. 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.B.2 of today's notice. For additional information on the estimated product conversion and capital conversion costs, see chapter 12 of the NOPR 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.

DOE developed initial estimates of the base case average manufacturer markup through an examination of corporate annual reports and Securities and Exchange Commission (SEC) 10–K reports. Furthermore, DOE refined the estimates of manufacturer markup by equipment class based on feedback received from manufacturers and information received from HI.

For the MIA, 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. 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.

Under the flat markup scenario, DOE maintains the same markup in the base 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:

	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
VTS	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 calculated the cost recovery markups are calculated as follows:

	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
VTS	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 unit over which costs can be recouped. The simple payback timeframes are as follows:

	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.

3. Manufacturer Interviews

As part of the MIA, DOE discussed potential impacts of standards with ten pump manufacturers. The interviewed manufacturers account for approximately 40 percent of the domestic pump market. In interviews, DOE asked manufacturers to describe their major concerns about this rulemaking. This section (IV.J.3) highlights manufacturers' interview statements that helped shaped DOE's understanding of the potential impacts of an energy conservation standard on the industry.

a. Alignment With European Union Energy Efficiency Standards

Multiple manufacturers emphasized the importance of harmonizing U.S. energy conservation standards with existing EU standards for clean water pumps. Manufacturers stated that harmonized standards would promote regulatory consistency and would enable them to better coordinate product redesigns and reduce conversion costs. If U.S. and EU standards are not harmonized, some manufacturers noted they would have to carry a greater number of product lines to service separate markets or to comply with efficiency standards in both domestic and European markets. Manufacturers also indicated that harmonized standards could help to improve U.S. manufacturers' access to foreign markets and would help to avoid a situation where lower domestic standards enable EU-compliant manufacturers to market their pumps to U.S. consumers as more efficient than pumps manufactured domestically. Manufacturers noted that expansion beyond the EU Directive parameters will add complexity and cost to the tasks of the manufacturers and create a significant financial burden for manufacturers to comply with the standards, particularly with respect to double-suction pumps and vertical turbines beyond 6-inch bowl assemblies. *See* Section III.A.1.

In contrast, one manufacturer stated that aligning U.S. standards with EU standards would give European manufacturers an advantage because they would have products that could immediately comply with the U.S. standard, while U.S. manufacturers would have conversion costs to achieve the new efficiency level.

b. Pattern Production and Engineering Constraints

Many manufacturers raised concerns regarding potential tooling bottlenecks. In general, much of the industry relies on the same resources for patterns used to produce the impeller and bowl. Manufacturers were concerned there would not be enough pattern production capacity available if the entire industry attempted to redesign products within the same three to five year timeframe. Furthermore, manufacturers expressed concern surrounding insufficient availability of engineering resources (mainly design engineers) required to redesign a high volume of pump lines during a short time period. Manufacturers stated that limited pump design expertise in the industry could create time delays in complying with new standards.

c. Conversion Requirements

Manufacturers raised concerns over potentially significant barriers to achieving compliance with new standards, particularly at higher efficiency levels. If U.S. standards exceeded levels comparable to an EU minimum efficiency index (MEI)[53] of 0.4, several manufacturers indicated they would have to develop entirely new product platforms at significant cost. At an MEI of 0.7, many indicated they would close manufacturing facilities rather than upgrade them to comply with any efficiency standards. Additionally, manufacturers suggested that conversion requirements would likely accelerate trends toward industry consolidation, as smaller manufacturers elect to exit the market rather than invest in product redesigns.

d. Exclusion of Specific Pump Types

Manufacturers expressed concern over which pumps would be included in the rulemaking; two of these manufacturers raised concerns specifically with the prospect of regulating circulator pumps (*i.e.,* small pumps that circulate liquid in water heating or hydronic space conditioning systems in buildings). Manufacturers stated that compared to the European market, the U.S. market for circulator pumps is very small and would not present a large opportunity to save energy. Manufacturers also stated that the investment required by U.S. circulator pump manufacturers will be too high relative to the return on investment. They also mentioned that in most situations, due to the higher cost of high-efficiency equipment and the relatively low cost of energy in the U.S., consumers would not see a return on investment for a long period of time.

K. Emissions Analysis

In the emissions analysis, DOE estimated the reduction in power sector emissions of CO_2, NO_X, SO_2, Hg, CH4, and N_2O from new energy conservation standards for the considered pump equipment. In addition, DOE estimated emissions impacts in production activities (extracting, processing, and transporting fuels) that provide the energy inputs to power plants. These are referred to as ''upstream'' emissions. Together, these emissions account for the full-fuel-cycle (FFC). In accordance with DOE's FFC Statement of Policy (76 FR 51281, August 18, 2011, as amended at 77 FR 49701, Aug. 17, 2012), this FFC analysis includes impacts on emissions of methane (CH_4) and nitrous oxide (N_2O), both of which are recognized as greenhouse gases.

DOE primarily conducted the emissions analysis using emissions factors for CO_2 and most of the other gases derived from data in *AEO 2014.* Combustion emissions of CH_4 and N_2O were estimated using emissions intensity factors published by the Environmental Protection Agency (EPA) through its GHG Emissions Factors Hub.[54] DOE developed separate emissions factors for power sector emissions and upstream emissions. The method that DOE used to derive emissions factors is described in chapter 13 of the NOPR TSD.

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 the physical units by the gas's global warming potential (GWP) over a 100-year time horizon. Based on the Fifth Assessment Report of the Intergovernmental Panel on Climate Change,[55] DOE used GWP values of 28 for CH_4 and 265 for N_2O.

EIA prepares the *Annual Energy Outlook* using NEMS. Each annual version of NEMS incorporates the projected impacts of existing air quality regulations on emissions. *AEO 2014* generally represents current legislation and environmental regulations, including recent Government actions, for which implementing regulations were available as of October 31, 2013.

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). 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),

[53] The EU sets efficiency standards based on desired percentages of the market to cut off, which it refers to as minimum efficiency indexes, or MEIs. A MEI of 0.4, for example, indicates an efficiency standard designed to eliminate the least efficient 40 percent of products from the market.

[54] See: *http://www.epa.gov/climateleadership/inventory/ghg-emissions.html.*

[55] 1 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.

which created an allowance-based trading program that operates along with the Title IV program. CAIR was remanded to the U.S. Environmental Protection Agency (EPA) by the U.S. Court of Appeals for the District of Columbia Circuit, but it remained in effect. 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). 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.[56] The court ordered EPA to continue administering CAIR. The emissions factors used for today's NOPR, which are based on *AEO 2014,* assume that CAIR remains a binding regulation through 2040.[57]

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 around 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 final 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 2014* 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 that would be 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. Therefore, DOE believes that energy efficiency standards will 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.[58] 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. 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 today's NOPR 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 2014,* which incorporates MATS.

In response to the Framework Document, EEI noted that EPA projects significant reductions in particulate emissions from electric generating units as a result of MATS compliance. (EEI, No.31 at p. 4.) EEI also believed that DOE should incorporate the most recent AEO and EPA's most recent analyses in the emissions analysis. Power sector emissions of criteria air pollutants have dropped dramatically. (EEI, No. 31 at p. 4.) As discussed above, the *AEO 2014* projections that serve as a reference case for measuring the impacts of potential standards account for the MATS and other emissions rules for which implementing regulations were available as of October 31, 2013.

L. Monetizing Carbon Dioxide and Other Emissions Impacts

As part of the development of this NOPR, 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 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 NOPR, 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 NOPR 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

[56] See *EME Homer City Generation, LP* v. *EPA,* 696 F.3d 7, 38 (D.C. Cir. 2012).

[57] 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. 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. See *EPA* v. *EME Homer City Generation,* No 12–1182, slip op. at 32 (U.S. April 29, 2014). Because DOE is using emissions factors based on *AEO 2014* for today's NOPR, the analysis assumes 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 SO_2 emissions.

[58] 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.

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.

e. 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.

f. 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.4 presents the values in the 2010 interagency group report,[59] which is reproduced in appendix 14A of the NOPR TSD.

[59] *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: *http://www.whitehouse.gov/sites/default/files/omb/inforeg/for-agencies/Social-Cost-of-Carbon-for-RIA.pdf*).

TABLE IV.4—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 today's notice were generated using the most recent versions of the three integrated assessment models that have been published in the peer-reviewed literature.[60] (See appendix 14B of the NOPR TSD for further information.) Table IV.5 shows the updated sets of SCC estimates in five year increments from 2010 to 2050. Appendix 14B of the NOPR 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.5—ANNUAL SCC VALUES FROM 2013 INTERAGENCY UPDATE, 2010–2050

[in 2007 dollars per metric ton CO_2]

Year	Discount rate (%)			
	5	3	2.5	3
	Average	Average	Average	95th Percentile
2010	11	32	51	89
2015	11	37	57	109
2020	12	43	64	128
2025	14	47	69	143
2030	16	52	75	159
2035	19	56	80	175
2040	21	61	86	191
2045	24	66	92	206
2050	26	71	97	220

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.

In summary, in considering the potential global benefits resulting from reduced CO_2 emissions, DOE used the values from the 2013 interagency report, adjusted to 2013$ using the Gross Domestic Product price deflator. For each of the four cases specified, the values used for emissions in 2015 were $12.0, $40.5, $62.4, and $119 per metric ton avoided (values expressed in 2013$). 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.

[60] *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 November 2013) (Available at: *http://www.whitehouse.gov/sites/default/files/omb/assets/inforeg/technical-update-social-cost-of-carbon-for-regulator-impact-analysis.pdf*).

2. Valuation of Other Emissions Reductions

As noted above, DOE has taken into account how new energy conservation standards would reduce NO_X emissions in those 22 States not affected by emissions caps. DOE estimated the monetized value of NO_X emissions reductions resulting from each of the TSLs considered for today's NOPR based on estimates found in the relevant scientific literature. Estimates of monetary value for reducing NO_X from stationary sources range from $476 to $4,893 per ton (2013$).[61] DOE calculated monetary benefits using a medium value for NO_X emissions of $2,684 per short ton (in 2013$), and real discount rates of 3 percent and 7 percent.

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 power generation industry that would result from the adoption of new or amended energy conservation standards. In the utility impact analysis, DOE analyzes the changes in installed electrical capacity and generation that would result for each trial standard level. The analysis is based on published output from NEMS, which is a public domain, multi-sectored, partial equilibrium model of the U.S. energy sector. Each year, NEMS is updated to produce 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 those published side cases that incorporate efficiency-related policies to estimate the marginal impacts of reduced energy demand on the utility sector. 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. Chapter 15 of the NOPR TSD describes the utility impact analysis in further detail.

N. Employment Impact Analysis

Employment impacts include direct and indirect impacts. Direct 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). 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.[62] 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 NOPR, 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).[63] 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 NOPR, 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 NOPR TSD.

V. Analytical Results

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 were selected to 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 proposed to set the baseline and max-tech levels equal to those established in Europe, but was unable to develop intermediate efficiency levels or TSLs due to lack of available cost data for this equipment. As a result, the baseline efficiency level

[61] U.S. Office of Management and Budget, Office of Information and Regulatory Affairs, *2006 Report to Congress on the Costs and Benefits of Federal Regulations and Unfunded Mandates on State, Local, and Tribal Entities,* Washington, DC. Available at: *www.whitehouse.gov/sites/default/files/omb/assets/omb/inforeg/2006_cb/2006_cb_final_report.pdf.*

[62] *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).

[63] 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*).

has been specified for all TSLs 1 through 4, with the max-tech level being specified for TSL 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 1	EL 2	EL 3	EL 4	EL 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 chosen 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.D.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	129.63
RSV.3600 *	133.20	133.20	133.20	133.20	133.20	133.20
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

* 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 standards would have on the LCC and PBP, when compared to the base case described in section IV.F.1. DOE also examined the impacts of potential 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 NOPR 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 base 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 base case and purchase more expensive and efficient redesigned pumps in the standards case. The simple payback and LCC savings are measured relative to the base-case efficiency distribution in the compliance year (see section IV.F.1 for a description of the base case).

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

TSL	Efficiency level	Average costs (2013$)				Simple payback (years)	Average lifetime (years)
		Installed cost	First year's operating cost	Lifetime operating cost	LCC		
	Base Case	$1,639	$2,271	$17,546	$19,185		13
1	1	1,672	2,261	17,470	19,142	3.3	13
2	2	1,704	2,240	17,317	19,021	2.2	13
3	3	1,768	2,222	17,177	18,945	2.6	13
4	4	1,863	2,198	16,997	18,861	3.1	13
5	5	2,026	2,172	16,796	18,822	3.9	13

Note: The results for each TSL are calculated considering all consumers. The PBP is measured relative to the base case.

TABLE V.4—LCC SAVINGS RELATIVE TO THE BASE CASE EFFICIENCY DISTRIBUTION FOR ESCC.1800

TSL	Efficiency level	Life-cycle cost savings	
		% of consumers that experience	Average savings *
		Net Cost	(2013$)
1	1	12	$43
2	2	11	164
3	3	23	240
4	4	30	324
5	5	42	362

* 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 (2013$)				Simple payback (years)	Average lifetime (years)
		Installed cost	First year's operating cost	Lifetime operating cost	LCC		
	Base Case	$1,092	$1,592	$9,823	$10,915		11
1	1	1,098	1,588	9,800	10,898	1.4	11
2	2	1,111	1,574	9,713	10,823	1.0	11
3	3	1,141	1,565	9,653	10,794	1.8	11
4	4	1,170	1,551	9,566	10,736	1.9	11
5	5	1,215	1,528	9,422	10,638	1.9	11

Note: The results for each TSL are calculated considering all consumers. The PBP is measured relative to the base case.

TABLE V.6—LCC SAVINGS RELATIVE TO THE BASE CASE EFFICIENCY DISTRIBUTION FOR ESCC.3600

TSL	Efficiency level	Life-cycle cost savings	
		% of consumers that experience	Average savings *
		Net cost	(2013$)
1	1	0.7	$17
2	2	1.8	92
3	3	14	122
4	4	14	180
5	5	12	278

* 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 (2013$)				Simple payback (years)	Average lifetime (years)
		Installed cost	First year's operating cost	Lifetime operating cost	LCC		
	Base Case	$1,891	$3,424	$40,983	$42,874		23
1	1	1,893	3,423	40,973	42,866	2.4	23
2	2	1,943	3,406	40,759	42,701	2.8	23

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

TSL	Efficiency level	Average costs (2013$)				Simple payback (years)	Average lifetime (years)
		Installed cost	First year's operating cost	Lifetime operating cost	LCC		
3	3	2,004	3,384	40,498	42,502	2.8	23
4	4	2,151	3,342	39,988	42,139	3.1	23
5	5	2,314	3,301	39,498	41,812	3.4	23

Note: The results for each TSL are calculated considering all consumers. The PBP is measured relative to the base case.

TABLE V.8—LCC SAVINGS RELATIVE TO THE BASE CASE EFFICIENCY DISTRIBUTION FOR ESFM.1800

TSL	Efficiency level	Life-cycle cost savings	
		% of consumers that experience	Average savings *
		Net cost	(2013$)
1	1	0.26	$8.0
2	2	6.5	173
3	3	15	372
4	4	24	735
5	5	26	1,062

* 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 (2013$)				Simple payback (years)	Average lifetime (years)
		Installed cost	First year's operating cost	Lifetime operating cost	LCC		
	Base Case	$1,349	$5,278	$51,268	$52,616		20
1	1	1,357	5,271	51,201	52,558	1.2	20
2	2	1,396	5,218	50,674	52,070	0.8	20
3	3	1,441	5,171	50,214	51,655	0.9	20
4	4	1,529	5,117	49,676	51,205	1.1	20
5	5	1,648	5,036	48,890	50,538	1.2	20

Note: The results for each TSL are calculated considering all consumers. The PBP is measured relative to the base case.

TABLE V.10—LCC SAVINGS RELATIVE TO THE BASE CASE EFFICIENCY DISTRIBUTION FOR ESFM.3600

TSL	Efficiency level	Life-cycle cost savings	
		% of consumers that experience	Average savings *
		Net cost	(2013$)
1	1	0.29	$58
2	2	1.9	547
3	3	4.7	961
4	4	7.0	1,411
5	5	8.4	2,078

* 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 (2013$)				Simple payback (years)	Average lifetime (years)
		Installed cost	First year's operating cost	Lifetime operating cost	LCC		
	Base Case	$2,128	$1,891	$16,760	$18,888		16
1	1	2,145	1,884	16,692	18,837	2.3	16
2	2	2,194	1,868	16,545	18,739	2.8	16
3	3	2,281	1,852	16,407	18,688	3.9	16
4	4	2,432	1,835	16,254	18,686	5.4	16

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

TSL	Efficiency level	Average costs (2013$)				Simple payback (years)	Average lifetime (years)
		Installed cost	First year's operating cost	Lifetime operating cost	LCC		
5	5	2,614	1,811	16,040	18,654	6.1	16

Note: The results for each TSL are calculated considering all consumers. The PBP is measured relative to the base case.

TABLE V.12—LCC SAVINGS RELATIVE TO THE BASE CASE EFFICIENCY DISTRIBUTION FOR IL.1800

TSL	Efficiency level	Life-cycle cost savings	
		% of consumers that experience	Average savings *
		Net cost	(2013$)
1	1	1.8	$51
2	2	6.9	149
3	3	15	200
4	4	25	202
5	5	36	234

* 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 (2013$)				Simple payback (years)	Average lifetime (years)
		Installed cost	First year's operating cost	Lifetime operating cost	LCC		
	Base Case	$1,473	$2,046	$14,211	$15,684		13
1	1	1,484	2,038	14,155	15,639	1.4	13
2	2	1,525	2,019	14,020	15,545	1.9	13
3	3	1,578	1,997	13,865	15,443	2.1	13
4	4	1,650	1,980	13,747	15,397	2.7	13
5	5	1,797	1,946	13,510	15,307	3.2	13

Note: The results for each TSL are calculated considering all consumers. The PBP is measured relative to the base case.

TABLE V.14—LCC SAVINGS RELATIVE TO THE BASE CASE EFFICIENCY DISTRIBUTION FOR IL.3600

TSL	Efficiency level	Life-cycle cost savings	
		% of consumers that experience	Average savings *
		Net cost	(2013$)
1	1	2.0	$46
2	2	13	139
3	3	11	241
4	4	14	288
5	5	20	377

* 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 (2013$)				Simple payback (years)	Average lifetime (years)
		Installed cost	First year's operating cost	Lifetime operating cost	LCC		
	Base Case	$692	$1,025	$5,857	$6,549		11
1	1	697	1,025	5,855	6,551	11	11
2	2	711	1,021	5,830	6,542	4.2	11
3	3	732	1,002	5,726	6,458	1.7	11
4	4	772	989	5,654	6,426	2.2	11
5	5	821	977	5,584	6,405	2.7	11

Note: The results for each TSL are calculated considering all consumers. The PBP is measured relative to the base case.

TABLE V.16—LCC SAVINGS RELATIVE TO THE BASE CASE EFFICIENCY DISTRIBUTION FOR VTS.3600

TSL	Efficiency level	Life-cycle cost savings	
		% of consumers that experience Net Cost	Average savings * (2013$)
1	1	1.4	$(2.4)
2	2	21	7.2
3	3	4.4	91
4	4	8.5	123
5	5	13	144

* 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.[64] Chapter 11 of the NOPR TSD provides more detailed discussion on the LCC subgroup analysis and results.

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

TSL	Energy efficiency level	LCC savings (2013$ *)		Simple payback period (years)	
		VFD-users	Non-VFD users	VFD-users	Non-VFD users
1	1	$12	$43	5.6	3.3
2	2	71	164	3.6	2.2
3	3	91	240	4.4	2.6
4	4	104	324	5.2	3.1
5	5	63	362	6.5	3.9

* 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 (2013$ *)		Simple payback period (years)	
		VFD-users	Non-VFD users	VFD-users	Non-VFD users
1	1	$8.7	$17	2.3	1.4
2	2	51	92	1.6	1.0
3	3	57	122	2.8	1.8
4	4	83	180	3.0	1.9
5	5	127	278	3.0	1.9

* 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 (2013$ *)		Simple payback period (years)	
		VFD-users	Non-VFD users	VFD-users	Non-VFD users
1	1	$4.3	$8.0	3.9	2.4
2	2	85	173	4.6	2.8
3	3	186	372	4.6	2.8
4	4	355	735	5.1	3.1
5	5	494	1,062	5.6	3.4

* Parentheses indicate negative values.

[64] 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.20—COMPARISON OF IMPACTS FOR VFD USERS WITH NON-VFD USERS, ESFM.3600

TSL	Energy efficiency level	LCC savings (2013$ *)		Simple payback period (years)	
		VFD-users	Non-VFD users	VFD-users	Non-VFD users
1	1	$33	$58	2.0	1.2
2	2	319	547	1.3	0.8
3	3	558	961	1.4	0.9
4	4	802	1,411	1.8	1.1
5	5	1,168	2,078	2.0	1.2

* 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 (2013$ *)		Simple payback period (years)	
		VFD-users	Non-VFD users	VFD-users	Non-VFD users
1	1	$26	$51	3.6	2.3
2	2	67	149	4.5	2.8
3	3	64	200	6.4	3.9
4	4	6.3	202	8.8	5.4
5	5	($46)	234	9.9	6.1

* 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 (2013$ *)		Simple payback period (years)	
		VFD-users	Non-VFD users	VFD-users	Non-VFD users
1	1	$25	$46	2.2	1.4
2	2	67	139	3.1	1.9
3	3	111	241	3.5	2.1
4	4	113	288	4.3	2.7
5	5	112	377	5.2	3.2

* 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 (2013$ *)		Simple payback period (years)	
		VFD-users	Non-VFD users	VFD-users	Non-VFD users
1	1	$(3.5)	$(2.4)	18	11
2	2	(2.6)	7.2	6.6	4.2
3	3	44	91	2.7	1.7
4	4	50	123	3.5	2.2
5	5	46	144	4.2	2.7

* Parentheses indicate negative values.

c. Rebuttable Presumption Payback

As discussed in section III.H.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	3.4	2.2	2.6	3.1	3.9
ESCC.3600	1.4	1.0	1.7	1.8	1.9
ESFM.1800	2.4	2.8	2.8	3.1	3.4
ESFM.3600	1.2	0.8	0.9	1.1	1.2
IL.1800	2.3	2.8	3.9	5.4	6.0
IL.3600	1.3	1.9	2.1	2.7	3.2
VTS.3600	11	4.2	1.8	2.3	2.7

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 NOPR 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 base 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 base case and each standards case that results from the sum of discounted cash flows from the base year 2014 through 2048, 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 base 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 base case.

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

*	Units	Base case	Trial standard level				
			1	2	3	4	5
INPV	$M	121.4	111.6	81.9	22.4	(85.0)	(228.4)
Change in INPV	$M		(9.8)	(39.5)	(99)	(206.3)	(349.8)
	%		(8.0)	(32.5)	(81.6)	(170.0)	(288.2)
Total Conversion Costs.	$M		19.9	78.4	174.3	335.0	547.7
Free Cash Flow (2018).	$M	12.2	5.6	(16.1)	(58.7)	(130.1)	(224.4)
Free Cash Flow (2018).	% Change		(54.3)	(232.5)	(582.0)	(1167.5)	(1942.4)

* Values in parentheses are negative values.

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

*	Units	Base case	Trial standard level				
			1	2	3	4	5
INPV	$M	121.4	121.8	129.7	125.4	114.1	94.1
Change in INPV	$M		0.4	8.3	4.0	(7.2)	(27.3)
	%		0.3	6.9	3.3	(6.0)	(22.5)

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

%	Units	Base case	Trial standard level				
			1	2	3	4	5
Total Conversion Costs.	$M	....	19.9	78.4	174.3	335.0	547.7
Free Cash Flow (2018).	$M	12.2	5.6	(16.1)	(58.7)	(130.1)	(224.4)
Free Cash Flow (2018).	% Change ...	....	(54.3)	(232.5)	(582.0)	(1167.5)	(1942.4)

* Values in parentheses are negative values.

TSL 1 represents EL 1 for all equipment classes. At TSL 1, DOE estimates impacts on INPV for pump manufacturers to range from −8.0 percent to 0.3 percent, or a change in INPV of −$9.8 million to $0.4 million. At this potential standard level, industry free cash flow is estimated to decrease by approximately 54.3 percent to $5.6 million, compared to the base-case value of $12.2 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 $19.9 million, driven by hydraulic redesigns.

TSL 2 represents EL 2 across all equipment classes. At TSL 2, DOE estimates impacts on INPV for pump manufacturers to range from −32.5 percent to 6.9 percent, or a change in INPV of −$39.5 million to $8.3 million. At this potential standard level, industry free cash flow is estimated to decrease by approximately 232.5 percent to −$16.1 million, compared to the base-case value of $12.2 million in the year before the compliance date (2019). Conversion costs for an estimated 25% of model offerings, would be approximately $78.4 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. At TSL 3, DOE estimates impacts on INPV for pump manufacturers to range from −81.6 percent to 3.3 percent, or a change in INPV of −$99 million to $4 million. At TSL 3, industry conversion costs for an estimated 40% of model offerings would be approximately $174.3 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. At TSL 4, DOE estimates impacts on INPV for pump manufacturers to range from −170 percent to −6 percent, or a change in INPV of −$206.3 million to −$7.2 million. At this potential standard level, industry free cash flow is estimated to decrease by approximately 1167.5 percent relative to the base-case value of $12.2 million in the year before the compliance date (2019). The total industry conversion costs for an estimated 55% of model offerings would be approximately $335 million. The 1167.5% 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. At TSL 5, DOE estimates impacts on INPV for pump manufacturers to range from −288.2 percent to −22.5 percent, or a change in INPV of −$349.8 million to −$27.3 million. At this potential standard level, industry free cash flow is estimated to decrease by approximately 1942.4 percent relative to the base-case value of $12.2 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 $547.7 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.

DOE requests comment on the capital conversion costs and product conversion costs estimated for each TSL. This matter is identified as Issue 12 under ''Issues on Which DOE Seeks Comment'' in section VIII.E of this NOPR.

In section VI, DOE proposes 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. However, DOE notes that costs of updating marketing materials for pumps that do not have to be redesigned to meet the standard are not considered in the industry valuation figures because these costs would be incurred by manufacturers in order to make representations of energy use (PEI) according to the proposed test procedure, as well as to include labeling requirements, regardless of whether DOE set an energy conservation standard or what TSL DOE selected. These costs are discussed in section VI.

b. 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 base 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),[65] 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.

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

	Trial standard level					
	Base case	1	2	3	4	5
Potential Changes in Domestic Production Workers in 2020 (relative to a base 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 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 NOPR TSD.

DOE requests comment on the potential impacts on manufacturer employment and the specific drivers of any expected change in production line employment. This matter is identified as Issue 13 under ''Issues on Which DOE Seeks Comment'' in section VIII.E of this NOPR.

c. 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 proposed standard level. The level proposed today is based on a level that the CIP Working Group considered feasible for the industry. DOE requests comments on the potential for production line capacity constraints and on the potential for technical resource constraints due to the proposed standard.

DOE requests comments and data on capacity constraints at each TSL—including production capacity constraints, engineering resource constraints, and testing capacity constraints. In particular, DOE requests comment on whether the proposed compliance date allows for a sufficient conversion period to make the equipment design and facility updates necessary to meet a new standard. This matter is identified as Issue 14 under ''Issues on Which DOE Seeks Comment'' in section VIII.E of this NOPR.

d. 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

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

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 VI.B of this notice and chapter 12 of the NOPR TSD.

e. 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 2020 compliance date of standard proposed in this notice. The Department was not able to identify any additional regulatory burdens that met these criteria.

DOE requests comments the cumulative regulatory burden on manufacturers. Specifically, DOE seeks input on any product-specific Federal regulations with which compliance is required within three years of the proposed compliance date for any final pumps standards, as well as on recommendations on how DOE may be able to align varying regulations to mitigate cumulative burden. This matter is identified as Issue 15 under ''Issues on Which DOE Seeks Comment'' in section VIII.E of this NOPR.

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 base case described in section IV.H.2.

Table V.28 presents the estimated primary energy savings for each considered TSL, and Table V.29 presents the estimated FFC energy savings. The approach is further described in section IV.H.1.

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

Equipment class	Trial standard level (quads)				
	1	2	3	4	5
ESCC.1800	0.016	0.05	0.08	0.12	0.16
ESCC.3600	0.016	0.07	0.11	0.17	0.26
ESFM.1800	0.003	0.05	0.11	0.23	0.35
ESFM.3600	0.002	0.02	0.03	0.05	0.07
IL.1800	0.015	0.05	0.08	0.11	0.16
IL.3600	0.003	0.01	0.02	0.02	0.03
VTS.3600	0.002	0.02	0.11	0.17	0.22
Total—All Classes	0.056	0.27	0.54	0.87	1.26

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

TABLE V.29—CUMULATIVE NATIONAL FULL-FUEL-CYCLE ENERGY SAVINGS FOR PUMP TRIAL STANDARD LEVELS FOR UNITS SOLD IN 2020–2049

Equipment class	Trial standard level (quads)				
	1	2	3	4	5
ESCC.1800	0.017	0.05	0.08	0.12	0.17
ESCC.3600	0.017	0.08	0.12	0.18	0.28
ESFM.1800	0.003	0.06	0.12	0.25	0.37
ESFM.3600	0.002	0.02	0.03	0.05	0.07
IL.1800	0.016	0.05	0.08	0.12	0.17
IL.3600	0.003	0.01	0.02	0.02	0.03
VTS.3600	0.002	0.02	0.11	0.17	0.24
Total—All Classes	0.059	0.28	0.56	0.91	1.32

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

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.[66] 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.[67] 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.30. The impacts are counted over the lifetime of equipment purchased in 2020–2028.

TABLE V.30—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
ESCC.1800	0.004	0.013	0.020	0.03	0.04
ESCC.3600	0.004	0.019	0.029	0.04	0.07
ESFM.1800	0.001	0.014	0.030	0.06	0.09
ESFM.3600	0.001	0.004	0.008	0.01	0.02
IL.1800	0.004	0.012	0.020	0.03	0.04
IL.3600	0.001	0.002	0.004	0.01	0.01
VTS.3600	0.001	0.006	0.028	0.04	0.06
Total—All Classes	0.015	0.071	0.141	0.23	0.33

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,[68] DOE calculated NPV using both a seven-percent and a three-percent real discount rate. Table V.31 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.31—CUMULATIVE NET PRESENT VALUE OF CONSUMER BENEFIT FOR PUMP TRIAL STANDARD LEVELS FOR UNITS SOLD IN 2020–2049

Equipment class	Discount rate (%)	Trial standard level (billion 2013$ *)				
		1	2	3	4	5
ESCC.1800	3	0.052	0.20	0.29	0.40	0.47
	7	0.018	0.07	0.11	0.14	0.15
ESCC.3600	3	0.069	0.34	0.46	0.68	1.06
	7	0.028	0.14	0.18	0.26	0.41
ESFM.1800	3	0.010	0.20	0.44	0.88	1.28
	7	0.003	0.06	0.14	0.27	0.39
ESFM.3600	3	0.009	0.08	0.14	0.20	0.30
	7	0.003	0.03	0.05	0.07	0.11
IL.1800	3	0.063	0.18	0.25	0.28	0.34
	7	0.022	0.06	0.08	0.07	0.07
IL.3600	3	0.011	0.04	0.06	0.08	0.11
	7	0.004	0.01	0.02	0.03	0.04
VTS.3600	3	(0.001)	0.07	0.49	0.71	0.90
	7	(0.002)	0.02	0.20	0.28	0.35
Total—All Classes	3	0.213	1.11	2.13	3.23	4.47
	7	0.077	0.41	0.77	1.13	1.51

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

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

[67] 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.

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

The NPV results based on the aforementioned nine-year analytical period are presented in Table V.32. 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.

TABLE V.32—CUMULATIVE NET PRESENT VALUE OF CONSUMER BENEFIT FOR PUMP TRIAL STANDARD LEVELS FOR UNITS SOLD IN 2020–2028

Equipment class	Discount rate (%)	Trial standard level (billion 2013$ *)				
		1	2	3	4	5
ESCC.1800	3	0.017	0.06	0.10	0.13	0.15
	7	0.008	0.03	0.05	0.06	0.07
ESCC.3600	3	0.023	0.11	0.15	0.22	0.35
	7	0.013	0.06	0.08	0.12	0.18
ESFM.1800	3	0.003	0.07	0.14	0.29	0.42
	7	0.002	0.03	0.06	0.12	0.18
ESFM.3600	3	0.003	0.03	0.05	0.07	0.10
	7	0.001	0.01	0.02	0.03	0.05
IL.1800	3	0.021	0.06	0.08	0.09	0.10
	7	0.010	0.03	0.03	0.03	0.03
IL.3600	3	0.004	0.01	0.02	0.03	0.04
	7	0.002	0.01	0.01	0.01	0.02
VTS.3600	3	(0.001)	0.02	0.16	0.23	0.30
	7	(0.001)	0.01	0.09	0.13	0.16
Total—All Classes	3	0.070	0.36	0.70	1.06	1.45
	7	0.035	0.18	0.35	0.51	0.68

* 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 NOPR 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 proposed 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 NOPR 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 NOPR, 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.

DOE seeks comment on the impacts, if any, there would be on the level of utility and available features currently offered by manufacturers with respect to the pumps that would be regulated under this proposal. This matter is identified as Issue 16 under ''Issues on Which DOE Seeks Comment'' in section VIII.E of this NOPR.

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).)

To assist the Attorney General in making such a determination, DOE will provide DOJ with copies of this notice and the TSD for review. DOE will consider DOJ's comments on the proposed rule in preparing the final rule, and DOE will publish and respond to DOJ's comments in that document.

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 NOPR TSD.

Energy savings from new standards for the pump equipment classes covered in today's NOPR could also produce environmental benefits in the form of reduced emissions of air pollutants and greenhouse gases associated with electricity production. Table V.33 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 NOPR 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.33—CUMULATIVE EMISSIONS REDUCTION FOR POTENTIAL STANDARDS FOR PUMPS

	TSL				
	1	2	3	4	5
Power Sector Emissions					
CO_2 *(million metric tons)*	3.2	15	31	50	72
SO_2 (*thousand tons*)	2.6	13	25	40	58
NO_X *(thousand tons)*	2.5	12	23	38	55
Hg (*tons*)	0.008	0.039	0.077	0.124	0.180
CH4 (thousand tons)	0.32	1.54	3.07	4.95	7.20
N_2O (*thousand tons*)	0.05	0.22	0.44	0.71	1.03
Upstream Emissions					
CO_2 *(million metric tons)*	0.19	0.91	1.81	2.93	4.26
SO_2 (*thousand tons*)	0.03	0.16	0.32	0.51	0.74
NO_X *(thousand tons)*	2.7	13	26	42	61
Hg (*tons*)	0.0001	0.0004	0.0007	0.0011	0.0016
CH4 (thousand tons)	16	76	151	244	354
N_2O (*thousand tons*)	0.002	0.008	0.016	0.025	0.036
Total Emissions					
CO_2 *(million metric tons)*	3.4	16	33	53	77
SO_2 (*thousand tons*)	2.7	13	25	41	59
NO_X *(thousand tons)*	5.2	25	49	80	116
Hg (*tons*)	0.01	0.04	0.08	0.13	0.18
CH4 (thousand tons)	16	77	154	248	362
N_2O (*thousand tons*)	0.05	0.23	0.45	0.73	1.07

As part of the analysis for this NOPR, 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 SCC values for CO_2 emissions reductions in 2015, expressed in 2013$, are $12.0/ton, $40.5/ton, $62.4/ton, and $119/ton. The values for later years are higher due to increasing emissions-related costs as the magnitude of projected climate change increases.

Table V.34 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 NOPR TSD. *See* Section IV. L. for further details.

TABLE V.34—GLOBAL PRESENT VALUE OF CO_2 EMISSIONS REDUCTION FOR POTENTIAL STANDARDS FOR PUMPS

TSL	SCC Scenario * (million 2013$)			
	5% Discount rate, average	3% Discount rate, average	2.5% Discount rate, average	3% Discount rate, 95th percentile
Power Sector Emissions				
1	21	100	160	310
2	100	474	757	1468
3	199	944	1506	2921
4	319	1517	2421	4695
5	463	2205	3521	6826

TABLE V.34—GLOBAL PRESENT VALUE OF CO_2 EMISSIONS REDUCTION FOR POTENTIAL STANDARDS FOR PUMPS—Continued

TSL	SCC Scenario * (million 2013$)			
	5% Discount rate, average	3% Discount rate, average	2.5% Discount rate, average	3% Discount rate, 95th percentile
Upstream Emissions				
1	1.2	5.8	9.3	18
2	5.8	28	44	86
3	11	55	88	170
4	18	88	141	274
5	27	129	206	398
Total Emissions				
1	22	106	169	329
2	106	502	801	1554
3	210	999	1594	3092
4	337	1605	2563	4969
5	490	2334	3726	7224

* For each of the four cases, the corresponding SCC value for emissions in 2015 is $12.0, $40.5, $62.4 and $119 per metric ton (2013$).

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 NOPR 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 NOPR. The dollar-per-ton values that DOE used are discussed in section IV.L. Table V.35 presents the present value of cumulative NO_X emissions reductions for each TSL calculated using the average dollar-per-ton values and seven-percent and three-percent discount rates.

TABLE V.35—PRESENT VALUE OF NO_X EMISSIONS REDUCTION FOR POTENTIAL STANDARDS FOR PUMPS

TSL	Million 2013$	
	3% Discount rate	7% Discount rate
Power Sector Emissions		
1	3.1	1.4
2	15	6.4
3	29	13
4	47	20
5	68	29
Upstream Emissions		
1	3.3	1.4
2	16	6.4
3	31	13
4	50	20
5	72	30
Total Emissions		
1	6.5	2.8
2	30	13
3	60	25
4	97	41
5	141	59

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.36 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.36—PUMP TSLS: NET PRESENT VALUE OF CONSUMER SAVINGS COMBINED WITH NET PRESENT VALUE OF MONETIZED BENEFITS FROM CO_2 AND NO_X EMISSIONS REDUCTIONS

TSL	Consumer NPV at 7% discount rate added with: (billion 2013$)			
	SCC Value of $12.0/metric ton CO_2* and medium value for NO_X**	SCC Value of $40.5/metric ton CO_2* and medium value for NO_X**	SCC Value of $62.4/metric ton CO_2* and medium value for NO_X**	SCC Value of $119/metric ton CO_2* and medium value for NO_X**
1	0.2	0.3	0.4	0.5
2	1.2	1.6	1.9	2.7
3	2.4	3.2	3.8	5.3
4	3.7	4.9	5.9	8.3
5	5.1	6.9	8.3	12
	Consumer NPV at 7% discount rate added with: (billion 2013$)			
1	0.1	0.2	0.2	0.4
2	0.5	0.9	1.2	2.0
3	1.0	1.8	2.4	3.9
4	1.5	2.8	3.7	6.1
5	2.1	3.9	5.3	8.8

Note: Parentheses indicate negative values.
* These label values represent the global SCC in 2015, in 2013$. The present values have been calculated with scenario-consistent discount rates.
** Medium Value corresponds to $2,684 per ton of NO_X emissions.

Although adding the value of consumer savings to the values of emission reductions provides a valuable perspective, two issues should be considered. First, the national operating cost 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 the SCC are performed with different methods that use quite 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.

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 has weighed the value of such negotiation in establishing the standards proposed in today's rule. DOE has 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.

C. Proposed Standards

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 today's NOPR, 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 V.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 V.B.2.b, and the indirect employment impacts in section V.B.3.c.

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

Table V.37, Table V.38, and Table V.39 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.37—SUMMARY OF ANALYTICAL RESULTS FOR PUMPS: NATIONAL IMPACTS

Category	TSL 1	TSL 2	TSL 3	TSL 4	TSL 5
National FFC Energy Savings *(quads)*.	0.059	0.28	0.56	0.91	1.32.
NPV of Consumer Benefits (2013$ billion)					
3% discount rate	0.213	1.11	2.13	3.23	4.47.
7% discount rate	0.077	0.41	0.77	1.13	1.51.
Cumulative FFC Emissions Reduction					
CO_2 *(million metric tons)*.	3.4	16	33	53	77.
SO_2 *(thousand tons)*	2.7	13	25	41	59.
NO_X *(thousand tons)*	5.2	25	49	80	116.
Hg *(tons)*	0.01	0.04	0.08	0.13	0.18.
CH_4 *(thousand tons)*	16	77	154	248	362.
N_2O *(thousand tons)*	0.05	0.23	0.45	0.73	1.07.
Value of Emissions Reduction					
CO_2 (2013$ million)*	22 to 329	106 to 1554	210 to 3092	337 to 4969	490 to 7224.
NO_X—3% discount rate *(2013$ million)*.	6.5	30	60	97	141.
NO_X—7% discount rate *(2013$ million)*.	2.8	13	25	41	59.

* 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.38—NPV OF CONSUMER BENEFITS BY EQUIPMENT CLASS

Equipment class	Discount rate (%)	Trial standard level (billion 2013$ *)				
		1	2	3	4	5
ESCC.1800	3	0.052	0.20	0.29	0.40	0.47
	7	0.018	0.07	0.11	0.14	0.15
ESCC.3600	3	0.069	0.34	0.46	0.68	1.06
	7	0.028	0.14	0.18	0.26	0.41
ESFM.1800	3	0.010	0.20	0.44	0.88	1.28
	7	0.003	0.06	0.14	0.27	0.39
ESFM.3600	3	0.009	0.08	0.14	0.20	0.30
	7	0.003	0.03	0.05	0.07	0.11
IL.1800	3	0.063	0.18	0.25	0.28	0.34
	7	0.022	0.06	0.08	0.07	0.07
IL.3600	3	0.011	0.04	0.06	0.08	0.11
	7	0.004	0.01	0.02	0.03	0.04
VTS.3600	3	(0.001)	0.07	0.49	0.71	0.90
	7	(0.002)	0.02	0.20	0.28	0.35
Total—All Classes	3	0.213	1.11	2.13	3.23	4.47
	7	0.077	0.41	0.77	1.13	1.51

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

TABLE V.39—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 base case value of 121.4 (2013$ millions).	111.6 to 121.8	81.9 to 129.7	22.4 to 125.3	(85.0) to 114.1	(228.4) to 94.1.
Industry NPV (% change).	(8.0) to 0.3	(32.5) to 6.9	(81.6) to 3.3	(170.0) to (6.0)	(288.2) to (22.5).
Consumer Mean LCC Savings (2013$)					
ESCC.1800	$43	$164	$240	$324	$362.

TABLE V.39—SUMMARY OF ANALYTICAL RESULTS FOR PUMPS: MANUFACTURER AND CONSUMER IMPACTS—Continued

	TSL 1	TSL 2	TSL 3	TSL 4	TSL 5
ESCC.3600	$17	$92	$122	$180	$278.
ESFM.1800	$8.0	$173	$372	$735	$1,062.
ESFM.3600	$58	$547	$961	$1,411	$2,078.
IL.1800	$51	$149	$200	$202	$234.
IL.3600	$46	$139	$241	$288	$377.
VTS.3600	($2.4)	$7.2	$91	$123	$144.
Consumer Simple PBP (years)					
ESCC.1800	3.3	2.2	2.6	3.1	3.9.
ESCC.3600	1.4	1.0	1.8	1.9	1.9.
ESFM.1800	2.4	2.8	2.8	3.1	3.4.
ESFM.3600	1.2	0.8	0.9	1.1	1.2.
IL.1800	2.3	2.8	3.9	5.4	6.1.
IL.3600	1.4	1.9	2.1	2.7	3.2.
VTS.3600	11	4.2	1.7	2.2	2.7.
Percent Consumers with Net Cost (%)					
ESCC.1800	12	11	23	30	42.
ESCC.3600	0.7	1.8	14	14	12.
ESFM.1800	0.26	6.5	15	24	26.
ESFM.3600	0.29	1.9	4.7	7.0	8.4.
IL.1800	1.8	6.9	15	25	36.
IL.3600	2.0	13	11	14	20.
VTS.3600	1.4	21	4.4	8.5	13

Note: Parentheses indicate negative values.

First, DOE considered TSL 5, which would save an estimated total of 1.32 quads of energy, an amount DOE considers significant. TSL 5 has an estimated NPV of consumer benefit of $1.51 billion using a 7-percent discount rate, and $4.47 billion using a 3-percent discount rate. The cumulative emissions reductions at TSL 5 are 77 million metric tons of CO_2, 116 thousand tons of NO_X, and 0.18 tons of Hg. The estimated monetary value of the CO_2 emissions reductions at TSL 5 ranges from $490 million to $7,224 million. At TSL 5, the average LCC savings ranges from $144 to $2,078 depending on equipment class. The fraction of consumers with negative LCC benefits range from 8.4 percent to 42 percent depending on equipment class. At TSL 5, the projected change in INPV ranges from a decrease of $349.8 million to a decrease of $27.3 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 288.2 percent in INPV for manufacturers.

Accordingly, the Secretary tentatively 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 benefits 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 $1.13 billion using a 7-percent discount rate, and $3.23 billion using a 3-percent discount rate. The cumulative emissions reductions at TSL 4 are 53 million metric tons of CO_2, 80 thousand tons of NO_X, and 0.13 tons of Hg. The estimated monetary value of the CO_2 emissions reductions at TSL 4 ranges from $337 million to $4,969 million. At TSL 4, the average LCC savings ranges from $123 to $1,411 depending on equipment class. The fraction of consumers with negative LCC benefits range from 7.0 percent to 30 percent depending on equipment class. At TSL 4, the projected change in INPV ranges from a decrease of $206.3 million to a decrease of $7.2 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 170 percent in INPV for manufacturers.

Accordingly, the Secretary tentatively 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 benefits 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 0.56 quads of energy, an amount DOE considers significant. TSL 3 has an estimated NPV of consumer benefit of $0.77 billion using a 7-percent discount rate, and $2.13 billion using a 3-percent discount rate. The cumulative emissions reductions at TSL 3 are 33 million metric tons of CO_2, 49 thousand tons of NO_X, and 0.08 tons of Hg. The estimated monetary value of the CO_2 emissions reductions at TSL 3 ranges from $210 million to $3,092 million. At TSL 3, the average LCC savings are range from $91 to $961 depending on equipment class. The fraction of consumers with negative LCC benefits ranged from 4.4 percent to 23 percent depending on equipment class. At TSL 3, the projected change in INPV ranges from a decrease of $99 million to an increase of $4 million. If the lower bound of the range of impacts is reached, TSL 3 could result in a net loss of up to 81.6 percent in INPV for manufacturers.

Accordingly, the Secretary tentatively 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 benefits 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 0.28 quads of energy, an amount DOE considers significant. TSL 2 has an estimated NPV of consumer benefit of $0.41 billion using a 7-percent discount rate, and $1.11 billion using a 3-percent discount rate. The cumulative emissions reductions at TSL 2 are 16 million metric tons of CO_2, 25 thousand tons of NO_X, and 0.04 tons of Hg. The estimated monetary value of the CO_2 emissions reductions at TSL 3 ranges from $106 million to $1,554 million. At TSL 2, the average LCC savings range from $7.2 to $547 depending on equipment class. The fraction of consumers with negative LCC benefits range from 1.8 percent to 21 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 $8.3 million. If the lower bound of the range of impacts is reached, TSL 2 could result in a net loss of up to 32.5 percent in INPV for manufacturers.

After considering the analysis and weighing the benefits and the burdens, DOE has tentatively 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 benefits and the potential reduction in INPV for manufacturers.

In addition, the proposed standards are 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 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 Secretary of Energy has tentatively concluded that TSL 2 would save a significant amount of energy and is technologically feasible and economically justified. For the above reasons, DOE today proposes to adopt the energy conservation standards for pumps at TSL 2. Table V.40 presents the proposed energy conservation standards for pumps.

TABLE V.40—PROPOSED ENERGY CONSERVATION STANDARDS FOR PUMPS

Equipment class	Proposed standard level *	Proposed 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	134.13
VTS.3600.CL	1.00	134.13
VTS.1800.VL	1.00	134.13
VTS.3600.VL	1.00	134.13

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

2. Summary of Benefits and Costs (Annualized) of the Proposed Standards

The benefits and costs of today's proposed 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 2013$, of the benefits from operating equipment that meets the proposed 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.[69] 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.41 shows the annualized values for the proposed 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 $40.5/t in 2015, the cost of the standards proposed in this document is $16.9 million per year in increased equipment costs, while the benefits are $60 million per year in reduced equipment operating costs, $29 million in CO_2 reductions, and $1.3 million in reduced NO_X emissions. In this case, the net benefit amounts to $73 million per year. Using a 3-percent discount rate for all benefits and costs and the average SCC series that has a value of $40.5/t in 2015, the cost of the standards proposed in this document is $17.5 million per year in increased equipment costs, while the benefits are $81 million per year in reduced operating costs, $29 million in CO_2 reductions, and $1.7 million in reduced NO_X emissions. In this case, the net benefit amounts to $94 million per year.

[69] For the annualization methodology, see footnote 13.

TABLE V.41—ANNUALIZED BENEFITS AND COSTS OF PROPOSED STANDARDS (TSL 2) FOR PUMPS

	Discount rate	Million 2013$/year		
		Primary estimate *	Low net benefits estimate *	High net benefits estimate *
Benefits				
Operating Cost Savings	7	60	54	67
	3	81	72	93
CO_2 Reduction Monetized Value ($12.0/t case) **	5	8	8	9
CO_2 Reduction Monetized Value ($40.5/t case) **	3	29	27	31
CO_2 Reduction Monetized Value ($62.4/t case) **	2.5	42	39	46
CO_2 Reduction Monetized Value $119/t case) **	3	89	83	97
NO_X Reduction at $2,684/ton **	7	1.3	1.3	1.4
	7 plus CO_2 range	1.3	1.6	1.9
Total Benefits †	7 plus CO_2 range	69 to 150	63 to 138	78 to 166
	7	90	82	100
	3 plus CO_2 range	91 to 172	81 to 156	104 to 192
	3	112	100	126
Costs				
Incremental Equipment Costs	7	16.9	18.6	17.2
	3	17.5	19.5	17.7
Net Benefits/Costs				
Total†	7 plus CO_2 range	53 to 133	44 to 119	61 to 148
	7	73	63	83
	3 plus CO_2 range	74 to 155	62 to 136	86 to 174
	3	94	80	108

* 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 products purchased in 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 from the *AEO 2014* Reference case, Low Estimate, and High Estimate, respectively. In addition, incremental equipment costs reflect a constant rate in the Primary Estimate, an increase rate in the Low Benefits Estimate, and a decline rate in the High Benefits Estimate. The methods used to derive projected price trends are explained in section IV.F.2.a.

** The CO_2 values represent global monetized values of the SCC, in 2013$, 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.

† Total Benefits for both the 3% and 7% cases are derived using the series corresponding to the average SCC with 3-percent discount rate ($40.5/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

In the Framework Document, DOE noted that 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)).

In response to the Framework document, HI and Grundfos supported labeling that would include the rated efficiency value of the pump. (HI, No. 25 at p. 11; Grundfos, No. 24 at p. 19). Grundfos noted that this would provide transparency to consumers to make better purchasing considerations and would not be expected to result in significant additional burden. Grundfos added that markings should not conflict with other information presently included on nameplates, that additional bossing on the pump castings should not be required, but that potentially Energy Guide-type labels could be placed on pump packaging prior to shipping. Grundfos also recommended harmonization with EU 547. (Grundfos, No. 24 at p. 19). HI noted that including efficiency on the label would allow the buyer or end-user to select the most efficient product available. (HI, No. 25 at p. 11). The Advocates also noted that development of a DOE test procedure for pumps including motors could facilitate a labeling scheme to encourage the greater use of pumps with VSDs across a wide horsepower range. (The Advocates, No. 32 at p. 7).

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_{CL}.
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 has reviewed the recommendations of the working group with respect to the three requirements in EPCA restricting the Secretary's authority to promulgate labeling rules. (42 U.S.C. 6315(h)). DOE considered applying these requirements to both the pump nameplate and marketing materials.

First, DOE finds that the working group labeling recommendations are technologically and economically feasible with respect to each equipment class in this rulemaking. Pump manufacturers currently include nameplates on their pumps and it is technologically feasible for them to provide energy efficiency information on a nameplate as well without presenting a significant incremental burden. Furthermore, as the additional information proposed to be added to the nameplate is minimal and, in some cases, may already be included on the nameplate of some pump manufacturers, DOE believes that the size of the nameplate typically will not be required to increase and, thus, there will not be an incremental cost for adding additional information to pump nameplates.[70] Costs of updating marketing materials for pumps that must be redesigned to meet the standard were included in the conversion costs for the industry and are accounted for in the industry cash-flow analysis results and industry valuation figures in section V.B.2. For pumps that do not need to be redesigned to meet the standard, DOE estimates that the costs of updating marketing materials to include the labeling requirements would be up to $3750 per pump model.[71] In the absence of a standard, this would result in additional cost to the industry of approximately $13 million. DOE estimates that the investment could result in a loss of INPV compared to a base case with no labeling requirement of up to approximately 5%. For the proposed standard, the additional cost to industry for updating marketing materials for pumps that do not have to be redesigned would be approximately $10 million. DOE estimates that the investment could result in an additional loss of INPV compared to a base case with no labeling requirement of up to approximately 4% beyond that estimated from the proposed standard.[72] Therefore, DOE has determined that establishing labeling requirements would be economically feasible.

Second, DOE believes the labeling recommendations proposed by the working group will likely result in significant energy savings. The related energy conservation standards are expected to save 0.27 quads. Requiring labels that include the rated value subject to the standards will increase consumer awareness of the standards. As a result, requiring the labels may increase consumer demand for more efficient pumps, thus leading to additional savings beyond that calculated for the standards. In addition, the labels will make it easier for consumers to compare the expected performance of a bare pump to that of a pump with controls, thus increasing the likelihood that a consumer will select a pump with controls. Such purchasing decisions will result in additional energy savings beyond that of the standard by potentially increasing the market share of pumps sold with controls and therefore using less power during operating hours.

Third, DOE finds that the recommended working group labeling requirements are likely to assist consumers in making purchasing decisions. By including the rated metric on the nameplate and marketing materials, consumers will have the information needed to compare performance between pump models, with the assurance that the ratings were calculated according to a DOE-specified test procedure. As stated previously, the labeling recommendations will assist consumers in making purchasing decisions between bare pumps and pumps with controls, by allowing them to fairly accurately estimate the potential energy savings from using controls in a variable load situation. As noted previously, Grundfos and HI both suggested in comments that labels would assist consumers in making purchasing decisions. (Grundfos, No. 24 at p. 19; HI, No. 25 at p. 11). This was also a primary reason the recommendation was made by the working group.

DOE also notes that the recommended working group labeling recommendations meet the EPCA requirement that labels, at a minimum, include the energy efficiency of the equipment to which the rulemaking applies, as tested under the prescribed DOE test procedure. (42 U.S.C. 6315(b)). In this case, that information is PEI_{CL} or PEI_{VL}, depending on pump configuration. Therefore, DOE is proposing to adopt the labeling requirements recommended by the CIP Working Group, as shown in Table VI.1. Additionally, DOE proposes that these same labeling requirements be applied

[70] Manufacturers will likely deplete their stock of existing nameplates prior to the compliance date of any labeling requirements. Therefore, in order to meet the labeling requirements, they will be buying redesigned nameplates—likely at the same cost as the old ones—and then printing new information on them—likely at the same cost as previously.

[71] HI estimated the average cost for updating marketing (literature, data sheets, curves, pump selection tools, sales training, compliance documentation, etc.) for a hydraulic redesign to range from $32,000 for a 1-hp model to $27,000 for a 200-hp model. DOE assumed $30,000 on average. The marketing costs provided by HI were for developing new materials for redesigned pump models. For this exercise only literature and data sheets are relevant, which DOE estimated would represent half of the marketing costs. In addition, in this case, DOE is estimating the incremental cost for making a few additions to literature rather than complete design of new materials. DOE assumed these additions would cost only 25% or less of full material development.

[72] Approximately 3500 models are in the scope of this rulemaking. In the absence of the standard, none of these models would have to be redesigned and would thus incur $3750 each in costs for updating marketing materials. At TSL 2, 25% of pump models would have to be redesigned, and creating new marketing materials for these pumps is already accounted for in the MIA. The 75% of pump models that do not have to be redesigned would incur $3750 each.

to marketing materials in addition to the pump nameplate. See 42 U.S.C. 6315(c)(3).

DOE is tentatively proposing the following requirements for display of information: All orientation, spacing, type sizes, type faces, and line widths to display this required information shall 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, shall be identified in the form ''PEI_{CL} ___'' or ''PEI_{VL} ___.'' The model number shall be in one of the following forms: ''Model ____'' or ''Model number ____'' or ''Model No. ____.'' The unit's impeller diameter shall be in the form ''Imp. Dia. ____(in.).'' DOE seeks input on these proposed requirements. This is identified as Issue 17 in section VIII.E, ''Issues on Which DOE Seeks Comment.''

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. Therefore, DOE requests comment on the feasibility of including the impeller diameter for each unit on the nameplate. Specifically, when shipping bare pumps to distributors, would it be more appropriate for this field to be left blank and filled in by the distributor? This is identified as Issue 18 in section VIII.E, ''Issues on Which DOE Seeks Comment.''

B. Certification Requirements

1. Certification Report Requirements

Since pumps are a distinct type of covered equipment under EPCA and would have entirely separate reporting requirements from other types of covered equipment, DOE proposes to include the reporting requirements in a new section 429.59 within subpart B of 10 CFR part 429. This section would also include sampling requirements, which are discussed in the test procedure NOPR. 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. Proposed additional requirements established 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^{in}_i).

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

DOE has reviewed the working group recommendations and made some modifications and additions. DOE is proposing that the following recommended items be required in certification reports without modifications:

- Manufacturer name;
- Model number(s);
- Equipment class;
- PEI_{CL} or PEI_{VL} as applicable;
- Number of stages tested;
- Full impeller diameter (in.); and
- Whether the PEI_{CL} or PEI_{VL} is calculated or tested.

DOE is proposing that the following recommended items be required in certification reports with modifications for clarity relating to units and operating conditions:

- 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; and
- Driver power input at each required load point *i* (P^{in}_i), corrected to nominal speed, in horsepower (hp).

DOE is proposing that the following additional items be required in certification reports to assist with verification:

- Nominal speed for certification in revolutions per minute (rpm)—
  - Required to verify equipment class as well as calculations for parameters that must be corrected to nominal speed;
- 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)—
  - Necessary for DOE to determine appropriate test procedure method to follow when verifying ratings; and
- 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 (%)—
  - Necessary for DOE to complete calculations in test procedure when verifying ratings.

Finally, DOE is proposing that PER_{CL} or PER_{VL}, as applicable, and pump efficiency at BEP be required in certification reports in order to provide additional performance information to assist with future regulatory efforts or utility programs related to pumps.

DOE requests comment on modifications or additions to the proposed reporting requirements for certification of pumps. DOE requests comment on whether pump efficiency at BEP should be required to be included in the certification reports. This is identified as Issue 19 in section VIII.E, ''Issues on Which DOE Seeks Comment.''

2. Definition of Manufacturer

In 10 CFR part 431, regarding the energy efficiency program for certain commercial and industrial equipment, manufacturer is defined in section 431.2 as ''any person who manufactures industrial equipment, including any manufacturer of a commercial packaged boiler.'' In addition, manufacture means ''to manufacture, produce, assemble, or import.''

In response to the Framework Document, the CA IOUs and the Advocates suggested that DOE define ''manufacturer'' more broadly such that distributors who package pumps with motors for sale would be subject to the standards. (CA IOUs, No. 26 at p. 3; The Advocates, No. 32 at pp. 6–7.) The Advocates added that it would support OEMs being subject to standards, but would not support contractors or installers to be considered ''manufacturers.'' (Id.)

Earthjustice noted that based on the definitions in EPCA, if a standard applies to pump/motor combinations, connecting or packaging a motor and pump would ordinarily count as manufacturing the combined product. (Earthjustice, No. 30 at p. 2.) It also added that contractors or installers would not be covered. (Id.)

On the other hand, AHRI recommended that if DOE establishes a regulatory regime that includes pump packages with VSDs, that pump manufacturers manage compliance of the extended product and that separately sold VFDs remain outside of DOE's authority. (AHRI, No. 28 at p. 2.)

The CIP Working Group also discussed the definition of manufacturer on several occasions. (See EERE–2013–BT–NOC–0039–0014, pp. 32–33, pp. 39–57, and pp. 79–82; EERE–2013–BT–NOC–0039–0015, pp. 134, 203–223; EERE–2013–BT–NOC–0039–0062, pp.

316–327; and EERE–2013–BT–NOC–0039–0106, pp. 174–176)

DOE has reviewed the comments and notes that it has already proposed a definition that would apply when determining which entity constitutes the pump manufacturer in a separate rulemaking. DOE refers readers to its proposed test procedure for pumps. Today's proposal would, however, detail the requirements that a pump manufacturer would need to meet when certifying a given pump as compliant with any energy conservation standards that DOE may adopt. These provisions, which would be part of 10 CFR part 429, would detail the general and product-specific information relating to each basic model of pump that a manufacturer must submit to the Department as part of the certification and compliance report.

C. Enforcement Provisions

DOE has reviewed the enforcement provisions specified in subpart C of 10 CFR part 429 and is proposing that they are appropriate and sufficient for pumps. DOE is proposing a single modification to specify that § 429.110(e)(ii) on enforcement testing would apply to pumps as well as the already listed equipment.

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 today's standards address are as follows:

(1) The cost of gathering relevant information and difficulties in analyzing it 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 pumps that are not captured by the users of such equipment. These benefits include externalities related to public health, environmental protection, and national 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.

In addition, DOE has determined that today's regulatory action is an ''economically significant regulatory action'' under Executive Order 12866. DOE presented to the Office of Information and Regulatory Affairs (OIRA), which is part of OMB, a copy of the draft rule for review along with other documents prepared for this rulemaking, including a regulatory impact analysis (RIA). These documents are part of the rulemaking docket. The assessments prepared pursuant to Executive Order 12866 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 today's NOPR 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 regulatory flexibility analysis (RFA) 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 IRFA 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. 65 FR 30836, 30848, May 15, 2000, as amended at 65 FR 53533, 53544, Sept. 5, 2000, and codified at 13 CFR part 121. The size standards are listed by North American Industry Classification System (NAICS) code and industry description and are available at *http://www.sba.gov/category/navigation-structure/contracting/contracting-officials/small-business-size-standards*. 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 and 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 proposed 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. Based on this information, it is possible that DOE's list of 25 small domestic players may not include all small U.S. manufacturers in the industry. DOE requests comment on the number and names of small manufacturers producing covered equipment.

Before issuing this NOPR, DOE interviewed two small business manufacturers of pumps. 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 given by larger manufacturers supported and informed DOE's description and estimate of compliance requirements, which are presented in section VII.B.2. In general, DOE found very little information in the public domain about the role of small manufacturers in this industry.

Today's proposed 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.[73]

DOE requests additional information on the number of small businesses in the industry, the names of those small businesses, and their role in the market. This matter is identified as Issue 20 under ''Issues on Which DOE Seeks Comment'' in section VIII.E of this NOPR.

DOE made key assumptions about the market share and product offerings of small manufacturers in its analysis. Specifically, DOE estimated that small manufacturers accounted for approximately 36% of the total industry model offerings.

DOE requests data on the market share of small manufacturers and on the number of model offerings from small manufacturers. This matter is identified as Issue 21 under ''Issues on Which DOE Seeks Comment'' in section VIII.E of this NOPR.

2. Description and Estimate of Compliance Requirements

At TSL 2, the level proposed in today's notice, 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. DOE requests comment on the difference in the per-model redesign costs between small and large manufacturers. Table VI.1 below shows the relative impacts of conversion costs on small manufacturers relative to large manufacturers.

DOE requests data on the cost of hydraulic redesigns for a small manufacturer. This matter is identified as Issue 22 under ''Issues on Which DOE Seeks Comment'' in section VIII.E of this NOPR.

TABLE VII.1—IMPACTS OF CONVERSION COSTS ON A SMALL MANUFACTURER AT THE PROPOSED STANDARD

	Capital conversion cost as a percentage of annual capital expenditures	Product conversion cost as a percentage of annual R&D expense	Total conversion cost as a percentage of annual revenue	Total conversion cost as a percentage of annual EBIT
Average Large Manufacturer	303	1579	32	582
Average Small Manufacturer	374	1013	25	464

[73] HI membership includes 48 manufacturers of product within the scope of this rulemaking, of which 10 are small domestic manufacturers.

The total conversion costs are approximately 25% of revenue and 464% of earnings before interest and tax (EBIT) for a small manufacturer. For large manufacturers, the total conversion costs are approximately 32% of revenue and 582% of EBIT. 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 proposed standard. Given that small manufacturers have greater difficulty securing outside capital [74] 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.

DOE requests data on the cost of capital for small manufacturers to better quantify how small manufacturers might be disadvantaged relative to large competitors. DOE also invites comment on DOE's calculations in Table VII.1, which show that the relative impact of conversion costs on the average small business, as estimated as a percentage of annual research and development expenses and total revenue, would be less than the impact felt by average large manufacturer. This matter is identified as Issue 23 under ''Issues on Which DOE Seeks Comment'' in section VIII.E of this NOPR.

DOE requests comment and data on the impact of the proposed standard on small business manufacturers. This matter is identified as Issue 24 under ''Issues on Which DOE Seeks Comment'' in section VIII.E of this NOPR.

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 primary alternatives to the proposed rule are the other TSLs besides the one being considered today, TSL 2. DOE explicitly considered the role of manufacturers, including small manufacturers, in its selection of TSL 2 rather than TSLs 3, 4, or 5. With respect to TSL 5, DOE estimated that while there would be significant consumer benefits stemming from the projected energy savings of 1.32 quads (ranging from $1.51 billion using a 7% discount rate to $4.47 using a 3% discount rate) along with emissions reductions, the overall impacts would yield over a 288 percent drop in INPV, which would create negative LCC benefits and a significant burden on the industry that outweighed the potential benefits at TSL 5. Similarly, with respect to TSL 4, DOE projected that in spite of the 0.91 quads of energy savings (and accompanying consumer benefits ranging from $1.13 billion using a 7-percent discount rate to $3.23 billion using a 3-percent discount rate) along with emission reduction benefits, the potential negative impacts on industry—estimated to be as much as a 170 percent drop in INPV—were sufficient to weigh against the adoption of this TSL. Finally, with respect to TSL 3, DOE concluded that the estimated 0.56 quads of energy savings (and accompanying consumer benefits ranging from $0.77 billion using a 7-percent discount rate to $2.13 billion using a 3-percent discount rate) along with emission reduction benefits, the potential negative impacts on industry—a nearly 82 percent drop in INPV—weighed against the adopting this TSL. (Chapter 12 of the NOPR TSD contains additional information about the impact of this rulemaking on manufacturers.) Accordingly, DOE is not adopting any of these alternatives and, instead, is proposing the standards set forth in this rulemaking. (See chapter 17 of the NOPR TSD for further detail on the policy alternatives DOE considered.)

In addition to the other TSLs being considered, chapter 17 of the NOPR TSD and section V.B.7 include reports on a regulatory impact analysis (RIA). For the pumps that would be affected by this rulemaking, the RIA discusses the following policy alternatives: (1) Consumer rebates; (2) consumer tax credits; (3) manufacturer tax credits; (4) voluntary energy efficiency targets; and (5) bulk government purchases. While these alternatives may mitigate to some varying extent the economic impacts on small entities compared to the standards, DOE determined that the energy savings of these alternatives are significantly smaller than those that would be expected to result from adoption of the proposed standard levels (ranging from approximately 0.2 percent to 78 percent of the primary energy savings from the proposed standards).

DOE notes that if a manufacturer finds that meeting the standard for pumps would cause special hardship, inequity, or unfair distribution of burdens, the manufacturer may petition the Office of Hearings and Appeals (OHA) for exception relief or exemption from the standard pursuant to OHA's authority under section 504 of the DOE Organization Act (42 U.S.C. 7194), as implemented at subpart B of 10 CFR part 1003. OHA has the authority to grant such relief on a case-by-case basis if it determines that a manufacturer has demonstrated that meeting the standard would cause hardship, inequity, or unfair distribution of burdens.

DOE seeks comment and, in particular, data on the impacts of this rulemaking on small businesses. (See Issue 24 under ''Issues on Which DOE Seeks Comment'' in section VIII.E. of this NOPR.)

C. Review Under the Paperwork Reduction Act

In the event that DOE adopts its proposed standards, pump manufacturers would need to certify to DOE that their products comply with any applicable energy conservation standards. In certifying compliance, manufacturers would need to test their products according to the applicable DOE test procedures for pumps that DOE may adopt 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. 76 FR 12422, March 7, 2011. The collection-of-information requirement for the certification and recordkeeping is subject to review and approval by OMB under the Paperwork Reduction Act (PRA). This requirement has been approved by OMB under OMB

[74] 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.*

control number 1910–1400. Public reporting burden for the certification is estimated to average 20 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 proposed 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 proposed rule fits within the 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 proposed rule. DOE's CX determination for this proposed rule is available at *http://cxnepa.energy.gov/*.

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. EPCA governs and prescribes Federal preemption of State regulations as to energy conservation for the products that are the subject of today's proposed 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.) 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; and (3) provide a clear legal standard for affected conduct rather than a general standard and promote simplification and burden reduction. 61 FR 4729, Feb. 7, 1996. 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 has determined that, to the extent permitted by law, this proposed 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 proposed 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 proposed ''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 small governments. 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/gc/office-general-counsel*.

Although this proposed rule does not contain a Federal intergovernmental mandate, it may require expenditures of $100 million or more on the private sector. Specifically, the proposed rule will likely result in a final rule that could require expenditures of $100 million or more. Such expenditures may include: (1) Investment in research and development and in capital expenditures by pump 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 pumps, starting on the compliance date for the applicable standard.

Section 202 of UMRA authorizes a Federal agency to respond to the content requirements of UMRA in any other statement or analysis that accompanies the proposed rule. 2 U.S.C. 1532(c). The content requirements of section 202(b) of UMRA relevant to a private sector mandate substantially overlap the economic analysis requirements that apply under section 325(o) of EPCA and Executive Order 12866. The **SUPPLEMENTARY INFORMATION** section of the NOPR and the ''Regulatory Impact Analysis'' section of the TSD for this proposed rule respond to those requirements.

Under section 205 of UMRA, the Department is obligated to identify and consider a reasonable number of regulatory alternatives before promulgating a rule for which a written statement under section 202 is required. 2 U.S.C. 1535(a). DOE is required to select from those alternatives the most cost-effective and least burdensome alternative that achieves the objectives of the proposed rule, unless DOE publishes an explanation for doing otherwise, or the selection of such an alternative is inconsistent with law. As authorized by 42 U.S.C. 6311(1)(A), this proposed rule would establish energy conservation standards that are designed to achieve the maximum improvement in energy efficiency for pumps that DOE has determined to be both technologically feasible and economically justified. A full discussion of the alternatives considered by DOE is presented in the ''Regulatory Impact Analysis'' section of the TSD for this proposed rule.

H. Review Under the Treasury and General Government Appropriations Act, 1999

Section 654 of the Treasury and General Government Appropriations Act, 1999 (Pub. L. 105–277) requires Federal agencies to issue a Family Policymaking Assessment for any rule that may affect family well-being. This proposed 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

DOE has determined, under Executive Order 12630, ''Governmental Actions and Interference with Constitutionally Protected Property Rights,'' 53 FR 8859, Mar. 18, 1988, that this proposed regulation would not result in any takings that might require compensation under the Fifth Amendment to the U.S. Constitution.

J. Review Under the Treasury and General Government Appropriations Act, 2001

Section 515 of the Treasury and General Government Appropriations Act, 2001 (44 U.S.C. 3516, note) provides for Federal agencies to review most disseminations of information to the public under guidelines established by each agency pursuant to general guidelines issued by OMB. OMB's guidelines were published at 67 FR 8452, Feb. 22, 2002, and DOE's guidelines were published at 67 FR 62446, Oct. 7, 2002. DOE has reviewed today's NOPR under the OMB and DOE guidelines and has concluded that it is consistent with applicable policies in those guidelines.

K. Review Under Executive Order 13211

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 proposed 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 proposed 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 tentatively concluded that this regulatory action, which sets forth energy conservation standards for pumps, is not a significant energy action, because the proposed 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 the proposed 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. 70 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*.

VIII. Public Participation

A. Attendance at the Public Meeting

The time, date, and location of the public meeting are listed in the **DATES** and **ADDRESSES** sections at the beginning of this notice. If you plan to attend the public meeting, please notify Ms. Brenda Edwards at (202) 586–2945 or *Brenda.Edwards@ee.doe.gov*.

Please note that foreign nationals visiting DOE Headquarters are subject to advance security screening procedures. Any foreign national wishing to participate in the meeting should advise DOE as soon as possible by contacting Ms. Edwards to initiate the necessary procedures. Please also note that those wishing to bring laptops into the Forrestal Building will be required to obtain a property pass. Visitors should avoid bringing laptops, or allow an extra 45 minutes.

Due to the REAL ID Act implemented by the Department of Homeland Security (DHS), there have been recent changes regarding ID requirements for individuals wishing to enter Federal buildings from specific states and U.S. territories. Driver's licenses from the following states or territory will not be accepted for building entry and one of the alternate forms of ID listed below will be required. DHS has determined that regular driver's licenses (and ID cards) from the following jurisdictions are not acceptable for entry into DOE facilities: Alaska, American Samoa, Arizona, Louisiana, Maine, Massachusetts, Minnesota, New York, Oklahoma, and Washington. Acceptable alternate forms of Photo-ID include: U.S. Passport or Passport Card; an Enhanced Driver's License or Enhanced ID-Card issued by the states of Minnesota, New York or Washington (Enhanced licenses issued by these states are clearly marked Enhanced or Enhanced Driver's License); a military ID or other Federal government issued Photo-ID card.

In addition, participants may attend the public meeting via webinar. Webinar registration information, participant instructions, and information about the capabilities available to webinar participants will be published on DOE's Web site. Participants are responsible for ensuring their systems are compatible with the webinar software.

B. Procedure for Submitting Prepared General Statements for Distribution

Any person who has plans to present a prepared general statement may request that copies of his or her statement be made available at the public meeting. Such persons may submit requests, along with an advance electronic copy of their statement in PDF (preferred), Microsoft Word or Excel, WordPerfect, or text (ASCII) file format, to the appropriate address shown in the **ADDRESSES** section at the beginning of this NOPR. The request and advance copy of statements must be received at least one week before the public meeting and may be emailed, hand-delivered, or sent by mail. DOE prefers to receive requests and advance copies via email. Please include a telephone number to enable DOE staff to make follow-up contact, if needed.

C. Conduct of the Public Meeting

DOE will designate a DOE official to preside at the public meeting and may also use a professional facilitator to aid discussion. The meeting will not be a judicial or evidentiary-type public hearing, but DOE will conduct it in accordance with section 336 of EPCA (42 U.S.C. 6306). A court reporter will be present to record the proceedings and prepare a transcript. DOE reserves the right to schedule the order of presentations and to establish the procedures governing the conduct of the public meeting. After the public meeting, interested parties may submit further comments on the proceedings as well as on any aspect of the rulemaking until the end of the comment period.

The public meeting will be conducted in an informal, conference style. DOE will present summaries of comments received before the public meeting, allow time for prepared general statements by participants, and encourage all interested parties to share their views on issues affecting this rulemaking. Each participant will be allowed to make a general statement (within time limits determined by DOE), before the discussion of specific topics. DOE will allow, as time permits, other participants to comment briefly on any general statements.

At the end of all prepared statements on a topic, DOE will permit participants to clarify their statements briefly and comment on statements made by others. Participants should be prepared to answer questions by DOE and by other participants concerning these issues. DOE representatives may also ask questions of participants concerning other matters relevant to this rulemaking. The official conducting the public meeting will accept additional comments or questions from those attending, as time permits. The presiding official will announce any further procedural rules or modification of the above procedures that may be needed for the proper conduct of the public meeting.

A transcript of the public meeting will be included in the docket, which can be viewed as described in the *Docket* section at the beginning of this NOPR. In addition, any person may buy a copy of the transcript from the transcribing reporter.

D. Submission of Comments

DOE will accept comments, data, and information regarding this proposed rule before or after the public meeting, but no later than the date provided in the **DATES** section at the beginning of this proposed rule. Interested parties may submit comments, data, and other information using any of the methods described in the **ADDRESSES** section at the beginning of this NOPR.

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

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

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

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

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

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

Comments, data, and other information submitted to DOE electronically should be provided in PDF (preferred), Microsoft Word or Excel, WordPerfect, or text (ASCII) file format. Provide documents that are not secured, are written in English, and are free of any defects or viruses. Documents should not contain special characters or any form of encryption and, if possible, they should carry the electronic signature of the author.

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

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

Factors of interest to DOE when evaluating requests to treat submitted information as confidential include: (1) A description of the items; (2) whether and why such items are customarily treated as confidential within the industry; (3) whether the information is generally known by or available from other sources; (4) whether the information has previously been made available to others without obligation concerning its confidentiality; (5) an explanation of the competitive injury to the submitting person which would result from public disclosure; (6) when such information might lose its confidential character due to the passage of time; and (7) why disclosure of the information would be contrary to the public interest.

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

E. Issues on Which DOE Seeks Comment

Although DOE welcomes comments on any aspect of this proposal, DOE is particularly interested in receiving comments and views of interested parties concerning the following issues:

1. Whether all RSV models sold in the United States are based on a global platform.
2. Whether there are any pump models that would pass 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.
3. Whether the market distribution channels include all appropriate intermediate steps, and the estimated market share of each channel.
4. Information and data on average annual operating hours for the pump types and applications in the scope of this rulemaking.
5. Information and data on typical load profiles for the pump types and applications in the scope of this rulemaking.
6. 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.
7. The most appropriate trend to use for real (inflation-adjust) pump prices.
8. Whether any of the efficiency levels considered in this NOPR might lead to an increase in installation costs, and if so, data regarding the magnitude of the increased cost for each relevant efficiency level.
9. DOE seeks comment on whether new standards would be likely to affect shipments.
10. The penetration rate of VFDs relative to the scope of this rulemaking, the average power reduction from use of a VFD, the ''effectiveness rate'' of a VFD, the percent of shipments with trimmed impellers, and the average percent impeller trim.
11. Whether a rebound effect should be included in the determination of annual energy savings and, if so, data to assist in calculation of the rebound effect.
12. DOE requests comment on the capital conversion costs and product conversion costs estimated for each TSL.
13. DOE requests comment on the potential impacts on manufacturer employment and the specific drivers of any expected change in production line employment.
14. DOE requests comments and data on capacity constraints at each TSL—including production capacity constraints, engineering resource constraints, and testing capacity constraints. In particular, DOE requests comment on whether the proposed compliance date allows for a sufficient conversion period to make the equipment design and facility updates necessary to meet a new standard.
15. DOE requests comments the cumulative regulatory burden on manufacturers. Specifically, DOE seeks input on any product-specific Federal regulations that go into effect within three years of the proposed effective date and recommendations on how DOE may be able to align varying regulations in order to mitigate cumulative burden.
16. DOE seeks comment on the impacts, if any, there would be on the level of utility and available features currently offered by manufacturers with respect to the pumps that would be regulated under this proposal.
17. DOE seeks input on the requirements for display of required information on labels.
18. DOE seeks comment on the feasibility of including the impeller diameter for each unit on the nameplate. Specifically, when shipping bare pumps to distributors, would it be more appropriate for this field to be left blank and filled in by the distributor?
19. DOE requests comment on modifications or additions to the proposed reporting requirements for certification of pumps. DOE requests comment on whether pump efficiency at BEP should be required to be included in the certification reports.
20. DOE requests additional information on the number of small businesses in the industry, the names of those small businesses, and their role in the market.
21. DOE requests data on the market share of small manufacturers and on the number of model offerings from small manufacturers.
22. DOE requests data on the cost of hydraulic redesigns for a small manufacturer.

DOE requests data on the cost of capital for small manufacturers to better quantify how small manufacturers might be disadvantaged relative to large competitors. DOE also invites comment on DOE's calculations in Table VII.1, which show that the relative impact of conversion costs on the average small business, as estimated as a percentage of annual research and development expenses and total revenue, would be less than the impact felt by average large manufacturer.

23. DOE requests comment and data on the impact of the proposed standard on small business manufacturers.

IX. Approval of the Office of the Secretary

The Secretary of Energy has approved publication of today's proposed 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, Reporting and recordkeeping requirements.

Issued in Washington, DC, on March 17, 2015.

David T. Danielson,

Assistant Secretary, Energy Efficiency and Renewable Energy.

For the reasons set forth in the preamble, DOE proposes to amend 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(b)(13) is revised to read as follows:

§ 429.12 General requirements applicable to certification reports.

* * * * *

(b) * * *

(13) Product specific information listed in §§ 429.14 through 429.59 of this chapter.

* * * * *

■ 3. Section 429.59 as proposed to be added in the April 1, 2015, issue of the **Federal Register**, is amended by adding paragraph (b) 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 shall include the following public product-specific information:

(i) For bare pumps, pumps sold with drivers other than electric motors, and pumps sold with single-phase electric motors: Manufacturer name; model number(s); equipment class from the table in § 431.465(b) of this chapter; PEI_{CL}; PER_{CL}; the rated (tested) speed of rotation in revolutions per minute (rpm) at the best efficiency point (BEP) of the pump; the nominal speed of rotation in revolutions per minute (rpm); 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; calculated driver power input at each load point *i* (P^{in}_i), corrected to nominal speed, in horsepower (hp); pump efficiency at BEP in percent (%); full impeller diameter in inches (in.); the pump configuration (*i.e.,* bare pump); for RSV and VTS pumps, the number of stages tested; and for VTS pumps, the bowl diameter in inches (in.).

(ii) For pumps sold with electric motors not equipped with continuous or non-continuous controls: Manufacturer name; model number(s); equipment class from the table in § 431.465(b) of this chapter; PEI_{CL}; PER_{CL}; the rated (tested) speed of rotation in revolutions per minute (rpm) at the best efficiency point (BEP) of the pump; the nominal speed of rotation in revolutions per minute (rpm); 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; driver power input at each load point *i* (P^{in}_i), corrected to nominal speed, in horsepower (hp); pump efficiency at BEP in percent (%); full impeller diameter in inches (in.); whether the PEI_{CL} is calculated or tested; the pump configuration (*i.e.,* pump sold with an electric motor); for RSV and VTS pumps, number of stages tested; for VTS pumps, the bowl diameter in inches (in.); and for pumps sold with electric motors regulated by DOE's energy conservation standards for electric motors at § 431.25 of this chapter other single-phase induction motors, the nominal motor efficiency in percent (%) and the motor horsepower (hp) for the motor with which the pump is being rated

(iii) For pumps sold with electric motors, other than single-phase induction motors, and continuous or non-continuous controls: Manufacturer name; model number(s); equipment class from the table in § 431.465(b) of this chapter; PEI_{VL}; PER_{VL}; the rated (tested) speed of rotation in revolutions per minute (rpm) at the best efficiency point (BEP) of the pump; the nominal speed of rotation for certification in revolutions per minute (rpm); 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; 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); pump efficiency at BEP in percent (%); full impeller diameter in inches (in.); whether the PEI_{VL} is calculated or tested; the pump configuration (*i.e.,* pump sold with a motor and continuous or non-continuous controls); for RSV and VTS pumps, the number of stages tested; for VTS pumps, the bowl diameter in inches (in.); and for pumps sold with electric motors regulated by DOE's energy conservation standards for electric motors at § 431.25 of this chapter, the nominal motor efficiency in percent (%) and the motor horsepower (hp) for the motor with which the pump is being rated.

■ 4. Revise § 429.110(e)(1)(ii) introductory text to read as follows:

§ 429.110 Enforcement testing.

* * * * *

(e) * * *

(1) * * *

(ii) For automatic commercial ice makers; commercial refrigerators, freezers, and refrigerator-freezers; refrigerated bottled or canned vending machines; commercial HVAC and WH equipment; and pumps, DOE will use an initial sample size of not more than four units and follow the sampling plans in appendix B of this subpart (Sampling Plan for Enforcement Testing of Covered Equipment and Certain Low-Volume Covered Products). If fewer than four units of a basic model are available for testing when the manufacturer receives the notice, then:

* * * * *

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

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

Authority: 42 U.S.C. 6291–6317.

■ 6. 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 [DATE 4 YEARS AFTER PUBLICATION OF FINAL RULE] and that:

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

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

(3) Conforms to the characteristics listed in paragraph (c) 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 section:

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

Equipment class [1]	Maximum PEI [2]	C-Value [3]
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	134.13
VTS.3600.CL	1.00	134.13
VTS.1800.VL	1.00	134.13
VTS.3600.VL	1.00	134.13

[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, IL = in-line, RSV = radially split, multi-stage, vertical, in-line, diffuser casing, VTS = vertical turbine submersible); (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 subpart Y of part 431.

[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 subpart Y of part 431.

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

(1) Shaft power of at least 1 hp but no greater than 200 hp at the best efficiency point (BEP) at full impeller diameter for the number of stages required for testing (see appendix A to subpart Y of part 431);

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

(3) Maximum head of 459 feet at BEP at full impeller diameter;

(4) Design temperature range from −10 to 120 °C;

(5) 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

(6) For VTS pumps, a 6-inch or smaller bowl diameter.

(7) Except that the energy efficiency standards in paragraph (b) of this section do not apply to the following pumps:

(i) Fire pumps.

(ii) Self-priming pumps.

(iii) Prime-assist pumps.

(iv) Sealless pumps.

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

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

■ 7. 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}) as determined pursuant to § 431.464, and for pumps sold with motors and continuous or non-continuous controls, the rated pump energy index—variable load (PEI_{VL}) as determined pursuant to § 431.464;

(ii) The model number; and

(iii) The unit's actual impeller diameter, as distributed in commerce.

(2) *Display of required information.* All orientation, spacing, type sizes, type faces, and line widths to display this required information shall 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, shall be identified in the form ''PEI_{CL} ____'' or ''PEI_{VL} ____.'' The model number shall be in one of the following forms: ''Model ____'' or ''Model number ____'' or ''Model No. ____.'' The unit's impeller diameter shall 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, shall 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]

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