DEPARTMENT OF ENERGY

10 CFR Parts 429 and 431

[EERE–2020–BT–STD–0007]

RIN 1904–AF55

Energy Conservation Program: Energy Conservation Standards for Expanded Scope Electric Motors

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

ACTION: Notice of proposed rulemaking and announcement of public meeting.

SUMMARY: The Energy Policy and Conservation Act, as amended (''EPCA''), prescribes energy conservation standards for various consumer products and certain commercial and industrial equipment, including electric motors. In this notice of proposed rulemaking (''NOPR''), DOE proposes new energy conservation standards for a subset of electric motors, expanded scope electric motors, expressed in terms of average full-load efficiency, and also announces a public meeting to receive comment on these proposed standards and associated analyses and results.

DATES:

Comments: DOE will accept comments, data, and information regarding this NOPR no later than February 13, 2024.

Meeting: DOE will hold a public meeting on Wednesday, January 17, 2024, from 10 a.m. to 4 p.m., in Washington, DC. This meeting will also be broadcast as a webinar.

Comments regarding the likely competitive impact of the proposed standard should be sent to the Department of Justice contact listed in the **ADDRESSES** section on or before January 16, 2024.

ADDRESSES: The public meeting will be held at the U.S. Department of Energy, Forrestal Building, Room 1E–245, 1000 Independence Avenue SW, Washington, DC 20585. See section VII of this document, ''Public Participation,'' for further details, including procedures for attending the in-person meeting, webinar registration information, participant instructions, and information about the capabilities available to webinar participants.

Interested persons are encouraged to submit comments using the Federal eRulemaking Portal at *www.regulations.gov* under docket number EERE–2020–BT–STD–0007. Follow the instructions for submitting comments. Alternatively, interested persons may submit comments, identified by docket number EERE–2020–BT–STD–0007, by any of the following methods:

Email: ElecMotors2020STD0007@ee.doe.gov. Include the docket number EERE–2020–BT–STD–0007 in the subject line of the message.

Postal Mail: Appliance and Equipment Standards Program, U.S. Department of Energy, Building Technologies Office, Mailstop EE–5B, 1000 Independence Avenue SW, Washington, DC 20585–0121. Telephone: (202) 287–1445. If possible, please submit all items on a compact disc (''CD''), in which case it is not necessary to include printed copies.

Hand Delivery/Courier: Appliance and Equipment Standards Program, U.S. Department of Energy, Building Technologies Office, 950 L'Enfant Plaza SW, 6th Floor, Washington, DC 20024. Telephone: (202) 287–1445. If possible, please submit all items on a CD, in which case it is not necessary to include printed copies.

No telefacsimiles (''faxes'') will be accepted. For detailed instructions on submitting comments and additional information on this process, see section VII of this document.

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

The docket web page can be found at *www.regulations.gov/docket/EERE-2020-BT-STD-0007.* The docket web page contains instructions on how to access all documents, including public comments, in the docket. See section VII of this document for information on how to submit comments through *www.regulations.gov.*

EPCA requires the Attorney General to provide DOE a written determination of whether the proposed standard is likely to lessen competition. The U.S. Department of Justice Antitrust Division invites input from market participants and other interested persons with views on the likely competitive impact of the proposed standard. Interested persons may contact the Antitrust Division at *energy.standards@usdoj.gov* on or before the date specified in the **DATES** section. Please indicate in the ''Subject'' line of your email the title and Docket Number of this proposed rulemaking.

FOR FURTHER INFORMATION CONTACT:

Mr. Jeremy Dommu, U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, Building Technologies Office, EE–5B, 1000 Independence Avenue SW, Washington, DC 20585–0121. Email: *ApplianceStandardsQuestions@ee.doe.gov.*

Ms. Kristin Koernig, U.S. Department of Energy, Office of the General Counsel, GC–33, 1000 Independence Avenue SW, Washington, DC 20585–0121. Telephone: (202) 586–3593. Email: *kristin.koernig@hq.doe.gov.*

For further information on how to submit a comment, review other public comments and the docket, or participate in the public meeting, contact the Appliance and Equipment Standards Program staff at (202) 287–1445 or by email: *ApplianceStandardsQuestions@ee.doe.gov.*

SUPPLEMENTARY INFORMATION:

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I. Synopsis of the Proposed Rule

The Energy Policy and Conservation Act, Public Law 94–163, as amended (''EPCA''),[1] authorizes DOE to regulate the energy efficiency of a number of consumer products and certain industrial equipment. (42 U.S.C. 6291–6317) Title III, Part C[2] of EPCA established the Energy Conservation Program for Certain Industrial Equipment. (42 U.S.C. 6311–6317) Such equipment includes electric motors. Expanded scope electric motors (''ESEMs''), a subcategory of electric motors, are the subject of this rulemaking. This proposed rulemaking does not address small electric motors that are covered under title 10 of the Code of Federal Regulations (''CFR'') part 431 subpart X.

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

In accordance with these and other statutory provisions discussed in this document, DOE analyzed the benefits and burdens of four trial standard levels (''TSLs'') for ESEMs. The TSLs and their associated benefits and burdens are discussed in detail in sections V.A through V.C of this document. As discussed in section V.C of this document, DOE has tentatively determined that TSL 2 represents the maximum improvement in energy efficiency that is technologically feasible and economically justified. The proposed standards, which are expressed in average full-load efficiency, are shown in Table I–1 through Table I–3 and are equivalent to those recommended in a joint recommendation for energy conservation standards for ESEMs[3] (''December 2022 Joint Recommendation'') from the Electric Motors Working Group, representing the motors industry, energy efficiency organizations and utilities.[4] [5]

Upon receipt of the December 2022 Joint Recommendation, DOE considered whether the statutory requirements of

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

[2] For editorial reasons, upon codification in the U.S. Code, Part C was re-designated Part A–1.

[3] In the letter, this category is referred to as ''SNEM.'' See discussion on the change in terminology in sections III.A and III.B of this document.

[4] Full recommendation available at: *www.regulations.gov/comment/EERE-2020-BT-STD-0007-0038.*

[5] The members of the Electric Motors Working Group included American Council for an Energy-Efficient Economy, Appliance Standards Awareness Project, National Electrical Manufacturers Association, Natural Resources Defense Council, Northwest Energy Efficiency Alliance, Pacific Gas & Electric Company, San Diego Gas & Electric, and Southern California Edison.

42 U.S.C. 6295(p)(4) would be satisfied and thus warrant the issuance of a direct final rule by DOE. In particular, EPCA requires DOE to determine whether the recommended standard contained in a statement submitted jointly by interested parties is in accordance with 42 U.S.C. 6295(o); *i.e.,* whether the recommended standard would achieve the maximum improvement in energy efficiency that is technologically feasible and economically justified. (42 U.S.C. 6295(p)(4)(A)(i)) If the Secretary determines the recommended standard is in accordance with 42 U.S.C. 6295(o), the Secretary may issue a final rule that establishes the recommended energy conservation standard. (*Id.*) If the Secretary determines that a direct final rule cannot be issued based on the statement, the Secretary must publish a notice of the determination, together with an explanation of the reasons for such determination. (42 U.S.C. 6295(p)(4)(A)(ii)) EPCA defines seven factors by which DOE must determine whether a proposed standard is economically justified. (42 U.S.C. 6295(o)(2)(B)(i)(I)–(VII)) Having considered the December 2022 Joint Recommendation, DOE has tentatively determined that the recommended standard is in accordance with 42 U.S.C. 6295(o). However, because EPCA does not require DOE to issue a direct final rule under 42 U.S.C. 6295(p), DOE is interested in seeking public comment on the proposed, and recommended, standards level through this proposed rule to better understand the impacts of those standards.

These proposed standards, if adopted, would apply to all ESEMs listed in Table I–1 through Table I–3 manufactured in, or imported into, the United States starting on January 1, 2029.

TABLE I–1—PROPOSED ENERGY CONSERVATION STANDARDS FOR HIGH AND MEDIUM-TORQUE ESEMs

[Compliance Starting on January 1, 2029] [Recommended TSL 2]

hp	Average full load efficiency							
	Open				Enclosed			
	2-pole	4-pole	6-pole	8-pole	2-pole	4-pole	6-pole	8-pole
0.25	59.5	59.5	57.5		59.5	59.5	57.5	
0.33	64.0	64.0	62.0	50.5	64.0	64.0	62.0	50.5
0.5	68.0	69.2	68.0	52.5	68.0	67.4	68.0	52.5
0.75	76.2	81.8	80.2	72.0	75.5	75.5	75.5	72.0
1	80.4	82.6	81.1	74.0	77.0	80.0	77.0	74.0
1.5	81.5	83.8			81.5	81.5	80.0	
2	82.9	84.5			82.5	82.5		
3	84.1				84.0			

TABLE I–2—PROPOSED ENERGY CONSERVATION STANDARDS FOR LOW-TORQUE ESEMs

[Compliance Starting on January 1, 2029] [Recommended TSL 2]

hp	Average full load efficiency							
	Open				Enclosed			
	2-pole	4-pole	6-pole	8-pole	2-pole	4-pole	6-pole	8-pole
0.25	63.9	66.1	60.2	52.5	60.9	64.1	59.2	52.5
0.33	66.9	69.7	65.0	56.6	63.9	67.7	64.0	56.6
0.5	68.8	70.1	66.8	57.1	65.8	68.1	65.8	57.1
0.75	70.5	74.8	73.1	62.8	67.5	72.8	72.1	62.8
1	74.3	77.1	77.3	65.7	71.3	75.1	76.3	65.7
1.5	79.9	82.1	80.5	72.2	76.9	80.1	79.5	72.2
2	81.0	82.9	81.4	73.3	78.0	80.9	80.4	73.3
3	82.4	84.0	82.5	74.9	79.4	82.0	81.5	74.9

TABLE I–3—PROPOSED ENERGY CONSERVATION STANDARDS FOR POLYPHASE ESEMs

[Compliance Starting on January 1, 2029] [Recommended TSL 2]

hp	Average full load efficiency							
	Open				Enclosed			
	2-pole	4-pole	6-pole	8-pole	2-pole	4-pole	6-pole	8-pole
0.25	65.6	69.5	67.5	62.0	66.0	68.0	66.0	62.0
0.33	69.5	73.4	71.4	64.0	70.0	72.0	70.0	64.0
0.5	73.4	78.2	75.3	66.0	72.0	75.5	72.0	66.0
0.75	76.8	81.1	81.7	70.0	75.5	77.0	74.0	70.0
1	77.0	83.5	82.5	75.5	75.5	77.0	74.0	75.5
1.5	84.0	86.5	83.8	77.0	84.0	82.5	87.5	78.5
2	85.5	86.5		86.5	85.5	85.5	88.5	84.0
3	85.5	86.9		87.5	86.5	86.5	89.5	85.5

A. Benefits and Costs to Consumers

Table I–4 presents DOE's evaluation of the economic impacts of the proposed standards on consumers of ESEMs, as measured by the average life-cycle cost (''LCC'') savings and the simple payback period (''PBP'').[6] The average LCC savings are positive for all representative units, and the PBP is less than the average lifetime of ESEMs, which is estimated to be 7.1 years (see section IV.F of this document).

TABLE I–4—IMPACTS OF PROPOSED ENERGY CONSERVATION STANDARDS ON CONSUMERS OF ESEMS

Representative unit	Average LCC savings (2022$)	Simple payback period (years)
ESEM High/Med Torque, 4 poles, enclosed, 0.25 hp	51	1.1
ESEM High/Med Torque, 4 poles, enclosed, 1 hp	138	0.9
ESEM High/Med Torque, 4 poles, enclosed, 5 hp	147	0.7
ESEM Low Torque, 6 poles, enclosed, 0.25 hp	100	1.5
ESEM Low Torque, 6 poles, enclosed, 0.5 hp	26	2.0
ESEM Polyphase, 4 poles, enclosed, 0.25 hp	83	0.8
AO–ESEM High/Med Torque, 4 poles, enclosed, 0.25 hp	160	0.8
AO–ESEM High/Med Torque, 4 poles, enclosed, 1 hp	121	0.7
AO–ESEM High/Med Torque, 4 poles, enclosed, 5 hp	88	1.3
AO–ESEM Low Torque, 6 poles, enclosed, 0.25 hp	40	1.8
AO–ESEM Low Torque, 6 poles, enclosed, 0.5 hp	51	1.2
AO–ESEM Polyphase, 4 poles, enclosed, 0.25 hp	138	1.1

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

B. Impact on Manufacturers

The industry net present value (''INPV'') is the sum of the discounted cash flows to the industry from the base year through the end of the analysis period (2024–2058). Using a real discount rate of 9.1 percent, DOE estimates that the INPV for manufacturers of ESEMs in the case without new standards is $2,019 million in 2022$. Under the proposed standards, DOE estimates the change in INPV to range from −13.1 percent to −6.5 percent, which is approximately −$264 million to −$131 million. In order to bring equipment into compliance with new standards, it is estimated that industry will incur total conversion costs of $339 million.

DOE's analysis of the impacts of the proposed standards on manufacturers is described in section IV.J of this document. The analytic results of the manufacturer impact analysis (''MIA'') are presented in section V.B.2 of this document.

C. National Benefits and Costs[7]

DOE's analyses indicate that the proposed energy conservation standards for ESEMs would save a significant amount of energy. Relative to the case without new standards, the lifetime energy savings for ESEMs purchased in the 30-year period that begins in the anticipated year of compliance with the new standards (2029–2058) amount to 8.9 quadrillion British thermal units (''Btu''), or quads.[8] This represents a savings of 9 percent relative to the energy use of these products in the case without new standards (referred to as the ''no-new-standards case'').

The cumulative net present value (''NPV'') of total consumer benefits of the proposed standards for ESEMs ranges from $38.3 billion (at a 7-percent discount rate) to $72.8 billion (at a 3-percent discount rate). This NPV expresses the estimated total value of future operating-cost savings minus the estimated increased equipment and installation costs for ESEMs purchased in 2029–2058.

In addition, the proposed standards for ESEMs are projected to yield significant environmental benefits. DOE estimates that the proposed standards would result in cumulative emission reductions (over the same period as for energy savings) of 160.5 million metric tons (''Mt'')[9] of carbon dioxide (''CO_2''), 43.8 thousand tons of sulfur dioxide (''SO_2''), 299.8 thousand tons of nitrogen oxides (''NO_X''), 1,362.2 thousand tons of methane (''CH_4''), 1.4 thousand tons of nitrous oxide (''N_2O''), and 0.3 tons of mercury (''Hg'').[10]

DOE estimates the value of climate benefits from a reduction in greenhouse gases (''GHG'') using four different estimates of the social cost of CO_2 (''SC–CO_2''), the social cost of methane (''SC–CH_4''), and the social cost of nitrous oxide (''SC–N_2O''). Together these represent the social cost of GHG (''SC–GHG''). DOE used interim SC–GHG values (in terms of benefit per ton of GHG avoided) developed by an Interagency Working Group on the Social Cost of Greenhouse Gases (''IWG'').[11] The derivation of these values is discussed in section IV.L of this document. For presentational purposes, the climate benefits associated with the average SC–GHG at a 3-percent discount rate are estimated to be $9.4 billion. DOE does not have a single central SC–GHG point estimate and it emphasizes the importance and value of considering the benefits

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

[7] All monetary values in this document are expressed in 2022 dollars.

[8] The quantity refers to full-fuel-cycle (''FFC'') energy savings. FFC energy savings includes the energy consumed in extracting, processing, and transporting primary fuels (*i.e.,* coal, natural gas, petroleum fuels), and, thus, presents a more complete picture of the impacts of energy efficiency standards. For more information on the FFC metric, see section IV.H.1 of this document.

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

[11] To monetize the benefits of reducing GHG emissions this analysis uses the interim estimates presented in the *Technical Support Document: Social Cost of Carbon, Methane, and Nitrous Oxide Interim Estimates Under Executive Order 13990* published in February 2021 by the IWG. (''February 2021 SC–GHG TSD''). *www.whitehouse.gov/wp-content/uploads/2021/02/TechnicalSupportDocument_SocialCostofCarbonMethaneNitrousOxide.pdf.*

calculated using all four sets of SC–GHG estimates.

DOE estimated the monetary health benefits of SO_2 and NO_X emissions reductions using benefit per ton estimates from the Environmental Protection Agency (''EPA''),[12] as discussed in section IV.L of this document. DOE estimated the present value of the health benefits would be $7.9 billion using a 7-percent discount rate, and $18.3 billion using a 3-percent discount rate.[13] DOE is currently only monetizing health benefits from changes in ambient fine particulate matter (''$PM_{2.5}$'') concentrations from two precursors (SO_2 and NO_X), and from changes in ambient ozone from one precursor (for NO_X), but will continue to assess the ability to monetize other effects such as health benefits from reductions in direct $PM_{2.5}$ emissions.

Table I–5 summarizes the monetized benefits and costs expected to result from the proposed standards for ESEMs. There are other important unquantified effects, including certain unquantified climate benefits, unquantified public health benefits from the reduction of toxic air pollutants and other emissions, unquantified energy security benefits, and distributional effects, among others.

TABLE I–5—SUMMARY OF MONETIZED BENEFITS AND COSTS OF PROPOSED ENERGY CONSERVATION STANDARDS FOR ESEMS
[TSL 2]

	Billion $2022
3% discount rate	
Consumer Operating Cost Savings	54.7
Climate Benefits *	9.4
Health Benefits **	18.3
Total Benefits †	82.4
Consumer Incremental Equipment Costs ‡	9.7
Net Benefits	72.8
Change in Producer Cashflow (INPV ††)	(0.3)–(0.1)
7% discount rate	
Consumer Operating Cost Savings	26.1
Climate Benefits * (3% discount rate)	9.4
Health Benefits **	7.9
Total Benefits †	43.5
Consumer Incremental Equipment Costs ‡	5.1
Net Benefits	38.3
Change in Producer Cashflow (INPV ††)	(0.3)–(0.1)

Note: This table presents the costs and benefits associated with ESEMs shipped in 2029–2058. These results include consumer, climate, and health benefits which accrue after 2029 from the equipment shipped in 2029–2058.

* Climate benefits are calculated using four different estimates of the social cost of carbon (SC–CO_2), methane (SC–CH_4), and nitrous oxide (SC–N_2O) (model average at 2.5 percent, 3 percent, and 5 percent discount rates; 95th percentile at 3 percent discount rate) (see section IV.L of this document). Together these represent the global SC–GHG. For presentational purposes of this table, the climate benefits associated with the average SC–GHG at a 3 percent discount rate are shown; however, DOE emphasizes the importance and value of considering the benefits calculated using all four sets of SC–GHG estimates. To monetize the benefits of reducing GHG emissions, this analysis uses the interim estimates presented in the *Technical Support Document: Social Cost of Carbon, Methane, and Nitrous Oxide Interim Estimates Under Executive Order 13990* published in February 2021 by the IWG

** Health benefits are calculated using benefit-per-ton values for NO_X and SO_2. DOE is currently only monetizing (for SO_2 and NO_X) $PM_{2.5}$ precursor health benefits and (for NO_X) ozone precursor health benefits, but will continue to assess the ability to monetize other effects such as health benefits from reductions in direct $PM_{2.5}$ emissions. See section IV.L of this document for more details.

† Total and net benefits include those consumer, climate, and health benefits that can be quantified and monetized. For presentation purposes, total and net benefits for both the 3-percent and 7-percent cases are presented using the average SC–GHG with 3-percent discount rate.

‡ Costs include incremental equipment costs.

†† Operating Cost Savings are calculated based on the life cycle costs analysis and national impact analysis as discussed in detail below. See sections IV.F and IV.H of this document. DOE's national impacts analysis includes all impacts (both costs and benefits) along the distribution chain beginning with the increased costs to the manufacturer to manufacture the equipment and ending with the increase in price experienced by the consumer. DOE also separately conducts a detailed analysis on the impacts on manufacturers (the MIA). See section IV.J of this document. In the detailed MIA, DOE models manufacturers' pricing decisions based on assumptions regarding investments, conversion costs, cashflow, and margins. The MIA produces a range of impacts, which is the rule's expected impact on the INPV. The change in INPV is the present value of all changes in industry cash flow, including changes in production costs, capital expenditures, and manufacturer profit margins. Change in INPV is calculated using the industry weighted average cost of capital value of 9.1 percent that is estimated in the MIA (see chapter 12 of the NOPR TSD for a complete description of the industry weighted average cost of capital). For ESEMs, those values are −$264 million and −$131 million. DOE accounts for that range of likely impacts in analyzing whether a TSL is economically justified. See section IV.J of this document. DOE is presenting the range of impacts to the INPV under two markup scenarios: the Preservation of Gross Margin scenario, which is the manufacturer markup scenario used in the calculation of Consumer Operating Cost Savings in this table, and the Preservation of Operating Profit scenario, where DOE assumed manufacturers would not be able to increase per-unit operating profit in proportion to increases in manufacturer production costs. DOE includes the range of estimated INPV in the above table, drawing on the MIA explained further in section IV.J of this document, to provide additional context for assessing the estimated impacts of this rule to society, including potential changes in production and consumption, which is consistent with OMB's Circular A–4 and E.O. 12866. If DOE were to include the INPV into the net benefit calculation for this proposed rule, the net benefits would range from $72.5 billion to $72.7 billion at 3-percent discount rate and would range from $38.0 billion to $38.2 billion at 7-percent discount rate. Numbers in parentheses are negative numbers. DOE seeks comment on this approach.

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

[13] DOE estimates the economic value of these emissions reductions resulting from the considered TSLs for the purpose of complying with the requirements of Executive Order 12866.

The benefits and costs of the proposed standards can also be expressed in terms of annualized values. The monetary values for the total annualized net benefits are (1) the reduced consumer operating costs, minus (2) the increase in product purchase prices and installation costs, plus (3) the value of climate and health benefits of emission reductions, all annualized.[14]

The national operating cost savings are domestic private U.S. consumer monetary savings that occur as a result of purchasing the covered products and are measured for the lifetime of ESEMs shipped in 2029–2058. The benefits associated with reduced emissions achieved as a result of the proposed standards are also calculated based on the lifetime of ESEMs shipped in 2029–2058. Total benefits for both the 3-percent and 7-percent cases are presented using the average GHG social costs with 3-percent discount rate. Estimates of SC–GHG values are presented for all four discount rates in section V.B of this document.

Table I–6 presents the total estimated monetized benefits and costs associated with the proposed standard, expressed in terms of annualized values. The results under the primary estimate are as follows.

Using a 7-percent discount rate for consumer benefits and costs and health benefits from reduced NO_X and SO_2 emissions, and the 3-percent discount rate case for climate benefits from reduced GHG emissions, the estimated cost of the standards proposed in this rule is $543 million per year in increased equipment costs, while the estimated annual benefits are $2,757 million in reduced equipment operating costs, $542 million in climate benefits, and $836 million in health benefits. In this case. The net benefit would amount to $3,592 million per year.

Using a 3-percent discount rate for all benefits and costs, the estimated cost of the proposed standards is $556 million per year in increased equipment costs, while the estimated annual benefits are $3,140 million in reduced operating costs, $542 million in climate benefits, and $1,052 million in health benefits. In this case, the net benefit would amount to $4,179 million per year.

TABLE I–6—ANNUALIZED BENEFITS AND COSTS OF PROPOSED ENERGY CONSERVATION STANDARDS FOR ESEMS
[TSL 2]

	Million 2022$/year		
	Primary estimate	Low-net-benefits estimate	High-net-benefits estimate
3% discount rate			
Consumer Operating Cost Savings	3,140	2,962	3,341
Climate Benefits *	542	526	562
Health Benefits **	1,052	1,021	1,089
Total Benefits †	4,734	4,509	4,992
Consumer Incremental Equipment Costs ‡	556	598	529
Net Benefits	4,179	3,911	4,464
Change in Producer Cashflow (INPV ††)	(25)–(13)	(25)–(13)	(25)–(13)
7% discount rate			
Consumer Operating Cost Savings	2,757	2,615	2,921
Climate Benefits * (3% discount rate)	542	526	562
Health Benefits **	836	814	863
Total Benefits †	4,135	3,955	4,346
Consumer Incremental Equipment Costs ‡	543	578	520
Net Benefits	3,592	3,377	3,826
Change in Producer Cashflow (INPV ††)	(25)–(13)	(25)–(13)	(25)–(13)

Note: This table presents the costs and benefits associated with ESEMs shipped in 2029–2058. These results include consumer, climate, and health benefits which accrue after 2058 from the equipment shipped in 2029–2058. The Primary, Low Net Benefits, and High Net Benefits Estimates utilize projections of energy prices from the *AEO2023* Reference case, Low Economic Growth case, and High Economic Growth case, respectively. In addition, incremental equipment costs reflect a constant rate in the Primary Estimate, an increasing rate in the Low Net Benefits Estimate, and a declining rate in the High Net Benefits Estimate. The methods used to derive projected price trends are explained in sections IV.F and IV.4 of this document. Note that the Benefits and Costs may not sum to the Net Benefits due to rounding.

* Climate benefits are calculated using four different estimates of the global SC–GHG (see section IV.L of this document). For presentational purposes of this table, the climate benefits associated with the average SC–GHG at a 3 percent discount rate are shown; however, DOE emphasizes the importance and value of considering the benefits calculated using all four sets of SC–GHG estimates. To monetize the benefits of reducing GHG emissions, this analysis uses the interim estimates presented in the *Technical Support Document: Social Cost of Carbon, Methane, and Nitrous Oxide Interim Estimates Under Executive Order 13990* published in February 2021 by the IWG.

** Health benefits are calculated using benefit-per-ton values for NO_X and SO_2. DOE is currently only monetizing (for SO_2 and NO_X) $PM_{2.5}$ precursor health benefits and (for NO_X) ozone precursor health benefits but will continue to assess the ability to monetize other effects such as health benefits from reductions in direct $PM_{2.5}$ emissions. See section IV.L of this document for more details.

† Total benefits for both the 3-percent and 7-percent cases are presented using the average SC–GHG with 3-percent discount rate.

‡ Costs include incremental equipment costs.

[14] To convert the time-series of costs and benefits into annualized values, DOE calculated a present value in 2022, the year used for discounting the NPV of total consumer costs and savings. For the benefits, DOE calculated a present value associated with each year's shipments in the year in which the shipments occur (*e.g.,* 2030), and then discounted the present value from each year to 2022. Using the present value, DOE then calculated the fixed annual payment over a 30-year period, starting in the compliance year, that yields the same present value.

†† Operating Cost Savings are calculated based on the life cycle costs analysis and national impact analysis as discussed in detail below. See sections IV.F and IV.H of this document. DOE's national impacts analysis includes all impacts (both costs and benefits) along the distribution chain beginning with the increased costs to the manufacturer to manufacture the equipment and ending with the increase in price experienced by the consumer. DOE also separately conducts a detailed analysis on the impacts on manufacturers (the MIA). See section IV.J. of this document. In the detailed MIA, DOE models manufacturers' pricing decisions based on assumptions regarding investments, conversion costs, cashflow, and margins. The MIA produces a range of impacts, which is the rule's expected impact on the INPV. The change in INPV is the present value of all changes in industry cash flow, including changes in production costs, capital expenditures, and manufacturer profit margins. The annualized change in INPV is calculated using the industry weighted average cost of capital value of 9.1 percent that is estimated in the MIA (see chapter 12 of the NOPR TSD for a complete description of the industry weighted average cost of capital). For ESEMs, those values are −$25 million and −$13 million. DOE accounts for that range of likely impacts in analyzing whether a TSL is economically justified. See section IV.J of this NOPR. DOE is presenting the range of impacts to the INPV under two markup scenarios: the Preservation of Gross Margin scenario, which is the manufacturer markup scenario used in the calculation of Consumer Operating Cost Savings in this table, and the Preservation of Operating Profit Markup scenario, where DOE assumed manufacturers would not be able to increase per-unit operating profit in proportion to increases in manufacturer production costs. DOE includes the range of estimated annualized change in INPV in the above table, drawing on the MIA explained further in section IV.J of this document to provide additional context for assessing the estimated impacts of this rule to society, including potential changes in production and consumption, which is consistent with OMB's Circular A–4 and E.O. 12866. If DOE were to include the INPV into the annualized net benefit calculation for this proposed rule, the annualized net benefits would range from $4,154 million to $4,166 million at 3-percent discount rate and would range from $3,567 million to $3,579 million at 7-percent discount rate. Numbers in parentheses are negative numbers. DOE seeks comment on this approach.

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

D. Conclusion

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. Specifically, with regards to technological feasibility, equipment achieving these standard levels are already commercially available for all equipment classes covered by this proposal. As for economic justification, DOE's analysis shows that the benefits of the proposed standard exceed, to a great extent, the burdens of the proposed standards.

Using a 7-percent discount rate for consumer benefits and costs and NO_X and SO_2 reduction benefits, and a 3-percent discount rate case for GHG social costs, the estimated cost of the proposed standards for ESEMs is $543 million per year in increased equipment costs, while the estimated annual benefits are $2,757 million in reduced equipment operating costs, $542 million in climate benefits and $836 million in health benefits. The net benefit amounts to $3,592 million per year.

The significance of energy savings offered by a new or amended energy conservation standard cannot be determined without knowledge of the specific circumstances surrounding a given rulemaking.[15] For example, some covered products and equipment have substantial energy consumption occur during periods of peak energy demand. The impacts of these products on the energy infrastructure can be more pronounced than products with relatively constant demand. Accordingly, DOE evaluates the significance of energy savings on a case-by-case basis.

As previously mentioned, the standards are projected to result in estimated national energy savings of 8.9 quad FFC, the equivalent of the primary annual energy use of 95.7 million homes. In addition, they are projected to reduce CO_2 emissions by 160.5 Mt. Based on these findings, DOE has initially determined the energy savings from the proposed standard levels are "significant" within the meaning of 42 U.S.C. 6295(o)(3)(B). A more detailed discussion of the basis for these tentative conclusions is contained in the remainder of this document and the accompanying technical support document ("TSD").

DOE also considered more-stringent energy efficiency levels as potential standards, and is still considering them in this proposed rulemaking. However, DOE has tentatively concluded that the potential burdens of the more-stringent energy efficiency levels would outweigh the projected benefits.

Based on consideration of the public comments DOE receives in response to this document and related information collected and analyzed during the course of this proposed rulemaking effort, DOE may adopt energy efficiency levels presented in this document 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 this proposed rule, as well as some of the relevant historical background related to the establishment of standards for ESEMs.

A. Authority

EPCA authorizes DOE to regulate the energy efficiency of a number of consumer products and certain industrial equipment. Title III, Part C of EPCA, added by Public Law 95–619, Title IV, section 441(a), established the Energy Conservation Program for Certain Industrial Equipment, which sets forth a variety of provisions designed to improve the energy efficiency of certain types of industrial equipment, including electric motors. (42 U.S.C. 6311(1)(A)) ESEMs, the subject of this document, are a category of electric motors.

The Energy Policy Act of 1992 ("EPACT 1992") (Pub. L. 102–486 (Oct. 24, 1992)) further amended EPCA by establishing energy conservation standards and test procedures for certain commercial and industrial electric motors that are manufactured alone or as a component of another piece of equipment. In December 2007, Congress enacted the Energy Independence and Security Act of 2007 ("EISA 2007") (Pub. L. 110–140 (Dec. 19, 2007). Section 313(b)(1) of EISA 2007 updated the energy conservation standards for those electric motors already covered by EPCA and established energy conservation standards for a larger scope of motors not previously covered by standards. (42 U.S.C. 6313(b)(2)) EISA 2007 also revised certain statutory definitions related to electric motors. See EISA 2007, sec. 313 (amending statutory definitions related to electric motors at 42 U.S.C. 6311(13)).

The energy conservation program under EPCA, consists essentially of four parts: (1) testing, (2) labeling, (3) the establishment of Federal energy conservation standards, and (4) certification and enforcement procedures. Relevant provisions of EPCA include definitions (42 U.S.C. 6311), test procedures (42 U.S.C. 6314), labeling provisions (42 U.S.C. 6315), energy conservation standards (42 U.S.C. 6313), and the authority to require information and reports from

[15] Procedures, Interpretations, and Policies for Consideration in New or Revised Energy Conservation Standards and Test Procedures for Consumer Products and Commercial/Industrial Equipment, 86 FR 70892, 70901 (Dec. 13, 2021).

manufacturers (42 U.S.C. 6316; U.S.C. 6296).

Federal energy efficiency requirements for covered equipment established under EPCA generally supersede state laws and regulations concerning energy conservation testing, labeling, and standards. (42 U.S.C. 6316(a) and 42 U.S.C. 6316(b); 42 U.S.C. 6297) DOE may, however, grant waivers of Federal preemption in limited instances for particular state laws or regulations, in accordance with the procedures and other provisions set forth under EPCA. (*See* 42 U.S.C. 6316(a) (applying the preemption waiver provisions of 42 U.S.C. 6297))

Subject to certain criteria and conditions, DOE is required to develop test procedures to measure the energy efficiency, energy use, or estimated annual operating cost of each covered equipment. (*See* 42 U.S.C. 6316(a); 42 U.S.C. 6295(o)(3)(A) and (r)) Manufacturers of covered equipment must use the Federal test procedures as the basis for: (1) certifying to DOE that their equipment complies with the applicable energy conservation standards adopted pursuant to EPCA (42 U.S.C. 6316(a); 42 U.S.C. 6295(s)), and (2) making representations about the efficiency of that equipment (42 U.S.C. 6314(d)). Similarly, DOE must use these test procedures to determine whether the equipment complies with relevant standards promulgated under EPCA. (42 U.S.C. 6316(a); 42 U.S.C. 6295(s)) The DOE test procedure for ESEMs appear at 10 CFR part 431, subpart B, appendix B (''appendix B'').

DOE must follow specific statutory criteria for prescribing new or amended standards for covered equipment, including ESEMs. Any new or amended standard for a covered product must be designed to achieve the maximum improvement in energy efficiency that the Secretary of Energy determines is technologically feasible and economically justified. (42 U.S.C. 6316(a); 42 U.S.C. 6295(o)(2)(A)) Furthermore, DOE may not adopt any standard that would not result in the significant conservation of energy. (42 U.S.C. 6316(a); 42 U.S.C. 6295(o)(3))

Moreover, DOE may not prescribe a standard (1) for certain equipment, including ESEMs, if no test procedure has been established for the equipment, or (2) if DOE determines by rule that the standard is not technologically feasible or economically justified. (42 U.S.C. 6316(a); 42 U.S.C. 6295(o)(3)(A)–(B)) In deciding whether a proposed standard is economically justified, DOE must determine whether the benefits of the standard exceed its burdens. (42 U.S.C. 6316(a); 42 U.S.C. 6295(o)(3)(A)–(B)) DOE must make this determination after receiving comments on the proposed standard, and by considering, to the greatest extent practicable, the following seven statutory factors:

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

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

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

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

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

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

(7) Other factors the Secretary of Energy (''Secretary'') considers relevant. (42 U.S.C. 6316(a); 42 U.S.C. 6295(o)(2)(B)(i)(I)–(VII))

Further, 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 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. 6316(a); 42 U.S.C. 6295(o)(2)(B)(iii))

EPCA also contains what is known as an ''anti-backsliding'' provision, which prevents the Secretary from prescribing any amended standard that either increases the maximum allowable energy use or decreases the minimum required energy efficiency of a covered product. (42 U.S.C. 6316(a); 42 U.S.C. 6295(o)(1)) Also, the Secretary may not prescribe an amended or new standard if interested persons have established by a preponderance of the evidence that the standard is likely to result in the unavailability in the United States in any covered product type (or class) of performance characteristics (including reliability), features, sizes, capacities, and volumes that are substantially the same as those generally available in the United States. (42 U.S.C. 6316(a); 42 U.S.C. 6295(o)(4))

Additionally, EPCA specifies requirements when promulgating an energy conservation standard for a covered product or equipment that has two or more subcategories. DOE must specify a different standard level for a type or class of product that has the same function or intended use, if DOE determines that products within such group: (A) consume a different kind of energy from that consumed by other covered products within such type (or class); or (B) have a capacity or other performance-related feature which other products within such type (or class) do not have and such feature justifies a higher or lower standard. (42 U.S.C. 6316(a); 42 U.S.C. 6295(q)(1)) In determining whether a performance-related feature justifies a different standard for a group of equipment, DOE must consider such factors as the utility to the consumer of such a feature and other factors DOE deems appropriate. (*Id.*) Any rule prescribing such a standard must include an explanation of the basis on which such higher or lower level was established. (42 U.S.C. 6316(a); 42 U.S.C. 6295(q)(2))

B. Background

1. Current Standards

DOE does not currently have energy conservation standards for ESEMs even though DOE has the authority to regulate electric motors broadly. DOE has adopted energy conservation standards for medium electric motors (''MEMs'') at 10 CFR 431.25 (see section III.A of this document for further description), as well as small electric motors (''SEMs'') at 10 CFR 431.446, which are separately regulated categories.

2. History of Standards Rulemaking for ESEMs

On May 21, 2020, DOE issued an early assessment request for information (''RFI'') (''May 2020 Early Assessment Review RFI'') in which DOE stated that it was initiating an early assessment review to determine whether any new or amended standards would satisfy the relevant requirements of EPCA for a new or amended energy conservation standard for electric motors and sought information related to that effort. Specifically, DOE sought data and information that could enable the agency to determine whether DOE should propose a ''no new standard'' determination because a more stringent standard: (1) would not result in a significant savings of energy; (2) is not technologically feasible; (3) is not economically justified; or (4) any combination of the foregoing. 85 FR 30878, 30879.

On March 2, 2022, DOE published a Preliminary Analysis for electric motors (''March 2022 Preliminary Analysis''). 87 FR 11650. In conjunction with the March 2022 Preliminary Analysis, DOE published the March 2022 Preliminary TSD, which presented the results of the in-depth technical analyses in the following areas: (1) engineering; (2) markups to determine equipment price; (3) energy use; (4) LCC and PBP; and (5) national impacts. The results presented included the current scope of electric motors regulated at 10 CFR 431.25, in addition to an expanded scope of motors, including electric motors above 500 horsepower, air-over electric motors, and ESEMs.[16] *See* chapter 2 of the March 2022 Preliminary TSD. DOE requested comment on a number of topics regarding the analysis presented. However, DOE is only responding to comments pertaining to ESEMs and air-over expanded scope electric motors (''AO–ESEMs'') in this NOPR, as DOE responded to the rest of the comments pertaining to medium electric motors and their air-over equivalents in the Electric Motors Direct Final Rule published on June 1, 2023 (''June 2023 DFR'') that amended energy conservation standards for medium electric motors and their air-over equivalents. 88 FR 36066.

On April 5, 2022, DOE held a public webinar in which it presented the methods and analysis in the March 2022 Preliminary Analysis and solicited public comment. (''April 5, 2022, Public Meeting'').

TABLE II–1—MARCH 2022 PRELIMINARY ANALYSIS WRITTEN COMMENTERS

Commenter(s)	Reference in this NOPR	Docket No.	Commenter type
American Council for an Energy-Efficient Economy, Appliance Standards Awareness Project, National Electrical Manufacturers Association, Natural Resources Defense Council, Northwest Energy Efficiency Alliance, Pacific Gas & Electric Company, San Diego Gas & Electric, Southern California Edison.	Electric Motors Working Group.	38	Working Group.
Appliance Standards Awareness Project, American Council for an Energy-Efficient Economy, Natural Resources Defense Council, New York State Energy Research and Development Authority.	Joint Advocates	27	Efficiency Advocacy Organizations.
Association of Home Appliance Manufacturers; Air-Conditioning, Heating, and Refrigeration Institute.	AHAM and AHRI	25	Trade Association.
Air-Conditioning, Heating, and Refrigeration Institute	AHRI	26	Trade Association.
Pacific Gas and Electric Company, San Diego Gas and Electric, and Southern California Edison; collectively, the California Investor-Owned Utilities.	CA IOUs	30	Utilities.
Electrical Apparatus Service Association, Inc	EASA	21	Trade Association.
Hydraulics Institute	HI	31	Trade Association.
Lennox International	Lennox	29	Manufacturer.
Northwest Energy Efficiency Alliance	NEEA	33	Efficiency Advocacy Organization.
National Electrical Manufacturers Association, Association of Home Appliance Manufacturers, the Air-Conditioning, Heating, and Refrigeration Institute, the Medical Imaging Technology Alliance, the Outdoor Power Equipment Institute, Home Ventilating Institute, and the Power Tool Institute.	Joint Industry Stakeholders.	23	Trade Associations.
National Electrical Manufacturers Association	NEMA	22	Trade Association.

A parenthetical reference at the end of a comment quotation or paraphrase provides the location of the item in the public record.[17] To the extent that interested parties have provided written comments that are substantively consistent with any oral comments provided during the April 5, 2022, public meeting, DOE cites the written comments throughout this document.

By letter dated December 22, 2022, DOE received the December 2022 Joint Recommendation from the Electric Motors Working Group. The December 2022 Joint Recommendation addressed energy conservation standards for high-torque, medium-torque, low-torque, and polyphase ESEMs that are 0.25–3 hp, and AO–ESEMs. The December 2022 Joint Recommendation recommended a compliance date for updated energy conservation standards for AO–ESEMs as well. (Electric Motors Working Group, No. 38 at p. 5)

3. Electric Motors Working Group Recommended Standard Levels

This section summarizes the standard levels recommended in the December 2022 Joint Recommendation and the subsequent procedural steps taken by DOE. Further discussion on scope is provided in section III.A of this document. The Electric Motors Working Group stated that the recommended levels would minimize potential market disruptions by allowing smaller designs to remain on the market. Specifically the Electric Motors Working Group stated that the recommended levels for high and medium torque ESEM could allow smaller capacitor start induction run (''CSIR'') motors and currently unregulated split-phase motors, which are common in certain space-constrained products; for low torque ESEMs, the Electric Motors Working Group stated that manufacturers believe efficiency levels above the recommended levels could result in significant increases in the physical size, unavailability of product, and, in some cases, may be extremely difficult to achieve with current permanent split capacitor (''PSC'') technology; and for AO–ESEMs, the Electric Motors Working Group stated that the recommended levels represented the highest feasible efficiencies given the potential design constraints associated with their use in covered equipment. (*Id.* at pp. 3–5)

Recommendation A: For high-torque and medium-torque ESEMs (*i.e.,* CSIR, capacitor start capacitor run (''CSCR''), and split-phase motors), the Electric Motors Working Group recommended the following standard levels, expressed in average full-load efficiency:

(1) Values for open and enclosed motors rated at 0.25, 0.33, and 0.5 hp (all pole configurations) that are largely based on the levels in NEMA MG 1, Table 12–19, ''Premium Efficiency Levels for Capacitor-Start/Induction-

[16] In the March 2022 Preliminary Analysis, DOE used the term small, non-small electric motor, electric motors (''SNEMs'') to designate ESEMs.

[17] The parenthetical reference provides a reference for information located in the docket of DOE's rulemaking to develop energy conservation standards for electric motors. (Docket No. EERE–2020–BT–STD–0007, which is maintained at *www.regulations.gov*). The references are arranged as follows: (commenter name, comment docket ID number, page of that document).

Run Single-Phase Small Motors.'' The exceptions are the open and enclosed 0.5 hp 4-pole values, which have lower efficiency standards described in Table II–2. For cases where Table 12–19 lists two frame sizes (*e.g.,* 48 and 56 frame) for a given hp rating, the recommended efficiency level reflects the smaller frame size (*i.e.,* lower efficiency).

(2) Values for open motors (2-, 4-, 6-pole) above 0.5 hp that are consistent with the current small electric motor standards for CSCR and CSIR motors found in 10 CFR part 431, subpart X (§ 431.446).

(3) Values for 8-pole open motors above 0.5 hp and all enclosed motors above 0.5 hp that are based on the levels in NEMA MG 1, Table 12–20, ''Premium Efficiency Levels for Capacitor-Start/Capacitor-Run Single-Phase Small Motors.'' For cases where Table 12–20 lists two frame sizes (*e.g.,* 48 and 56 frame) for a given hp rating, the recommended efficiency level reflects the smaller frame size (*i.e.,* lower efficiency).

TABLE II–2—RECOMMENDED ENERGY CONSERVATION STANDARDS FOR HIGH-TORQUE AND MEDIUM-TORQUE ESEMs

[*i.e.,* CSIR, CSCR, and split-phase motors]

hp	Average full load efficiency							
	Open				Enclosed			
	2-pole	4-pole	6-pole	8-pole	2-pole	4-pole	6-pole	8-pole
0.25	59.5	59.5	57.5	....	59.5	59.5	57.5	....
0.33	64.0	64.0	62.0	50.5	64.0	64.0	62.0	50.5
0.5	68.0	69.2	68.0	52.5	68.0	67.4	68.0	52.5
0.75	76.2	81.8	80.2	72.0	75.5	75.5	75.5	72.0
1	80.4	82.6	81.1	74.0	77.0	80.0	77.0	74.0
1.5	81.5	83.8	....	....	81.5	81.5	80.0	....
2	82.9	84.5	....	....	82.5	82.5	....	....
3	84.1	....	....	....	84.0	....	....	....

(*Id.* at pp. 3, 6).

Recommendation B: For low-torque ESEMs (*i.e.,* shaded pole and PSC motors), the Electric motors Working Group recommended the following standard levels, expressed in terms of average full-load efficiency:

(1) Values for open motors rated at 0.25 hp, 0.33 hp, and 1.5 hp and above that are based on DOE's new efficiency level (EL 3).[18]

(2) Values for open motors rated at 0.5, 0.75, and 1.0 hp that are based on DOE's new EL 2, with two exceptions:[19]

(a) The 6-pole, 1.0 hp value is the mid-point between EL 2 (75.3%) and EL 3 (79.2%)

(b) The 2-pole, 0.5 hp value is the mid-point between EL 2 (66.4%) and EL 3 (71.1%)

(3) Values for enclosed motors that are based on the equivalent open motor efficiency but are adjusted to account for the lack of additional cooling, which is a function of motor rpm (*i.e.,* number of poles). The adjustment is 3% for 2-pole motors, 2% for 4-pole motors, 1% for 6-pole motors, and 0% for 8-pole motors.

TABLE II–3—RECOMMENDED ENERGY CONSERVATION STANDARDS FOR LOW-TORQUE ESEMs

[*i.e.,* shaded pole and PSC motors]

hp	Average full load efficiency							
	Open				Enclosed			
	2-pole	4-pole	6-pole	8-pole	2-pole	4-pole	6-pole	8-pole
0.25	63.9	66.1	60.2	52.5	60.9	64.1	59.2	52.5
0.33	66.9	69.7	65.0	56.6	63.9	67.7	64.0	56.6
0.5	68.8	70.1	66.8	57.1	65.8	68.1	65.8	57.1
0.75	70.5	74.8	73.1	62.8	67.5	72.8	72.1	62.8
1	74.3	77.1	77.3	65.7	71.3	75.1	76.3	65.7
1.5	79.9	82.1	80.5	72.2	76.9	80.1	79.5	72.2
2	81.0	82.9	81.4	73.3	78.0	80.9	80.4	73.3
3	82.4	84.0	82.5	74.9	79.4	82.0	81.5	74.9

(*Id.* at pp. 4, 6)

Recommendation C: For polyphase ESEMs (*i.e.,* three-phase ESEMs), the Electric Motors Working Group recommended the following standard levels, expressed in terms of average full-load efficiency:

(1) Values for 2-pole, 4-pole, and 6-pole open motors that are consistent with the current small electric motor standards for polyphase motors found in 10 CFR part 431, subpart X (§ 431.446).

(2) Values for 8-pole open and all enclosed motors from NEMA MG 1, Table 12–21, ''Premium Efficiency Levels for Three-Phase Induction Small Motors.'' For cases where Table 12–21 lists two frame sizes (*e.g.,* 48 and 56 frame) for a given hp rating, the recommended efficiency level reflects the smaller frame size (*i.e.,* lower efficiency).

[18] ''DOE's new efficiency level'' refers to preliminary efficiency levels that were developed during the private negotiations of the Electric Motors Working Group. See Table II–3 for the final values chosen from those preliminary efficiency levels.

[19] See footnote 18.

TABLE II–4—RECOMMENDED ENERGY CONSERVATION STANDARDS FOR POLYPHASE ESEMS
[*i.e.,* Three-Phase ESEMs]

hp	Average full load efficiency							
	Open				Enclosed			
	2-pole	4-pole	6-pole	8-pole	2-pole	4-pole	6-pole	8-pole
0.25	65.6	69.5	67.5	62.0	66.0	68.0	66.0	62.0
0.33	69.5	73.4	71.4	64.0	70.0	72.0	70.0	64.0
0.5	73.4	78.2	75.3	66.0	72.0	75.5	72.0	66.0
0.75	76.8	81.1	81.7	70.0	75.5	77.0	74.0	70.0
1	77.0	83.5	82.5	75.5	75.5	77.0	74.0	75.5
1.5	84.0	86.5	83.8	77.0	84.0	82.5	87.5	78.5
2	85.5	86.5	....	86.5	85.5	85.5	88.5	84.0
3	85.5	86.9	....	87.5	86.5	86.5	89.5	85.5

(*Id.*)

Recommendation D: The Electric Motors Working Group recommended that if standards are warranted for AO–ESEMs, DOE set the standards at the same levels as those for comparable ESEMs used in non-air-over applications. (*Id.* at p. 5)

Recommendation E: The Electric Motors Working Group recommended that DOE align the compliance date for AO–ESEMs with the compliance date for updated energy conservation standards for Commercial Unitary Air Conditioners/Heat Pumps (''CUAC/HPs'') currently under negotiation in DOE's Appliance Standards and Rulemaking Federal Advisory Committee (''ASRAC'') Working Group on CUAC/HPs. The Electric Motors Working Group stated this recommended compliance date would appropriately balance energy savings and the time needed for manufacturers of equipment with AO–ESEMs to re-design products. (*Id.*)

DOE notes that the scope and standards proposed in this document are equivalent to those recommended by the Electric Motors Working Group. Regarding the compliance year for energy conservation standards for ESEMs, the Electric Motors Working Group recommended that DOE align the compliance date for AO–ESEMs with the compliance date for updated energy conservation standards for CUAC/HP, which were under negotiation in DOE's ASRAC Working Group on CUAC/HPs at the time. Since then, the CUAC/HP negotiations have concluded and include a recommended compliance year of 2029 (*i.e.,* January 1, 2029).[20] ESEMs are a type of electric motor, but not among the types of electric motor for which Congress established standards and a rulemaking schedule in 42 U.S.C. 6313(b). As such, they are exempt from the requirements of 42 U.S.C. 6313(b), including the compliance deadlines provided in that section. Because section 42 U.S.C. 6316(a) applies certain requirements of 42 U.S.C. 6295(l)–(s) of EPCA to certain equipment, including electric motors, DOE considered whether the compliance deadlines of 42 U.S.C. 6295(m)(4) applies to ESEMs. 42 U.S.C. 6295(m)(4)(A) defines compliance deadlines for specific products; however, electric motors and ESEMs are not listed, nor does 42 U.S.C. 6316 apply a cross reference on how to apply these paragraphs to electric motors or ESEMs. Accordingly, DOE has determined that these compliance deadlines do not apply to ESEMs. Additionally, DOE reviewed section 6295(m)(4)(B), which states that a manufacturer shall not be required to apply new standards to a product with respect to which other new standards have been required in the prior 6-year period. As no standards for ESEMs have not yet been established, this paragraph also does not apply to ESEMs. As such, DOE has determined that it has discretion to establish compliance deadlines for ESEMs. Therefore, DOE proposes a January 1, 2029, compliance date in accordance with the recommendation from the Electric Motors Working Group. DOE has tentatively determined that this compliance date would provide sufficient lead time to motor manufacturers based on the recommendation from the Electric Motors Working Group, which includes NEMA.

[20] *See* CUAC/HP ASRAC Working group term sheet at: *www.regulations.gov/document/EERE-2022-BT-STD-0015-0087.*

C. Deviation From Process Rule

In accordance with section 3(a) of 10 CFR part 430, subpart C, appendix A (''Process Rule''), DOE notes that it is deviating from the provision in the Process Rule regarding the pre-NOPR and NOPR stages for an energy conservation standards rulemaking.

1. Public Comment Period

Section 6(f)(2) of the Process Rule specifies that the length of the public comment period for a NOPR will be not less than 75 calendar days. For this NOPR, DOE has opted instead to provide a 60-day comment period, consistent with EPCA requirements. (42 U.S.C. 6316(a); 42 U.S.C. 6295(p). DOE is opting to deviate from the 75-day comment period because stakeholders have already been afforded multiple opportunities to provide comments on this proposed rulemaking. As noted previously, DOE requested comment on various issues pertaining to this standards rulemaking in the May 2020 Early Assessment Review RFI and provided stakeholders with a 30-day comment period. 85 FR 30878. Additionally, DOE provided a 60-day comment period for stakeholders to provide input on the analyses presented in the March 2022 Preliminary Analysis. 87 FR 11650. The analytical assumptions and approaches used for the analyses conducted for this NOPR are similar to those used for the preliminary analysis. Furthermore, as discussed previously in this document, the standards proposed in this document are equivalent to those recommended by the Electric Motors Working Group for the electric motor types subject to this proposal. Therefore, DOE believes a 60-day comment period is appropriate and will provide interested parties with a meaningful opportunity to comment on the proposed rule.

2. Framework Document

Section 6(a)(2) of the Process Rule states that if DOE determines it is appropriate to proceed with a rulemaking, the preliminary stages of a rulemaking to issue or amend an energy conservation standard that DOE will undertake will be a framework document and preliminary analysis, or an advance notice of proposed rulemaking. While DOE published a preliminary analysis for this rulemaking (*see* 87 FR 11650), DOE did not publish a framework document in conjunction with the preliminary analysis. DOE notes, however, that chapter 2 of the March 2022 Preliminary TSD that accompanied the March 2022 Preliminary Analysis—entitled *Analytical Framework, Comments from Interested Parties, and DOE Responses*—describes the general analytical framework that DOE uses in evaluating and developing potential new energy conservation standards.[21] As such, publication of a separate framework document would be largely redundant of chapter 2 of the March 2022 Preliminary TSD.

III. General Discussion

DOE developed this proposal after considering oral and written comments, data, and information from interested parties that represent a variety of interests, including the December 2022 Joint Recommendation. The following discussion addresses issues raised by these commenters.

A. Scope of Coverage and Equipment Classes

1. General Scope of Coverage and Equipment Classes

This document covers certain equipment meeting the definition of electric motors as defined in 10 CFR 431.12. Specifically, the definition for ''electric motor'' is ''a machine that converts electrical power into rotational mechanical power.'' 10 CFR 431.12. This NOPR addresses ESEMs, which are covered under 10 CFR part 431 subpart B. This NOPR does not address small electric motors, which are covered under 10 CFR part 431 subpart X.[22]

Currently, DOE regulates MEMs falling into the NEMA Design A, NEMA Design B, NEMA Design C, and fire pump motor categories and those electric motors that meet the criteria specified at 10 CFR 431.25(g). 10 CFR 431.25(h)–(j). Section 431.25(g) specifies that the relevant standards apply only to electric motors, including partial electric motors, that satisfy the following criteria:

(1) Are single-speed, induction motors;

(2) Are rated for continuous duty (MG 1) operation or for duty type S1 (IEC);

(3) Contain a squirrel-cage (MG 1) or cage (IEC) rotor;

(4) Operate on polyphase alternating current 60-hertz sinusoidal line power;

(5) Are rated 600 volts or less;

(6) Have a 2-, 4-, 6-, or 8-pole configuration;

(7) Are built in a three-digit or four-digit NEMA frame size (or IEC metric equivalent), including those designs between two consecutive NEMA frame sizes (or IEC metric equivalent), or an enclosed 56 NEMA frame size (or IEC metric equivalent);

(8) Produce at least one horsepower (0.746 kW) but not greater than 500 horsepower (373 kW), and

(9) Meet all of the performance requirements of one of the following motor types: A NEMA Design A, B, or C motor or an IEC Design N, NE, NEY, NY or H, HE, HEY, HYmotor.[23]

10 CFR 431.25(g).

The definitions for ''NEMA Design A motors,'' ''NEMA Design B motors,'' ''NEMA Design C motors,'' ''fire pump electric motors,'' ''IEC Design N motor,'' and ''IEC Design H motor,'' as well as ''E'' and ''Y'' designated IEC Design motors, are codified in 10 CFR 431.12. DOE has also currently exempted certain categories of motors from standards. The exemptions are as follows:

(1) Air-over electric motors;

(2) Component sets of an electric motor;

(3) Liquid-cooled electric motors;

(4) Submersible electric motors; and

(5) Inverter-only electric motors.

10 CFR 431.25(l).

On October 19, 2022, DOE published the electric motors test procedure final rule (''October 2022 Final Rule''). 87 FR 63588. As part of the October 2022 Final Rule, DOE expanded the test procedure scope to additional categories of electric motors that currently do not have energy conservation standards. 87 FR 63588, 63593–63606. The expanded test procedure scope included the following:

(1) Electric motors having a rated horsepower above 500 and up to 750 hp that meets the criteria listed at § 431.25(g), with the exception of criteria § 431.25(g)(8) to air-over electric motors (''AO–MEMs''), and inverter-only electric motors;

(2) Expanded Scope Electric Motors (''ESEM'', formally known as ''small, non-small electric motor, electric motors'' or ''SNEMs''), that are not air-over electric motors, which:

(a) Are not a small electric motor, as defined at § 431.442 and is not a dedicated pool pump motors as defined at § 431.483;

(b) Are rated for continuous duty (MG 1) operation or for duty type S1 (IEC);

(c) Operate on polyphase or single-phase alternating current 60-hertz (Hz) sinusoidal line power; or is used with an inverter that operates on polyphase or single-phase alternating current 60-hertz (Hz) sinusoidal line power;

(d) Are rated for 600 volts or less;

(e) Are a single-speed induction motor capable of operating without an inverter or is an inverter-only electric motor;

(f) Produce a rated motor horsepower greater than or equal to 0.25 horsepower (0.18 kW); and

(g) Are built in the following frame sizes: any two-, or three-digit NEMA frame size (or IEC equivalent) if the motor operates on single-phase power; any two-, or three-digit NEMA frame size (or IEC equivalent) if the motor operates on polyphase power, and has a rated motor horsepower less than 1 horsepower (0.75 kW); or a two-digit NEMA frame size (or IEC metric equivalent), if the motor operates on polyphase power, has a rated motor horsepower equal to or greater than 1 horsepower (0.75 kW), and is not an enclosed 56 NEMA frame size (or IEC metric equivalent).

(3) ESEMs that are air-over electric motors (''AO–ESEMs'') and inverter-only electric motors;

(4) A synchronous electric motor, which:

(a) Is not a dedicated pool pump motor as defined at § 431.483 or is not an air-over electric motor;

(b) Is a synchronous electric motor;

(c) Is rated for continuous duty (MG 1) operation or for duty type S1 (IEC);

(d) Operates on polyphase or single-phase alternating current 60-hertz (Hz) sinusoidal line power; or is used with an inverter that operates on polyphase or single-phase alternating current 60-hertz (Hz) sinusoidal line power;

(e) Is rated 600 volts or less; and

(f) Produces at least 0.25 hp (0.18 kW) but not greater than 750 hp (559 kW).

(5) Synchronous electric motors that are inverter-only electric motors.

See section 1.2, appendix B.

In the October 2022 Final Rule, DOE noted that, for these motors newly included within the scope of the test procedure for which there was no established energy conservation standards, such as ESEMs and AO–

[21] The March 2022 Preliminary TSD is available at *www.regulations.gov/document/EERE-2020-BT-STD-0007-0010.*

[22] DOE uses the term ''expanded scope electric motor'' or ''ESEM'' (formally known as ''small, non-small electric motor, electric motors'' or ''SNEMs''), to describe those small electric motors that are not included in the definition ''small electric motor'' under EPCA, but otherwise fall within the definition of ''electric motor'' under EPCA. The term ''small electric motor'' means a NEMA general purpose alternating current single-speed induction motor, built in a two-digit frame number series in accordance with NEMA Standards Publication MG1–1987. (42 U.S.C. 6311(13)(G)).

[23] DOE added the ''E'' and ''Y'' designations for IEC Design motors into 10 CFR 431.25(g) in the electric motors test procedure final rule. 87 FR 63588, 63596–636597, 63606 (Oct. 19, 2022).

ESEMs, manufacturers would not be required to use the test procedure to certify these motors to DOE until such time as a standard is established. 87 FR 63588, 63591.[24] Further, the October 2022 Final Rule continued to exclude the following categories of electric motors:

(1) Inverter-only electric motors that are air-over electric motors;

(2) Component sets of an electric motor;

(3) Liquid-cooled electric motors; and

(4) Submersible electric motors.

Due to the number of electric motor characteristics (*e.g.,* horsepower rating, pole configuration, and enclosure), in the March 2022 Preliminary Analysis, DOE used two constructs to help develop appropriate energy conservation standards for electric motors: ''equipment class'' and ''equipment class groups.'' An equipment class represents a unique combination of motor characteristics for which DOE is establishing a specific energy conservation standard. This includes permutations of electric motor design topologies (*i.e.,* CSIR/CSCR, split phase, shaded pole, PSC, or polyphase), standard horsepower ratings (*i.e.,* standard ratings from 0.25 to 3 horsepower varying based on torque level and pole count), pole configurations (*i.e.,* 2-, 4-, 6-, or 8-pole), and enclosure types (*i.e.,* open or enclosed). An ECG is a collection of electric motors that share a common design trait. Equipment class groups include motors over a range of horsepower ratings, enclosure types, and pole configurations. Essentially, each equipment class group is a collection of a large number of equipment classes with the same design trait. As such, in the March 2022 Preliminary Analysis, DOE presented equipment class groups based on electric motor topology, horsepower rating, pole configuration. and enclosure type. *See* sections 2.3.1 and 3.2.2 of the March 2022 Preliminary TSD.

In the March 2022 Preliminary Analysis, DOE analyzed the additional motors now included within the scope of the test procedure after the October 2022 Final Rule. *See* sections 2.2.1 and 2.2.3.2 of the March 2022 Preliminary TSD. This analysis included MEMs from 1–500hp, AO–MEMs, and ESEMs (including AO–ESEMs). This NOPR proposes new standards for only a portion of the scope analyzed in the March 2022 Preliminary Analysis and included within the scope of the test procedure after the October 2022 Final Rule. Specifically, in this NOPR, DOE is only proposing standards for ESEMs, including AO–ESEMs. As further described in section IV.A.3 of this document, DOE used multiple performance characteristics to establish the equipment classes used in this NOPR. Among these performance characteristics are locked-rotor torque and number of phases of the input power of a motor, used to create the following groups: high and medium torque single-phase ESEMs (*i.e.,* CSIR/CSCR and split phase), low torque single phase ESEMs (*i.e.,* shaded pole, PSC) and polyphase ESEMs that meet the criteria a) through g) as listed previously (*See* section 1.2, 10 CFR part 431, appendix B). These are typically used in residential as well as commercial and industrial applications.

Further discussion on equipment classes and the basis used to establish them is provided in section IV.A.3 of this document.

2. Structure of the Regulatory Text

In addition to proposing new requirements for ESEMs, in this NOPR, DOE proposes to move portions of the existing electric motor regulations that pertain to the energy conservation standards and their compliance dates (at 10 CFR 431.25) to improve clarity. In this NOPR, DOE proposes to revise 10 CFR 431.25 by retaining the existing electric motor energy conservation standards and their compliance dates, adding provisions pertaining to ESEMs, and reorganizing all provisions currently in 10 CFR 431.25 by compliance date (*i.e.,* each section has a different compliance date) to improve clarity. See Table III–1 for details.

TABLE III–1—REVISIONS TO 10 CFR 431.25

Current location	Content high-level description	Proposed revised location	Impact
§ 431.25(a)–(f)	Describes standards for certain electric motors manufactured on or after December 19, 2010, but before June 1, 2016.	None	None—Removed as these requirements are no longer current.
§ 431.25(k), § 431.25(q)	Describes how to establish the horsepower for purposes of determining the required minimum nominal full-load efficiency of an electric motor.	§ 431.25(a)	Avoids repeating identical provisions in each subsection.
§ 431.25(g)	Describes the criteria for inclusion for certain electric motors manufactured on or after June 1, 2016, but before June 1, 2027 subject to energy conservation standards.	§ 431.25(b)(1)(i)	Moves the ''inclusion'' criteria, so that the proper scope is presented fully upfront in each section.
§ 431.25(h)	Describes standards for certain NEMA Design A and B electric motors (and IEC equivalent) manufactured on or after June 1, 2016, but before June 1, 2027.	§ 431.25(b)(2)(i)	Makes each section ''comprehensive'' by carrying over the existing standards for all electric motors categories in each section.
§ 431.25(i)	Describes standards for certain NEMA Design C electric motors (and IEC equivalent) manufactured on or after June 1, 2016.	§ 431.25(b)(2)(ii), § 431.25(c)(2)(iv), § 431.25(d)(3)(iv).	Makes each section ''comprehensive'' by carrying over the existing standards for all electric motors categories in each section.

[24] However, manufacturers making voluntary representations respecting the energy consumption or cost of energy consumed by such motors are required to use the DOE test procedure for making such representations beginning 180 days following publication of the October 2022 Final Rule. *Id.* at 87 FR 63591.

TABLE III–1—REVISIONS TO 10 CFR 431.25—Continued

Current location	Content high-level description	Proposed revised location	Impact
§ 431.25(j)	Describes standards for certain fire pump electric motors (and IEC equivalent) manufactured on or after June 1, 2016.	§ 431.25(b)(2)(iii), § 431.25(c)(2)(v), § 431.25(d)(3)(v).	Makes each section "comprehensive" by carrying over the existing standards for all electric motors categories in each section.
§ 431.25(l)	Describes the criteria for exclusion for certain electric motors manufactured on or after June 1, 2016, but before June 1, 2027 subject to energy conservation standards.	§ 431.25(b)(1)(ii)	Moves the "exemptions" to directly after the "inclusion" criteria, so that the proper scope is presented fully upfront in each section, prior to presenting the sub-group criteria and standards.
§ 431.25(m)	Describes the criteria for inclusion for certain electric motors manufactured on or after June 1, 2027 subject to energy conservation standards.	§ 431.25(c)(1)(i)	Moves the "inclusion" criteria, so that the proper scope is presented fully upfront in each section.
§ 431.25(n)	Describes standards for certain NEMA Design A and B electric motors (and IEC equivalent),but excluding fire pump electric motors and air-over electric motors manufactured on or after June 1, 2027.	§ 431.25(c)(2)(i), § 431.25(d)(3)(i)	Makes each section "comprehensive" by carrying over the existing standards for all electric motors categories in each section.
§ 431.25(o)	Describes standards for certain air-over NEMA Design A and B electric motors (and IEC equivalent), built in standard frame size manufactured on or after June 1, 2027.	§ 431.25(c)(2)(ii), § 431.25(d)(3)(ii)	Makes each section "comprehensive" by carrying over the existing standards for all electric motors categories in each section.
§ 431.25(p)	Describes standards for certain air-over NEMA Design A and B electric motors (and IEC equivalent), built in specialized frame size manufactured on or after June 1, 2027.	§ 431.25(c)(2)(iii), § 431.25(d)(3)(iii)	Makes each section "comprehensive" by carrying over the existing standards for all electric motors categories in each section.
§ 431.25(r)	Describes the criteria for exclusion for certain electric motors manufactured on or after June 1, 2027, subject to energy conservation standards.	§ 431.25(c)(1)(ii)	Moves the "exemptions" to directly after the "inclusion" criteria, so that the proper scope is presented fully upfront in each section, prior to presenting the sub-group criteria and standards.
New section	Describes the criteria for inclusion as ESEM.	§ 431.25(d)(2)(i)	New section—Adds the ESEM provisions proposed in this NOPR.
New section	Describes the criteria for exclusion for certain ESEM electric motors manufactured on or after January 1, 2029.	§ 431.25(d)(2)(ii)	New section—Adds the ESEM provisions proposed in this NOPR.
New section	Describes standards for certain high and medium torque ESEM manufactured on or after January 1, 2029.	§ 431.25(d)(3)(vi)	New section—Adds the ESEM provisions proposed in this NOPR.
New section	Describes standards for certain low torque ESEMs manufactured on or after January 1, 2029.	§ 431.25(d)(3)(vii)	New section—Adds the ESEM provisions proposed in this NOPR.
New section	Describes standards for certain polyphase ESEMs manufactured on or after January 1, 2029.	§ 431.25(d)(3)(viii)	New section—Adds the ESEM provisions proposed in this NOPR.

3. Air-Over Medium Electric Motors and Air-Over ESEMs

The June 2023 DFR amended the existing energy conservation standards for electric motors by establishing higher standards for certain horsepower electric motors and expanding the scope of the energy conservation standards to include certain air-over electric motors and electric motors with horsepower greater than 500. DOE adopted standards that were consistent with a joint recommendation that was submitted to DOE on November 15, 2022 (the ''November 2022 Joint Recommendation''), after determining that the new and amended energy conservation standards for these products would result in significant conservation of energy and are technologically feasible and economically justified. 88 FR 36066, 36067–36069.

In the June 2023 DFR, DOE described that DOE currently regulates MEMs falling into the NEMA Design A, NEMA Design B, NEMA Design C, and fire pump motor categories and those electric motors that meet the criteria specified at 10 CFR 431.25(g). *See id.* at 88 FR 36079–36080; 10 CFR 431.25(h)–(j). Specifically, DOE noted the nine criteria used to describe currently regulated MEMs, including the criteria at 10 CFR 431.25(g)(7), which specifies MEMs: ''Are built in a three-digit or four-digit NEMA frame size (or IEC metric equivalent), including those designs between two consecutive NEMA frame sizes (or IEC metric equivalent), or an enclosed 56 NEMA frame size (or IEC metric equivalent)''. 88 FR 36066, 36080.

In the June 2023 DFR, to support the new energy conservations standards for air-over electric motors, DOE created new equipment classes: one for standard frame size air-over motors (''AO–MEM (Standard frame size)'')) and one for specialized frame size air-over electric motors (''AO-Polyphase (Specialized frame size)''). *Id.* at 88 FR 36088. DOE also established a definition for ''specialized frame size,'' based on a table that specified the maximum NEMA frame diameter (or size) for a given motor horsepower, pole configuration, and enclosure combination. *Id.* This table was part of the November 2022 Joint Recommendation. *Id.* In this table, the maximum frame diameter specified ranges from a 48 NEMA frame motor diameter up to a 210 NEMA frame diameter, therefore including intermediate sizes such as 56 NEMA frame size in enclosed and open enclosure configurations. *Id.*

To clarify that AO-Polyphase (Specialized frame size) are not included in the scope of electric motors included as ESEMs, DOE proposes to add ''and do not have an air-over enclosure and a specialized frame size if the motor operates on polyphase power'' to the ESEM scope criteria in the proposed paragraph (d)(2)(i)(1) of 10 CFR 431.25 in this NOPR. DOE notes that AO–MEM (Standard frame size) do not meet the frame criteria for ESEMs and are not included in the scope of ESEMs.

In the June 2023 DFR, DOE further noted that the specialized frame size air-over electric motors equipment class included frame sizes beyond those described at 10 CFR 431.25(g)(7). *Id.* To better characterize this distinction in frame sizes, DOE stated that it was renaming ''Specialized Frame Size AO–MEMs'' (from the November 2022 Joint Recommendation) to ''AO–Polyphase (Specialized frame size).'' *Id.* DOE added that only the naming convention was changed compared to the November 2022 Joint Recommendation; and the scope of motors being represented in that equipment class continued to stay the same as in the November 2022 Joint Recommendation. *Id.*

The general scope description in 10 CFR 431.25(m) of the regulatory text published in the June 2023 DFR presents the nine criteria that determine what electric motors the standards in 10 CFR 431.25 apply to. Specifically, the criteria at 10 CFR 431.25(m)(7) specifies that the standards apply to electric motors that: ''Are built in a three-digit or four-digit NEMA frame size (or IEC metric equivalent), including those designs between two consecutive NEMA frame sizes (or IEC metric equivalent), or an enclosed 56 NEMA frame size (or IEC metric equivalent).''

When describing the energy conversation standards adopted for specialized frame sizes air-over electric motors, DOE specified that the standards are applicable to ''air-over electric motor meeting the criteria in paragraph (m) of this section and [. . .] built in a specialized frame size'' in section 10 CFR 431.25(p) of the regulatory text published in the June 2023 DFR. 88 FR 36066, 36150.

As published, the general scope description in 10 CFR 431.25(m)(7) of the regulatory text in the June 2023 DFR, and the scope description in section 10 CFR 431.25(p) may be interpreted as inconsistent with the scope of electric motors included in the AO–Polyphase (Specialized frame size) equipment class analyzed in the June 2023 DFR, and for which DOE intended to establish new standards in 10 CFR 431.25(p). Specifically, DOE identified that the criteria at 10 CFR 431.25 (m)(7), which is identical to the criteria currently at 10 CFR 431.25(g)(7), excludes specialized frame air-over motors built in two-digit NEMA frame sizes (other than enclosed 56 frame size motors). Therefore, while in the preamble, DOE explicitly stated that the specialized frame size air-over electric motors equipment class included frame sizes beyond those described at 10 CFR 431.25(g)(7), the regulatory text as written may be interpreted as limiting the covered frame sizes to those specifically described at 10 CFR 431.25(g)(7).

Therefore, to clarify the intent of the preamble of the June 2023 DFR when establishing standards for the AO-polyphase (Specialized frame size) equipment class, which was to include frame sizes beyond those described at 10 CFR 431.25(g)(7), DOE proposes to make the following clarification by adding ''or have an air-over enclosure and a specialized frame size'' to the criteria originally included under 10 CFR 431.25 (m)(7) in the June 2023 DFR, to read as follows: ''Are built in a three-digit or four-digit NEMA frame size (or IEC metric equivalent), including those designs between two consecutive NEMA frame sizes (or IEC metric equivalent), or an enclosed 56 NEMA frame size (or IEC metric equivalent), or have an air-over enclosure and a specialized frame size''. As previously discussed, DOE proposes to re-organize the regulatory text at 10 CFR 431.25 and therefore is adding this proposed clarification in the new paragraphs (c)(1)(i)(7) and (d)(1)(i)(7).

B. Test Procedure

EPCA sets forth generally applicable criteria and procedures for DOE's adoption and amendment of test procedures. (42 U.S.C. 6314(a)) Manufacturers of covered equipment must use these test procedures to certify to DOE that their equipment complies with energy conservation standards and to quantify the efficiency of their equipment. On October 19, 2022, DOE published the October 2022 Final Rule. 87 FR 63588. As described previously in this document, the October 2022 Final Rule expanded the types of motors included within the scope of the test procedure, including the new class of ESEMs for which DOE is establishing energy conservation standards in this NOPR. DOE's test procedures for electric motors are currently prescribed at appendix B as ''small, non-small-electric-motor electric motor'' and measure the full-load efficiency of an electric motor. To harmonize terminology, in this NOPR, DOE is replacing any reference to small, non-small-electric-motor electric motor (''SNEM'') in appendix B with the term ''expanded scope electric motor,'' or ''ESEM.''

C. Represented Values

DOE's energy conservation standards for electric motors are currently prescribed at 10 CFR 431.25. DOE's current energy conservation standards for electric motors are expressed in terms of nominal full-load efficiency and manufacturers must certify the represented value of nominal full-load efficiency of each basic model. 10 CFR 429.64. The provisions establishing how to determine the average full-load efficiency and the nominal full-load efficiency of a basic model are provided at 10 CFR 429.64.

As discussed in section II.B.3 of this document, the ESEM standard levels recommended by the Electric Motors Working Group are expressed in average full-load efficiency and not in terms of nominal full-load efficiency. To align with the Electric Motors Working Group recommendations, DOE proposes to revise the provisions related to the determination of the represented values for ESEMs at 10 CFR 429.64 such that manufacturers of ESEMs would certify a represented value of average full-load efficiency instead of a represented value of nominal full-load efficiency. DOE also proposes edits to 10 CFR 429.70(j) to reflect the use of a represented value of average full-load efficiency instead of a represented value of nominal full-load efficiency for ESEMs.

DOE requests comments on the proposal to use a represented value of average full-load efficiency for ESEMs and proposed revisions to 10 CFR 429.64 and 429.70(j).

D. Technological Feasibility

1. General

In each energy conservation standards rulemaking, DOE conducts a screening analysis based on information gathered on all current technology options and prototype designs that could improve the efficiency of the products or equipment that are the subject of this proposed rulemaking. As the first step in such an analysis, DOE develops a list of technology options for consideration in consultation with manufacturers, design engineers, and other interested parties. DOE then determines which of those means for improving efficiency are technologically feasible. DOE considers technologies incorporated in commercially-available products or in working prototypes to be technologically feasible. 10 CFR 431.4; sections 6(c)(3)(i) and 7(b)(1), Process Rule.

After DOE has determined that particular technology options are technologically feasible, it further evaluates each technology option in light of the following additional screening criteria: (1) practicability to manufacture, install, and service; (2) adverse impacts on product utility or availability; (3) adverse impacts on health or safety, and (4) unique-pathway proprietary technologies. 10 CFR 431.4; sections 6(b)(3)(ii)–(v) and 7(b)(2)–(5), Process Rule. Section IV.B of this document discusses the results of the screening analysis for ESEMs, particularly the designs DOE considered, those it screened out, and those that are the basis for the standards considered in this rulemaking. For further details on the screening analysis for this proposed 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 product, it must determine the maximum improvement in energy efficiency or maximum reduction in energy use that is technologically feasible for such product. (42 U.S.C. 6316(a); 42 U.S.C. 6295(p)(1)) Accordingly, in the engineering analysis, DOE determined the maximum technologically feasible (''max-tech'') improvements in energy efficiency for ESEMs, using the design parameters for the most efficient products available on the market or in working prototypes. The max-tech levels that DOE determined for this proposed rulemaking are described in section IV.C of this proposed rule and in chapter 5 of the NOPR TSD.

E. Energy Savings

1. Determination of Savings

For each TSL, DOE projected energy savings from application of the TSL to ESEMs purchased in the 30-year period that begins in the year of compliance with the proposed standards (2029–2058).[25] The savings are measured over the entire lifetime of ESEMs purchased in the previous 30-year period. DOE quantified the energy savings attributable to each TSL as the difference in energy consumption between each standards case and the no-new-standards case. The no-new-standards case represents a projection of energy consumption that reflects how the market for a product would likely evolve in the absence of new energy conservation standards.

DOE used its national impact analysis (''NIA'') spreadsheet model to estimate national energy savings (''NES'') from potential new standards for ESEMs. The NIA spreadsheet model (described in section IV.H of this document) calculates energy savings in terms of site energy, which is the energy directly consumed by products at the locations where they are used. For electricity, DOE reports national energy savings in terms of primary energy savings, which is the savings in the energy that is used to generate and transmit the site electricity. DOE also calculates NES in terms of FFC energy savings. The FFC metric includes the energy consumed in extracting, processing, and transporting primary fuels (*i.e.,* coal, natural gas, petroleum fuels), and thus presents a more complete picture of the impacts of energy conservation standards.[26] DOE's approach is based on the calculation of an FFC multiplier for each of the energy types used by covered products or equipment. For more information on FFC energy savings, see section IV.H of this document.

[25] Each TSL is composed of specific efficiency levels for each product class. The TSLs considered for this NOPR are described in section V.A of this document. DOE conducted a sensitivity analysis that considers impacts for products shipped in a 9-year period.

[26] The FFC metric is discussed in DOE's statement of policy and notice of policy amendment. 76 FR 51282 (Aug. 18, 2011), as amended at 77 FR 49701 (Aug. 17, 2012).

2. Significance of Savings

To adopt any new or amended standards for a covered product, DOE must determine that such action would result in significant energy savings. (42 U.S.C. 6316(a); 42 U.S.C. 6295(o)(3)(B))

The significance of energy savings offered by a new or amended energy conservation standard cannot be determined without knowledge of the specific circumstances surrounding a given proposed rulemaking.[27] For example, some covered products and equipment have most of their energy consumption occur during periods of peak energy demand. The impacts of these products on the energy infrastructure can be more pronounced than products with relatively constant demand. Accordingly, DOE evaluates the significance of energy savings on a case-by-case basis, taking into account the significance of cumulative FFC national energy savings, the cumulative FFC emissions reductions, and the need to confront the global climate crisis, among other factors.

As stated, the standard levels proposed in this NOPR are projected to result in national energy savings of 8.9 quad FFC, the equivalent of the primary annual energy use of 95.7 million homes. Based on the amount of FFC savings, the corresponding reduction in emissions, and need to confront the global climate crisis, DOE has tentatively determined the energy savings from the standard levels proposed in this NOPR are ''significant'' within the meaning of 42 U.S.C. 6316(a) and 42 U.S.C. 6295(o)(3)(B).

F. Economic Justification

1. Specific Criteria

As noted previously, EPCA provides seven factors to be evaluated in determining whether a potential energy conservation standard is economically justified. (42 U.S.C. 6316(a); 42 U.S.C. 6295(o)(2)(B)(i)(I)–(VII)) The following sections discuss how DOE has addressed each of those seven factors in this proposed rulemaking.

a. Economic Impact on Manufacturers and Consumers

In determining the impacts of a potential new or amended standard on manufacturers, DOE conducts an MIA, as discussed in section IV.J of this document. DOE first uses an annual cash-flow approach to determine the quantitative impacts. This step includes

[27] The numeric threshold for determining the significance of energy savings established in a final rule published on February 14, 2020 (85 FR 8626, 8670) was subsequently eliminated in a final rule published on December 13, 2021 (86 FR 70892).

both a short-term assessment—based on the cost and capital requirements during the period between when a regulation is issued and when entities must comply with the regulation—and a long-term assessment over a 30-year period. The industry-wide impacts analyzed include (1) INPV, which values the industry on the basis of expected future cash flows, (2) cash flows by year, (3) changes in revenue and income, and (4) other measures of impact, as appropriate. Second, DOE analyzes and reports the impacts on different types of manufacturers, including impacts on small manufacturers. Third, DOE considers the impact of standards on domestic manufacturer employment and manufacturing capacity, as well as the potential for standards to result in plant closures and loss of capital investment. Finally, DOE takes into account cumulative impacts of various DOE regulations and other regulatory requirements on manufacturers.

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

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

EPCA requires DOE to consider the savings in operating costs throughout the estimated average life of the covered product in the type (or class) compared to any increase in the price of, or in the initial charges for, or maintenance expenses of, the covered product that are likely to result from a standard. (42 U.S.C. 6316(a); 42 U.S.C. 6295(o)(2)(B)(i)(II)) DOE conducts this comparison in its LCC and PBP analysis.

The LCC is the sum of the purchase price of 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 discount rates appropriate for consumers. 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.

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

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

c. Energy Savings

Although significant conservation of energy is a separate statutory requirement for adopting an energy conservation standard, EPCA requires DOE, in determining the economic justification of a standard, to consider the total projected energy savings that are expected to result directly from the standard. (42 U.S.C. 6316(a); 42 U.S.C. 6295(o)(2)(B)(i)(III)) As discussed in section IV.H of this document, DOE uses the NIA spreadsheet models to project national energy savings.

d. Lessening of Utility or Performance of Products

In establishing product classes and in evaluating design options and the impact of potential standard levels, DOE evaluates potential standards that would not lessen the utility or performance of the considered products. (42 U.S.C. 6316(a); 42 U.S.C. 6295(o)(2)(B)(i)(IV)) Based on data available to DOE, the standards proposed in this document would not reduce the utility or performance of the equipment under consideration in this proposed 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. 6316(a); 42 U.S.C. 6295(o)(2)(B)(i)(V)) It also directs the Attorney General to determine the impact, if any, of any lessening of competition likely to result from a 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. 6316(a); 42 U.S.C. 6295(o)(2)(B)(ii)) 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 publish and respond to the Attorney General's determination in the final rule. DOE invites comment from the public regarding the competitive impacts that are likely to result from this proposed rule. In addition, stakeholders may also provide comments separately to DOJ regarding these potential impacts. See the **ADDRESSES** section for information to send comments to DOJ.

f. Need for National Energy Conservation

DOE also considers the need for national energy and water conservation in determining whether a new or amended standard is economically justified. (42 U.S.C. 6316(a); 42 U.S.C. 6295(o)(2)(B)(i)(VI)) The energy savings from the proposed standards are likely to provide improvements to the security and reliability of the Nation's energy system. Reductions in the demand for electricity also may result in reduced costs for maintaining the reliability of the Nation's electricity system. DOE conducts a utility impact analysis to estimate how standards may affect the Nation's needed power generation capacity, as discussed in section IV.M of this document.

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

g. Other Factors

In determining whether an energy conservation standard is economically justified, DOE may consider any other factors that the Secretary deems to be relevant. (42 U.S.C. 6316(a); 42 U.S.C. 6295(o)(2)(B)(i)(VII)) To the extent DOE identifies any relevant information regarding economic justification that does not fit into the other categories described previously, DOE could consider such information under ''other factors.''

2. Rebuttable Presumption

EPCA creates a rebuttable presumption that an energy conservation standard is economically justified if the additional cost to the consumer of the equipment 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. 6313(a); 42 U.S.C. 6295(o)(2)(B)(iii) DOE's LCC and PBP analyses generate values used to calculate the effects that new energy conservation standards would have on the PBP for consumers. These analyses include, but are not limited to, the 3-year PBP 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. 6313(a) and 42 U.S.C. 6295(o)(2)(B). 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 document.

IV. Methodology and Discussion of Related Comments

This section addresses the analyses DOE has performed for this proposed rulemaking with regard to ESEMs. Separate subsections address each component of DOE's analyses. In this NOPR, DOE is only addressing comments and analysis specific to the scope of motors provided in the December 2022 Joint Recommendation (*i.e.,* ESEMs and AO–ESEMs). As such, any analysis and comments related to MEMs and AO–MEMs were addressed in the separate June 2023 DFR published on June 1, 2023. 88 FR 36066.

DOE used several analytical tools to estimate the impact of the standards proposed in this document. The first tool is a spreadsheet that presents the calculations of the LCC savings and PBP of potential new energy conservation standards. The national impacts analysis uses a second spreadsheet set that provides shipments projections and calculates national energy savings and net present value of total consumer costs and savings expected to result from potential energy conservation standards. DOE uses the third spreadsheet tool, the Government Regulatory Impact Model (''GRIM''), to assess manufacturer impacts of potential standards. These three spreadsheet tools are available on the DOE website for this rulemaking: *www.regulations.gov/docket/EERE-2020-BT-STD-0007.* Additionally, DOE used output from the latest version of the Energy Information Administration's (''EIA's'') *Annual Energy Outlook* (''*AEO*''), a widely known energy projection for the United States, for the emissions and utility impact analyses.

A. Market and Technology Assessment

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

1. Scope of Coverage

This document covers ESEMs, a category of electric motors. The term ''electric motor'' is defined at 10 CFR 431.12. Specifically, the definition for ''electric motor'' is ''a machine that converts electrical power into rotational mechanical power.'' 10 CFR 431.12.

In the March 2022 Preliminary Analysis, DOE presented analysis for the current scope of electric motors regulated at 10 CFR 431.25, in addition to certain expanded scope, including air-over electric motors, and ESEMs and AO–ESEMs. See chapter 2 of the March 2022 Preliminary TSD. Since then, DOE has published the October 2022 Final Rule, which established test procedures for expanded scope, as discussed in detail in section III.B of this NOPR. Additionally, DOE has also published the June 2023 DFR, which established energy conservations standards for MEMs and AO–MEMs.

In response to the scope presented in the March 2022 Preliminary Analysis, DOE received a number of comments, which are discussed in the subsections below. In this NOPR, DOE is only addressing comments and analysis specific to the scope of motors proposed in this NOPR, which includes ESEMs and AO–ESEMs.

NEEA supported the inclusion of ESEMs in the scope of the standards. NEEA noted that including ESEMs will allow comparison of performance and informed purchase decisions. (NEEA, No. 33 at p. 2)

AHAM and AHRI strongly opposed DOE's plan to expand the existing scope of coverage of electric motors to include motors destined for particular applications in finished goods, and instead recommended that DOE should apply a finished-product approach to energy efficiency regulations. (AHAM and AHRI, No. 25 at pp. 7–9) Lennox added that it strongly objects to any expansion of coverage (including development of test procedures, energy conservation requirements, and/or certification requirements) for electric motors that would circumvent the statutory exemption that Congress provided for small electric motors that are components of EPCA-covered products/equipment. (Lennox, No. 29 at p. 3) AHAM and AHRI commented that they interpret the EPCA exemption for SEMs that are components of covered product and equipment as to also mean that small special and definite purpose motors, whether they are classified as small electric motors or as an ESEM, should not be subject to energy conservation standards. AHAM and AHRI stated that such motors are, by definition, destined for particular products, and when that product is a covered product/piece of equipment, that motor is destined for a product already subject to energy conservation standards and has defining features to identify it as such. (AHAM and AHRI, No. 25 at pp. 1,6)

AHRI and AHAM further commented that regulating ESEMs could affect the following product categories: clothes washers (top and front load), clothes dryers, food waste disposers, refrigerators, room air conditioners, and stick vacuums. Apart from stick vacuums and food waste disposers, AHAM and AHRI noted that the products listed are already subject to energy conservation standards. AHAM and AHRI also commented that regulating ESEM and AO motors could impact the following products: small, large, very large commercial package air conditioning and heating equipment, residential air conditioners and heat pumps, single package vertical air conditioners and heat pumps, commercial and residential furnaces, commercial and residential boilers, commercial and residential water heaters, air cooled condensing unit, central station air handling units, geothermal heat pumps, unit coolers, unit ventilators, and water source heat pumps. (AHAM and AHRI, No. 25 at pp. 1–2)

HI recommended that dedicated-purpose ESEMs should be regulated as part of their final product instead of as motors specifically. (HI, No. 31 at p. 1)

The Joint Industry Stakeholders commented that they strongly object to any expansion of coverage (including development of test procedures, energy conservation requirements, and/or certification requirements) for electric motors that would circumvent the statutory exemption that Congress provided for small electric motors that are components of EPCA-covered products/equipment. They stated that embedded motor testing, and ultimately energy conservation standards, would save minimal energy and would create needless testing, paperwork, and record-keeping requirements that would raise costs for consumers. (Joint Industry Stakeholders, No. 23 at pp. 3–4) The Joint Industry Stakeholders and AHAM and AHRI agreed with the previous determination in which DOE recognized that Congress intentionally excluded these motors from coverage by DOE regulation when such motors are used as components of products and equipment that are already subject to DOE regulation, and they noted that these are the motors that DOE now seeks to regulate as ESEMs and by expanding the scope of the test procedure to ¼ hp. The Joint Industry Stakeholders and AHAM and AHRI added that, despite the similarity between ESEMs and SEMs, DOE is proposing to subject ESEMs used as components in EPCA-covered equipment/products to duplicative energy conservation standards at both the motor level and the finished product/equipment stage and that DOE provides no rationale or explanation for doing so. (Joint Industry Stakeholders, No. 23 at pp. 3–4; AHAM and AHRI, No. 25 at pp. 7- 9) Further, the Joint Industry Stakeholders commented that ESEMs include special and definite purpose motors that have been built to meet the needs of original equipment manufacturer (''OEM'') products. The Joint Industry Stakeholders added that many of these OEM products are already regulated by DOE. (Joint Industry Stakeholders, No. 23 at p. 2)

As discussed in the October 2022 Final Rule, EPCA, as amended through EISA 2007, provides DOE with the authority to regulate the expanded scope of motors addressed in this rule. 87 FR 63588, 63596. Before the enactment of EISA 2007, EPCA defined the term ''electric motor'' as any motor that is a general purpose T-frame, single-speed, foot-mounting, polyphase squirrel-cage induction motor of the NEMA, Design A and B, continuous rated, operating on 230/460 volts and constant 60 Hertz line power as defined in NEMA Standards Publication MG1–1987. (*See* 42 U.S.C. 6311(13)(A) (2006)) Section 313(a)(2) of EISA 2007 removed that definition and the prior limits that narrowly defined what types of motors would be considered as electric motors. In its place, EISA 2007 inserted a new ''Electric motors'' heading, and created two new subtypes of electric motors: General purpose electric motor (subtype I) and general purpose electric motor (subtype II). (42 U.S.C. 6311(13)(A)–(B) (2011)) In addition, section 313(b)(2) of EISA 2007 established energy conservation standards for four types of electric motors: general purpose electric motors (subtype I) (*i.e.,* subtype I motors) with a power rating of 1 to 200 horsepower; fire pump motors; general purpose electric motor (subtype II) (*i.e.,* subtype II motors) with a power rating of 1 to 200 horsepower; and NEMA Design B, general purpose electric motors with a power rating of more than 200 horsepower, but less than or equal to 500 horsepower. (42 U.S.C. 6313(b)(2)) The term ''electric motor'' was left undefined. However, in a May 4, 2012 final rule amending the electric motors test procedure (the ''May 2012 TP Final Rule''), DOE adopted the broader definition of ''electric motor,'' currently found in 10 CFR 431.12, because DOE noted that the absence of a definition may cause confusion about which electric motors are required to comply with mandatory test procedures and energy conservation standards, and the broader definition provided DOE with the flexibility to set energy conservation standards for other types of electric motors without having to continuously update the definition of ''electric motors''. 77 FR 26608, 26613.

Some electric motors included in this proposed rule may be sold embedded into covered products and equipment or sold alone as replacements. DOE is proposing new energy conservation standards for ESEMs in this proposed rule that apply to the motor's efficiency regardless of whether the ESEM is being sold alone or embedded into a covered product or equipment. As discussed in section III.D of this document, DOE has determined that energy savings from the standard levels proposed in this NOPR are ''significant'' within the meaning of 42 U.S.C. 6316(a) and 42 U.S.C. 6295(o)(3)(B)

The provisions of EPCA make clear that DOE may regulate electric motors ''alone or as a component of another piece of equipment.'' (*See* 42 U.S.C. 6313(b)(1) and (2) (providing that standards for electric motors be applied to electric motors manufactured ''alone or as a component of another piece of equipment'')) In contrast, Congress exempted SEM that are a component of a covered product or a covered equipment from the standards that DOE was required to establish under 42 U.S.C. 6317(b). Congress did not, however, similarly restrict electric motors.

Congress defined what equipment comprises a SEM—specifically, ''a NEMA general purpose alternating current single-speed induction motor, built in a two-digit frame number series in accordance with NEMA Standards Publication MG1–1987.'' [28] (42 U.S.C. 6311(13)(G)) ESEMs, which are electric motors, are not SEMs because they do not satisfy the more specific statutory SEM definition. Unlike SEMs, the statute does not limit DOE's authority to regulate an electric motor with respect to whether ''electric motors'' are stand-alone equipment items or components of a covered product or covered equipment. Rather, Congress specifically provided that DOE could regulate electric motors that are components of other covered equipment in the standards established by DOE. (*See* 42 U.S.C. 6313(b)(1) (providing that standards for electric motors be applied to electric motors manufactured ''alone or as a component of another piece of equipment'')) Accordingly, DOE disagrees with commenters that the SEM component exemption should apply to ESEMs and, therefore, includes ESEMs installed as components in other DOE-regulated products and equipment in these proposed energy conservation standards.

In addition, ESEMs are built in standard NEMA frame sizes and are not common in currently regulated consumer products including those listed by AHAM and AHRI (*i.e.,* clothes washers (top and front load), clothes

[28] DOE clarified, at industry's urging, that the definition also includes motors that are IEC metric equivalents to the specified NEMA motors prescribed by the statute. *See* 74 FR 32059, 32061–32062 (July 7, 2009); 10 CFR 431.442.

dryers, food waste disposers, refrigerators, room air conditioners, and stick vacuums). Therefore, DOE believes the standards proposed in this NOPR would not impact manufacturers of consumer products. In commercial equipment, DOE identified the following equipment as potentially incorporating ESEMs: walk-in coolers and freezers,[29] circulator pumps,[30] air circulating fans,[31] and commercial unitary air conditioning equipment.[32] If the proposed energy conservation standards for these rules finalize as proposed, DOE has identified that these rules would all: (1) have a compliance year that is at or before the ESEM standard compliance year (2029) and/or (2) require a motor that is either outside of the scope of this rule (*e.g.,* an electronically commutated motor (''ECM'')) or an ESEM with an efficiency above the proposed ESEM standards, and therefore not be impacted by the proposed ESEM rule (*i.e.,* the ESEM rule would not trigger a redesign of these equipment).

Furthermore, EPCA requires that any new or amended standard for covered equipment must be designed to achieve the maximum improvement in energy efficiency that the Secretary of Energy determines is technologically feasible and economically justified. (42 U.S.C. 6316(a); 42 U.S.C. 6295(o)(2)(A) and 42 U.S.C. 6295(o)(3)(B)) In this NOPR, DOE performs the necessary analyses to determine what new standards would meet the aforementioned criteria. Further, DOE has determined that the proposed standards provide cost-effective standards that would result in the significant conservation of energy. Further discussion on the analytical results and DOE's justification is provided in section V of this document.

NEEA commented that the term ''small, non-small electric motors'' is confusing and recommended using ''Other Small HP Motors (OSHM)'' or ''Other Small Electric Motors (OSEM)'' as alternative options. (NEEA, No. 33 at p. 2) DOE has opted to use the term ''ESEM'' in this NOPR.

The Joint Industry Stakeholders commented that the proposed definition for ESEMs used in the March 2022 Preliminary Analysis is vague. Specifically, the Joint Industry Stakeholders requested clarification regarding (1) the definition of full-rated load; (2) whether brushless permanent magnet motors were included; (3) whether some motors, which have motor assemblies that are connected to 60 Hz and which are rectified internally to DC power and require brush maintenance were included. (Joint Industry Stakeholders, No. 23 at pp. 1–2) In response, DOE notes that the October 2022 Final Rule finalized a definition for ''rated load,'' which is currently provided in 10 CFR 431.12 (87 FR 63588, 63623), and included specifications on what electric motors meet the definition of ESEM, which is currently provided in section 1 of appendix B (87 FR 63588, 63599). Specifically, 10 CFR 431.12 currently relates rated load to full-load, full rated load, or rated full-load, and defines it as ''the rated output power of an electric motor.'' Further, section 1.1 of appendix B states that an ESEM means a motor that ''is a single-speed induction motor capable of operating without an inverter or is an inverter-only electric motor''; therefore, the ESEM scope does not include non-induction electric motors. However, DOE does separately include in scope ''synchronous electric motors,'' which entails an electric motor that is ''synchronous'' and ''produces at least 0.25 hp but not greater than 750 hp''. *See* Section 1.1, appendix B. However, DOE is not adopting standards for synchronous electric motors in this NOPR. Finally, the ESEM scope specifically states that an electric motor would meet the scope if it operates on polyphase or single-phase alternating current 60-hertz (Hz) sinusoidal line power; or is used with an inverter that operates on polyphase or single-phase alternating current 60-hertz (Hz) sinusoidal line power. An ''inverter'' is defined as ''an electronic device that converts an input AC or DC power into a controlled output AC or DC voltage or current. An inverter may also be called a converter.'' 10 CFR 431.12.

The Joint Industry Stakeholders recommended that DOE exclude refrigeration compressor motors from the scope of the ESEM rulemaking. The Joint Industry Stakeholders explained that such motors are hermetically sealed and are cooled by the refrigerant flowing within the appliance/equipment, and that there is no accurate way to measure the efficiency of just the motor and thus, it is not appropriate or feasible to include refrigeration compressor motors in the scope of this rulemaking. (Joint Industry Stakeholders, No. 23 at p. 9) DOE defines a liquid-cooled electric motor as a motor that is cooled by liquid circulated using a designated cooling apparatus such that the liquid or liquid-filled conductors come into direct contact with the parts of the motor but is not submerged in a liquid during operation. 10 CFR 431.12. DOE reviewed refrigeration compressor motors and understands that they would be considered a liquid-cooled electric motor according to this definition because they require flowing refrigerant to adequately cool during operation. The designated cooling apparatus in this case is shared with the greater refrigeration system. Liquid-cooled electric motors are currently exempt from DOE's standards for electric motors, generally. *See* 10 CFR 431.25(l)(3). Accordingly, because the refrigeration compressor motor described by the commenters meets the definition of a ''liquid-cooled electric motor,'' it is exempt from the test procedure and energy conservation standards proposed by this NOPR. DOE also notes that many refrigeration compressor motors are not built in standard NEMA frame sizes, and this would also disqualify them from the scope of this NOPR. As such, DOE does not see a need to specifically exempt refrigeration compression motors from the scope of this NOPR, but may revisit the issue in the future, as necessary.

Additionally, NEMA stated that there is no room for explosion proof motors to accommodate a run capacitor because of the added enclosure constraints associated with explosion proof motors. (NEMA, No. 22 at p. 3) DOE agrees with NEMA that the enclosure constraints for explosion proof motors do not allow for the addition of a run capacitor. The new standard levels proposed by this NOPR will not require CSIR motors to incorporate an additional run capacitor and will not require CSIR motors to be replaced by CSCR motors. Therefore, DOE believes NEMA's concern is addressed.

The CA IOUs recommended exploring stakeholder interest in convening an ASRAC Working Group to clearly define the scope of an ESEM regulation before moving forward with an energy conservation standard rulemaking. (CA IOUs, No. 30 at p. 2) In response, DOE notes that several members of industry and other stakeholders did convene on a negotiation, which ended in the December 2022 Joint Recommendation. The December 2022 Joint Recommendation limited its scope to high-torque and medium-torque ESEMs, low-torque ESEMs, and polyphase ESEMs.

[29] The walk-in coolers and walk-in freezers standards rulemaking docket number is: EERE–2015–BT–STD–0016.

[30] The circulator pumps energy conservation standard rulemaking docket number is: EERE–2016–BT–STD–0004.

[31] The commercial and industrial fans and blowers energy conservation standard rulemaking docket number is: EERE–2013–BT–STD–0006. Air circulating fans are a subcategory of fans.

[32] The small, large, and very large air-cooled commercial package air conditioners and heat pumps energy conservation standard rulemaking docket number is: EERE–2013–BT–STD–0007.

The Joint Industry Stakeholders also commented that ESEMs are the same as SEMs and that DOE's reliance on the SEM data as an analog to ESEM performance demonstrates that the products are the same. Additionally, the Joint Industry Stakeholders said that DOE did not provide sufficient data to support its analysis or to allow commenters to fully understand, interpret, or analyze the March 2022 Preliminary TSD and provide meaningful comment. The Joint Industry Stakeholders also stated that DOE's reliance on old data for what DOE claims is a different product and its drawing of conclusions without providing further detail fails to meet the requirements of the Administrative Procedure Act (''APA'') or the Data Quality Act. (Joint Industry Stakeholders, No. 23 at pp. 2–3) As noted previously, EPCA provides a very specific definition for SEMs that DOE regulates under 10 CFR part 431 subpart X. ESEMs can be similar to SEMs in many aspects, but nevertheless fall outside of the EPCA-provided definition. Accordingly, ESEMs are treated differently for purposes of DOE's energy conservation standards. That DOE used SEMs data as an analog to ESEM performance to help construct the March 2022 Preliminary Analysis does not change the fact that they are treated differently under EPCA, or that, as electric motors, DOE may regulate ESEMs used as components in other covered equipment. Notably, in response to the comment from the Joint Stakeholders, DOE has made updates to the ESEMs analysis in this NOPR compared to what was presented in the March 2022 Preliminary Analysis; specifically, DOE has performed additional testing, teardowns, and modeling of electric motors that more closely align with the ESEM scope and updated the engineering analysis accordingly. In addition, DOE reviewed the latest motor catalog data to inform the updated analyses. Further discussion on this updated analysis is provided in section IV.C of this document. Therefore, DOE has met the APA's requirements as DOE has explained throughout this NOPR and in the NOPR TSD the details of the analysis conducted by DOE and the information DOE relied on in conducting that analysis. Further, DOE has complied with DOE's guidelines for implementing the Data Quality Act that ensure the quality, objectivity, utility, and integrity of the data presented in this document.[33]

2. Air-Over ESEMs

In response to the March 2022 Preliminary Analysis, AHRI commented that air-over motors are explicitly exempted from regulation in 10 CFR 431.25(l), and that DOE has not overcome the challenges to include these exempted products, procedurally or technically. AHRI added that the claimed similarities between SEMs and the newly proposed AO–ESEMs category warrant the same exemption for AO–ESEMs that Congress expressly provided for small electric motors, and AHRI referenced the requirement of EPCA, which says that energy conservation standards ''shall not apply to any small electric motor which is a component of a covered product under section 6292(a) of this title or covered equipment under section 6311 of this title.'' (AHRI, No. 26 at pp. 1, 2)

With regards to the comment from AHRI, DOE is covering AO–ESEMs under its ''electric motors'' authority. (42 U.S.C. 6311(1)(A); 42 U.S.C. 6313(b)) As discussed in section III.A of this document, the statute does not limit DOE's authority to regulate electric motors (that are not SEMs) with respect to whether they are stand-alone equipment items or as components of a covered product or covered equipment. *See* 42 U.S.C. 6313(b)(1) (providing that standards for electric motors be applied to electric motors manufactured ''alone or as a component of another piece of equipment'') AO–ESEMs do not fall within the SEMs definition under EPCA, and, therefore, DOE is regulating AO–ESEMs under its ''electric motors'' authority.

DOE's previous determination in the December 2013 Final Rule to exclude air-over electric motors from scope was due to insufficient information available to DOE at the time to support establishment of a test method. 78 FR 75962, 75974–75975. Since that time, NEMA published a test standard for air-over motors in Section IV, ''Performance Standards Applying to All Machines,'' Part 34 ''Air-Over Motor Efficiency Test Method'' of NEMA MG 1–2016 (''NEMA Air-over Motor Efficiency Test Method''). The air-over method was originally published as part of the 2017 NEMA MG–1 Supplements and is also included in the latest version of NEMA MG 1–2016. Accordingly, in the October 2022 Final Rule, DOE included air-over electric motors in the test procedure scope and established test procedures for such motors. 87 FR 63588, 63597. In this NOPR, DOE has analyzed the scope of electric motors based on the finalized test procedures and proposes new energy conservation standards for AO–ESEMs that align with the December 2022 Joint Recommendation.

3. Equipment Classes

When evaluating and establishing energy conservation standards, DOE may establish separate standards for a group of covered products (*i.e.,* establish a separate equipment class) if DOE determines that separate standards are justified based on the type of energy used, or if DOE determines that a product's capacity or other performance-related feature justifies a different standard. (42 U.S.C. 6316(a); 42 U.S.C. 6295(q)(1)) In making a determination whether a performance-related feature justifies a different standard, DOE must consider such factors as the utility of the feature to the consumer and other factors DOE determines are appropriate. (*Id.*)

In the March 2022 Preliminary Analysis, DOE considered potential equipment classes defined on the basis of motor horsepower rating, pole configuration (*i.e.,* 2, 4, 6, or 8 poles), enclosure type (*i.e.,* open or enclosed construction), locked-rotor torque level (*i.e.,* high, medium, or low), type of input power (*i.e.,* phase), and motor cooling approach (*i.e.,* air-over or non-air-over). *See* chapter 2 of the March 2022 Preliminary TSD.

Regarding horsepower, DOE has previously established separate equipment classes for electric motors on the basis of horsepower rating. In an electric motors final rule that published on May 29, 2014 (''May 2014 Electric Motors Final Rule''), DOE discussed that horsepower is a performance attribute of an electric motor that is directly related to the capacity of an electric motor to perform useful work, and that horsepower generally scales with efficiency. 79 FR 30934, 30958. For example, a 50-horsepower electric motor would generally be considered more efficient than a 10-horsepower electric motor. *Id.* For these reasons, DOE has tentatively determined that horsepower represents a performance-related feature that justifies separate equipment classes for ESEMs.

Regarding pole configuration, DOE has also previously established separate equipment classes for electric motors on the basis of pole configuration. In the May 2014 Electric Motors Final Rule, DOE discussed that the number of poles in an induction motor determines the synchronous speed (*i.e.,* revolutions per minute) of that motor, and that there is an inverse relationship between the number of poles and a motor's speed. *Id.* at 79 FR 30958–30959. As the number

[33] See the discussion of the Data Quality Act in section VI.J of this document; see also *www.energy.gov/sites/prod/files/cioprod/documents/finalinfoqualityguidelines03072011.pdf.*

of poles increases from two to four to six to eight, the synchronous speed drops from 3,600 to 1,800 to 1,200 to 900 revolutions per minute, respectively. *Id.* The number of poles has a direct impact on the electric motor's performance and achievable efficiency because the number of poles affects the amount of available space inside an electric motor that can be used to accommodate efficiency improvements. *Id.* For example, eight pole motors have twice as many poles as four-pole motors and, correspondingly, less space for efficiency improvements. *Id.* For these reasons, DOE has tentatively determined that pole configuration represents a performance-related feature that justifies separate equipment classes for ESEMs.

Regarding enclosure type, DOE has also previously established separate equipment classes for electric motors on the basis of enclosure type. In the May 2014 Electric Motors Final Rule, DOE discussed that electric motors manufactured with open construction allow a free interchange of air between the electric motor's interior and exterior. *Id.* at 79 FR 30959. Whereas, electric motors with enclosed construction have no direct air interchange between the motor's interior and exterior (but are not necessarily air-tight) and may be equipped with an internal fan for cooling. *Id.* Whether an electric motor is open or enclosed affects its utility; open motors are generally not used in harsh operating environments, whereas totally enclosed electric motors often are. *Id.* The enclosure type also affects an electric motor's ability to dissipate heat, which directly affects efficiency. For these reasons, DOE has tentatively determined that the enclosure type represents a performance-related feature that justifies separate equipment classes ESEMs.

Regarding locked-rotor torque level, DOE considered three classifications of locked-rotor torque in the March 2022 Preliminary Analysis: high, medium, and low. The high locked-rotor torque motor topologies included CSCR and CSIR motors; the medium locked-rotor torque topologies included split phase motors; and the low locked-rotor torque topologies included PSC and shaded pole motors. Locked-rotor torque refers to torque developed by an electric motor whose rotor is locked in place, *i.e.,* not rotating. Locked-rotor torque characterizes a motor's ability to begin moving loads at rest, an attribute which is important to varying degree across applications. Certain applications, for example, some fans, may be relatively indifferent to locked-rotor torque; whereas for others, a minimum locked-rotor torque may be required to begin operation. DOE understands that high and medium locked-rotor torque motors are generally physically larger than low-locked rotor torque motors and may not fit in many embedded applications that low locked-rotor torque motors are used in. Additionally, low locked-rotor torque motors may not provide sufficient starting torque (*i.e.,* the motor would stall and the application would never start) to the many applications that have a high starting load (*e.g.,* compressors and pumps). DOE also understands that high and medium locked-rotor torque motors generally operate inherently more efficiently than low locked-rotor torque motors. As such, DOE has tentatively determined that separate standards (*i.e.,* separate equipment classes) are warranted for the high/medium locked-rotor torque topologies (*i.e.,* CSCR, CSIR, and split phase) and low locked-rotor torque topologies (*i.e.,* PSC and shaded pole). In the March 2022 Preliminary Analysis, DOE sought comment on whether any applications require a low locked-rotor torque and would not operate with a high locked-rotor torque motor, and whether locked-rotor torque is necessary to maintain as an equipment class factor if the highest-torque motor types (*e.g.,* CSCR) can reach the highest available efficiency levels among the set of electric motors which are used as substitutes for similar applications. Section 2.3.1.2 of the March 2022 TSD.

In response to the equipment classes presented in the March 2022 Preliminary Analysis, NEMA agreed that locked-rotor torque (or alternatively, the motor technology) is necessary to maintain as an equipment class factor even if the high locked-rotor torque ESEMs can reach the highest efficiencies among the full range of ESEMs (regardless of locked-rotor torque categorization). They substantiated their recommendation by stating that certain high locked-rotor torque motors are often not interchangeable with lower locked-rotor torque motors in specific applications because of the larger physical size of the high locked-rotor torque motor due to the presence of additional capacitors. (NEMA, No. 22 at pp. 6–7) The December 2022 Joint Recommendation recommended equipment classes with locked-rotor torque as one of the differentiators among equipment classes, although in contrast to the March 2022 Preliminary Analysis, it merged the high and medium locked-rotor torque classes to form a single high locked-rotor torque class. DOE infers from this recommendation that the performance of split phase motors does not inherently differ substantially from the performance of CSCR and CSIR motors, such that a higher or lower energy conservation standard for split phase motors would not be warranted in relation to a standard established for CSCR and CSIR motors. As such, DOE has tentatively determined that separate equipment classes for ESEMs are warranted for two groupings of locked-rotor torque: high and medium locked-rotor torque (represented by the grouping of CSCR, CSIR, and split phase topologies) and low locked-rotor torque (represented by the grouping of PSC and shaded pole topologies).

Regarding motor cooling approach, DOE discussed the differentiation between air-over and non-air-over motors in the March 2022 Preliminary Analysis. *See* section 2.3.1.2 of the March 2022 Preliminary TSD. DOE currently defines an air-over electric motor at 10 CFR 431.12 as an electric motor ''rated to operate in and be cooled by the airstream of a fan or blower that is not supplied with the motor and whose primary purpose is providing airflow to an application other than the motor driving it.'' As such, air-over motors are often designed without an internal fan, which allows for smaller packaging, reduced cost, and the potential for higher-efficiency performance because the motor is not driving an internal fan. DOE notes, however, the inability to self-cool may be a limitation in many applications where cooling airflow is unavailable or too variable to provide a reliable cooling source. For these reasons, DOE has tentatively determined that the cooling approach represents a performance-related feature that justifies separate equipment classes for AO–ESEMs.

Based on the above considerations, DOE is proposing to establish equipment class groupings for ESEMs based on the following characteristics: horsepower rating, pole configuration (*i.e.,* 2, 4, 6, or 8 poles), enclosure type (*i.e.,* open or enclosed), locked-rotor torque level (*i.e.,* high and medium locked-rotor torque, represented by the grouping of CSCR, CSIR, and split phase topologies; and low locked-rotor torque, represented by the grouping of PSC and shaded pole topologies), type of input power (*i.e.,* phase), and motor cooling approach (*i.e.,* air-over or non-air-over). Table IV–1 presents the equipment class groups proposed in this NOPR. Within each equipment class group, DOE would establish individual equipment classes for each pole configuration, enclosure type, and horsepower range. The equipment class groups shown in Table IV–1 represent a total of 350 equipment classes.

TABLE IV–1—EQUIPMENT CLASS GROUPS

Equipment class groups ("ECG")	Motor topology	Horsepower rating	Pole configuration	Enclosure	Cooling requirements
1	CSCR, CSIR, Split Phase	.25–3	2, 4, 6, 8	Open Enclosed.	Non-Air-Over.
2	PSC, Shaded Pole	.25–3	2, 4, 6, 8	Open Enclosed.	Non-Air-Over.
3	Polyphase	.25–3	2, 4, 6, 8	Open Enclosed.	Non-Air-Over.
4	CSCR, CSIR, Split Phase	.25–3	2, 4, 6, 8	Open Enclosed.	Air-Over
5	PSC, Shaded Pole	.25–3	2, 4, 6, 8	Open Enclosed.	Air-Over
6	Polyphase	.25–3	2, 4, 6, 8	Open	Air-Over

DOE requests comment on the proposed equipment classes for this NOPR.

4. Technology Options

In the March 2022 Preliminary Analysis market and technology assessment, DOE identified several technology options that were initially determined to improve the efficiency of ESEMs, as measured by the DOE test procedure. Table IV–2 presents the technology options considered in the March 2022 Preliminary Analysis.

TABLE IV–2—MARCH 2022 PRELIMINARY ANALYSIS TECHNOLOGY OPTIONS TO INCREASE MOTOR EFFICIENCY

Type of loss to reduce	Technology option
Stator I2R Losses	Increase cross-sectional area of copper in stator slots. Decrease the length of coil extensions.
Rotor I2R Losses	Increase cross-sectional area of end rings. Increase cross-sectional area of rotor conductor bars. Use a die-cast copper rotor cage.
Core Losses	Use electrical steel laminations with lower losses (watts/lb). Use thinner steel laminations. Increase stack length (*i.e.,* add electrical steel laminations).
Friction and Windage Losses	Optimize bearing and lubrication selection. Improve cooling system design.
Stray-Load Losses	Reduce skew on rotor cage. Improve rotor bar insulation.

DOE maintains the same technology options from the March 2022 Preliminary Analysis in this NOPR. DOE received a number of comments regarding technology options. As these options are applicable to electric motors, broadly, DOE responded to these comments in the June 2023 DFR and refers to that discussion for purposes of technology options considered in this NOPR. *See* 88 FR 36066, 36089–36090.

5. Imported Embedded Motors

In response to the March 2022 Preliminary Analysis, DOE received comments regarding compliance logistics and general issues regarding embedded motors being imported into the United States. NEMA commented that they estimate between 30 and 60 percent of ESEMs will be imported as a motor or embedded in a piece of equipment, and that the importers of these equipment are the responsible parties to comply. NEMA stated that if DOE ignores these importers, the rule will harm American equipment manufacturers incorporating ESEMs who compete with offshore suppliers and will not maintain a ''level playing field'' amongst motor manufacturers. NEMA added that they believe that adding the ESEM categories as defined in the March 2022 Preliminary TSD will have significant negative effects on U.S. suppliers and jobs, giving offshore equipment producers an unfair advantage over American producers. NEMA continued by saying that if DOE does not provide a funded and feasible border enforcement plan, the energy savings estimates for a regulation for ESEM will need to be adjusted by removing the savings of the offshore motors that escape regulation. (NEMA, No. 22 at pp. 18–19) DOE recognizes that importing embedded motors within larger pieces of equipment poses logistical challenges regarding the compliance of these embedded motors with the new energy conservation standards. However, DOE notes that imported motors that meet the scope criteria proposed in this NOPR will be subject to the energy conservation standards that are being promulgated regardless of whether the motor is imported on its own or embedded in a separate piece of equipment. DOE is committed to enforcing its regulations in a fair and equitable manner to ensure a level playing field is preserved for domestic manufacturers.

B. Screening Analysis

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

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

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

that technology will not be considered further.

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

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

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

10 CFR 431.4; 10 CFR part 430, subpart C, appendix A, 6(c)(3) and 7(b).

In summary, if DOE determines that a technology, or a combination of technologies, fails to meet one or more of the listed five criteria, it will be excluded from further consideration in the engineering analysis. The reasons for eliminating any technology are discussed in the following sections.

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

1. Screened-Out Technologies

In the March 2022 Preliminary TSD, DOE screened out amorphous metal laminations and plastic bonded iron powder (''PBIP'') from the analysis. DOE requested further data on the feasibility of amorphous steel being used in electric motors at scale. *See* chapter 3 of the March 2022 Preliminary TSD. In response, DOE received comments regarding the technologies excluded from this engineering analysis, which DOE responded to in the June 2023 DFR as those comments are applicable to the broader suite of electric motors (including ESEMs). In the June 2023 DFR, DOE determined that it was not definitive that amorphous steel could meet all the screening criteria, and therefore, DOE continued to screen out amorphous metal in the June 2023 DFR on the basis of technological feasibility. 88 FR 36066, 36091. That reasoning continues to apply in the case of the ESEMs within the scope of this NOPR.

Accordingly, consistent with the March 2022 Preliminary Analysis and the June 2023 DFR, DOE is continuing to screen out amorphous metal laminations and PBIP in this NOPR.

2. Remaining Technologies

In the March 2022 Preliminary TSD, DOE did not screen out the following technology options: increasing cross-sectional area of copper in stator slots; decreasing the length of coil extensions; increasing cross-sectional area of end rings; increasing cross-sectional area of rotor conductor bars; using a die-cast copper rotor cage; using electrical steel laminations with lower losses (watts/lb); using thinner steel laminations; increasing stack length; optimizing bearing and lubrication selection; improving cooling system design; reducing skew on rotor cage; and improving rotor bar insulation. *See* chapter 3 of the March 2022 Preliminary TSD. DOE received comments regarding the remaining technologies included in this engineering analysis, which were responded to in the June 2023 DFR as those comments are applicable to the broader suite of electric motors (including ESEMs). 88 FR 36066, 36091–36092. DOE believes the responses to those comments in the June 2023 DFR are applicable to this discussion regarding ESEMs. Accordingly, DOE has not screened out any of these technologies for its analysis in this NOPR.

Otherwise, through a review of each technology, DOE concludes that all of the other identified technologies listed in this section met all five screening criteria to be examined further as design options in DOE's NOPR analysis. The design options screened-in are consistent with the design options from the March 2022 Preliminary Analysis. DOE determined that these technology options are technologically feasible because they are being used or have previously been used in commercially-available equipment or working prototypes. DOE also finds that all of the remaining technology options meet the other screening criteria (*i.e.,* practicable to manufacture, install, and service and do not result in adverse impacts on consumer utility, product availability, health, or safety). For additional details, see chapter 4 of the NOPR TSD.

DOE requests comment on the remaining technology options considered in this NOPR.

C. Engineering Analysis

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

1. Efficiency Analysis

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

In this proposed rulemaking, DOE applied a combination of the efficiency-level approach and the design-option approach to establish efficiency levels to analyze. The design-option approach was used to characterize efficiency levels that are not available on the market but appear to be market solutions for those higher efficiency levels if sufficient demand existed. For the efficiency levels available on the market, sufficient performance data was publicly available to characterize these levels.

a. Representative Units Analyzed

Due to the large number of equipment classes, DOE did not directly analyze all equipment classes of electric motors considered in this NOPR. Instead, DOE selected representative units based on two factors: (1) the quantity of motor models available within an equipment class and (2) the ability to scale to other equipment classes.

For this NOPR, DOE updated the horsepower output and pole configuration in response to feedback received on the March 2022 Preliminary Analysis and on feedback received through manufacturer interviews. For more information on the manufacturer interviews, see section IV.J.2 of this document. Table IV–3 presents the representative units analyzed, and the covered horsepower ranges for each of the representative units.

TABLE IV–3 REPRESENTATIVE UNITS ANALYZED

ECG	Representative unit (RU)	Representative unit horsepower	Represented horsepower range (all poles, all enclosures)
ESEM High Torque	1	0.25	0.25 ≤ hp ≤ 0.50.
	2	1	0.5 < hp ≤ 3.
ESEM Low Torque	3	0.25	0.25 hp.
	4	0.5	0.25 < hp ≤ 3.
ESEM Polyphase	5	0.25	0.25 ≤ hp ≤ 3.
AO–ESEM High Torque	6	0.25	0.25 ≤ hp ≤ 0.50.
	7	1	0.5 < hp ≤ 3.
AO–ESEM Low Torque	8	0.25	0.25 hp.
	9	0.5	0.25 < hp ≤ 3
AO–ESEM Polyphase	10	0.25	0.25 ≤ hp ≤ 3.

In response to the March 2022 Preliminary Analysis, DOE received a comment from NEMA stating that DOE should conduct more testing of motor efficiency at higher efficiency levels rather than relying so heavily on scaled results. (NEMA, No. 22 at pp. 15, 24) DOE notes that teardowns of motors at higher efficiency levels were conducted for each ECG that was directly analyzed. This comment was also discussed in section IV.C.1 of the June 2023 DFR. *See* 88 FR 36066, 36093. DOE believes the responses to that comment in the June 2023 DFR are applicable to this discussion regarding ESEMs. Additionally, for more information on scaling as it pertains to ESEMs, see section IV.C.5 of this document.

DOE requests comment on the representative units used in this NOPR.

b. Baseline Efficiency

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

In the March 2022 Preliminary Analysis, DOE generated a baseline efficiency level for ESEMs by creating a curve-fit of motor losses vs. hp based on the SEM energy conservation standards located at 10 CFR 431.446, and shifting this curve-fit down to fit what was observed in catalog data for a given ESEM ECG. *See* chapter 5 of the March 2022 Preliminary TSD. In response to the March 2022 Preliminary Analysis, DOE received comments on how the baseline efficiencies were established for ESEMs.

The Joint Advocates commented that DOE tested five ESEMs with and without the fan using the proposed NOPR test procedure to determine the difference in efficiency between AO and non-AO motors. Removing the motor fan resulted in baseline efficiencies several percent higher for the AO–ESEMs. As such, the Joint Advocates recommend that DOE analyze appropriate baseline efficiency levels for AO motors. (Joint Advocates, No. 27 at p. 3)

NEMA disagreed with how DOE created the baseline for ESEMs and suggested that the baseline be determined through testing and not rely on unverified performance models. (NEMA, No. 22 at p. 15) With regards to the comment from NEMA, DOE acknowledges that testing individual models is the most ideal way to gather performance data for electric motors. However, due to the very high volume of combinations of motor topologies, horsepower, frame sizes, pole counts, speeds, unique motor construction, and other parameters, DOE has recognized it to be unrealistic to test every possible motor available in the U.S. market. As such, DOE is modeling performance using a catalog of all electric motors (including ESEMs) available for sale in the U.S. market, which contains specific data for all relevant parameters of electric motor performance, including locked rotor torque, pole count, horsepower output, speed, nominal efficiency, current draw, as well as many others. DOE created the baseline using a similar combination of the catalog performance data and trends that DOE developed and modeled in the 2010 SEM standard rulemaking when DOE was similarly faced with a high volume of potential SEM model possibilities. Given the similarities between SEMs and ESEMs, DOE believes that a baseline created with a methodology parallel to the previous SEM rulemaking is a reasonable approach for creating energy conservation standards for ESEMs. Accordingly, in this NOPR, DOE used a mix of catalog data, current SEM standards, and test data to establish the baseline efficiencies. For ECGs 1–3, DOE began with the methodology that was used in March 2022 Preliminary Analysis to establish the baseline. For ECGs 1 and 3, DOE then shifted the baseline (*i.e.,* increased the losses across all horsepowers by a flat multiplier to shift the entire curve uniformly) to account for the least efficient ESEMs in each ECG at various horsepower ratings. For ECG 2, DOE used test data to determine the efficiency of shaded pole motors at the horsepower ratings where they are used and combined that with the shifted SEM standard to create a baseline. For more information, see chapter 5 of the NOPR TSD.

DOE requests comment on the baseline efficiencies used in this NOPR.

c. Higher Efficiency Levels

As part of DOE's analysis, the maximum available efficiency level is the highest efficiency unit currently available on the market. DOE also defines a ''max-tech'' efficiency level to represent the maximum possible efficiency for a given equipment.

In the March 2022 Preliminary Analysis, DOE established the higher efficiency levels by shifting the baseline efficiencies up a certain number of NEMA bands. In response to the March 2022 Preliminary Analysis, DOE received comments regarding the analysis used to determine efficiencies at higher levels, which were responded to in the June 2023 DFR. 88 FR 36066, 36096–36097. In that final rule, DOE determined that the approach used in the March 2022 Preliminary Analysis continued to be appropriate. *Id.* at 88 FR 36097. DOE believes the rationale from its responses in the June 2023 DFR is applicable to this NOPR. As such, for this NOPR, DOE considered several design options for higher efficiencies: improved electrical steel for the stator and rotor, using die-cast copper rotors, increasing stack length, and any other applicable design options remaining after the screening analysis when improving electric motor efficiency from the baseline level up to a max-tech level. As each of these design options are added, the manufacturer's cost generally increases and the electric motor's efficiency improves. DOE worked with a subject matter expert with design experience and motor performance simulation software to develop the highest efficiency levels technologically feasible for each representative unit analyzed, and used a combination of electric motor software design programs and subject matter expert input to develop these levels. The subject matter expert also checked his designs against tear-down data and calibrated his software using the relevant test results. DOE notes that for all efficiency levels of directly modeled representative units, the frame size was constrained to that of the baseline unit. DOE also notes that the full-load speed of the simulated motors did not stay the same throughout all efficiency levels. Depending on the materials used to meet a given efficiency level, the full-load speed of the motor may increase compared to a lower efficiency model, but for the representative units analyzed this was not always the case. Employing these design options, higher efficiency levels can be reached without resulting in any significant size increase and without changing the key electrical and mechanical characteristics of the motor. See chapter 5 of the NOPR TSD for more details on the full-load speeds of modeled units.

DOE requests comment on the proposal to constrain the frame size of all efficiency levels to that of the baseline unit.

For the max-tech efficiencies in the engineering analysis, DOE considered 35H210 silicon steel, which has the lowest theoretical maximum core loss of all steels considered in this engineering analysis, and the thinnest practical thickness for use in motor laminations. The max-tech designs also have the highest possible slot fill, maximizing the number of motor laminations that can fit inside the motor. Further details are provided in chapter 5 of the NOPR TSD.

The max-tech for all equipment classes was created by using the curve shape of motor losses vs. horsepower for the SEM energy conservation standards and shifting that curve up to intersect with the representative unit efficiencies for a given ECG. For intermediate efficiency levels that were higher than an ECG's baseline but not the max-tech efficiency considered, DOE used a consistent approach across all ECGs. EL 1 was an average of the full-load efficiencies of the baseline, EL 2 contained the levels recommended in the December 2022 Joint Recommendation, and EL 3 was an average of the full-load efficiencies of EL 2 and max-tech.

Table IV–4 presents a summary of the description of the higher efficiency levels analyzed in this NOPR. For additional details on the efficiency levels, see chapter 5 of the NOPR TSD.

TABLE IV–4—HIGHER EFFICIENCIES ANALYZED

EL0	EL1	EL2	EL3	EL4
Baseline	Average of EL0 and EL2	Joint Recommended Levels	Average of EL2 and EL4	Max-tech.

2. Cost Analysis

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

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

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

☐ *Price surveys:* If neither a physical nor catalog teardown is feasible (for example, for tightly integrated products such as fluorescent lamps, which are infeasible to disassemble and for which parts diagrams are unavailable) or cost-prohibitive and otherwise impractical (*e.g.* large commercial boilers), DOE conducts price surveys using publicly available pricing data published on major online retailer websites and/or by soliciting prices from distributors and other commercial channels.

In the March 2022 Preliminary Analysis, DOE conducted the analysis using a combination of physical teardowns and software modeling. DOE contracted a professional motor laboratory to disassemble various electric motors and record what types of materials were present and how much of each material was present, recorded in a final bill of materials (''BOM''). To supplement the physical teardowns, software modeling by a subject matter expert was also used to generate BOMs for select efficiency levels of directly analyzed representative units. The resulting bill of materials provides the basis for the manufacturer production cost (''MPC'') estimates. *See* chapter 5 of the March 2022 Preliminary TSD.

In response to the March 2022 Preliminary Analysis, DOE received a number of comments pertaining to the cost analysis, which were responded to in the June 2023 DFR. 88 FR 36066, 36098–36099. In that final rule, DOE determined that the approach used in the March 2022 Preliminary Analysis continued to be appropriate. *Id.* at 88 FR 36099. DOE believes the rationale from its responses in the June 2023 DFR is applicable to this NOPR. Accordingly, in this NOPR, DOE continues to use the approach from the March 2022 Preliminary Analysis by determining costs using a combination of physical teardowns and software modeling. In addition, as part of this NOPR, DOE supplemented other critical inputs to the MPC estimate, including material prices assumed, scrap costs, overhead costs, and conversion costs incurred by the manufacturer, using information provided by manufacturers under a nondisclosure agreement (''NDA'') through both manufacturer interviews and the Electric Motors Working Group. Through these nondisclosure agreements, DOE solicited and received feedback on inputs like recent electrical steel prices by grade, the cost of critical components of ESEMs like capacitors or conductors, motors at different efficiency levels, and rated motor output. See chapter 5 of the NOPR TSD for more detail on the scrap, overhead, and conversion costs, as well as material prices used.

Finally, to account for manufacturers' non-production costs and profit margin, DOE applies a non-production cost multiplier (the manufacturer markup) to the MPC. The resulting manufacturer selling price (''MSP'') is the price at which the manufacturer distributes a unit into commerce. DOE developed an average manufacturer markup by examining the annual Securities and Exchange Commission (''SEC'') 10–K reports filed by publicly-traded manufacturers primarily engaged in ESEM manufacturing and whose combined product range includes ESEMs. DOE used a non-production markup of 37 percent for all ESEMs considered in this NOPR.

3. Technical Specifications

DOE received comments in response to the March 2022 Preliminary Analysis regarding the technical design and performance specifications of ESEMs analyzed in this NOPR. The Joint Industry Stakeholders and AHAM and AHRI commented that more-efficient motors become heavier and larger and that DOE needs to account for the loss of consumer demanded utility in terms of portability or ease of lifting by one person. (Joint Industry Stakeholders, No. 23 at p. 6; AHAM and AHRI, No. 25 at p. 12) The Joint Industry Stakeholders commented that DOE must factor portability into its calculations and considerations for technological feasibility or risk violation of EPCA provision 42 U.S.C. 6295(o)(2)(B)(i)(I)–(VII) The Joint Industry Stakeholders provided results of the AHAM Home Comfort Survey showing that portability is important to PAC owners. The Joint Industry Stakeholders added that DOE should screen out technology options that increase weight and should not use it as a design option in its analysis of higher efficiency levels. The Joint Industry Stakeholders added that DOE must account for physical growth (*i.e.,* girth) of appliances as a result of incorporation of larger ESEMs as a consumer-demanded utility with regards to portability, or fall short of EPCA 6295(o)(2)(B)(i)(I)–(VII). (Joint Industry Stakeholders, No. 23 at pp. 6–8) AHAM and AHRI noted that space constraints in many appliances require that manufacturers use the smallest possible component that meets the required performance for the product. Additionally, they stated larger motors will also decrease the space available for additional features, thereby preventing finished product manufacturers from offering those features to consumers. (AHAM and AHRI, No. 25 at p. 12)

In response to these comments, DOE notes that size increase of ESEMs analyzed as part of this NOPR is limited, and efficiency levels at or below the levels recommended in the December 2022 Joint Recommendation will not result in a significant weight increase relative to the present weight of ESEMs, specifically at the selected TSL 2 (*i.e.,* recommended level). DOE revised the preliminary analysis to account for space-constrained and non-space constrained motor designs that actively limit the amount of additional active material that can fit into the ESEM, limiting the potential for size and weight increase as well. DOE's analysis assumes that higher ELs can be reached without significant increase in size. DOE made this assumption to analyze a representative unit that could be more widely adopted without significant redesign from end-users. However, as discussed in section II.B.3 of this document, the Electric Motor Working Group expressed that any efficiency requirements at or above EL 3, could result in market disruption and may not allow smaller size motors to remain on the market. DOE acknowledges that at or above EL 3, some manufacturers may choose to rely on design options that would significantly increase the physical size of ESEMs. This could result in a significant and widespread disruption to the OEM markets that used ESEMs as an embedded product, as those OEMs may have to make significant changes to their equipment that use ESEMs because those ESEMs could become larger in physical size.[34]

DOE requests comment on the assumption that higher ELs (particularly ELs 3 and 4) can be reached without significant increase in size.

DOE requests comment on the potential for market disruption at higher ELs and if manufacturers could design motors at ELs 3 and 4 that do not increase in size, or if for the final rule, DOE should model motors larger than what is considered in this NOPR.

The Joint Industry Stakeholders commented that if lower speed motors are no longer available, appliances may be forced to incorporate higher speed motors which may cause short-cycling in HVAC and refrigeration applications and result in negative impacts in other appliances. The Joint Industry Stakeholders provided the example of a vacuum cleaner where a higher speed motor could lead to increased suction and reduce the ability to move the vacuum. (Joint Industry Stakeholders, No. 23 at pp. 8–9)

DOE notes that the ESEM performance models generated by the subject matter expert for the representative units did not always increase in speed as efficiency increased and that the energy conservation standards proposed by this NOPR apply to motors of varying operating speeds across multiple pole-configurations. As such, DOE does not expect the respective standard levels and equipment classes to result in the unavailability of motors with specific speed characteristics. DOE has also found that many vacuum cleaners currently on the market utilize suction[35] motors and universal[36] motors that have brushes, and are not

[34] DOE believes there will be several impacts of larger motors on downstream users and consumers of these motors, and the difficulty to accommodate a larger motor varies across applications. An increase in motor size may result in new motors that fit in their existing systems. DOE notes that this impact to OEMs and end users may be difficult to quantify because of range of applications these motors go into, and DOE expects the potential impacts of larger motors to vary by end use application.

[35] Suction motor design & operation are described at *www.ristenbatt.com/xcart/Suction-Motor-Design-and-Operation.html*—(last accessed on 5/31/2023).

[36] A major application of Universal Motors is electric vacuum cleaners. ''Universal motor'' is defined at *www.nidec.com/en/technology/motor/glossary/000/0565/* (last accessed on 5/31/2023).

single-speed induction motors, thus are not within the scope of this NOPR.

AHAM and AHRI commented that they expect electric motors, particularly fractional horsepower electric motors, would increase in price because larger/faster motors will require additional materials for the motor stack, windings, and other components. Moreover, AHAM and AHRI commented that efficiency requirements could push manufacturers to different, more expensive, motor topologies. AHAM and AHRI added that the certification, testing, and reporting requirements will also add cost. AHAM and AHRI provided an estimate that 6,015 basic models of equipment would have one or more motors under the scope of this proposed regulation. Applying a $304,000 per basic model cost estimate to redesign the equipment to accommodate a redesigned motor, AHAM and AHRI estimate the cost of this regulation for OEMs will exceed $1.83 billion. (AHAM and AHRI, No. 25 at pp. 9–12)

The Joint Industry Stakeholders and Lennox stated that if a new ESEM cannot be incorporated into an existing, previously-purchased appliance or OEM product, the consumer must source salvage/repaired component motors or purchase new products entirely. The Joint Stakeholders and Lennox commented that consumers will either face significant repair bills due to field modifications to incorporate new ESEM or lost use of devices due to inability to repair with a new ESEM. The Joint Industry Stakeholders and Lennox commented that DOE did not incorporate the impact of consumers being forced to prematurely purchase new equipment. The Joint Industry Stakeholders and Lennox added that DOE fails to account for these additional OEM equipment repair costs and for the fact that many consumers will be left without a repair option and forced to prematurely purchase new equipment or a new appliance and place additional burden on low-income consumers. (Joint Industry Stakeholders, No. 23 at pp. 5–6; Lennox, No. 29 at p. 5) AHAM and AHRI commented that setting energy conservation standards on motors that are components of finished goods would result in unavailability of replacement motors and consumers would be forced to purchase a new appliance they cannot afford because the existing equipment can no longer be serviced. (AHAM and AHRI, No. 25 at p. 10)

Lennox commented that DOE must thoroughly evaluate the loss of repairability for installed/owned HVACR systems that contain newly regulated ESEMs, which could force consumers to undertake unnecessary and costly premature replacement of HVACR systems. (Lennox, No. 29 at p. 5)

As discussed previously in this section, DOE revised the engineering analysis from the March 2022 Preliminary Analysis, and, as such, the proposed standards in this NOPR result in no significant increases to the size of an affected ESEM, which means there is no loss in repairability for previously-purchased appliances because the form, fit, and function of the ESEMs are maintained at the proposed TSLs. In addition, the proposed levels would preserve key criteria that are used to identify suitable replacement motors,[37] such as frame sizes, voltages, horsepower, pole configurations, enclosure constructions, and mountings, and DOE believes drop-in replacement motors would remain available and there would be no major market disruption, as highlighted by the Electric Motors Working Group. DOE further notes that OEM equipment can usually accommodate different models of motors and online cross-referencing tools [38] exist to help consumers identify motors that can be used as drop-in replacements. However, as discussed in section II.B.3 of this document, the Electric Motor Working group expressed that any efficiency requirements at or above EL 3, could result in market disruption and may not allow smaller size motor to remain on the market. Although DOE's engineering analysis assumes that higher ELs can be reached without significant increase in size, DOE acknowledges that at or above EL 3 (*i.e.,* above the proposed TSL), some manufacturers may choose to rely on design options that would significantly increase the physical size of ESEMs and there is uncertainty as to whether the size, fit and function would be maintained at these levels. At or above EL3, this could result in a significant and widespread disruption to the OEM markets that used ESEMs as an embedded product, as those OEMs may have to make significant changes to their equipment that use ESEMs because those ESEMs could become larger in physical size.

Regarding the additional OEM testing and certification costs, while DOE conducts a MIA to address the industry burden on the manufacturer of the considered covered equipment, DOE typically does not include the impacts to other manufacturers. The MIA for this rulemaking specifically examined the conversion costs that electric motor manufacturers (including OEMs that also manufacture electric motors) would incur due to the analyzed energy conservation standards for electric motors in comparison to the revenue and free cash electric motor manufacturers receive. The OEM testing and certification costs were not included in the MIA, and neither were the OEM revenues and free cash flows, as these costs and revenue are not specific to electric motor manufacturers. However, as noted by the Electric Motors Working Group, the proposed standards for ESEMs are not expected to cause broad market disruption. In addition, DOE fixed the frame size, which remained the same across efficiency levels. As such, the energy conservation standards proposed in this NOPR would preserve the frame sizes of electric motors on the market today. Further, as discussed in section IV.A.1 of this document, ESEMs are built in standard NEMA frame sizes and are not common in currently regulated consumer products including those listed by AHAM and AHRI (*i.e.,* clothes washers (top and front load), clothes dryers, food waste disposers, refrigerators, room air conditioners, and stick vacuums). Therefore, DOE believes the standards as proposed would not impact manufacturers of consumer products. In commercial equipment, DOE identified the following equipment as potentially incorporating ESEMs: walk-in coolers and freezers, circulator pumps, air circulating fans, and commercial unitary air conditioning equipment. If the proposed energy conservation standards for these rules finalize as proposed, DOE identified that these rules would all: (1) have a compliance year that is at or before the ESEM standard compliance year (2029) and/or (2) require a motor that is either outside of the scope of this rule (*e.g.,* an ECM) or an ESEM with an efficiency above the proposed ESEM standards, and therefore not be impacted by the proposed ESEM rule (*i.e.,* the ESEM rule would not trigger a redesign of these equipment). Therefore, DOE has tentatively determined that OEMs would already have to redesign these equipment to comply with these energy conservation standards, and the ESEM rule would not trigger another redesign of these equipment because the end-use equipment regulation would require

[37] See "How to cross reference an OEM motor." Available at *http://hvacknowitall.com/blog/how-to-cross-reference-an-oem-motor* (last accessed September 28, 2023); Rheem and Ruud PROTECH "Selecting a Motor." Available at *assets.unilogcorp.com/267/ITEM/DOC/PROTECH_51_100998_33_Catalog.pdf* (last accessed September 28, 2023).

[38] See *www.emotorsdirect.ca/hvac.*

higher efficiency ESEMs or out of scope electric motors. Consequently, although DOE did not include any OEM testing and certification costs in this NOPR, DOE does not estimate these impacts to be significant.

4. Cost-Efficiency Results

The results of the engineering analysis are reported as cost-efficiency data (or ''curves'') in the form of MSP (in dollars) versus full-load efficiency (in %), which form the basis for subsequent analysis. DOE developed ten curves representing the six equipment class groups. The methodology for developing the curves started with determining the full-load efficiency and MPCs for baseline motors. Above the baseline, DOE implemented various combinations of design options to achieve each efficiency level. Design options were implemented until all available technologies were employed (*i.e.,* at a max-tech level). To account for manufacturers' non-production costs and profit margin, DOE applies a manufacturer markup to the MPC, resulting in the MSP. See the following tables for the final results and chapter 5 of the NOPR TSD for additional detail on the engineering analysis.

Table IV-5 Cost-Efficiency Results (Non-Air-Over Representative Units)

RU	HP	Pole	ECG	Enclosure	Full-load Efficiency (%)					MSP (2022$)				
					EL0	EL1	EL2	EL3	EL4	EL0	EL1	EL2	EL3	EL4
6	.25	4	High/Medium Torque	Enclosed	46.78	53.14	59.50	66.41	73.31	$66.61	$69.55	$79.24	$126.22	$201.70
7	1	4	High/Medium Torque	Enclosed	65.53	72.77	80.00	82.80	85.59	$122.12	$132.21	$146.95	$222.58	$332.26
8	.25	6	Low Torque	Enclosed	36.23	47.72	59.20	65.49	71.77	$54.61	$66.18	$87.54	$121.65	$172.04
9	.5	6	Low Torque	Enclosed	56.33	61.06	65.80	73.35	80.90	$79.07	$103.86	$108.13	$160.54	$206.41
10	.25	4	Polyphase	Enclosed	57.86	62.93	68.00	74.61	81.21	$70.58	$74.34	$82.54	$112.63	$183.02

Table IV-6 Cost-Efficiency Results (Air-Over Representative Units)

RU	HP	Pole	ECG	Enclosure	Full-load Efficiency (%)					MSP (2022$)				
					EL0	EL1	EL2	EL3	EL4	EL0	EL1	EL2	EL3	EL4
6	.25	4	AO - High/Medium Torque	Enclosed	46.78	53.14	59.50	66.41	73.31	$62.06	$65.30	$75.57	$121.14	$195.82
7	1	4	AO - High/Medium Torque	Enclosed	65.53	72.77	80.00	82.80	85.59	$117.60	$127.88	$142.72	$218.00	$326.32
8	.25	6	AO - Low Torque	Enclosed	36.23	47.72	59.20	65.49	71.77	$50.16	$61.98	$83.06	$116.30	$166.07
9	.5	6	AO- Low Torque	Enclosed	56.33	61.06	65.80	73.35	80.90	$74.88	$99.12	$103.67	$154.32	$200.11
10	.25	4	AO - Polyphase	Enclosed	57.86	62.93	68.00	74.61	81.21	$66.75	$70.77	$79.07	$108.88	$178.58

5. Scaling Methodology

Due to the large number of equipment classes, DOE was not able to perform a detailed engineering analysis on each one. Instead, DOE focused its analysis on the representative units and scaled the results to equipment classes not directly analyzed in the engineering analysis. In the March 2022 Preliminary Analysis, DOE used the current standards at 10 CFR 431.25 as a basis to scale the efficiency of the representative units to all other equipment classes. In order to scale for efficiency levels above baseline, the efficiencies for the representative units were shifted up or down by however many NEMA bands, because these bands are commonly used by industry when describing motor efficiency, that efficiency level was above current standards. DOE received a number of comments regarding scaling methodology, to which DOE responded to in the June 2023 DFR. 88 FR 36066, 36099–36100. In that final rule, DOE determined that the approach used in the March 2022 Preliminary Analysis continued to be appropriate. *Id.* at 88 FR 36100. DOE believes the rationale from its responses in the June 2023 DFR is applicable to this NOPR.

In this NOPR, to scale across horsepower, pole configuration, and enclosure, DOE again relied on industry-recognized levels of efficiency when possible, or shifted forms of these levels. For example: when an efficiency level for a representative unit was NEMA Premium, Table 12–12 of NEMA MG 1–2016 was used to determine the efficiency of all the non-representative unit equipment classes. This method of scaling was also done for IE4 levels of efficiency, electric motor fire pump levels, and shifted versions of NEMA Premium (see section IV.C.1 of this document for a description of efficiency levels analyzed). DOE relied on industry-recognized levels because they sufficiently capture the effects of enclosure, pole configuration, frame size, and horsepower on motor efficiency.

D. Markups Analysis

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

In the March 2022 Preliminary Analysis, DOE identified distribution channels for electric motors and their respective market shares (*i.e.,* percentage of sales going through each channel). For ESEMs, the main parties in the distribution chain are OEMs, equipment or motor wholesalers, retailers, and contractors. See section 6.2 of the March 2022 Preliminary TSD. DOE did not receive any comment on the distribution channels identified in response to the March 2022 Preliminary Analysis. DOE retained these distribution channels for this NOPR.

DOE developed baseline and incremental markups for each actor in the distribution chain. Baseline markups are applied to the price of equipment with baseline efficiency, while incremental markups are applied to the difference in price between baseline and higher-efficiency models (the incremental cost increase). The incremental markup is typically less than the baseline markup and is designed to maintain similar per-unit operating profit before and after new or amended standards.[39]

In the March 2022 Preliminary Analysis, DOE relied on economic data from the U.S. Census Bureau and on 2020 RS Means Electrical Cost Data to estimate average baseline and incremental markups. Specifically, DOE estimated the OEM markups for electric motors based on financial data of different sets of OEMs that use respective electric motors from the latest 2019 Annual Survey of Manufactures.[40] The relevant sets of OEMs identified were listed in Table 6.4.2 of the March 2022 Preliminary TSD, using six-digit code level North American Industry Classification System (''NAICS''). Further, DOE collected information regarding sales taxes from the Sales Tax Clearinghouse.[41]

In response to the March 2022 Preliminary Analysis, NEMA agreed that 95 percent of ESEMs reach the market through the OEM equipment channel. NEMA further commented that Table 6.4.2 of the March 2022 Preliminary TSD should be replaced by Table IV.3 of the Import Data Declaration Proposed Rule.[42] (NEMA, No. 22 at p. 18) Table IV.3 of the Import Data Declaration Proposed Rule provides a list of five-digit code level NAICS.[43] DOE reviewed the corresponding six-digit code level NAICS and identified the following additional OEM as relevant in the context of OEMs incorporating ESEMs in their equipment: 333991 ''Power-driven handtool manufacturing;'' 333999 ''All other miscellaneous general Purpose machinery manufacturing;'' 335210 ''Small electrical appliance manufacturing;'' and 335220 ''Major appliance manufacturing''. Other NAICS codes were either already included in the March 2022 Preliminary Analysis or did not correspond to OEMs incorporating ESEMs in their equipment.

For this NOPR, DOE revised the OEM baseline and incremental markups calculation to account for these additional NAICS codes. In addition, DOE relied on updated data from the economic data from the U.S. Census Bureau, 2023 RS Means Electrical Cost Data, and the updated data from the Sales Tax Clearinghouse.

Chapter 6 of the NOPR TSD provides details on DOE's development of markups for ESEMs.

DOE requests data and information to characterize the distribution channels for ESEMs and associated market shares.

E. Energy Use Analysis

The purpose of the energy use analysis is to determine the annual energy consumption of ESEMs at different efficiencies for a representative sample of residential, commercial, and industrial consumers, and to assess the energy savings potential of increased ESEM efficiency. The energy use analysis estimates the range of energy use of ESEMs in the field (*i.e.,* as they are actually used by consumers). For each consumer in the sample, the energy use is calculated by multiplying the annual average motor input power by the annual operating hours. The energy use analysis provides the basis for other analyses DOE performed, particularly assessments of the energy savings and the savings in consumer operating costs that could result from adoption of new standards.

1. Consumer Sample

DOE created a consumer sample to represent consumers of electric motors in the commercial, industrial, and residential sectors. DOE used the sample to determine electric motor annual energy consumption as well as to conduct the LCC and PBP analyses. Each consumer in the sample was assigned a sector, an application, and a region. The sector and application determine the usage profile of the electric motor and the economic characteristics of the motor owner vary by sector and region. In addition, residential consumers were assigned household income groups. In the March 2022 Preliminary Analysis, DOE primarily relied on data from the 2018 Commercial Building Energy Consumption Survey (''CBECS''),[44] the 2018 Manufacturing Energy Consumption Survey (''MECS''),[45] the 2015 Residential Energy Consumption Survey (''RECS''), a previous DOE Technical Support Document (''January 2021 Final Determination Technical Support Document'') related to small electric motors,[46] and a DOE–AMO report ''U.S. Industrial and Commercial Motor System Market Assessment Report Volume 1: Characteristics of the Installed Base'' (''MSMA'' or ''DOE–AMO report'').[47] See chapter 7 of the March 2022 Preliminary TSD.

Specifically, in the March 2022 Preliminary Analysis, for ESEMs, DOE used information from the Small Electric Motors January 2021 Final Determination Technical Support Document to develop sector specific distributions. Since the publication of the March 2022 Preliminary Analysis, DOE updated the consumer sample to

[39] Because the projected price of standards-compliant equipment is typically higher than the price of baseline equipment, using the same markup for the incremental cost and the baseline cost would result in higher per-unit operating profit. While such an outcome is possible, DOE maintains that in markets that are reasonably competitive it is unlikely that standards would lead to a sustainable increase in profitability in the long run.

[40] U. S. Census Bureau. 2019 Annual Survey of Manufactures (ASM): Statistics for Industry Groups and Industries. *www.census.gov/programs-surveys/asm.html* (last accessed March 23, 2021).

[41] Sales Tax Clearinghouse Inc. State Sales Tax Rates Along with Combined Average City and County Rates. July 2021. *thestc.com/STrates.stm* (last accessed July 1, 2021).

[42] NEMA also provided the following link: *www.regulations.gov/document/EERE-2015-BT-CE-0019-0001.*

[43] Each five-digit code level NAICS includes several six-digit code level NAICS.

[44] U.S. Department of Energy–Energy Information Administration, ''2018 Commercial Buildings Energy Consumption Survey (CBECS),'' 2018 CBECS Survey Data, 2018, *https://www.eia.gov/consumption/commercial/data/2018/index.php?view=methodology.*

[45] 2018 Manufacturing Energy Consumption Survey,'' *https://www.eia.gov/consumption/manufacturing/data/2018/pdf/Table11_1.pdf.*

[46] Technical Support Document: Energy Efficiency Program for Consumer Products and Commercial and Industrial Equipment: Small Electric Motors Final Determination (Prepared for the Department of Energy by Staff Members of Navigant Consulting, Inc and Lawrence Berkeley National Laboratory, January 2021),'' *www.regulations.gov/document/EERE-2019-BT-STD-0008-0035.*

[47] Prakash Rao *et al.,* ''U.S. Industrial and Commercial Motor System Market Assessment Report Volume 1: Characteristics of the Installed Base,'' January 12, 2021, *doi.org/10.2172/1760267.*

reflect the latest version of RECS (*i.e.,* 2020 RECS).[48] DOE also revised the distribution of ESEMs by sector to reflect that the majority of single-phase motors are used in the residential and commercial sectors [49] and incorporate the industrial and commercial sector distributions as published in the June 2023 DFR.

In response to DOE's requests for feedback regarding consumer sample in the March 2022 Preliminary Analysis, NEMA referred DOE to the MSMA report (NEMA, No. 22 at p. 19) As previously described, DOE relied on information from the MSMA report to inform its consumer sample. DOE did not receive any additional comments related to the consumer sample developed in the March 2022 Preliminary Analysis and, in this NOPR, DOE continued to rely on the MSMA report to characterize motor use in the commercial and industrial sectors.

DOE requests data and information to characterize the distribution of ESEMs by sector (commercial, industrial, and residential sectors) as well as the distribution of ESEMs by application in each sector.

2. Motor Input Power

In the March 2022 Preliminary Analysis, DOE calculated the motor input power as the sum of (1) the electric motor's rated horsepower multiplied by its operating load (*i.e.,* the motor output power), and (2) the losses at the operating load (*i.e.,* part-load losses). DOE estimated distributions of motor average annual operating load by application and sector based on information from the MSMA report. DOE determined the part-load losses using outputs from the engineering analysis (full-load efficiency at each efficiency level) and published part-load efficiency information from 2016 and 2020 catalog data from several manufacturers to model motor part-load losses as a function of the motor's operating load. See section 7.2.2 of the March 2022 Preliminary TSD.

In response to DOE's requests for feedback regarding distributions of average annual operating load by application and sector in the March 2022 Preliminary Analysis, NEMA referred DOE to the MSMA report. (NEMA, No. 22 at p. 19) As previously described, DOE relied on information from the MSMA report to characterize average annual operating loads. DOE did not receive any additional comments related to the distributions of operating loads developed in the March 2022 Preliminary Analysis and retained the same approach for this NOPR.

DOE did not receive any comments on its approach to determine part-load losses and retained the same methodology for this NOPR. However, DOE updated its analysis to account for more recent part-load efficiency information from 2022 manufacturer catalogs.

DOE seeks data and additional information to characterize ESEM operating loads.

3. Annual Operating Hours

In the March 2022 Preliminary Analysis, DOE used information from the MSMA report to establish distributions of motor annual hours of operation by application for the commercial and industrial sectors. See section 7.2.5 of the March 2022 Preliminary TSD. The MSMA report provided average, mean, median, minimum, maximum, and quartile boundaries for annual operating hours across industrial and commercial sectors by application and showed no significant difference in average annual hours of operation between horsepower ranges. DOE used this information to develop application-specific statistical distributions of annual operating hours in the commercial and industrial sectors.

For electric motors used in the agricultural sector (which were not included in the MSMA report), DOE derived statistical distributions of annual operating hours of irrigation pumps by region using data from the 2013 Census of Agriculture Farm and Ranch Irrigation Survey.

For ESEMs used in the residential sector (which is a sector that was not studied in the MSMA report), DOE did not receive any comments specific to the residential sector. DOE retained the approach used in the March 2022 Preliminary Analysis and relied on the distributions of operating hours by application as presented in chapter 7 of the January 2021 Final Determination Technical Support Document pertaining to SEMs.

In response to DOE's requests for feedback regarding distributions of average annual operating hours by application and sector in the March 2022 Preliminary Analysis, NEMA referred DOE to the MSMA report. (NEMA, No. 22 at p. 20) As previously described, DOE relied on information from the MSMA report to inform its distributions of annual operating hours in the commercial and industrial sectors. For other sectors not included in the MSMA report, DOE relied on additional data sources as previously described. DOE did not receive any additional comments related to the distributions of operating hours developed in the March 2022 Preliminary Analysis and retained the same approach for this NOPR.

DOE requests comment on the distribution of average annual operating hours by application and sector used to characterize the variability in energy use for ESEMs.

4. Impact of Electric Motor Speed

Any increase in operating speeds as the efficiency of the motor is increased could affect the energy saving benefits of more efficient motors in certain variable torque applications (*i.e.,* fans, pumps, and compressors) due to the cubic relation between speed and power requirements (*i.e.,* ''affinity law''). In the March 2022 Preliminary Analysis, DOE accounted for any changes in the motor's rated speed with an increase in efficiency levels, for those electric motors that are currently regulated under 10 CFR 431.25 and for AO–MEMs and for which the engineering analysis provided speed information by EL. Based on information from a European motor study,[50] DOE assumed that 20 percent of consumers with fan, pump, and air compressor applications would be negatively impacted by higher operating speeds. For other electric motor categories that it analyzed in the March 2022 Preliminary Analysis, including ESEMs, DOE did not characterize the motor speed by ELs as part of the engineering analysis and DOE did not include this impact in the analysis. See section 7.2.2.1 of the March 2022 Preliminary TSD.

[48] ''2020 Residential Energy Consumption Survey Data,'', *https://www.eia.gov/consumption/residential/data/2020/https://www.eia.gov/consumption/residential/data/2020/* (last accessed July 5, 2023).

[49] Goetzler, William, Sutherland, Timothy, and Reis, Callie. Energy Savings Potential and Opportunities for High-Efficiency Electric Motors in Residential and Commercial Equipment. United States: N. p., 2013. Web. doi:10.2172/1220812. Available at: *osti.gov/biblio/1220812* (last accessed April 18, 2023).

[50] ''EuP–LOT–30-Task-7-Jun-2014.Pdf,'' Available at *www.eup-network.de/fileadmin/user_upload/EuP-LOT-30-Task-7-Jun-2014.pdf* (last accessed April 26, 2021). The European motor study estimated, as a ''worst case scenario,'' that up to 40 percent of consumers purchasing motors for replacement applications may not see any decrease or increase in energy use due to this impact and did not incorporate any change in energy use with increased speed. In addition, the European motor study also predicts that any energy use impact will be reduced over time because new motor driven equipment would be designed to take account of this change in speed. Therefore, the study did not incorporate this effect in the analysis (*i.e.,* 0 percent of negatively impacted consumers). In the absence of additional data to estimate the percentage of consumers that may be negatively impacted in the compliance year, DOE relied on the mid-point value of 20 percent.

In response to the March 2022 Preliminary Analysis, the Joint Advocates requested clarifications regarding how DOE accounted for the impact of the increase motor speed on the energy use, as well as how motor slip was incorporated into the energy use analysis. (Joint Advocates, No. 27 at pp. 4–5) [51]

DOE described the method and assumptions used to calculate the impact of higher speed on energy use in section 7.2.2.1 of the March 2022 Preliminary TSD. In this NOPR, DOE provided additional details on the methodology and equations used as part of Appendix 7A in the NOPR TSD.

NEMA commented that nearly 100 percent of fans, pumps and compressors using ESEMs would be negatively impacted by an increase in speed. In addition, NEMA commented that it would take up to two years for OEMs to redesign and recertify an equipment with a motor that has higher speed and provided an example calculation to illustrate the impacts of higher speed operation. (NEMA, No. 22 at pp. 20–21, 49)

The Joint Industry Stakeholders commented that DOE should consider the full impact of higher speed motors by considering new products as well as replacement. The Joint Industry Stakeholders added that DOE only incorporated the effect of increased speeds in currently regulated motors and air-over motors and that this effect should also be accounted for in ESEMs. The Joint Industry Stakeholders commented that if lower speed motors are no longer available, appliances may be forced to incorporate higher speed motors, which may cause short-cycling in HVAC and refrigeration applications and result in negative impacts in other appliances. (Joint Industry Stakeholders, No. 23 at pp. 8–9)

In this NOPR, DOE included the effect of increased speeds in the energy use calculation for all equipment classes. DOE reviewed information related to pump, fans, and compressor applications driven by electric motors [52] and notes that in the commercial land industrial sectors: (1) 7 to 20 percent of motors used in these applications are paired with VFDs, which allow the user to adjust the speed of the motor; [53] (2) approximately half of fans operate with belts, which also allow the user to adjust the speed of the driven fan; [54] (3) some applications would benefit from increase in speeds as the work would be completed at a higher load in less operating hours (*e.g.,* pump filling water tank faster at increased speed); and (4) not all fans, pumps and compressors are variable torque loads to which the affinity laws applies. Therefore, less than 100 percent of motor in these applications would experience an increase in energy use as a result of an increase in speed. In addition, as described in the European motor study, the increase in speed would primarily impact replacement motors installed in applications that previously operated with a lower speed motor. For these reasons, DOE has determined that assuming that 100 percent of fans, pumps and compressors using ESEM would be negatively impacted by an increase in speed would not be representative. DOE continues to rely on a 20 percent assumption used in the March 2022 Preliminary Analysis, based on the European motor study. In addition, DOE incorporated a sensitivity analysis allowing the user to consider this effect for three additional scenarios described in appendix 7–A of the NOPR TSD (*i.e.,* 0 percent, 50 percent and 100 percent).

Chapter 7 of the NOPR TSD provides details on DOE's energy use analysis for ESEMs.

DOE seeks data and additional information to support the analysis of projected energy use impacts related to any increases in motor nominal speed.

F. Life-Cycle Cost and Payback Period Analysis

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

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

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

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

For each considered efficiency level in each equipment class, DOE calculated the LCC and PBP for a nationally representative set of consumers. As stated previously, DOE developed consumer samples from various data sources (*see* section IV.E.1 of this document). For each sample consumer, DOE determined the energy consumption for the ESEM and the appropriate energy price. By developing a representative sample of consumers, the analysis captured the variability in energy consumption and energy prices associated with the use of ESEMs.

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

The computer model DOE uses to calculate the LCC relies on a Monte Carlo simulation to incorporate uncertainty and variability into the analysis. The Monte Carlo simulations randomly sample input values from the probability distributions and ESEM consumer samples. The model calculated the LCC for equipment at each efficiency level for 10,000 consumers per simulation run. The analytical results include a distribution of 10,000 data points showing the range of LCC savings for a given efficiency

[51] The motor slip is the difference between the motor's synchronous speed and actual speed which is lower than the synchronous speed). At higher ELs, the speed of a given motor may increase and the motor slip may decrease.

[52] DOE did not have data specific to pumps driven by ESEMs and relied on pump, fans, and compressor applications driven by the broader category of electric motors.

[53] See Figure 64 and Figure 71 of the MSMA report.

[54] *See* 2016 Fan Notice of Data Availability, 81 FR 75742 (Nov. 1, 2016); LCC spreadsheet, ''LCC sample'' worksheet, ''Belt vs. direct driven fan distribution'' available at *www.regulations.gov/document/EERE-2013-BT-STD-0006-0190.*

level relative to the no-new-standards case efficiency distribution. In performing an iteration of the Monte Carlo simulation for a given consumer, equipment efficiency is chosen based on its probability. If the chosen equipment efficiency is greater than or equal to the efficiency of the standard level under consideration, the LCC calculation reveals that a consumer is not impacted by the standard level. By accounting for consumers who already purchase more-efficient equipment, DOE avoids overstating the potential benefits from increasing equipment efficiency. DOE calculated the LCC and PBP for consumers of ESEMs as if each were to purchase a new equipment in the first year of required compliance with new standards. DOE used 2029 as the first year of compliance with any new standards for ESEMs as discussed in section II.B.3 of this document.

Table IV–7 summarizes the approach and data DOE used to derive inputs to the LCC and PBP calculations. The subsections that follow provide further discussion. Details of the spreadsheet model, and of all the inputs to the LCC and PBP analyses, are contained in chapter 8 of the NOPR TSD and its appendices.

TABLE IV–7—SUMMARY OF INPUTS AND METHODS FOR THE LCC AND PBP ANALYSIS *

Inputs	Source/method
Equipment Cost	Derived by multiplying MPCs by manufacturer and retailer markups and sales tax, as appropriate. Used a constant price trend to project equipment costs based on historical data.
Installation Costs	Assumed no change with efficiency level other than shipping costs.
Annual Energy Use	Motor input power multiplied by annual operating hours per year. *Variability:* Primarily based on the MSMA report, 2018 CBECS, 2018 MECS, and 2020 RECS.
Energy Prices	*Electricity:* Based on EEI Typical Bills and Average Rates Reports data for 2022. *Variability:* Regional energy prices determined for four census regions.
Energy Price Trends	Based on *AEO2023* price projections.
Repair and Maintenance Costs	Assumed ESEMs are not repaired. Assumed no change in maintenance costs with efficiency level.
Equipment Lifetime	*Average:* 7.1 years (6.8 to 9.3 years depending on the equipment class group and horsepower considered).
Discount Rates	*Residential:* Approach involves identifying all possible debt or asset classes that might be used to purchase the considered appliances, or might be affected indirectly. Primary data source was the Federal Reserve Board's Survey of Consumer Finances. *Non-residential:* Calculated as the weighted average cost of capital for entities purchasing electric motors. Primary data source was Damodaran Online.
Compliance Date	2029.

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

In response to the March 2022 Preliminary Analysis, the Joint Industry Stakeholders commented that double-regulation has no corresponding consumer benefits in the form of reduced power consumption given the appliance regulations being unchanged and the fact that a more efficient motor does not necessarily translate to a more efficient product when incorporated into a finished good. The Joint Industry Stakeholders commented that to potentially increase the cost of an OEM product, without a corresponding energy savings, would mean a net loss for consumers and negative national impacts. The Joint Industry Stakeholders noted that the DOE used operating hours for the following categories of equipment: air compressors, refrigeration compressors, fans and blowers, pumps material handling, material processing, other, and agricultural pumps. Of these, the Joint Industry Stakeholders noted that electric motors used in air compressors, refrigeration compressors, fans and blowers, pumps and agricultural pumps are already regulated to some extent and that DOE made no apparent effort to account for this and deduct a significant portion of those estimated hours. (Joint Industry Stakeholders, No. 23 at p. 5) AHAM and AHRI commented that expanding coverage to special and definite purpose motors would force manufacturers to incorporate more expensive motors and increase the cost of appliances and equipment, while not necessarily improving the energy performance of the finished product (whether it be a covered product/equipment or not). (AHAM and AHRI, No. 25 at p. 9) Lennox commented that DOE must accurately assess, and avoid double-counting, energy savings when assessing potential efficiency improvements from motors used in already-regulated HVAC equipment. Lennox commented that it is unclear in the LCC and PBP analysis if DOE accounted for double regulation and eliminated energy savings already achieved from system-level HVACR regulation. (Lennox, No. 29 at p. 4) HI commented that there is a potential for duplicate accounting of energy savings when regulating motors in general. HI stated that, in addition to the ESEMs, there is a potential for other motor product efficiencies to be counted twice such as the use of inverter-only products in pumps when the DOE calculates savings in their evaluations (one for inverter only motors, and another for pumps using those motors). (HI, No. 31 at p. 1)

As highlighted in a previous DOE report, motor energy savings potential and opportunities for higher efficiency electric motors in commercial and residential equipment would result in overall energy savings.[55] In addition, some manufacturers advertise electric motors as resulting in energy savings in HVAC equipment.[56] All other characteristics of the equipment and motor being held constant, increasing the efficiency of the motor component will increase the efficiency of the overall equipment.[57] Therefore, DOE disagrees with the Joint Industry Stakeholders that an increase in motor efficiency would not result in a more

[55] U.S. DOE Building technology Office, Energy Savings Potential and Opportunities for High-Efficiency Electric Motors in residential and Commercial Equipment, December 2013. Available at: *www.energy.gov/eere/buildings/downloads/motor-energy-savings-potential-report.*

[56] See, for example, Nidec and ABB: *http://acim.nidec.com/motors/usmotors/industry-applications/hvac;bit.ly/3wEIQyu.*

[57] As discussed in section IV.E.4 of this document, DOE acknowledges that in some cases higher efficiency motors may operate at higher speeds which could offset some of the expected energy savings.

efficient equipment when incorporated into a given equipment. In addition, DOE's analysis ensures the LCC and NIA analysis do not result in double-counting of energy savings by accounting for consumers who already purchase more-efficient products and calculating LCC and energy savings relative to a no-new standards case efficiency distribution. *See* section IV.F.8 of this document. Finally, any future analysis in support of energy conservation standards for equipment incorporating motors would also account for equipment that already incorporate more-efficient electric motors and would not result in any double counting of energy savings resulting from motor efficiency improvements.

1. Equipment Cost

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

To project an equipment price trend for electric motors, DOE obtained historical Producer Price Index (''PPI'') data for integral horsepower motors and generators manufacturing spanning the time period 1969–2022 and for fractional horsepower motors and generators manufacturing between 1967–2022 from the Bureau of Labor Statistics (''BLS'').[58] The PPI data reflect nominal prices, adjusted for electric motor quality changes. An inflation-adjusted (deflated) price index for integral and fractional horsepower motors and generators manufacturing was calculated by dividing the PPI series by the implicit price deflator for Gross Domestic Product. The deflated price index for integral horsepower motors was found to align with the copper, steel and aluminum deflated price indices. DOE believes that the extent to how these trends will continue in the future is very uncertain. In addition, the deflated price index for fractional horsepower motors was mostly flat during the entire period from 1967 to 2022. Therefore, DOE relied on a constant price assumption as the default price factor index to project future electric motor prices.

[58] Series ID PCU3353123353123 and PCU3353123353121 for integral and fractional horsepower motors and generators manufacturing, respectively; *www.bls.gov/ppi/*.

DOE did not receive any comments on price trends in response to the March 2022 Preliminary Analysis and retained the same approach in this NOPR.

DOE requests data and information regarding the most appropriate price trend to use to project ESEM prices.

2. Installation Cost

Installation cost includes labor, overhead, and any miscellaneous materials and parts needed to install the equipment. Electric motor installation cost data from 2023 RS Means Electrical Cost Data show a variation in installation costs according to the motor horsepower (for three-phase electric motors), but not according to efficiency. DOE found no evidence that installation costs would be impacted with increased efficiency levels. Therefore, in the March 2022 Preliminary Analysis, DOE did not incorporate changes in installation costs for motors that are more efficient than baseline equipment. DOE assumed there is no variation in installation costs between a baseline efficiency motor and a higher efficiency motor except in terms of shipping costs. These shipping costs were based on weight data from the engineering analysis for the representative units. *See* section 8.2.4 of the March 2022 Preliminary Analysis.

In response to the March 2022 Preliminary Analysis, EASA commented that if a motor is replaced with a physically larger frame, the replacement would have higher installation costs because of the added complexity of modifying the mounting setup to accommodate the larger motor, and in some case would be impossible. (EASA, No. 21 at pp. 2–3)

As noted in section IV.C.1.c of this document, DOE fixed the frame size, which remains the same across efficiency levels in the analysis. Therefore, DOE did not account for any changes in installation costs due to changes in frame sizes and, in this NOPR, DOE retained the approach used in the March 2022 Preliminary Analysis and assumed there is no variation in installation costs between a baseline efficiency motor and a higher efficiency motor except in terms of shipping costs.

DOE requests comment on whether any of the efficiency levels considered in this NOPR might lead to an increase in installation costs, and if so, DOE seeks supporting data regarding the magnitude of the increased cost per unit for each relevant efficiency level and the reasons for those differences.

3. Annual Energy Consumption

For each sampled consumer, DOE determined the energy consumption for an electric motor at different efficiency levels using the approach described previously in section IV.E of this document.

4. Energy Prices

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

DOE derived electricity prices in 2022 using data from EEI Typical Bills and Average Rates reports. Based upon comprehensive, industry-wide surveys, this semi-annual report presents typical monthly electric bills and average kilowatt-hour costs to the customer as charged by investor-owned utilities. For the residential sector, DOE calculated electricity prices using the methodology described in Coughlin and Beraki (2018).[59] For the non-residential sectors, DOE calculated electricity prices using the methodology described in Coughlin and Beraki (2019).[60]

DOE's methodology allows electricity prices to vary by sector, region and season. In the analysis, variability in electricity prices is chosen to be consistent with the way the consumer economic and energy use characteristics are defined in the LCC analysis. For electric motors, DOE relied on variability by region and sector. See chapter 8 of the NOPR TSD for more details.

To estimate energy prices in future years, DOE multiplied the 2022 energy prices by the projection of annual average price changes for each of the nine census divisions from the Reference case in *AEO2023,* which has an end year of 2050.[61] To estimate price trends after 2050, the 2050 prices were held constant.

[59] Coughlin, K. and B. Beraki.2018. Residential Electricity Prices: A Review of Data Sources and Estimation Methods. Lawrence Berkeley National Lab. Berkeley, CA. Report No. LBNL–2001169. *https://ees.lbl.gov/publications/residential-electricity-prices-review*.

[60] Coughlin, K. and B. Beraki. 2019. Non-residential Electricity Prices: A Review of Data Sources and Estimation Methods. Lawrence Berkeley National Lab. Berkeley, CA. Report No. LBNL–2001203. *https://ees.lbl.gov/publications/non-residential-electricity-prices*.

[61] Energy Information Administration. *Annual Energy Outlook 2023.* Available at *www.eia.gov/outlooks/aeo/* (last accessed May 1, 2023).

5. Maintenance and Repair Costs

Repair costs are associated with repairing or replacing equipment components that have failed in an equipment; maintenance costs are associated with maintaining the operation of the equipment.

In the March 2022 Preliminary Analysis, for the maintenance costs, DOE did not find data indicating a variation in maintenance costs between baseline efficiency and higher efficiency motors. The cost of replacing bearings, which is the most common maintenance practice, is constant across efficiency levels. Therefore, DOE did not include maintenance costs in the LCC analysis. See Section 8.3.3 of the March 2022 Preliminary Analysis.

DOE did not receive any comments related to maintenance costs and retained the same approach in this NOPR.

DOE considers a motor repair as including rewinding and reconditioning. See section 8.3.3 of the March 2022 Preliminary Analysis TSD. In the March 2022 Preliminary Analysis, DOE only included repair costs for units with a horsepower greater than 20 horsepower and did not consider any repair for the ESEM representative units. *See* section 8.3.3 of the March 2022 Preliminary Analysis.

In response to the March 2022 Preliminary Analysis, EASA commented that the definition of repair must be clear for the purposes of estimating the number of repairs and should be provided in a separate ''Definitions'' section. (EASA, No. 21 at p. 5) As noted previously, DOE considers a motor repair as including rewinding and reconditioning and describes the term in chapter 8 of the NOPR TSD (this was also described in chapter 8 of the March 2022 Preliminary Analysis). Other non-rewinding related practices, such as bearing replacement, were considered as part of the maintenance costs.

DOE did not receive any comments supporting inclusion of repair costs for ESEMs and, in this NOPR, continued to exclude repair costs for ESEMs in line with the approach used in the March 2022 Preliminary Analysis.

DOE requests comment on whether any of the efficiency levels considered in this NOPR might lead to an increase in maintenance and repair costs, and if so, DOE seeks supporting data regarding the magnitude of the increased cost per unit for each relevant efficiency level and the reasons for those differences.

6. Equipment Lifetime

In the March 2022 Preliminary Analysis, DOE established separate average mechanical lifetime estimates for single phase and polyphase ESEMs and AO–ESEMs. DOE then developed Weibull distributions of mechanical lifetimes (in hours). The lifetime in years for a sampled electric motor is calculated by dividing the sampled mechanical lifetime by the sampled annual operating hours of the electric motor. In addition, DOE considered that ESEMs and AO–ESEMs are typically embedded in a piece of equipment (*i.e.,* an application). For such applications, DOE developed Weibull distributions of application lifetimes expressed in years and compared the sampled motor mechanical lifetime (in years) with the sampled application lifetime. DOE assumed that the electric motor would be retired at the earlier of the two ages. See section 8.3.4 of the March 2022 Preliminary Analysis.

In response to the March 2022 Preliminary Analysis, EASA commented that the definition of lifetime must be clear and should be provided in a separate ''Definitions'' section. (EASA, No. 21 at p. 5) In response, DOE notes that it considers a motor lifetime as the age at which an equipment is retired from service and describes the term in chapter 8 of the NOPR TSD (this was also described in chapter 8 of the March 2022 Preliminary Analysis).

DOE did not receive any comments regarding ESEMs and AO–ESEMs lifetimes and continued to apply the same approach in this NOPR as in the March 2022 Preliminary Analysis.

DOE requests comment on the equipment lifetimes (both in years and in mechanical hours) used for each representative unit considered in the LCC and PBP analyses.

7. Discount Rates

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

DOE applies weighted average discount rates calculated from consumer debt and asset data, rather than marginal or implicit discount rates.[62] The LCC analysis estimates net present value over the lifetime of the equipment, so the appropriate discount rate will reflect the general opportunity cost of consumer funds, taking this time scale into account. Given the long-time horizon modeled in the LCC, the application of a marginal interest rate associated with an initial source of funds is inaccurate. Regardless of the method of purchase, consumers are expected to continue to rebalance their debt and asset holdings over the LCC analysis period, based on the restrictions consumers face in their debt payment requirements and the relative size of the interest rates available on debts and assets. DOE estimates the aggregate impact of this rebalancing using the historical distribution of debts and assets.

To establish residential discount rates for the LCC analysis, DOE identified all relevant household debt or asset classes in order to approximate a consumer's opportunity cost of funds related to appliance energy cost savings. It estimated the average percentage shares of the various types of debt and equity by household income group using data from the Federal Reserve Board's triennial Survey of Consumer Finances[63] (''SCF'') starting in 1995 and ending in 2019. Using the SCF and other sources, DOE developed a distribution of rates for each type of debt and asset by income group to represent the rates that may apply in the year in which the new standards would take effect. DOE assigned each sample household a specific discount rate drawn from one of the distributions. The average rate across all types of household debt and equity and income groups, weighted by the shares of each type, is 3.7 percent.

To establish non-residential discount rates, DOE estimated the weighted-average cost of capital using data from Damodaran Online.[64] The weighted-average cost of capital is commonly used to estimate the present value of cash flows to be derived from a typical company project or investment. Most companies use both debt and equity capital to fund investments, so their cost of capital is the weighted average of the cost to the firm of equity and debt financing. DOE estimated the cost of equity using the capital asset pricing

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

[63] Federal Reserve Board. *Survey of Consumer Finances (SCF)* for 1995, 1998, 2001, 2004, 2007, 2010, 2013, 2016, and 2019.

[64] Damodaran, A. *Data Page: Historical Returns on Stocks, Bonds and Bills—United States.* 2021. *pages.stern.nyu.edu/~adamodar/* (last accessed April 26, 2022).

model, which assumes that the cost of equity for a particular company is proportional to the systematic risk faced by that company. The average commercial and industrial discount rates are 6.8 percent and 7.3 percent, respectively.

See chapter 8 of the NOPR TSD for further details on the development of consumer discount rates.

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

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

In the March 2022 Preliminary Analysis, DOE relied on model counts by efficiency from the 2016 and 2020 Manufacturer Catalog Data to estimate the energy efficiency distribution of electric motors for 2027 and assumed no changes in electric motor efficiency over time. For some AO–ESEM representative units, DOE did not have enough models with efficiency information and used the efficiency distributions of the corresponding non-AO equipment class instead. In the March 2022 Preliminary Analysis, DOE used a Monte Carlo simulation to draw from the efficiency distributions and randomly assign an efficiency to the electric motor purchased by each sample household in the no-new-standards case. The resulting percent shares within the sample match the market shares in the efficiency distributions. *See* chapter 8 of the March 2022 Preliminary TSD.

In response to the March 2022 Preliminary Analysis, NEMA disagreed with the DOE estimates for ESEM and AO–ESEM efficiency distributions and commented that these distributions were modeled/estimated, rather than gathered properly and accurately through testing and other means. NEMA commented that DOE should not develop estimates and interpolations and instead finalize test procedures. NEMA added that energy efficiency information does not exist because Federal test procedures for some of these motors have not been established. (NEMA, No. 22 at p. 23)

As noted previously, due to the very high volume of combinations of motor topologies, horsepower, frame sizes, pole counts, speeds, unique motor construction, and other parameters, DOE has recognized it to be unrealistic to test every possible motor available in the U.S. market. In the absence of such data, DOE relied on model counts by efficiency from manufacturer Catalog Data and updated the data to reflect 2022 catalog offerings (using the 2022 Motor Database). In addition, the electric motors test procedure finalized in the October 2022 Final Rule relies on industry test methods published in 2016.[65] 87 FR 63588. For ESEMs, DOE believes manufacturers have used, and currently use, these industry test methods to evaluate the efficiency of electric motors as reported in their catalogs.

As previously noted, in the March 2022 Preliminary Analysis, DOE assumed no changes in electric motor efficiency over time. DOE did not receive any comment on this assumption and retained the same approach in this NOPR: to estimate the energy efficiency distribution of electric motors for 2029, DOE assumed no changes in electric motor efficiency over time. The estimated market shares for the no-new-standards case for electric motors are shown in Table IV–8 by equipment class group and horsepower range.

TABLE IV–8—NO-NEW STANDARDS CASE EFFICIENCY DISTRIBUTIONS IN THE COMPLIANCE YEAR

Equipment class group	Horsepower range	EL0 (%)	EL1 (%)	EL2 (%)	EL3 (%)	EL4 (%)
ESEM High/Med Torque	0.25 ≤ hp ≤ 0.50	24.1	43.1	16.2	16.0	0.7
	0.5 < hp ≤ 3	37.5	49.1	11.9	1.4	0.1
ESEM Low Torque	0.25 hp	4.2	16.0	79.9	0.0	0.0
	0.25 < hp ≤ 3	41.5	22.0	26.8	9.8	0.0
ESEM Polyphase	0.25 ≤ hp ≤ 3	9.6	23.1	53.3	13.4	0.5
AO–ESEM High/Med Torque	0.25 ≤ hp ≤ 0.50	26.7	33.3	20.0	6.7	13.3
	0.5 < hp ≤ 3	32.4	38.2	17.6	11.8	0.0
AO–ESEM Low Torque	0.25 hp	1.8	21.8	58.2	18.2	0.0
	0.25 < hp ≤ 3	9.8	26.1	55.4	8.7	0.0
AO–ESEM Polyphase	0.25 ≤ hp ≤ 3	37.7	26.0	33.8	2.6	0.0

* May not sum to 100% due to rounding.

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

The existence of market failures in the commercial and industrial sectors is well supported by the economics literature and by a number of case studies as discussed in the remainder of this section. DOE did not receive any comments specific to the random assignment of no-new-standards case efficiencies (sampled from the developed efficiency distribution) in the LCC model and continued to rely on the same approach to reflect market failures in the ESEM market, as noted in the following examples. First, a recognized problem in commercial settings is the principal-agent problem, where the building owner (or building developer) selects the equipment and the tenant (or subsequent building owner) pays for energy costs.[66 67] In the case of ESEMs, for many companies, the energy bills are paid for the company as a whole and

[65] NEMA Standards Publication MG 1–2016, ''Motors and Generators: Air-Over Motor Efficiency Test Method Section IV Part 34'', *www.nema.org/docs/default-source/standards-document-library/part-34-addition-to-mg1-2016-watermarkd91d7834-cf4f-4a87-b86f-bef96b7dad54.pdf?sfvrsn=cbf1386d_3.*

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

[67] Blum, H. and Sathaye, J. (2010). ''Quantitative Analysis of the Principal-Agent Problem in Commercial Buildings in the U.S.: Focus on Central Space Heating and Cooling,'' Lawrence Berkeley National Laboratory, LBNL–3557E. (Available at: *escholarship.org/uc/item/6p1525mg*) (Last accessed January 20, 2022).

not allocated to individual departments. This practice provides maintenance and engineering staff little incentives to pursue energy saving investments because the savings in energy bills provide little benefits to the decision-making maintenance and engineering staff. (Nadel et al.) [68] Second, the nature of the organizational structure and design can influence priorities for capital budgeting, resulting in choices that do not necessarily maximize profitability.[69] In the case of ESEMs, within manufacturing as a whole, motor system energy costs constitute less than 1 percent of total operating costs and energy efficiency has a low level of priority among capital investment and operating objectives. (Xenergy,[70] Nadel et al.) Third, there are asymmetric information and other potential market failures in financial markets in general, which can affect decisions by firms with regard to their choice among alternative investment options, with energy efficiency being one such option.[71] In the case of electric motors, Xenergy identified the lack of information concerning the nature of motor system efficiency measures—their benefits, costs, and implementation procedures—as a principal barrier to their adoption. In addition, Almeida [72] reports that the attitude of electric motor end-user is characterized by bounded rationality where they adopt ''rule of thumb'' routines because of the complexity of market structure which makes it difficult for motors end-users to get all the information they need to make an optimum decision concerning allocation of resources. The rule of thumb is to buy the same type and brand as the failed motor from the nearest retailer. Almeida adds that the same problem of bounded rationality exists when end-users purchase electric motors incorporated in larger equipment. In general, end-users are only concerned about the overall performance of a machine, and energy efficiency is rarely a key factor in this performance. Motor selection is therefore often left to the OEM, which are not responsible for energy costs and prioritize price and reliability.

See chapter 8 of the NOPR TSD for further information on the derivation of the efficiency distributions.

DOE seeks information and data to help establish efficiency distribution in the no-new standards case for ESEMs. DOE requests data and information on any trends in the electric motor market that could be used to forecast expected trends in market share by efficiency levels for each equipment class.

9. Payback Period Analysis

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

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

As noted previously, EPCA establishes a rebuttable presumption that a standard is economically justified if the Secretary finds that the additional cost to the consumer of purchasing an equipment complying with an energy conservation standard level will be less than three times the value of the first year's energy savings resulting from the standard, as calculated under the applicable test procedure. (42 U.S.C. 6316(a); 42 U.S.C. 6295(o)(2)(B)(iii)) For each considered efficiency level, DOE determined the value of the first year's energy savings by calculating the energy savings in accordance with the applicable DOE test procedure, and multiplying those savings by the average energy price projection for the year in which compliance with the new standards would be required.

G. Shipments Analysis

DOE uses projections of annual equipment shipments to calculate the national impacts of potential new energy conservation standards on energy use, NPV, and future manufacturer cash flows.[73] The shipments model takes an accounting approach, tracking market shares of each equipment class and the vintage of units in the stock. Stock accounting uses equipment shipments as inputs to estimate the age distribution of in-service product stocks for all years. The age distribution of in-service product stocks is a key input to calculations of both the NES and NPV, because operating costs for any year depend on the age distribution of the stock.

First, in the March 2022 Preliminary Analysis, DOE estimated shipments in the base year (2020). DOE estimated the total shipments of ESEMs in 2020 to be 28.6 million units (including 7.9 million units of AO ESEMs). DOE developed a distribution of shipments by equipment class group and horsepower range based on model counts from the 2020 and 2016/2020 Manufacturer Catalog Data. See chapter 9 of the March 2022 Preliminary Analysis TSD.

DOE did not receive any comments related to the base year shipments estimates for ESEMs and retained the values estimated in the preliminary analysis in this NOPR, however, DOE only included motors up to 3hp, which were in the recommended scope of the December 2022 Joint Recommendation. For ESEMs (including AO ESEMs), DOE revised the distribution of shipments by horsepower range based on model counts from the 2022 Manufacturer Catalog Data.

In the March 2022 Preliminary Analysis, DOE projected shipments for ESEMs in the no-new standards case under the assumption that long-term growth of electric motor shipments will be driven the following sector-specific market drivers from *AEO2021:* commercial building floor space, housing numbers, and value of manufacturing activity for the commercial, residential, and industrial sector, respectively. In addition, DOE kept the distribution of shipments by

[68] Nadel, S., R.N. Elliott, M. Shepard, S. Greenberg, G. Katz & A.T. de Almedia. 2002. *Energy-Efficient Motor Systems: A Handbook on Technology, Program and Policy Opportunities.* Washington, DC: American Council for an Energy-Efficient Economy. Second Edition.

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

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

[70] Xenergy, Inc. (1998). United States Industrial Electric Motor Systems Market Opportunity Assessment. (Available at: *www.energy.gov/sites/default/files/2014/04/f15/mtrmkt.pdf*) (Last accessed January 20, 2022).

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

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

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

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

[72] de Almeida, E.L.F. (1998). ''Energy efficiency and the limits of market forces: The example of the electric motor market in France'', *Energy Policy,* 26(8), 643–653.

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

equipment class group and horsepower range constant across the analysis period.

In response to the March 2022 Preliminary Analysis, NEMA commented that legacy induction motors are being replaced by PDS (or power drive systems) consisting of a motor and controls/drives as a means to dramatically reduce power and integrate motor driven systems into sophisticated control schemes that continuously monitor processes managing flow, pressure, etc., to reduce operating costs and emissions. (NEMA, No. 22 at p. 23) In the case of ESEMs, DOE agrees with NEMA that some ESEMs could be replaced by non-induction motors such as ECMs. However, DOE does not have sufficient data to quantify the magnitude of such substitution, which could result in lower ESEM shipments. Instead, DOE established two additional shipments sensitivity scenario to account for the impacts of lower/higher ESEMs shipments estimates.

DOE did not receive any other comments specific to ESEM shipments projections and retained the same methodology as in the March 2022 Preliminary Analysis in this NOPR and revised the projections based on *AEO2023.*

DOE requests comment and additional data on its 2020 shipments estimates for ESEMs. DOE seeks comment on the methodology used to project future shipments of ESEMs. DOE seeks information on other data sources that can be used to estimate future shipments.

H. National Impact Analysis

The NIA assesses the NES and the NPV from a national perspective of total consumer costs and savings that would be expected to result from new standards at specific efficiency levels.[74] (''Consumer'' in this context refers to consumers of the equipment being regulated.) DOE calculates the NES and NPV for the potential standard levels considered based on projections of annual equipment shipments, along with the annual energy consumption and total installed cost data from the energy use and LCC analyses. For the present analysis, DOE projected the energy savings, operating cost savings, product costs, and NPV of consumer benefits over the lifetime of ESEMs sold from 2029 through 2058.

DOE evaluates the impacts of new standards by comparing a case without such standards with standards-case projections. The no-new-standards case characterizes energy use and consumer costs for each equipment class in the absence of new energy conservation standards. For this projection, DOE considers any historical trends in efficiency and various forces that are likely to affect the mix of efficiencies over time. DOE compares the no-new-standards case with projections characterizing the market for each equipment class if DOE adopted new standards at specific energy efficiency levels (*i.e.,* the TSLs or standards cases) for that class. For the standards cases, DOE considers how a given standard would likely affect the market shares of equipment with efficiencies greater than the standard.

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

Table IV–9 summarizes the inputs and methods DOE used for the NIA analysis for the NOPR. Discussion of these inputs and methods follows the table. See chapter 10 of the NOPR TSD for further details.

TABLE IV–9—SUMMARY OF INPUTS AND METHODS FOR THE NATIONAL IMPACT ANALYSIS

Inputs	Method
Shipments	Annual shipments from shipments model.
Compliance Date of Standard	2029.
Efficiency Trends	*No-new-standards case:* constant trend. *Standards cases:* constant trend.
Annual Energy Consumption per Unit	Annual weighted-average values are a function of energy use at each TSL.
Total Installed Cost per Unit	Annual weighted-average values are a function of cost at each TSL. Incorporates projection of future product prices based on historical data. (constant trend).
Annual Energy Cost per Unit	Annual weighted-average values as a function of the annual energy consumption per unit and energy prices.
Repair and Maintenance Cost per Unit	*Maintenance costs:* No change with efficiency level. *Repair costs:* No repair.
Energy Price Trends	*AEO2023* projections (to 2050) and held constant thereafter.
Energy Site-to-Primary and FFC Conversion	A time-series conversion factor based on *AEO2023*.
Discount Rate	Three and seven percent.
Present Year	2024.

1. Equipment Efficiency Trends

A key component of the NIA is the trend in energy efficiency projected for the no-new-standards case and each of the standards cases. Section IV.F.8 of this document describes how DOE developed an energy efficiency distribution for the no-new-standards case (which yields a shipment-weighted average efficiency) for each of the considered equipment classes for the year of anticipated compliance with a new standard. To project the trend in efficiency absent new standards for ESEMs and AO–ESEMs over the entire shipments projection period, DOE applied a constant trend, similar to what was done in the March 2022 Preliminary Analysis. The approach is further described in chapter 10 of the NOPR TSD.

For the standards cases, DOE used a ''roll-up'' scenario to establish the shipment-weighted efficiency for the year that standards are assumed to become effective (2029). In this scenario, the market shares of equipment in the no-new-standards case that do not meet the standard under consideration would ''roll up'' to meet the new standard level, and the market share of products above the standard would remain unchanged.

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

To develop standards case efficiency trends after 2029, DOE assumed no change over the forecast period.

DOE did not receive any comments on the projected efficiency trends in response to the March 2022 Preliminary Analysis and retained the same approach in this NOPR.

2. National Energy Savings

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

Use of higher-efficiency equipment is sometimes associated with a direct rebound effect, which refers to an increase in utilization of the equipment due to the increase in efficiency. In the March 2022 Preliminary Analysis, DOE requested comment and data regarding the potential increase in utilization of electric motors due to any increase in efficiency. *See* section 2.10.1 of the March 2022 Preliminary TSD. DOE did not find any data on the rebound effect specific to electric motors [75] and did not receive any comments supporting the inclusion of a rebound effect for ESEMs and AO–ESEMs. Therefore, DOE did not apply a rebound effect for ESEMs and AO–ESEMs.

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

3. Net Present Value Analysis

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

As discussed in section IV.F.1 of this document, DOE developed constant ESEM price trends based on historical PPI data. DOE applied the same trends to project prices for each equipment class at each considered efficiency level. DOE's projection of equipment prices is described in appendix 10C of the NOPR TSD.

To evaluate the effect of uncertainty regarding the price trend estimates, DOE investigated the impact of different equipment price projections on the consumer NPV for the considered TSLs for ESEMs. In addition to the default price trend, DOE considered two equipment price sensitivity cases: (1) a high price decline case and (2) a low price decline case based on historical PPI data. The derivation of these price trends and the results of these sensitivity cases are described in appendix 10C of the NOPR TSD.

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

In calculating the NPV, DOE multiplies the net savings in future years by a discount factor to determine their present value. For this NOPR, DOE estimated the NPV of consumer benefits using both a 3-percent and a 7-percent real discount rate. DOE uses these discount rates in accordance with guidance provided by the Office of Management and Budget (''OMB'') to Federal agencies on the development of regulatory analysis.[77] The discount rates for the determination of NPV are in contrast to the discount rates used in the LCC analysis, which are designed to reflect a consumer's perspective. The 7-percent real value is an estimate of the average before-tax rate of return to private capital in the U.S. economy. The 3-percent real value represents the ''social rate of time preference,'' which is the rate at which society discounts future consumption flows to their present value.

DOE requests comment and data regarding the potential increase in utilization of electric motors due to any increase in efficiency (''rebound effect'').

I. Consumer Subgroup Analysis

In analyzing the potential impact of new energy conservation standards on consumers, DOE evaluates the impact on identifiable subgroups of consumers that may be disproportionately affected by a new national standard. The purpose of a subgroup analysis is to determine the extent of any such

[75] *See, e.g.,* 86 FR 36111 for further discussion regarding DOE's explanation and findings regarding rebound effect for electric motors, broadly.

[76] For more information on NEMS, refer to *The National Energy Modeling System: An Overview 2009,* DOE/EIA–0581(2009), October 2009. Available at *www.eia.gov/forecasts/aeo/index.cfm* (last accessed 5/1/2023).

[77] United States Office of Management and Budget. *Circular A–4: Regulatory Analysis.* September 17, 2003. Section E. Available at *georgewbush-whitehouse.archives.gov/omb/memoranda/m03-21.html* (last accessed May 1, 2023).

disproportional impacts. DOE evaluates impacts on particular subgroups of consumers by analyzing the LCC impacts and PBP for those particular consumers from alternative standard levels. For this NOPR, DOE analyzed the impacts of the considered standard levels on three subgroups: (1) low-income households (for ESEMs used in the residential sector); (2) senior-only households (for ESEMs used in the residential sector); and (3) small-businesses. The analysis used subsets of the RECS 2020 sample composed of households that meet the criteria for the low-income and senior-only household subgroups. For small-businesses subgroup, DOE used the same sample of consumers but with subgroup-specific inputs. DOE determined the impact on the electric motors subgroups using the same LCC model, which is used for all consumers, but with subgroup-specific inputs as applicable.

In response to the March 2022 Preliminary Analysis, AHAM and AHRI commented that a forced redesign of motors used in finished goods will force changes by the OEM. AHAM and AHRI commented that this would be particularly damaging for small appliances and floor care products, which use special purpose motors and are sensitive to even small increases in component part costs. AHAM and AHRI commented that the increased cost could make some appliances and equipment too costly for low-income consumers to purchase and delay purchases of more efficient appliances and equipment for middle-income consumers. (AHAM and AHRI, No. 25 at pp. 9–10) In response to these comments, DOE performed a subgroup analysis for low-income consumers showing these consumers would not be disproportionately impacted. *See* section V.B.1.b of this document.

Chapter 11 in the NOPR TSD describes the consumer subgroup analysis.

DOE requests comment and data on the overall methodology used for the consumer subgroup analysis. DOE requests comment on whether additional consumer subgroups may be disproportionately affected by a new standard and warrant additional analysis in the final rule.

J. Manufacturer Impact Analysis

1. Overview

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

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

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

DOE conducted the MIA for this rulemaking in three phases. In Phase 1 of the MIA, DOE prepared a profile of the ESEMs manufacturing industry based on the market and technology assessment, preliminary manufacturer interviews, and publicly-available information. This included a top-down analysis of ESEM manufacturers that DOE used to derive preliminary financial inputs for the GRIM (*e.g.,* revenues; materials, labor, overhead, and depreciation expenses; selling, general, and administrative expenses (''SG&A''); and R&D expenses). DOE also used public sources of information to further calibrate its initial characterization of the ESEM manufacturing industry, including company filings of form 10–K from the SEC, corporate annual reports,[78] the U.S. Census Bureau's *Economic Census,*[79] and reports from D&B Hoovers.[80]

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

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

In Phase 3 of the MIA, DOE conducted structured, detailed interviews with representative manufacturers. During these interviews, DOE discussed engineering, manufacturing, procurement, and financial topics to validate assumptions used in the GRIM and to identify key issues or concerns. See section IV.J.3 of this document for a description of the key issues raised by manufacturers during the interviews. As part of Phase 3, DOE also evaluated subgroups of manufacturers that may be disproportionately impacted by new standards or that may not be accurately represented by the average cost assumptions used to develop the industry cash flow analysis. Such manufacturer subgroups may include

[78] *See www.sec.gov/edgar.*

[79] *See www.census.gov/programs-surveys/asm/data/tables.html.*

[80] *See app.avention.com.*

small business manufacturers, low-volume manufacturers, niche players, and/or manufacturers exhibiting a cost structure that largely differs from the industry average. DOE identified one subgroup for a separate impact analysis: small business manufacturers. The small business subgroup is discussed in section VI.B, ''Review under the Regulatory Flexibility Act'', of this document and in chapter 12 of the NOPR TSD.

2. Government Regulatory Impact Model and Key Inputs

DOE uses the GRIM to quantify the changes in cash flow due to new standards that result in a higher or lower industry value. The GRIM uses a standard, annual discounted cash-flow analysis that incorporates manufacturer costs, markups, shipments, and industry financial information as inputs. The GRIM models changes in costs, distribution of shipments, investments, and manufacturer margins that could result from new energy conservation standard. The GRIM spreadsheet uses the inputs to arrive at a series of annual cash flows, beginning in 2024 (the base year of the analysis) and continuing to 2058. DOE calculated INPVs by summing the stream of annual discounted cash flows during this period. For manufacturers of ESEMs, DOE initially estimated a real discount rate of 9.1 percent, which was the real discount rate used in the previous medium electric motors final rule that published on May 29, 2014 (''May 2014 Electric Motors Final Rule''). 79 FR 30934, 30938. DOE then asked for feedback on this value during manufacturer interviews. Manufacturers agreed this was still an appropriate value to use. Therefore, DOE used a real discount rate of 9.1 percent for the analysis in this NOPR.

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

a. Manufacturer Production Costs

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

DOE conducted the engineering analysis using a combination of physical teardowns and software modeling. DOE contracted a professional motor laboratory to disassemble various ESEMs and record what types of materials were present and how much of each material was present, recorded in a final BOM. To supplement the physical teardowns, software modeling by a subject matter expert was also used to generate BOMs for select efficiency levels of directly analyzed representative units.

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

b. Shipments Projections

The GRIM estimates manufacturer revenues based on total unit shipment projections and the distribution of those shipments by efficiency level. Changes in sales volumes and efficiency mix over time can significantly affect manufacturer finances. For this analysis, the GRIM uses the NIA's annual shipment projections derived from the shipments analysis from 2024 (the base year) to 2058 (the end year of the analysis period). See chapter 9 of the NOPR TSD for additional details.

c. Product and Capital Conversion Costs

New energy conservation standards could cause manufacturers to incur conversion costs to bring their production facilities and equipment 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 MIA, DOE classified these conversion costs into two major groups: (1) product conversion costs; and (2) capital conversion costs. Product conversion costs are investments in research, development, testing, marketing, and other non-capitalized costs necessary to make equipment designs comply with new energy conservation standards. Capital conversion costs are investments in property, plant, and equipment necessary to adapt or change existing production facilities such that new compliant equipment designs can be fabricated and assembled.

DOE calculated the product and capital conversion costs using a bottom-up approach based on feedback from manufacturers during manufacturer interviews. During manufacturer interviews, DOE asked manufacturers questions regarding the estimated equipment and capital conversion costs needed to produce ESEMs within an equipment class at each specific EL. DOE used the feedback provided by manufacturers to estimate the approximate amount of engineering time, testing costs, and capital equipment that would need to be purchased in order to redesign a single frame size for each EL. Some of the types of capital conversion costs manufacturers identified were the purchase of lamination die sets, winding machines, frame casts, and assembly equipment as well as other retooling costs. The two main types of product conversion costs manufacturers shared with DOE during interviews were the number of engineer hours necessary to re-engineer frames to meet higher efficiency standards and the testing costs, including thermal protection testing, to comply with higher efficiency standards.

DOE then took average values (*i.e.,* costs or number of hours) based on the range of responses given by manufacturers to calculate both the equipment and capital conversion cost necessary for a manufacturer to increase the efficiency of one frame size to a specific EL. DOE multiplied the conversion costs associated with manufacturing a single frame size at each EL by the number of frames each interviewed manufacturer produces. DOE finally scaled this number based on the market share of the manufacturers DOE interviewed to arrive at an industry-wide bottom-up product and capital conversion cost estimate for each representative unit at each EL.

In response to the March 2022 Preliminary Analysis, the Joint Industry Stakeholders and Lennox commented that there may be instances where substitution of a newer, larger, heavier, faster ESEM is feasible, but that it was not reasonable to assume this is always the case. The Joint Industry Stakeholders and Lennox added that OEM companies would be forced to expend significant resources seeking retrofit and repair options for recently purchased end-use OEM goods to account for unnecessary motor subcomponent changes. (Joint Industry Stakeholders, No. 23 at pp. 5–6; Lennox, No. 29 at p. 5) The Joint Industry

Stakeholders added that this could particularly impact small businesses. (Joint Industry Stakeholders, No. 23 at p. 5–6) The Joint Stakeholder also commented that while OEM manufacturers would likely redesign product, and incur a cost to do so, to avoid issues resulting from new motors, there may not be suitable replacement motors, which are immediately available due to DOE's proposed certification requirements, limiting approvals to a few third-party labs. The Joint Stakeholder added that these costs need to be accounted for in DOE's analysis. (*Id.* at p. 8)

In this NOPR, as noted in section IV.C.1 of this document, DOE assumes higher efficiency levels can be reached without resulting in any significant size increase and without changing the key electrical and mechanical characteristics of the motor. Therefore, DOE disagrees with the Joint Stakeholders and Lennox that the higher efficiency levels would force OEMs to redesign their equipment and result in redesign and re-tooling costs.

As previously discussed, DOE revised the March 2022 Preliminary Analysis to account for space-constrained and non-space constrained motor designs, which will continue to provide repair options to consumers. As stated in the December 2022 Joint Recommendation, motor manufacturers believe that efficiency levels higher than EL 2 could result in significant increases in the physical size of certain motors. (Electric Motors Working Group, No. 38 at p. 4) As part of the engineering analysis, DOE models representative units that are able to meet the efficiency requirements of EL 2 and below that would not result in a significantly increase in the physical size of the ESEMs. For ELs higher than EL 2 (*i.e.,* EL 3 and EL 4), DOE recognizes that ESEMs may significantly increase in physical size in order to meet those higher efficiency requirements. DOE also recognizes that this may result in a significant disruption to the OEM markets that used ESEMs as an embedded product. In addition, as discussed in section IV.C.3 of this document, DOE accounted for the impacts of any potential changes in speeds at higher efficiency levels.

In response to the March 2022 Preliminary Analysis, NEMA stated that many ESEMs have agency listings for thermal protection and any redesign of the motor will require retesting with the respective agencies. NEMA commented additionally that the time needed to complete this testing should be considered when setting the compliance date of any ESEM energy conservation standards, and that the cost associated with this agency testing must be accounted for in the cost analysis. (NEMA, No. 22 at pp. 3, 17) As previously stated in this section, DOE accounted for additional thermal protection testing in addition to the costs associated with redesigning each ESEM model as part of the product conversion costs. These product conversion costs, in addition to the capital conversion costs, are included when calculating the potential change in manufacturer INPV.

NEMA also commented that DOE must capture the OEM impacts in terms of costs of redesigning and retooling. NEMA noted that these costs will have a very wide variation: some will involve a few hours' worth of work while others could require several hundred hours plus material and recertification to regulating bodies and safety testers. NEMA commented further that single phase (and some small three phase) motors with agency certified overload protection will need several years to be recertified. In addition, NEMA noted that DOE should capture the installation cost impacts on end-users trying to repair appliances with larger, heavier, or faster replacement motors built to meet new standards. (NEMA, No. 22 at p. 21)

In response to these comments and as noted in section IV.F of this document, DOE determined that the installation costs for ESEMs would not change at higher efficiency levels compared to the baseline as DOE is maintaining the frame size of ESEMs constant across all efficiency levels analyzed. DOE is further limiting the stack length to be no greater than 20 percent longer than the baseline unit for that representative unit. In addition, as noted in section IV.C.3 of this document, the speed of the ESEMs across efficiency levels did not always increase with increasing efficiency and DOE accounted for speed variations in its energy use analysis (see section IV.E.4 of this document for more details).

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

d. Manufacturer Markup Scenarios

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

Under the preservation of gross margin scenario, DOE applied a single uniform "gross margin percentage" across all efficiency levels, which assumes that manufacturers would be able to maintain the same amount of profit as a percentage of revenues at all efficiency levels within an equipment class. DOE initially estimated a manufacturer markup of 1.37 for all ESEMs covered by this rulemaking in the no-new-standards case, which was the manufacturer markup for medium electric motors under 5 hp used in the May 2014 Electric Motors Final Rule. 79 FR 30934, 30938. DOE then asked for feedback on this manufacturer markup during manufacturer interviews. Manufacturers agreed this was an appropriate manufacturer markup to use for ESEMs covered by this rulemaking. Therefore, DOE used this same manufacturer markup of 1.37 for all equipment classes and ELs at each TSL (*i.e.,* the standards cases) in the preservation of gross margin scenario. This manufacturer markup scenario represents the upper-bound of manufacturer INPV and is the manufacturer markup scenario used to calculate the economic impacts on consumers.

Under the preservation of operating profit scenario, DOE modeled a situation in which manufacturers are not able to increase per-unit operating profit in proportion to increases in MPCs. Under this scenario, as MPCs increase, manufacturers reduce their manufacturer margins to maintain a cost competitive offering in the market. However, in this scenario manufacturers maintain their total operating profit in absolute dollars in the standards case, despite higher product costs and investment. Therefore, gross margin (as a percentage) shrinks in the standards cases for this manufacturer markup scenario. This manufacturer markup scenario represents the lower-bound to industry profitability under new energy conservation standards.

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

3. Manufacturer Interviews

DOE conducted additional interviews with manufacturers following the publication of the March 2022 Preliminary TSD in preparation for this analysis. In interviews, DOE asked manufacturers to describe their major concerns regarding this rulemaking. The following section highlights manufacturer concerns that helped inform the projected potential impacts of new standards on the industry. Manufacturer interviews are conducted under NDAs, so DOE does not document these discussions in the same way that it does public comments in the comment summaries and DOE's responses throughout the rest of this document.

During these interviews, most manufacturers stated that they were concerned that if energy conservation standards were set at the higher ELs, ESEM manufacturers may have to increase the size and footprint of potentially non-compliant ESEM models to meet these higher ELs. While ESEM manufacturers stated it is possible for them to meet higher ELs by increasing the size or footprint of their ESEMs, many of the ESEMs that they manufacture are embedded or incorporated in another product or equipment. They further stated that several of these products or equipment with embedded ESEMs are not able to accommodate a larger ESEMs into these space-constrained products or equipment.

As previously discussed, DOE revised the engineering analysis for this NOPR based on comments from the December 2022 Joint Recommendation, to assume that ESEMs at EL 2 or below would not result in a significant increase in physical size. (*See* Electric Motors Working Group, No. 38 at p. 4) For ELs higher than EL 2 (*i.e.,* EL 3 and EL 4), DOE recognizes that ESEMs may significantly increase in physical size in order to meet those higher efficiency requirements. DOE also recognizes that this may result in a significant disruption to the OEM market that used ESEMs as an embedded product.

K. Emissions Analysis

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

The analysis of electric power sector emissions of CO_2, NO_X, SO_2, and Hg uses emissions intended to represent the marginal impacts of the change in electricity consumption associated with new standards. The methodology is based on results published for the *AEO,* including a set of side cases that implement a variety of efficiency-related policies. The methodology is described in appendix 13A in the NOPR TSD. The analysis presented in this notice uses projections from *AEO2023.* Power sector emissions of CH_4 and N_2O from fuel combustion are estimated using Emission Factors for Greenhouse Gas Inventories published by the EPA.[81]

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

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

1. Air Quality Regulations Incorporated in DOE's Analysis

DOE's no-new-standards case for the electric power sector reflects the *AEO,* which incorporates the projected impacts of existing air quality regulations on emissions. *AEO2023* reflects, to the extent possible, laws and regulations adopted through mid-November 2022, including the emissions control programs discussed in the following paragraphs the emissions control programs discussed in the following paragraphs, and the Inflation Reduction Act.[82]

SO_2 emissions from affected electric generating units (''EGUs'') are subject to nationwide and regional emissions cap-and-trade programs. Title IV of the Clean Air Act sets an annual emissions cap on SO_2 for affected EGUs in the 48 contiguous States and the District of Columbia (''DC''). (42 U.S.C. 7651 *et seq.*) SO_2 emissions from numerous States in the eastern half of the United States are also limited under the Cross-State Air Pollution Rule (''CSAPR''). 76 FR 48208 (Aug. 8, 2011). CSAPR requires these states to reduce certain emissions, including annual SO_2 emissions, and went into effect as of January 1, 2015.[83] The *AEO* incorporates implementation of CSAPR, including the update to the CSAPR ozone season program emission budgets and target dates issued in 2016. 81 FR 74504 (Oct. 26, 2016). Compliance with CSAPR is flexible among EGUs and is enforced through the use of tradable emissions allowances. Under existing EPA regulations, for states subject to SO_2 emissions limits under CSAPR, any excess SO_2 emissions allowances resulting from the lower electricity demand caused by the adoption of an efficiency standard could be used to permit offsetting increases in SO_2 emissions by another regulated EGU.

However, beginning in 2016, SO_2 emissions began to fall as a result of the Mercury and Air Toxics Standards (''MATS'') for power plants.[84] 77 FR 9304 (Feb. 16, 2012). The final rule establishes power plant emission standards for mercury, acid gases, and non-mercury metallic toxic pollutants. Because of the emissions reductions under the MATS, it is unlikely that excess SO_2 emissions allowances resulting from the lower electricity demand would be needed or used to

[81] Available at *www.epa.gov/sites/production/files/2021-04/documents/emission-factors_apr2021.pdf* (last accessed July 12, 2021).

[82] For further information, see the Assumptions to *AEO2023* report that sets forth the major assumptions used to generate the projections in the Annual Energy Outlook. Available at *www.eia.gov/outlooks/aeo/assumptions/* (last accessed May 1, 2023).

[83] CSAPR requires states to address annual emissions of SO_2 and NO_X, precursors to the formation of fine particulate matter (''$PM_{2.5}$'') pollution, in order to address the interstate transport of pollution with respect to the 1997 and 2006 $PM_{2.5}$ National Ambient Air Quality Standards (''NAAQS''). CSAPR also requires certain states to address the ozone season (May-September) emissions of NO_X, a precursor to the formation of ozone pollution, in order to address the interstate transport of ozone pollution with respect to the 1997 ozone NAAQS. 76 FR 48208 (Aug. 8, 2011). EPA subsequently issued a supplemental rule that included an additional five states in the CSAPR ozone season program; 76 FR 80760 (Dec. 27, 2011) (Supplemental Rule), and EPA issued the CSAPR Update for the 2008 ozone NAAQS. 81 FR 74504 (Oct. 26, 2016).

[84] In order to continue operating, coal power plants must have either flue gas desulfurization or dry sorbent injection systems installed. Both technologies, which are used to reduce acid gas emissions, also reduce SO_2 emissions.

permit offsetting increases in SO_2 emissions by another regulated EGU. Therefore, energy conservation standards that decrease electricity generation will generally reduce SO_2 emissions. DOE estimated SO_2 emissions reduction using emissions factors based on *AEO2023.*

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

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

L. Monetizing Emissions Impacts

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

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

1. Monetization of Greenhouse Gas Emissions

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

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

DOE estimated the global social benefits of CO_2, CH_4, and N_2O reductions using SC–GHG values that were based on the interim values presented in the *Technical Support Document: Social Cost of Carbon, Methane, and Nitrous Oxide Interim Estimates under Executive Order 13990,* published in February 2021 by the IWG. (''February 2021 SC–GHG TSD'') The SC–GHGs is the monetary value of the net harm to society associated with a marginal increase in emissions in a given year, or the benefit of avoiding that increase. In principle, SC–GHGs includes the value of all climate change impacts, including (but not limited to) changes in net agricultural productivity, human health effects, property damage from increased flood risk and natural disasters, disruption of energy systems, risk of conflict, environmental migration, and the value of ecosystem services. The SC–GHGs therefore, reflect the societal value of reducing emissions of the gas in question by one metric ton. The SC–GHGs is the theoretically appropriate value to use in conducting benefit-cost analyses of policies that affect CO_2, N_2O and CH_4 emissions. As a member of the IWG involved in the development of the February 2021 SC–GHG TSD, DOE agrees that the interim SC–GHG estimates represent the most appropriate estimate of the SC–GHG until revised estimates have been developed reflecting the latest, peer-reviewed science.

The SC–GHGs estimates presented here were developed over many years, using transparent process, peer-reviewed methodologies, the best science available at the time of that process, and with input from the public. Specifically, in 2009, the IWG, that included the DOE and other executive branch agencies and offices was established to ensure that agencies were using the best available science and to promote consistency in the social cost of carbon (''SC–CO_2'') values used across agencies. The IWG published SC–CO_2 estimates in 2010 that were developed from an ensemble of three widely cited integrated assessment models (''IAMs'') that estimate global climate damages using highly aggregated representations of climate processes and the global economy combined into a single modeling framework. The three IAMs were run using a common set of input assumptions in each model for future population, economic, and CO_2 emissions growth, as well as equilibrium climate sensitivity—a measure of the globally averaged temperature response to increased atmospheric CO_2 concentrations. These estimates were updated in 2013 based on new versions of each IAM. In August 2016 the IWG published estimates of the social cost of methane (''SC–CH_4'') and nitrous oxide (''SC–N_2O'') using methodologies that are consistent with the methodology underlying the SC–CO_2 estimates. The modeling approach that extends the IWG SC–CO_2 methodology to non-CO_2 GHGs has undergone multiple stages of peer review. The SC–CH_4 and SC–N_2O estimates were developed by Marten *et al.*[85] and underwent a standard double-blind peer review process prior to journal publication. In 2015, as part of the response to public comments received to a 2013 solicitation for comments on the SC–CO_2 estimates, the IWG announced a National Academies of Sciences, Engineering, and Medicine review of the SC–CO_2 estimates to offer

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

advice on how to approach future updates to ensure that the estimates continue to reflect the best available science and methodologies. In January 2017, the National Academies released their final report, Valuing Climate Damages: Updating Estimation of the Social Cost of Carbon Dioxide, and recommended specific criteria for future updates to the SC–CO_2 estimates, a modeling framework to satisfy the specified criteria, and both near-term updates and longer-term research needs pertaining to various components of the estimation process.[86] Shortly thereafter, in March 2017, President Trump issued Executive Order 13783, which disbanded the IWG, withdrew the previous TSDs, and directed agencies to ensure SC–CO_2 estimates used in regulatory analyses are consistent with the guidance contained in OMB's Circular A–4, ''including with respect to the consideration of domestic versus international impacts and the consideration of appropriate discount rates'' (E.O. 13783, Section 5(c)). Benefit-cost analyses following E.O. 13783 used SC–GHG estimates that attempted to focus on the U.S.-specific share of climate change damages as estimated by the models and were calculated using two discount rates recommended by Circular A–4, 3 percent and 7 percent. All other methodological decisions and model versions used in SC–GHG calculations remained the same as those used by the IWG in 2010 and 2013, respectively.

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

First, the IWG found that the SC–GHG estimates used under E.O. 13783 fail to fully capture many climate impacts that affect the welfare of U.S. citizens and residents, and those impacts are better reflected by global measures of the SC–GHG. Examples of omitted effects from the E.O. 13783 estimates include direct effects on U.S. citizens, assets, and investments located abroad, supply chains, U.S. military assets and interests abroad, and tourism, and spillover pathways such as economic and political destabilization and global migration that can lead to adverse impacts on U.S. national security, public health, and humanitarian concerns. In addition, assessing the benefits of U.S. GHG mitigation activities requires consideration of how those actions may affect mitigation activities by other countries, as those international mitigation actions will provide a benefit to U.S. citizens and residents by mitigating climate impacts that affect U.S. citizens and residents. A wide range of scientific and economic experts have emphasized the issue of reciprocity as support for considering global damages of GHG emissions. If the United States does not consider impacts on other countries, it is difficult to convince other countries to consider the impacts of their emissions on the United States. The only way to achieve an efficient allocation of resources for emissions reduction on a global basis—and so benefit the U.S. and its citizens—is for all countries to base their policies on global estimates of damages. As a member of the IWG involved in the development of the February 2021 SC–GHG TSD, DOE agrees with this assessment and, therefore, in this NOPR, DOE centers attention on a global measure of SC–GHG. This approach is the same as that taken in DOE regulatory analyses from 2012 through 2016. A robust estimate of climate damages that accrue only to U.S. citizens and residents does not currently exist in the literature. As explained in the February SC–GHG 2021 TSD, existing estimates are both incomplete and an underestimate of total damages that accrue to the citizens and residents of the U.S. because they do not fully capture the regional interactions and spillovers discussed above, nor do they include all of the important physical, ecological, and economic impacts of climate change recognized in the climate change literature. As noted in the February 2021 SC–GHG TSD, the IWG will continue to review developments in the literature, including more robust methodologies for estimating a U.S.-specific SC–GHG value, and explore ways to better inform the public of the full range of carbon impacts. As a member of the IWG, DOE will continue to follow developments in the literature pertaining to this issue.

Second, the IWG found that the use of the social rate of return on capital (7 percent under current OMB Circular A–4 guidance) to discount the future benefits of reducing GHG emissions inappropriately underestimates the impacts of climate change for the purposes of estimating the SC–GHG. Consistent with the findings of the National Academies and the economic literature, the IWG continued to conclude that the consumption rate of interest is the theoretically appropriate discount rate in an intergenerational context,[87] and recommended that discount rate uncertainty and relevant aspects of intergenerational ethical considerations be accounted for in selecting future discount rates.

Furthermore, the damage estimates developed for use in the SC–GHG are estimated in consumption-equivalent terms, and so an application of OMB Circular A–4's guidance for regulatory analysis would then use the consumption discount rate to calculate the SC–GHG. DOE agrees with this assessment and will continue to follow developments in the literature pertaining to this issue. DOE also notes

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

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

that while OMB Circular A–4, as published in 2003, recommends using 3% and 7% discount rates as ''default'' values, Circular A–4 also reminds agencies that ''different regulations may call for different emphases in the analysis, depending on the nature and complexity of the regulatory issues and the sensitivity of the benefit and cost estimates to the key assumptions.'' On discounting, Circular A–4 recognizes that ''special ethical considerations arise when comparing benefits and costs across generations,'' and Circular A–4 acknowledges that analyses may appropriately ''discount future costs and consumption benefits . . . at a lower rate than for intragenerational analysis.'' In the 2015 Response to Comments on the Social Cost of Carbon for Regulatory Impact Analysis, OMB, DOE, and the other IWG members recognized that ''Circular A–4 is a living document'' and ''the use of 7 percent is not considered appropriate for intergenerational discounting. There is wide support for this view in the academic literature, and it is recognized in Circular A–4 itself.'' Thus, DOE concludes that a 7% discount rate is not appropriate to apply to value the social cost of greenhouse gases in the analysis presented in this analysis.

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

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

There are a number of limitations and uncertainties associated with the SC–GHG estimates. First, the current scientific and economic understanding of discounting approaches suggests discount rates appropriate for intergenerational analysis in the context of climate change are likely to be less than 3 percent, near 2 percent or lower.[88] Second, the IAMs used to produce these interim estimates do not include all of the important physical, ecological, and economic impacts of climate change recognized in the climate change literature and the science underlying their ''damage functions''—*i.e.,* the core parts of the IAMs that map global mean temperature changes and other physical impacts of climate change into economic (both market and nonmarket) damages—lags behind the most recent research. For example, limitations include the incomplete treatment of catastrophic and non-catastrophic impacts in the integrated assessment models, their incomplete treatment of adaptation and technological change, the incomplete way in which inter-regional and intersectoral linkages are modeled, uncertainty in the extrapolation of damages to high temperatures, and inadequate representation of the relationship between the discount rate and uncertainty in economic growth over long time horizons. Likewise, the socioeconomic and emissions scenarios used as inputs to the models do not reflect new information from the last decade of scenario generation or the full range of projections. The modeling limitations do not all work in the same direction in terms of their influence on the SC–CO_2 estimates. However, as discussed in the February 2021 TSD, the IWG has recommended that, taken together, the limitations suggest that the interim SC–GHG estimates used in this NOPR likely underestimate the damages from GHG emissions. DOE concurs with this assessment.

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

In response to the March 2022 Preliminary Analysis, NEMA disagreed with DOE's approach for estimating monetary benefits associated with emissions reductions. NEMA commented that this topic is too convoluted and subjective to be included in a rulemaking analysis for electric motor standards. NEMA added that DOE does not adequately examine or account for the significant impacts from ever-increasing investment in and use of renewable energy sources and associated decrease in emissions. (NEMA, No. 22 at p. 25)

DOE acknowledges that increasing use of renewable electricity sources will reduce CO_2 emissions and likely other emissions from the power sector faster than could have been expected when *AEO2023* was prepared. Nevertheless, DOE has used *AEO2023* for the purposes of quantifying emissions as DOE believes it continues to be the most appropriate projection at this time for such purposes. And to comply with the requirements of Executive Order 12866, DOE considered the estimated monetary benefits from the reduced emissions of CO_2, CH_4, N_2O, NO_X, and SO_2 that are

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

expected to result from each of the TSLs considered. It is important to note that even a significant reduction in the emissions benefits projected in this NOPR would not change DOE's decision about which standard levels to propose based on the December 2022 Joint Recommendation and DOE's analysis.

a. Social Cost of Carbon

The SC–CO_2 values used for this NOPR were based on the values developed for the IWG's February 2021 TSD, which are shown in Table IV–10 in five-year increments from 2020 to 2050. The set of annual values that DOE used, which was adapted from estimates published by EPA,[89] is presented in Appendix 14A of the NOPR TSD. These estimates are based on methods, assumptions, and parameters identical to the estimates published by the IWG (which were based on EPA modeling) and include values for 2051 to 2070.

TABLE IV–10—ANNUAL SC–CO_2 VALUES FROM 2021 INTERAGENCY UPDATE, 2020–2050

[2020$ per metric ton CO_2]

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

DOE multiplied the CO_2 emissions reduction estimated for each year by the SC–CO_2 value for that year in each of the four cases. DOE adjusted the values to 2022$ using the implicit price deflator for gross domestic product (''GDP'') from the Bureau of Economic Analysis. To calculate a present value of the stream of monetary values, DOE discounted the values in each of the four cases using the specific discount rate that had been used to obtain the SC–CO_2 values in each case.

b. Social Cost of Methane and Nitrous Oxide

The SC–CH_4 and SC–N_2O values used for this NOPR were based on the values developed for the February 2021 TSD. Table IV–11 shows the updated sets of SC–CH_4 and SC–N_2O estimates from the latest interagency update in 5-year increments from 2020 to 2050. The full set of annual values used is presented in Appendix 14–A of the NOPR TSD. To capture the uncertainties involved in regulatory impact analysis, DOE has determined it is appropriate to include all four sets of SC–CH_4 and SC–N_2O values, as recommended by the IWG. DOE derived values after 2050 using the approach described above for the SC–CO_2.

TABLE IV–11—ANNUAL SC–CH_4 AND SC–N_2O VALUES FROM 2021 INTERAGENCY UPDATE, 2020–2050

[2020$ per metric ton]

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

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

2. Monetization of Other Emissions Impacts

For this NOPR, DOE estimated the monetized value of NO_X and SO_2 emissions reductions from electricity generation using the latest benefit-per-ton estimates for that sector from the EPA's Benefits Mapping and Analysis Program.[90] DOE used EPA's values for $PM_{2.5}$-related benefits associated with NO_X and SO_2 and for ozone-related benefits associated with NO_X for 2025, 2030, and 2040, calculated with

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

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

discount rates of 3 percent and 7 percent. DOE used linear interpolation to define values for the years not given in the 2025 to 2040 period; for years beyond 2040, the values are held constant. DOE combined the EPA regional benefit-per-ton estimates with regional information on electricity consumption and emissions from *AEO2023* to define weighted-average national values for NO_X and SO_2 (see appendix 14B of the NOPR TSD).

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

DOE requests comment on how to address the climate benefits and non-monetized effects of the proposal.

M. Utility Impact Analysis

In the March 2022 Preliminary Analysis, DOE described the approach for conducting the utility impact analysis. See chapter 15 of the March 2022 Preliminary TSD. In response, NEMA commented that the proposed approach for assessing utility impacts appears to be sufficient. (NEMA, No. 22 at p. 25) In this NOPR, DOE continues to follow the same approach.

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

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

N. Employment Impact Analysis

In the March 2022 Preliminary Analysis, DOE described the approach for conducting the employment impact analysis. *See* chapter 16 of the March 2022 Preliminary TSD. In response, NEMA commented that the proposed approach for assessing national employment impacts appears to be sufficient. (NEMA, No. 22 at p. 25) In this NOPR, DOE continues to follow the same approach.

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

One method for assessing the possible effects on the demand for labor of such shifts in economic activity is to compare sector employment statistics developed by the Labor Department's 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.[91] There are many reasons for these differences, including wage differences and the fact that the utility sector is more capital-intensive and less labor-intensive than other sectors. Energy conservation standards have the effect of reducing consumer utility bills. Because reduced consumer expenditures for energy likely lead to increased expenditures in other sectors of the economy, the general effect of efficiency standards is to shift economic activity from a less labor-intensive sector (*i.e.,* the utility sector) to more labor-intensive sectors (*e.g.,* the retail and service sectors). Thus, the BLS data suggest that net national employment may increase due to shifts in economic activity resulting from energy conservation standards.

DOE estimated indirect national employment impacts for the standard levels considered in this NOPR using an input/output model of the U.S. economy called Impact of Sector Energy Technologies version 4 (''ImSET'').[92] ImSET is a special-purpose version of the ''U.S. Benchmark National Input-Output'' (''I–O'') model, which was designed to estimate the national employment and income effects of energy-saving technologies. The ImSET software includes a computer- based I–O model having structural coefficients that characterize economic flows among 187 sectors most relevant to industrial, commercial, and residential building energy use.

DOE notes that ImSET is not a general equilibrium forecasting model, and that the uncertainties involved in projecting employment impacts, especially changes in the later years of the analysis. Because ImSET does not incorporate price changes, the employment effects predicted by ImSET may over-estimate actual job impacts over the long run for this proposed rule. Therefore, DOE used ImSET only to generate results for near-term timeframes (2034), where these uncertainties are reduced. For more details on the employment impact analysis, see chapter 16 of the NOPR TSD.

V. Analytical Results and Conclusions

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

A. Trial Standard Levels

In general, DOE typically evaluates potential new standards for products

[91] See U.S. Department of Commerce—Bureau of Economic Analysis. *Regional Multipliers: A User Handbook for the Regional Input-Output Modeling System (RIMS II).* 1997. U.S. Government Printing Office: Washington, DC. Available at *www.bea.gov/scb/pdf/regional/perinc/meth/rims2.pdf* (last accessed July 1, 2021).

[92] Livingston, O.V., S.R. Bender, M.J. Scott, and R.W. Schultz. *ImSET 4.0: Impact of Sector Energy Technologies Model Description and User Guide.* 2015. Pacific Northwest National Laboratory: Richland, WA. PNNL–24563.

and equipment by grouping individual efficiency levels for each class into TSLs. Use of TSLs allows DOE to identify and consider manufacturer cost interactions between the equipment classes, to the extent that there are such interactions, and price elasticity of consumer purchasing decisions that may change when different standard levels are set.

In the analysis conducted for this NOPR, DOE analyzed the benefits and burdens of four TSLs for ESEMs. DOE developed TSLs that combine efficiency levels for each analyzed equipment class. DOE presents the results for the TSLs in this document, while the results for all efficiency levels that DOE analyzed are in the NOPR TSD.[93]

Table V–1 presents the TSLs and the corresponding efficiency levels that DOE has identified for potential new energy conservation standards for ESEMs. TSL 4 represents the maximum technologically feasible (''max-tech'') energy efficiency for all equipment classes. TSL 3 is equivalent to EL 3 for all equipment classes. TSL 2 is equivalent to EL 2 for all equipment classes and corresponds to the Electric Motors Working Group recommended levels. TSL 1 is equivalent to EL 1 for all equipment classes.

TABLE V–1—TRIAL STANDARD LEVELS FOR ESEMS

Equipment class group	Horsepower range	TSL1	TSL2	TSL3	TSL4
		Average of EL0 and EL2	Recommended levels	Average of EL2 and EL4	Max-tech
ESEM High/Med Torque	0.25 ≤ hp ≤ 0.50	EL1	EL2	EL3	EL4.
	0.5 < hp ≤ 3	EL1	EL2	EL3	EL4.
ESEM Low Torque	0.25 hp	EL1	EL2	EL3	EL4.
	0.25 < hp	EL1	EL2	EL3	EL4.
ESEM Polyphase	0.25 ≤ hp	EL1	EL2	EL3	EL4.
AO–ESEM High/Med Torque	0.25 ≤ hp ≤ 0.50	EL1	EL2	EL3	EL4.
	0.5 < hp ≤ 3	EL1	EL2	EL3	EL4.
AO–ESEM Low Torque	0.25 hp	EL1	EL2	EL3	EL4.
	0.25 < hp	EL1	EL2	EL3	EL4.
AO–ESEM Polyphase	0.25 ≤ hp	EL1	EL2	EL3	EL4.

DOE constructed the TSLs for this NOPR to include ELs representative of ELs with similar characteristics (*i.e.,* using similar efficiencies). Specifically, DOE aligned the efficiency levels for air-over and non-air-over ESEMs because of the similarities in the manufacturing processes between air-over and non-air-over ESEMs. In some cases, an AO–ESEM could be manufactured on the same line as a non-air-over ESEM by omitting the steps of manufacturing associated with the fan of a motor. DOE notes this alignment is in line with Electric Motors Working Group's recommendation in the December 2022 Joint Recommendation. While representative ELs were included in the TSLs, DOE considered all efficiency levels as part of its analysis.[94]

B. Economic Justification and Energy Savings

1. Economic Impacts on Individual Consumers

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

a. Life-Cycle Cost and Payback Period

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

Table V–2 through Table V–21 show the LCC and PBP results for the TSLs considered for each equipment class. In the first of each pair of tables, the simple payback is measured relative to the baseline product. In the second table, the impacts are measured relative to the efficiency distribution in the no-new-standards case in the compliance year (see section IV.F.8 of this document). Because some consumers purchase equipment with higher efficiency in the no-new-standards case, the average savings are less than the difference between the average LCC of the baseline equipment and the average LCC at each TSL. The savings refer only to consumers who are affected by a standard at a given TSL. Those who already purchase an equipment with efficiency at or above a given TSL are not affected. Consumers for whom the LCC increases at a given TSL experience a net cost.

[93] Results by efficiency level are presented in chapters 8, 10, and 12 of the NOPR TSD.

[94] Efficiency levels that were analyzed for this NOPR are discussed in section IV.C.4 of this document. Results by efficiency level are presented in chapters 8, 10, and 12 of the NOPR TSD.

TABLE V–2—AVERAGE LCC AND PBP RESULTS FOR ESEM—HIGH/MED TORQUE, 0.25 hp

TSL	Efficiency level	Average costs (2022$)				Simple payback (years)	Average lifetime (years)
		Installed cost	First year's operating cost	Lifetime operating cost	LCC		
	Baseline	186	98	509	696	....	7.7
1	1	192	86	447	639	0.5	7.7
2	2	211	76	397	607	1.1	7.7
3	3	296	68	354	649	3.7	7.7
4	4	434	62	322	755	6.9	7.7

Note: The results for each TSL are calculated assuming that all consumers use products at that efficiency level. The PBP is measured relative to the baseline product.

TABLE V–3—AVERAGE LCC SAVINGS RELATIVE TO THE NO-NEW-STANDARDS CASE FOR ESEM—HIGH/MED TORQUE, 0.25 hp

TSL	Efficiency level	Life-cycle cost savings	
		Percent of consumers that experience net cost	Average LCC savings* (2022)
1	1	2.0	56
2	2	16.7	51
3	3	51.2	−1
4	4	85.9	−107

* The savings represent the average LCC for affected consumers.

TABLE V–4—AVERAGE LCC AND PBP RESULTS FOR ESEM—HIGH/MED TORQUE, 1 hp

TSL	Efficiency level	Average costs (2022$)				Simple payback (years)	Average lifetime (years)
		Installed cost	First year's operating cost	Lifetime operating cost	LCC		
	Baseline	351	243	1,272	1,624	....	7.5
1	1	368	218	1,142	1,510	0.7	7.5
2	2	395	196	1,028	1,423	0.9	7.5
3	3	534	189	989	1,522	3.4	7.5
4	4	733	183	955	1,688	6.3	7.5

Note: The results for each TSL are calculated assuming that all consumers use products at that efficiency level. The PBP is measured relative to the baseline product.

TABLE V–5—AVERAGE LCC SAVINGS RELATIVE TO THE NO-NEW-STANDARDS CASE FOR ESEM—HIGH/MED TORQUE, 1 hp

TSL	Efficiency level	Life-cycle cost savings	
		Percent of consumers that experience net cost	Average LCC savings* (2022)
1	1	3.5	116
2	2	11.7	138
3	3	53.5	21
4	4	82.5	−145

* The savings represent the average LCC for affected consumers.

TABLE V–6—AVERAGE LCC AND PBP RESULTS FOR ESEM—LOW TORQUE, 0.25 hp

TSL	Efficiency level	Average costs (2022$)				Simple payback (years)	Average lifetime (years)
		Installed cost	First year's operating cost	Lifetime operating cost	LCC		
	Baseline	153	216	956	1,108	....	6.8
1	1	174	163	718	892	0.4	6.8
2	2	213	131	576	789	0.7	6.8

TABLE V–6—AVERAGE LCC AND PBP RESULTS FOR ESEM—LOW TORQUE, 0.25 hp—Continued

TSL	Efficiency level	Average costs (2022$)				Simple payback (years)	Average lifetime (years)
		Installed cost	First year's operating cost	Lifetime operating cost	LCC		
3	3	277	118	518	795	1.3	6.8
4	4	366	107	470	836	2.0	6.8

Note: The results for each TSL are calculated assuming that all consumers use products at that efficiency level. The PBP is measured relative to the baseline product.

TABLE V–7—AVERAGE LCC SAVINGS RELATIVE TO THE NO-NEW-STANDARDS CASE FOR ESEM—LOW TORQUE, 0.25 hp

TSL	Efficiency level	Life-cycle cost savings	
		Percent of consumers that experience net cost	Average LCC savings* (2022)
1	1	0.2	213
2	2	2.9	147
3	3	52.0	24
4	4	67.7	−17

* The savings represent the average LCC for affected consumers.

TABLE V–8—AVERAGE LCC AND PBP RESULTS FOR ESEM—LOW TORQUE, 0.5 hp

TSL	Efficiency level	Average costs (2022$)				Simple payback (years)	Average lifetime (years)
		Installed cost	First year's operating cost	Lifetime operating cost	LCC		
	Baseline	223	237	1,074	1,297		6.9
1	1	269	218	987	1,256	2.4	6.9
2	2	276	201	908	1,184	1.5	6.9
3	3	372	178	805	1,177	2.5	6.9
4	4	455	159	719	1,174	3.0	6.9

Note: The results for each TSL are calculated assuming that all consumers use products at that efficiency level. The PBP is measured relative to the baseline product.

TABLE V–9—AVERAGE LCC SAVINGS RELATIVE TO THE NO-NEW-STANDARDS CASE FOR ESEM—LOW TORQUE, 0.5 hp

TSL	Efficiency level	Life-cycle cost savings	
		Percent of consumers that experience net cost	Average LCC savings* (2022)
1	1	10.8	41
2	2	7.8	100
3	3	30.4	78
4	4	40.1	73

* The savings represent the average LCC for affected consumers.

TABLE V–10—AVERAGE LCC AND PBP RESULTS FOR ESEM—POLYPHASE TORQUE, 0.25 hp

TSL	Efficiency level	Average costs (2022$)				Simple payback (years)	Average lifetime (years)
		Installed cost	First year's operating cost	Lifetime operating cost	LCC		
	Baseline	199	68	432	631		9.3
1	1	206	62	394	600	1.2	9.3
2	2	222	57	362	584	2.0	9.3
3	3	277	51	325	602	4.6	9.3
4	4	405	47	297	702	9.7	9.3

Note: The results for each TSL are calculated assuming that all consumers use products at that efficiency level. The PBP is measured relative to the baseline product.

TABLE V–11—AVERAGE LCC SAVINGS RELATIVE TO THE NO-NEW-STANDARDS CASE FOR ESEM—POLYPHASE, 0.25 hp

TSL	Efficiency level	Life-cycle cost savings	
		Percent of consumers that experience net cost	Average LCC savings* (2022)
1	1	1.0	32
2	2	7.2	26
3	3	58.6	−8
4	4	95.0	−107

* The savings represent the average LCC for affected consumers.

TABLE V–12—AVERAGE LCC AND PBP RESULTS FOR AO–ESEM—HIGH/MED TORQUE, 0.25 hp

TSL	Efficiency level	Average costs (2022$)				Simple payback (years)	Average lifetime (years)
		Installed cost	First year's operating cost	Lifetime operating cost	LCC		
	Baseline	174	158	695	869		6.8
1	1	180	139	611	791	0.3	6.8
2	2	200	123	543	743	0.8	6.8
3	3	282	110	485	767	2.3	6.8
4	4	419	101	444	863	4.3	6.8

Note: The results for each TSL are calculated assuming that all consumers use products at that efficiency level. The PBP is measured relative to the baseline product.

TABLE V–13—AVERAGE LCC SAVINGS RELATIVE TO THE NO-NEW-STANDARDS CASE FOR AO–ESEM—HIGH/MED TORQUE, 0.25 hp

TSL	Efficiency level	Life-cycle cost savings	
		Percent of consumers that experience net cost	Average LCC savings* (2022)
1	1	1.3	76
2	2	7.8	83
3	3	36.0	37
4	4	64.6	−61

* The savings represent the average LCC for affected consumers.

TABLE V–14—AVERAGE LCC AND PBP RESULTS FOR AO–ESEM—HIGH/MED TORQUE, 1 hp

TSL	Efficiency level	Average costs (2022$)				Simple payback (years)	Average lifetime (years)
		Installed cost	First year's operating cost	Lifetime operating cost	LCC		
	Baseline	338	312	1,492	1,830		7.0
1	1	355	283	1,352	1,707	0.6	7.0
2	2	382	255	1,219	1,601	0.8	7.0
3	3	520	246	1,173	1,693	2.7	7.0
4	4	716	238	1,138	1,854	5.1	7.0

Note: The results for each TSL are calculated assuming that all consumers use products at that efficiency level. The PBP is measured relative to the baseline product.

TABLE V–15—AVERAGE LCC SAVINGS RELATIVE TO THE NO-NEW-STANDARDS CASE FOR AO–ESEM—HIGH/MED TORQUE, 1 hp

TSL	Efficiency level	Life-cycle cost savings	
		Percent of consumers that experience net cost	Average LCC savings* (2022)
1	1	2.0	122
2	2	5.9	160
3	3	44.4	37

TABLE V–15—AVERAGE LCC SAVINGS RELATIVE TO THE NO-NEW-STANDARDS CASE FOR AO–ESEM—HIGH/MED TORQUE, 1 hp—Continued

TSL	Efficiency level	Life-cycle cost savings	
		Percent of consumers that experience net cost	Average LCC savings * (2022)
4	4	81.9	−128

* The savings represent the average LCC for affected consumers.

TABLE V–16—AVERAGE LCC AND PBP RESULTS FOR AO–ESEM—LOW TORQUE, 0.25 hp

TSL	Efficiency level	Average costs (2022$)				Simple payback (years)	Average lifetime (years)
		Installed cost	First year's operating cost	Lifetime operating cost	LCC		
	Baseline	141	218	962	1,103		6.8
1	1	163	164	722	885	0.4	6.8
2	2	202	132	579	781	0.7	6.8
3	3	264	119	521	785	1.2	6.8
4	4	352	108	472	824	1.9	6.8

Note: The results for each TSL are calculated assuming that all consumers use products at that efficiency level. The PBP is measured relative to the baseline product.

TABLE V–17—AVERAGE LCC SAVINGS RELATIVE TO THE NO-NEW-STANDARDS CASE FOR AO–ESEM—LOW TORQUE, 0.25 hp

TSL	Efficiency level	Life-cycle cost savings	
		Percent of consumers that experience net cost	Average LCC savings * (2022$)
1	1	0.1	217
2	2	3.7	121
3	3	39.1	32
4	4	67.9	−13

* The savings represent the average LCC for affected consumers.

TABLE V–18—AVERAGE LCC AND PBP RESULTS FOR AO–ESEM—LOW TORQUE, 0.5 hp

TSL	Efficiency level	Average costs (2022$)				Simple payback (years)	Average lifetime (years)
		Installed cost	First year's operating cost	Lifetime operating cost	LCC		
	Baseline	213	257	1,144	1,357		6.8
1	1	257	237	1,053	1,310	2.2	6.8
2	2	265	218	969	1,234	1.3	6.8
3	3	358	194	860	1,218	2.3	6.8
4	4	441	174	770	1,211	2.7	6.8

Note: The results for each TSL are calculated assuming that all consumers use products at that efficiency level. The PBP is measured relative to the baseline product.

TABLE V–19—AVERAGE LCC SAVINGS RELATIVE TO THE NO-NEW-STANDARDS CASE FOR AO–ESEM—LOW TORQUE, 0.5 hp

TSL	Efficiency level	Life-cycle cost savings	
		Percent of consumers that experience net cost	Average LCC savings * (2022$)
1	1	2.1	48
2	2	2.9	88
3	3	34.4	50
4	4	42.2	52

* The savings represent the average LCC for affected consumers.

TABLE V–20—AVERAGE LCC AND PBP RESULTS FOR AO–ESEM—POLYPHASE, 0.25 hp

TSL	Efficiency level	Average costs (2022$)				Simple payback (years)	Average lifetime (years)
		Installed cost	First year's operating cost	Lifetime operating cost	LCC		
	Baseline	189	81	488	678		8.9
1	1	197	74	446	643	1.1	8.9
2	2	212	68	411	623	1.8	8.9
3	3	267	61	369	636	3.9	8.9
4	4	394	56	340	734	8.3	8.9

Note: The results for each TSL are calculated assuming that all consumers use products at that efficiency level. The PBP is measured relative to the baseline product.

TABLE V–21—AVERAGE LCC SAVINGS RELATIVE TO THE NO-NEW-STANDARDS CASE FOR AO–ESEM—POLYPHASE, 0.25 hp

TSL	Efficiency level	Life-cycle cost savings	
		Percent of consumers that experience net cost	Average LCC savings * (2022$)
1	1	2.7	35
2	2	9.7	40
3	3	48.6	13
4	4	87.8	−85

* The savings represent the average LCC for affected consumers.

b. Consumer Subgroup Analysis

In the consumer subgroup analysis, DOE estimated the impact of the considered TSLs on low-income households (for representative units with consumers in the residential sector[95]), senior-only households (for representative units with consumers in the residential sector), and small businesses. Table V–22 to Table V–24 compare the average LCC savings and PBP at each efficiency level for the consumer subgroups with similar metrics for the entire consumer sample for all equipment classes. In most cases, the average LCC savings and PBP for low-income households, senior-only household, and small-businesses at the considered efficiency levels are not substantially different from the average for all. Chapter 11 of the NOPR TSD presents the complete LCC and PBP results for the subgroups.

TABLE V–22—COMPARISON OF LCC SAVINGS AND PBP FOR LOW-INCOME HOUSEHOLD SUBGROUP AND ALL CONSUMERS

TSL	Average LCC savings * (2021$)		Simple payback (years)		Consumers with net benefit (%)		Consumers with net cost (%)	
	Low-income	All	Low-income	All	Low-income	All	Low-income	All
ESEM—High/Med Torque, 0.25 hp								
1	56	56	0.5	0.5	22.3	22.5	1.7	2.0
2	53	51	1.4	1.5	52.1	51.0	14.3	16.7
3	7	−1	4.9	5.3	36.1	32.4	45.9	51.2
4	−90	−107	9.2	10.0	19.7	13.6	77.9	85.9
ESEM—High/Med Torque, 1 hp								
1	116	116	0.7	0.7	33.9	34.0	3.4	3.5
2	138	138	1.0	1.1	74.4	74.2	11.1	11.7
3	24	21	4.6	4.7	46.0	44.9	51.9	53.5
4	−138	−145	8.6	8.7	18.9	17.4	80.5	82.5
ESEM—Low Torque, 0.25 hp								
1	210	213	0.4	0.4	3.9	4.0	0.2	0.2
2	148	147	0.9	1.0	17.5	17.5	2.6	3.0
3	29	24	3.1	3.3	50.2	48.0	48.1	52.0
4	−6	−17	4.6	5.0	35.7	32.3	62.6	67.7

[95] All representative units except for the ESEM Polyphase and AO–ESEM Polyphase, 0.5 hp are used in the residential sector.

TABLE V–22—COMPARISON OF LCC SAVINGS AND PBP FOR LOW-INCOME HOUSEHOLD SUBGROUP AND ALL CONSUMERS—Continued

TSL	Average LCC savings* (2021$)		Simple payback (years)		Consumers with net benefit (%)		Consumers with net cost (%)	
	Low-income	All	Low-income	All	Low-income	All	Low-income	All
ESEM—Low Torque, 0.5 hp								
1	43	41	2.3	2.4	32.0	31.7	10.0	10.8
2	101	100	1.2	1.3	56.2	56.2	7.1	7.8
3	84	78	2.7	2.8	61.1	60.1	28.3	30.4
4	82	73	3.2	3.3	61.0	59.9	37.7	40.1
AO–ESEM—High/Med Torque, 0.25 hp								
1	77	76	0.3	0.3	25.1	25.5	1.2	1.3
2	84	83	0.9	1.0	51.1	51.5	7.0	7.8
3	44	37	3.0	3.2	44.6	43.0	32.8	36.0
4	−46	−61	5.7	6.1	25.7	21.8	59.1	64.6
AO–ESEM—High/Med Torque, 1 hp								
1	122	122	0.6	0.6	30.5	30.6	2.0	2.0
2	160	160	0.9	0.9	65.3	65.5	5.8	5.9
3	39	37	3.9	3.9	44.3	44.0	43.8	44.4
4	−124	−128	7.6	7.7	18.8	18.1	80.9	81.9
AO–ESEM—Low Torque, 0.25 hp								
1	220	217	0.4	0.4	1.6	1.7	0.1	0.1
2	124	121	1.0	1.1	20.4	20.5	3.3	3.7
3	36	32	2.9	3.1	45.0	43.2	36.1	39.1
4	−3	−13	4.6	4.9	35.7	32.1	62.7	67.9
AO–ESEM—Low Torque, 0.5 hp								
1	51	48	2.1	2.2	7.1	7.0	2.0	2.2
2	90	88	0.8	0.8	31.9	32.0	2.5	2.9
3	56	50	2.8	3.0	58.0	56.7	31.5	34.4
4	64	52	3.2	3.4	59.3	57.8	38.8	42.2

TABLE V–23—COMPARISON OF LCC SAVINGS AND PBP FOR SENIOR-ONLY HOUSEHOLD SUBGROUP AND ALL CONSUMERS

TSL	Average LCC savings* (2021$)		Simple payback (years)		Consumers with net benefit (%)		Consumers with net cost (%)	
	Senior-only	All	Senior-only	All	Senior-only	All	Senior-only	All
ESEM—High/Med Torque, 0.25 hp								
1	56	56	0.5	0.5	22.4	22.5	2.1	2.0
2	51	51	1.5	1.5	51.0	51.0	16.7	16.7
3	−1	−1	5.3	5.3	32.4	32.4	51.3	51.2
4	−107	−107	10.0	10.0	13.6	13.6	85.9	85.9
ESEM—High/Med Torque hp								
1	116	116	0.7	0.7	34.0	34.0	3.5	3.5
2	138	138	1.1	1.1	74.1	74.2	11.7	11.7
3	21	21	4.7	4.7	44.8	44.9	53.6	53.5
4	−145	−145	8.7	8.7	17.4	17.4	82.5	82.5
ESEM—Low Torque, 0.25 hp								
1	212	213	0.4	0.4	4.0	4.0	0.2	0.2
2	146	147	1.0	1.0	17.5	17.5	3.0	3.0
3	24	24	3.3	3.3	48.0	48.0	52.0	52.0
4	−17	−17	5.0	5.0	32.1	32.3	67.9	67.7

TABLE V–23—COMPARISON OF LCC SAVINGS AND PBP FOR SENIOR-ONLY HOUSEHOLD SUBGROUP AND ALL CONSUMERS—Continued

TSL	Average LCC savings * (2021$)		Simple payback (years)		Consumers with net benefit (%)		Consumers with net cost (%)	
	Senior-only	All	Senior-only	All	Senior-only	All	Senior-only	All
ESEM—Low Torque, 0.5 hp								
1	41	41	2.4	2.4	31.6	31.7	10.8	10.8
2	99	100	1.3	1.3	56.2	56.2	7.8	7.8
3	78	78	2.8	2.8	60.0	60.1	30.5	30.4
4	72	73	3.3	3.3	59.8	59.9	40.2	40.1
AO–ESEM—High/Med Torque, 0.25 hp								
1	76	76	0.3	0.3	25.5	25.5	1.3	1.3
2	83	83	1.0	1.0	51.4	51.5	7.9	7.8
3	37	37	3.2	3.2	42.9	43.0	36.1	36.0
4	−62	−61	6.1	6.1	21.7	21.8	64.7	64.6
AO–ESEM—High/Med Torque, 1 hp								
1	122	122	0.6	0.6	30.6	30.6	2.0	2.0
2	160	160	0.9	0.9	65.5	65.5	5.9	5.9
3	37	37	3.9	3.9	44.0	44.0	44.4	44.4
4	−128	−128	7.7	7.7	18.1	18.1	81.9	81.9
AO–ESEM—Low Torque, 0.25 hp								
1	216	217	0.4	0.4	1.7	1.7	0.1	0.1
2	121	121	1.1	1.1	20.5	20.5	3.7	3.7
3	31	32	3.1	3.1	43.2	43.2	39.2	39.1
4	−14	−13	4.9	4.9	32.1	32.1	67.9	67.9
AO–ESEM—Low Torque, 0.5 hp								
1	47	48	2.2	2.2	7.0	7.0	2.1	2.2
2	88	88	0.8	0.8	32.0	32.0	2.9	2.9
3	50	50	3.0	3.0	56.7	56.7	34.5	34.4
4	52	52	3.4	3.4	57.8	57.8	42.2	42.2

TABLE V–24—COMPARISON OF LCC SAVINGS AND PBP FOR SMALL BUSINESS AND ALL CONSUMERS

TSL	Average LCC savings * (2021$)		Simple payback (years)		Consumers with net benefit (%)		Consumers with net cost (%)	
	Small business	All	Small business	All	Small business	All	Small business	All
ESEM—High/Med Torque, 0.25 hp								
1	58	56	0.5	0.5	22.5	22.5	2.0	2.0
2	54	51	1.4	1.5	51.2	51.0	16.5	16.7
3	3	−1	4.9	5.3	33.8	32.4	49.9	51.2
4	−102	−107	9.3	10.0	15.2	13.6	84.3	85.9
ESEM—High/Med Torque, 1 hp								
1	121	116	0.6	0.7	34.0	34.0	3.4	3.5
2	145	138	1.0	1.1	74.4	74.2	11.5	11.7
3	28	21	4.3	4.7	46.0	44.9	52.4	53.5
4	−136	−145	8.1	8.7	19.1	17.4	80.8	82.5
ESEM—Low Torque, 0.25 hp								
1	220	213	0.4	0.4	4.0	4.0	0.2	0.2
2	153	147	1.0	1.0	17.6	17.5	2.9	3.0
3	27	24	3.2	3.3	50.6	48.0	49.4	52.0
4	−12	−17	4.7	5.0	34.6	32.3	65.4	67.7

TABLE V–24—COMPARISON OF LCC SAVINGS AND PBP FOR SMALL BUSINESS AND ALL CONSUMERS—Continued

TSL	Average LCC savings * (2021$)		Simple payback (years)		Consumers with net benefit (%)		Consumers with net cost (%)	
	Small business	All	Small business	All	Small business	All	Small business	All
ESEM—Low Torque, 0.5 hp								
1	44	41	2.3	2.4	32.0	31.7	10.5	10.8
2	105	100	1.2	1.3	56.4	56.2	7.6	7.8
3	85	78	2.6	2.8	61.1	60.1	29.4	30.4
4	82	73	3.1	3.3	61.7	59.9	38.3	40.1
ESEM—Polyphase, 0.5 hp								
1	33	32	1.0	1.1	9.3	9.2	1.0	1.0
2	28	26	2.4	2.6	26.4	26.3	7.1	7.2
3	−7	−8	6.8	7.4	29.1	27.8	57.3	58.6
4	−105	−107	14.3	15.6	5.2	4.5	94.3	95.0
AO–ESEM—High/Med Torque, 0.25 hp								
1	79	76	0.3	0.3	25.5	25.5	1.3	1.3
2	86	83	0.9	1.0	51.6	51.5	7.7	7.8
3	42	37	3.0	3.2	44.4	43.0	34.6	36.0
4	−56	−61	5.7	6.1	23.4	21.8	62.9	64.6
AO–ESEM—High/Med Torque, 1 hp								
1	128	122	0.5	0.6	30.6	30.6	2.0	2.0
2	168	160	0.8	0.9	65.6	65.5	5.8	5.9
3	46	37	3.6	3.9	45.0	44.0	43.4	44.4
4	−119	−128	7.1	7.7	20.2	18.1	79.8	81.9
AO–ESEM—Low Torque, 0.25 hp								
1	225	217	0.4	0.4	1.7	1.7	0.1	0.1
2	127	121	1.0	1.1	20.6	20.5	3.7	3.7
3	35	32	2.9	3.1	45.1	43.2	37.3	39.1
4	−9	−13	4.6	4.9	34.3	32.1	65.7	67.9
AO–ESEM—Low Torque, 0.5 hp								
1	51	48	2.1	2.2	7.1	7.0	2.1	2.2
2	92	88	0.8	0.8	32.1	32.0	2.8	2.9
3	55	50	2.8	3.0	58.1	56.7	33.1	34.4
4	60	52	3.3	3.4	59.7	57.8	40.3	42.2
AO–ESEM—Polyphase, 0.5 hp								
1	37	35	1.0	1.1	33.8	33.7	2.6	2.7
2	42	40	1.9	2.0	53.4	53.3	9.6	9.7
3	16	13	4.7	5.1	50.1	48.8	47.3	48.6
4	−81	−85	9.9	10.8	13.9	12.2	86.1	87.8

c. Rebuttable Presumption Payback

As discussed in section IV.F.9 of this document, EPCA establishes a rebuttable presumption that an energy conservation standard is economically justified if the increased purchase cost for a product that meets the standard is less than three times the value of the first-year energy savings resulting from the standard. (42 U.S.C. 6316(a); 42 U.S.C. 6295(o)(2)(B)(iii)) In calculating a rebuttable presumption payback period for each of the considered TSLs, DOE used discrete values, and, as required by EPCA, based the energy use calculation on the DOE test procedures for ESEMs. In contrast, the PBPs presented in section V.B.1.a of this document were calculated using distributions that reflect the range of energy use in the field.

Table V–25 presents the rebuttable-presumption payback periods for the considered TSLs for ESEMs. While DOE examined the rebuttable-presumption criterion, it considered whether the standard levels considered for this proposed rule are economically justified through a more detailed analysis of the economic impacts of those levels, pursuant to 42 U.S.C. 6313(a) and 42 U.S.C. 6295(o)(2)(B)(i), that considers the full range of impacts to the consumer, manufacturer, Nation, and environment. The results of that analysis serve as the basis for DOE to definitively evaluate the economic justification for a potential standard level, thereby supporting or rebutting the results of any preliminary determination of economic justification.

TABLE V–25—REBUTTABLE-PRESUMPTION PAYBACK PERIODS

Equipment class	Payback period (years)			
	TSL1	TSL2	TSL3	TSL4
ESEM—High and Medium Torque, 0.25 hp	0.4	1.0	3.1	5.8
ESEM—High and Medium Torque, 1 hp	0.6	0.8	2.9	5.4
ESEM—Low Torque, 0.25 hp	0.4	0.7	1.2	1.8
ESEM—Low Torque, 0.5 hp	2.2	1.3	2.3	2.7
ESEM—Polyphase, 0.25 hp	1.0	1.7	3.9	8.3
AO–ESEM—High and Medium Torque, 0.25 hp	0.3	0.6	1.9	3.7
AO–ESEM—High and Medium Torque, 1 hp	0.5	0.7	2.4	4.4
AO–ESEM—Low Torque, 0.25 hp	0.4	0.6	1.1	1.7
AO–ESEM—Low Torque, 0.5 hp	2.0	1.2	2.1	2.5
AO–ESEM—Polyphase, 0.25 hp	0.9	1.5	3.4	7.1

2. Economic Impacts on Manufacturers

DOE performed an MIA to estimate the impact of new energy conservation standards on manufacturers of ESEM. The following section describes 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

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

To evaluate the range of cash flow impacts on the ESEM industry, DOE modeled two manufacturer markup scenarios that correspond to the range of possible market responses to new standards. Each manufacturer markup scenario results in a unique set of cash flows and corresponding INPVs at each TSL.

In the following discussion, the INPV results refer to the difference in industry value between the no-new-standards case and the standards cases that result from the sum of discounted cash flows from the base year (2024) through the end of the analysis period (2058). The results also discuss the difference in cash flows between the no-new standards case and the standards cases in the year before the estimated compliance date for new energy conservation standards. This figure represents the size of the required conversion costs relative to the cash flow generated by the ESEM industry in the absence of new energy conservation standards.

To assess the upper (less severe) end of the range of potential impacts on ESEM manufacturers, DOE modeled a preservation of gross margin scenario. This scenario assumes that, in the standards cases, ESEM manufacturers will be able to pass along all the higher MPCs required for more efficient equipment to their customers. Specifically, the industry will be able to maintain its average no-new-standards case gross margin (as a percentage of revenue) despite the higher MPCs in the standards cases. In general, the larger the MPC increases, the less likely manufacturers are to achieve the cash flow from operations calculated in this scenario because it is less likely that manufacturers will be able to fully pass on these larger production cost increases.

To assess the lower (more severe) end of the range of potential impacts on the ESEM manufacturers, DOE modeled a preservation of operating profit scenario. This scenario represents the lower end of the range of impacts on manufacturers because no additional operating profit is earned on the higher MPCs, eroding profit margins as a percentage of total revenue.

TABLE V–26—INDUSTRY NET PRESENT VALUE FOR ESEM MANUFACTURERS—PRESERVATION OF GROSS MARGIN SCENARIO

	Units	No-new-standards case	Trial standard level *			
			1	2	3	4
INPV	*2022$ millions*	2,019	1,883	1,888	1,820	1,710
Change in INPV	*2022$ millions*		(136)	(131)	(199)	(309)
	%		(6.7)	(6.5)	(9.9)	(15.3)

* Numbers may not sum exactly due to rounding. Numbers in parentheses are negative numbers.

TABLE V–27—INDUSTRY NET PRESENT VALUE FOR ESEM MANUFACTURERS—PRESERVATION OF OPERATING PROFIT SCENARIO

	Units	No-new-standards case	Trial standard level *			
			1	2	3	4
INPV	*2022$ millions*	2,019	1,818	1,755	1,035	73
Change in INPV	*2022$ millions*		(201)	(264)	(984)	(1,946)
	%		(9.9)	(13.1)	(48.7)	(96.4)

* Numbers may not sum exactly due to rounding. Numbers in parentheses are negative numbers.

TABLE V–28—CASH FLOW ANALYSIS FOR ESEM MANUFACTURERS

	Units	No-new-standards case	Trial standard level *			
			1	2	3	4
Free Cash Flow (2028)	2022$ millions	154	45	17	(313)	(764)
Change in Free Cash Flow (2028)	2022$ millions		(110)	(137)	(468)	(919)
	%		(71)	(89)	(303)	(595)
Product Conversion Costs	2022$ millions		125	141	326	572
Capital Conversion Costs	2022$ millions		149	198	792	1,584
Total Conversion Costs	2022$ millions		274	339	1,118	2,156

* Numbers may not sum exactly due to rounding. Numbers in parentheses are negative numbers.

TSL 4 sets the efficiency level at EL 4 for all ESEM equipment classes. At TSL 4, DOE estimates the impacts to INPV will range from a decrease of $1,946 million to a decrease of $309 million, which represents decreases to INPV by approximately 96.4 percent and 15.3 percent, respectively. At TSL 4, industry free cash flow (operating cash flow minus capital expenditures) is estimated to decrease to −$764 million, or a drop of 595 percent, compared to the no-new-standards case value of $154 million in 2028, the year leading up to the compliance date of new energy conservation standards. The significantly negative free cash flow in the years leading up to the compliance date implies that most, if not all, ESEM manufacturers will need to borrow funds in order to make the investments necessary to comply with standards at TSL 4. This has the potential to significantly alter the market dynamics as some smaller ESEM manufacturers may not be able to secure this funding and could exit the market as a result of standards set at TSL 4.

In the absence of new energy conservation standards, DOE estimates that less than 1 percent of ESEM (High/Med Torque), no ESEM (Low Torque), less than 1 percent of ESEM (Polyphase), 6 percent of AO–ESEM (High/Med Torque), no AO–ESEM (Low Torque), and no AO–ESEM (Polyphase) shipments will meet the ELs required at TSL 4 in 2029, the compliance year of new standards. Therefore, DOE estimates that manufacturers will have to redesign models representing over 99 percent of all ESEM shipments by the compliance date. It is unclear if most ESEM manufacturers would have the engineering capacity to complete the necessary redesigns within the 4-year compliance period. If manufacturers require more than 4 years to redesign their non-compliant ESEM models, they will likely prioritize redesigns based on sales volume, which could result in customers not being able to obtain compliant ESEMs covering the entire range of horsepower and motor configurations that they require.

Almost all ESEMs covered by this rulemaking will need to be redesigned at TSL 4. Therefore, DOE estimates that manufacturers will have to make significant investments in their manufacturing production equipment and the engineering resources dedicated to redesigning ESEM models. DOE estimates that manufacturers will incur approximately $572 million in product conversion costs and approximately $1,584 million in capital conversion costs. Product conversion costs include the engineering time to redesign almost all ESEM models and to re-test these newly redesigned models to meet the standards set at TSL 4. Capital conversion costs include the purchase of almost all new lamination die sets, winding machines, frame casts, and assembly equipment as well as other retooling costs to accommodate almost all ESEM models covered by this proposed rulemaking that will need to be redesigned.

At TSL 4, under the preservation of gross margin scenario, the shipment weighted average MPC significantly increases by approximately 117.7 percent relative to the no-new-standards case MPC. While this price increase results in additional revenue for manufacturers, the $2,156 million in total conversion costs estimated at TSL 4 outweighs this increase in manufacturer revenue and results in moderately negative INPV impacts at TSL 4 under the preservation of gross margin scenario.

Under the preservation of operating profit scenario, manufacturers earn the same nominal operating profit as would be earned in the no-new-standards case, but manufacturers do not earn additional profit from their investments. The significant increase in the shipment weighted average MPC results in a lower average manufacturer margin. This lower average manufacturer margin and the significant $2,156 million in total conversion costs result in significantly negative INPV impacts at TSL 4 under the preservation of operating profit scenario.

TSL 3 sets the efficiency level at EL 3 for all ESEM equipment classes. At TSL 3, DOE estimates the impacts to INPV will range from a decrease of $984 million to a decrease of $199 million, which represents decreases to INPV by approximately 48.7 percent and 9.9 percent, respectively. At TSL 3, industry free cash flow is estimated to decrease to −$313 million, or a drop of 303 percent, compared to the no-new-standards case value of $154 million in 2028, the year leading up to the compliance date of new energy conservation standards. The negative free cash flow in the years leading up to the compliance date implies that most, if not all, ESEM manufacturers will need to borrow funds in order to make the investments necessary to comply with standards. This has the potential to significantly alter the market dynamics as some smaller ESEM manufacturers may not be able to secure this funding and could exit the market as a result of standards set at TSL 3.

In the absence of new energy conservation standards, DOE estimates that 8 percent of ESEM (High/Med Torque), 8 percent of ESEM (Low Torque), 14 percent of ESEM (Polyphase), 15 percent of AO–ESEM (High/Med Torque), 11 percent of AOESEM (Low Torque), and 3 percent of AO–ESEM (Polyphase) shipments will meet or exceed the ELs requires at TSL 3 in 2029, the compliance year of new standards. Therefore, DOE estimates that manufacturers will have to redesign models representing approximately 91 percent of all ESEM shipments by the compliance date. It is unclear if most ESEM manufacturers would have the engineering capacity to complete the necessary redesigns within the 4-year compliance period. If manufacturers require more than 4 years to redesign their non-compliant ESEM models, they will likely prioritize redesigns based on sales volume, which could result in customers not being able to obtain compliant ESEMs covering the entire range of horsepower and motor configurations that they require.

The majority of ESEMs covered by this rulemaking will need to be redesigned at TSL 3. Therefore, DOE estimates that manufacturers will have to make significant investments in their manufacturing production equipment and the engineering resources dedicated to redesigning ESEM models. DOE estimates that manufacturers will incur approximately $326 million in product conversion costs and approximately $792 million in capital conversion costs. Product conversion costs include the engineering time to redesign approximately 91 percent of all ESEM models and to re-test these newly redesigned models to meet the standards set at TSL 3. Capital conversion costs include the purchase of almost all new lamination die sets, winding machines, frame casts, and assembly equipment as well as other retooling costs for approximately 91 percent of all ESEM models covered by this proposed rulemaking.

At TSL 3, under the preservation of gross margin scenario, the shipment weighted average MPC significantly increases by approximately 56.4 percent relative to the no-new-standards case MPC. While this price increase results in additional revenue for manufacturers, the $1,118 million in total conversion costs estimated at TSL 3 outweighs this increase in manufacturer revenue and results in moderately negative INPV impacts at TSL 3 under the preservation of gross margin scenario.

Under the preservation of operating profit scenario, manufacturers earn the same nominal operating profit as would be earned in the no-new-standards case, but manufacturers do not earn additional profit from their investments. The significant increase in the shipment weighted average MPC results in a lower average manufacturer margin. This lower average manufacturer margin and the significant $1,118 million in total conversion costs result in significantly negative INPV impacts at TSL 3 under the preservation of operating profit scenario.

TSL 2 sets the efficiency level at EL 2 for all ESEM equipment classes, which is the recommended level from the December 2022 Joint Recommendation. At TSL 2, DOE estimates the impacts to INPV will range from a decrease of $264 million to a decrease of $131 million, which represents decreases to INPV by approximately 13.1 percent and 6.5 percent, respectively. At TSL 2, industry free cash flow is estimated to decrease to $17 million, or a drop of 89 percent, compared to the no-new-standards case value of $154 million in 2028, the year leading up to the compliance date of new energy conservation standards.

In the absence of new energy conservation standards, DOE estimates that 22 percent of ESEM (High/Med Torque), 45 percent of ESEM (Low Torque), 67 percent of ESEM (Polyphase), 34 percent of AO–ESEM (High/Med Torque), 67 percent of AO–ESEM (Low Torque), and 36 percent of AO–ESEM (Polyphase) shipments will meet or exceed the ELs requires at TSL 2 in 2029, the compliance year of new standards. Therefore, DOE estimates that manufacturers will have to redesign models representing approximately 55 percent of all ESEM shipments by the compliance date.

DOE estimates that manufacturers will incur approximately $141 million in product conversion costs and approximately $198 million in capital conversion costs. Product conversion costs primarily include engineering time to redesign non-compliance ESEM models and to re-test these newly redesigned models to meet the standards set at TSL 2. Capital conversion costs include the purchase of lamination die sets, winding machines, frame casts, and assembly equipment as well as other retooling costs for all non-compliant ESEM models covered by this proposed rulemaking.

At TSL 2, under the preservation of gross margin scenario, the shipment weighted average MPC increases by approximately 9.6 percent relative to the no-new-standards case MPC. While this price increase results in additional revenue for manufacturers, the $339 million in total conversion costs estimated at TSL 2 outweighs this increase in manufacturer revenue and results in moderately negative INPV impacts at TSL 2 under the preservation of gross margin scenario.

Under the preservation of operating profit scenario, manufacturers earn the same nominal operating profit as would be earned in the no-new-standards case, but manufacturers do not earn additional profit from their investments. The increase in the shipment weighted average MPC results in a slightly lower average manufacturer margin. This lower average manufacturer margin and the $339 million in total conversion costs result in moderately negative INPV impacts at TSL 2 under the preservation of operating profit scenario.

TSL 1 sets the efficiency level at EL 1 for all ESEM equipment classes. At TSL 1, DOE estimates the impacts to INPV will range from a decrease of $201 million to a decrease of $136 million, which represents decreases to INPV by approximately 9.9 percent and 6.7 percent, respectively. At TSL 1, industry free cash flow is estimated to decrease to $45 million, or a drop of 71 percent, compared to the no-new-standards case value of $154 million in 2028, the year leading up to the compliance date of new energy conservation standards.

In the absence of new energy conservation standards, DOE estimates that 68 percent of ESEM (High/Med Torque), 66 percent of ESEM (Low Torque), 90 percent of ESEM (Polyphase), 70 percent of AO–ESEM (High/Med Torque), 92 percent of AO–ESEM (Low Torque), and 62 percent of AO–ESEM (Polyphase) shipments will meet or exceed the ELs requires at TSL 1 in 2029, the compliance year of new standards. Therefore, DOE estimates that manufacturers will have to redesign models representing approximately 26 percent of all ESEM shipments by the compliance date.

DOE estimates that manufacturers will incur approximately $125 million in product conversion costs and approximately $149 million in capital conversion costs. Product conversion costs primarily include engineering time to redesign non-compliance ESEM models and to re-test these newly redesigned models to meet the standards set at TSL 1. Capital conversion costs include the purchase of lamination die sets, winding machines, frame casts, and assembly equipment, as well as other retooling costs for all non-compliant ESEM models covered by this proposed rulemaking.

At TSL 1, under the preservation of gross margin scenario, the shipment weighted average MPC increases slightly by approximately 4.7 percent relative to the no-new-standards case MPC. While this price increase results in additional revenue for manufacturers, the $274 million in total conversion costs estimated at TSL 1 outweighs this increase in manufacturer revenue and results in moderately negative INPV impacts at TSL 1 under the preservation of gross margin scenario.

Under the preservation of operating profit scenario, manufacturers earn the same nominal operating profit as would be earned in the no-new-standards case, but manufacturers do not earn additional profit from their investments. The increase in the shipment weighted average MPC results in a slightly lower average manufacturer margin. This lower average manufacturer margin and the $274 million in total conversion costs result in moderately negative INPV impacts at TSL 1 under the preservation of operating profit scenario.

b. Direct Impacts on Employment

To quantitatively assess the potential impacts of new energy conservation standards on direct employment in the ESEM industry, DOE used the GRIM to estimate the domestic labor expenditures and number of direct employees in the no-new-standards case and in each of the standards cases during the analysis period.

DOE used statistical data from the U.S. Census Bureau's 2021 Annual Survey of Manufacturers (''ASM''), 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 involved with the manufacturing of ESEMs 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.

In the GRIM, DOE used the labor content of each piece of equipment and the MPCs to estimate the annual labor expenditures of the industry. DOE used Census data and interviews with manufacturers to estimate the portion of the total labor expenditures attributable to domestic labor.

The production worker estimates in this employment section cover only workers up to the line-supervisor level who are directly involved in fabricating and assembling ESEMs within a motor facility. Workers performing services that are closely associated with production operations, such as material handling with a forklift, are also included as production labor. DOE's estimates account for only production workers who manufacture the specific equipment covered by this proposed rulemaking.

The employment impacts shown in Table V–29 represent the potential production employment impacts resulting from new energy conservation standards. The upper bound of the results estimates the maximum change in the number of production workers that could occur after compliance with new energy conservation standards when assuming that manufacturers continue to produce the same scope of covered equipment in the same production facilities. It also assumes that domestic production does not shift to lower-labor-cost countries. Because there is a real risk of manufacturers evaluating sourcing decisions in response to new energy conservation standards, the lower bound of the employment results includes the estimated total number of U.S. production workers in the industry who could lose their jobs if some existing ESEM production was moved outside of the U.S. While the results present a range of employment impacts following 2029, this section also includes qualitative discussions of the likelihood of negative employment impacts at the various TSLs. Finally, the employment impacts shown are independent of the indirect employment impacts from the broader U.S. economy, which are documented in chapter 16 of the NOPR TSD.

Based on 2021 ASM data and interviews with manufacturers, DOE estimates approximately 15 percent of ESEMs covered by this proposed rulemaking sold in the U.S. are manufactured domestically. Using this assumption, DOE estimates that in the absence of new energy conservation standards, there would be approximately 784 domestic production workers involved in manufacturing all ESEMs covered by this rulemaking in 2029. Table V–29 shows the range of potential impacts of new energy conservation standards on U.S. production workers involved in the production of ESEMs covered by this rulemaking.

TABLE V–29—POTENTIAL CHANGE IN THE NUMBER OF DOMESTIC ESEM WORKERS

	No-new-standards case	Trail standard level			
		1	2	3	4
Domestic Production Workers in 2029	784	821	859	1,226	1,706
Domestic Non-Production Workers in 2029	449	470	492	702	977
Total Domestic Employment in 2029	1,233	1,291	1,351	1,928	2,683
Potential Changes in Total Domestic Employment in 2029 *	....	58–(37)	118–(75)	695–(442)	1,450–(784)

* DOE presents a range of potential impacts. Numbers in parentheses indicate negative values.

At the upper end of the range, all examined TSLs show an increase in the number of domestic production workers for ESEMs. The upper end of the range represents a scenario where manufacturers increase production hiring due to the increase in the labor associated with adding the required components and additional labor (*e.g.,* hand winding, etc.) to make more efficient ESEMs. However, as previously stated, this assumes that in addition to hiring more production employees, all existing domestic production would remain in the United States and not shift to lower labor-cost countries.

At the lower end of the range, all examined TSLs show a decrease in domestic production employment. The lower end of the domestic employment range assumes that some, or all, ESEM domestic production employment may shift to lower labor-cost countries in response to energy conservation standards. DOE estimates that approximately 85 percent of all ESEMs sold in the U.S. are manufactured abroad. At max-tech, TSL 4, DOE conservatively estimates that the remaining 15 percent of domestic production could shift to foreign production locations. DOE estimated this lower bound potential change in domestic employment based on the percent change in the MPC at each TSL.[96]

[96] Except for TSL 4, which has an MPC increase of higher than 100 percent. Therefore, DOE assumes all domestic employment moves abroad at this TSL.

c. Impacts on Manufacturing Capacity

The December 2022 Joint Recommendation stated that standards set at EL 2 for the ESEM High/Med Torque equipment class would minimize potential market disruptions by allowing CSIR and split-phase topologies to remain on the market, but only at smaller (0.25–0.5 hp) horsepower ratings. (Electric Motors Working Group, No. 38 at p. 3) The December 2022 Joint Recommendation also stated that standards set at EL 2 for the ESEM Low Torque equipment class would not create widespread market disruptions and that standards set at higher ELs could result in significant increases in the physical size, unavailability of product, and in some cases, may be extremely difficult to achieve with current PSC technology. (*Id.*)

Many ESEM manufacturers do not offer any ESEM models that would meet max-tech levels or one EL below max-tech (*i.e.,* TSL 4 and TSL 3, respectively). Based on the shipments analysis used in the NIA, DOE estimates that less than one percent and 9 percent of all ESEM shipments will meet max-tech and one EL below max-tech, respectively, in the no-new-standards case in 2029, the compliance year of new standards. Therefore, at TSL 4 and TSL 3, DOE estimates that manufacturers will have to redesign models representing over 99 percent and 91 percent, respectively, of all ESEM shipments by the compliance date. It is unclear if any ESEM manufacturers would have the engineering capacity to complete the necessary redesigns within the 4-year compliance period. If manufacturers require more than 4 years to redesign their non-compliant ESEM models, they will likely prioritize redesigns based on sales volume, which could result in customers not being able to obtain compliant ESEMs covering the entire range of horsepower and motor configurations that they require.

Lastly, during manufacturer interviews, most manufacturers stated they would not be able to provide a full portfolio of any ESEM equipment class for any standards that would be met using copper rotors. In DOE's engineering analysis, all representative units, except the ESEM—Low Torque, 0.5 hp and AO–ESEM—Low Torque, 0.5 hp representative units, are modeled to use copper rotors at the max-tech efficiency design (*i.e.,* EL 4). No other lower ELs are modeled to use die-cast copper rotors. Most manufacturers stated that they do not currently have the machinery, technology, or engineering resources to produce copper rotors in-house. Some manufacturers claim that the few manufacturers that do have the capability of producing copper rotors are not able to produce these motors in volumes sufficient to fulfill all shipments of that equipment class and would not be able to ramp up those production volumes over the four-year compliance period. For manufacturers to either completely redesign their motor production lines or significantly expand their very limited copper rotor production line would require a massive retooling and engineering effort, which could take more than a decade to complete. Most manufacturers stated they would have to outsource copper rotor production because they would not be able to modify their facilities and production processes to produce copper rotors in-house within a four-year time period. Most manufacturers agreed that outsourcing rotor die casting would constrain capacity by creating a bottleneck in rotor production, as there are very few companies that produce copper rotors.

Manufacturers also pointed out that there is substantial uncertainty surrounding the global availability and price of copper, which has the potential to constrain capacity. Several manufacturers expressed concern that the combination of all of these factors would make it impossible to support existing customers while redesigning equipment lines and retooling.

DOE estimates there is a strong likelihood of manufacturer capacity constraints in the near term for any standards that would likely require the use of copper rotors for any equipment classes both due to the uncertainty of the global supply of copper and due to the quantity of machinery that would need to be purchased and the engineering resources that would be required to produce copper rotors. Therefore, there could be significant market disruption for any standards set at EL 4 for any equipment class, except for the ESEM—Low Torque, 0.25–3 hp and the AO–ESEM—Low Torque, 0.25–3 hp equipment classes.

d. Impacts on Subgroups of Manufacturers

Using average cost assumptions to develop an industry cash-flow estimate may not be adequate for assessing differential impacts among manufacturer subgroups. Small manufacturers, niche equipment manufacturers, and manufacturers exhibiting cost structures substantially different from the industry average could be affected disproportionately. DOE discusses the impacts on small businesses in section VI.B of this document and did not identify any other adversely impacted ESEM-related manufacturer subgroups for this proposed rulemaking based on the results of the industry characterization.

e. Cumulative Regulatory Burden

One aspect of assessing manufacturer burden involves looking at the cumulative impact of multiple DOE standards and the product-specific regulatory actions of other Federal agencies that affect the manufacturers of a covered product or equipment. While any one regulation may not impose a significant burden on manufacturers, the combined effects of several existing or impending regulations may have serious consequences for some manufacturers, groups of manufacturers, or an entire industry. 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 equipment 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. DOE requests information regarding the impact of cumulative regulatory burden on manufacturers of ESEMs associated with multiple DOE standards or product-specific regulatory actions of other Federal agencies.

DOE evaluates product-specific regulations that will take effect approximately 3 years before or after the 2029 compliance date of any new energy conservation standards for ESEMs. This information is presented in Table V.30.

TABLE V.30—COMPLIANCE DATES AND EXPECTED CONVERSION EXPENSES OF FEDERAL ENERGY CONSERVATION STANDARDS AFFECTING ESEM MANUFACTURERS

Federal energy conservation standard	Number of mfrs *	Number of manufacturers affected from this rule **	Approx. standards year	Industry conversion costs (millions)	Industry conversion costs/product revenue *** (%)
Dedicated-Purpose Pool Pump Motors 88 FR 66966 (Sep. 28, 2023)	5	5	2026 & 2028	$56.2 (2022$)	5.1
Distribution Transformer 88 FR 1722 (Jan. 11, 2023) †	27	6	2027	$343 (2021$)	2.7

TABLE V.30—COMPLIANCE DATES AND EXPECTED CONVERSION EXPENSES OF FEDERAL ENERGY CONSERVATION STANDARDS AFFECTING ESEM MANUFACTURERS—Continued

Federal energy conservation standard	Number of mfrs *	Number of manufacturers affected from this rule **	Approx. standards year	Industry conversion costs (millions)	Industry conversion costs/product revenue *** (%)
Electric Motors 88 FR 36066 (Jun. 1, 2023)	74	74	2027	$468 (2021$)	2.6

* This column presents the total number of manufacturers identified in the energy conservation standard rule contributing to cumulative regulatory burden.
** This column presents the number of manufacturers producing ESEMs that are also listed as manufacturers in the listed energy conservation standard contributing to cumulative regulatory burden.
*** This column presents industry conversion costs as a percentage of product revenue during the conversion period. Industry conversion costs are the upfront investments manufacturers must make to sell compliant products/equipment. The revenue used for this calculation is the revenue from just the covered product/equipment associated with each row. The conversion period is the time frame over which conversion costs are made and lasts from the publication year of the final rule to the compliance year of the energy conservation standard. The conversion period typically ranges from 3 to 5 years, depending on the rulemaking.
† Indicates a proposed rulemaking. Final values may change upon the publication of a final rule.

In response to the March 2022 Preliminary Analysis, the Joint Stakeholders commented that regulating motors that are components significantly increases the burden on manufacturers if all products using special and definite purpose motors were suddenly forced to certify compliance with standards for component parts, including the testing, paperwork, and record-keeping requirements that accompany certification. (Joint Stakeholders, No. 23 at p. 5) As stated in section II.A and section IV.A.1 of this document, EPCA, as amended through EISA 2007, provides DOE with the authority to regulate the expanded scope of motors addressed in this rule, whether those electric motors are manufactured alone or as a component of another piece of equipment. DOE believes this ESEM proposed rulemaking would not impact manufacturers of consumer products. For commercial equipment, DOE identified the following equipment as potentially incorporating ESEMs: walk-in coolers and freezers, circulator pumps, air circulating fans, and commercial unitary air conditioning equipment. If the proposed energy conservation standards for these rules finalize as proposed, DOE identified that these rules would all: (1) have a compliance year that is at or before the ESEM standard compliance year (2029) and/or (2) require a motor that is either outside of the scope of ESEM (*e.g.,* an ECM) or an ESEM with an efficiency above the proposed ESEM standards, and therefore would not be impacted by this ESEM proposed rulemaking (*i.e.,* the ESEM rule would not trigger a redesign of these equipment).

3. National Impact Analysis

This section presents DOE's estimates of the national energy savings and the NPV of consumer benefits that would result from each of the TSLs considered as potential new standards.

a. Significance of Energy Savings

To estimate the energy savings attributable to potential new standards for ESEMs, DOE compared their energy consumption under the no-new-standards case to their anticipated energy consumption under each TSL. The savings are measured over the entire lifetime of products purchased in the 30-year period that begins in the year of anticipated compliance with new standards (2029–2058). Table V–31 presents DOE's projections of the national energy savings for each TSL considered for ESEMs. The savings were calculated using the approach described in section IV.H.2 of this document.

TABLE V–31—CUMULATIVE NATIONAL ENERGY SAVINGS FOR ESEMS; 30 YEARS OF SHIPMENTS
[2029–2058]

	Trial standard level			
	1	2	3	4
	(Quads)			
Primary energy	3.0	8.7	16.5	23.6
FFC energy	3.1	8.9	17.0	24.2

OMB Circular A–4 [97] requires agencies to present analytical results, including separate schedules of the monetized benefits and costs that show the type and timing of benefits and costs. Circular A–4 also directs agencies to consider the variability of key elements underlying the estimates of benefits and costs. For this NOPR, DOE undertook a sensitivity analysis using 9 years, rather than 30 years, of equipment shipments. The choice of a 9-year period is a proxy for the timeline in EPCA for the review of certain energy conservation standards and potential revision of and compliance with such revised standards.[98] The review

[97] U.S. Office of Management and Budget. *Circular A–4: Regulatory Analysis.* September 17, 2003. *http://obamawhitehouse.archives.gov/omb/circulars_a004_a-4* (last accessed May 1, 2023).

[98] EPCA requires DOE to review its standards at least once every 6 years, and requires, for certain products, a 3-year period after any new standard is promulgated before compliance is required, except that in no case may any new standards be required within 6 years of the compliance date of the previous standards. (42 U.S.C. 6316(a); 42 U.S.C. 6295(m)) While adding a 6-year review to the 3-year compliance period adds up to 9 years, DOE notes that it may undertake reviews at any time within the 6-year period and that the 3-year compliance date may yield to the 6-year backstop. A 9-year

timeframe established in EPCA is generally not synchronized with the equipment lifetime, equipment manufacturing cycles, or other factors specific to ESEMs. Thus, such results are presented for informational purposes only and are not indicative of any change in DOE's analytical methodology. The NES sensitivity analysis results based on a 9-year analytical period are presented in Table V–32. The impacts are counted over the lifetime of ESEMs purchased in 2029–2037.

TABLE V–32—CUMULATIVE NATIONAL ENERGY SAVINGS FOR ESEMS; 9 YEARS OF SHIPMENTS
[2029–2037]

	Trial standard level			
	1	2	3	4
	(Quads)			
Primary energy	0.8	2.4	4.5	6.4
FFC energy	0.8	2.4	4.6	6.6

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 ESEMs. In accordance with OMB's guidelines on regulatory analysis,[99] DOE calculated NPV using both a 7-percent and a 3-percent real discount rate. Table V–33 shows the consumer NPV results with impacts counted over the lifetime of equipment purchased in 2029–2058.

TABLE V–33—CUMULATIVE NET PRESENT VALUE OF CONSUMER BENEFITS FOR ESEMS; 30 YEARS OF SHIPMENTS
[2029–2058]

Discount rate	Trial standard level			
	1	2	3	4
	(billion 2022$)			
3 percent	14.0	45.0	50.4	36.8
7 percent	6.4	21.0	21.0	11.2

The NPV results based on the aforementioned 9-year analytical period are presented in Table V–34. The impacts are counted over the lifetime of equipment purchased in 2029–2037. As mentioned previously, such results are presented for informational purposes only and are not indicative of any change in DOE's analytical methodology or decision criteria.

TABLE V–34—CUMULATIVE NET PRESENT VALUE OF CONSUMER BENEFITS FOR ESEMS; 9 YEARS OF SHIPMENTS
[2029–2037]

Discount rate	Trial standard level			
	1	2	3	4
	(billion 2022$)			
3 percent	5.1	16.3	18.1	12.9
7 percent	3.2	10.3	10.1	5.2

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

c. Indirect Impacts on Employment

DOE estimates that new energy conservation standards for ESEMs will reduce energy expenditures for consumers of those equipment, with the resulting net savings being redirected to other forms of economic activity. These expected shifts in spending and economic activity could affect the demand for labor. As described in section IV.N of this document, DOE used an input/output model of the U.S. economy to estimate indirect

analysis period may not be appropriate given the variability that occurs in the timing of standards reviews and the fact that for some products, the compliance period is 5 years rather than 3 years.

[99] U.S. Office of Management and Budget. *Circular A–4: Regulatory Analysis.* September 17, 2003. *obamawhitehouse.archives.gov/omb/circulars_a004_a-4* (last accessed July 1, 2021).

employment impacts of the TSLs that DOE considered. There are uncertainties involved in projecting employment impacts, especially changes in the later years of the analysis. Therefore, DOE generated results for near-term timeframes (2029–2034), where these uncertainties are reduced.

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

4. Impact on Utility or Performance of Products

As discussed in section IV.C.1.c of this document, DOE has tentatively concluded that the standards proposed in this NOPR would not lessen the utility or performance of the ESEMs under consideration in this proposed rulemaking. Manufacturers of these products currently offer units that meet or exceed the proposed standards.

5. Impact of Any Lessening of Competition

DOE considered any lessening of competition that would be likely to result from new or amended standards. As discussed in section III.F.1.e of this document, 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. To assist the Attorney General in making this determination, DOE has provided DOJ with copies of this NOPR and the accompanying NOPR TSD for review. DOE will consider DOJ's comments on the proposed rule in determining whether to proceed to a final rule. DOE will publish and respond to DOJ's comments in that document. DOE invites comment from the public regarding the competitive impacts that are likely to result from this proposed rule. In addition, stakeholders may also provide comments separately to DOJ regarding these potential impacts. See the **ADDRESSES** section for information to send comments to DOJ.

6. Need of the Nation To Conserve Energy

Enhanced energy efficiency, where economically justified, improves the Nation's energy security, strengthens the economy, and reduces the environmental impacts (costs) of energy production. Reduced electricity demand due to energy conservation standards is also likely to reduce the cost of maintaining the reliability of the electricity system, particularly during peak-load periods. Chapter 15 in the NOPR TSD presents the estimated impacts on electricity generating capacity, relative to the no-new-standards case, for the TSLs that DOE considered in this proposed rulemaking.

Energy conservation resulting from potential energy conservation standards for ESEMs is expected to yield environmental benefits in the form of reduced emissions of certain air pollutants and greenhouse gases. Table V–35 provides DOE's estimate of cumulative emissions reductions expected to result from the TSLs considered in this NOPR. The emissions were calculated using the multipliers discussed in section IV.L of this document. DOE reports annual emissions reductions for each TSL in chapter 13 of the NOPR TSD.

TABLE V–35—CUMULATIVE EMISSIONS REDUCTION FOR ESEMS SHIPPED IN 2029–2058

	Trial standard level			
	1	2	3	4
Electric Power Sector Emissions				
CO_2 (*million metric tons*)	50.0	145.6	277.6	397.2
CH_4 (*thousand tons*)	3.4	10.0	19.2	27.5
N_2O (*thousand tons*)	0.5	1.4	2.6	3.8
SO_2 (*thousand tons*)	23.3	67.8	129.6	185.6
NO_X (*thousand tons*)	14.7	42.9	82.6	118.6
Hg (*tons*)	0.1	0.3	0.6	0.8
Upstream Emissions				
CO_2 (*million metric tons*)	5.1	14.9	28.4	40.6
CH_4 (*thousand tons*)	464.2	1,352.2	2,574.8	3,682.0
N_2O (*thousand tons*)	0.0	0.1	0.1	0.2
SO_2 (*thousand tons*)	79.6	232.0	441.7	631.7
NO_X (*thousand tons*)	0.3	0.9	1.7	2.5
Hg (*tons*)	0.0	0.0	0.0	0.0
Total FFC Emissions				
CO_2 (*million metric tons*)	55.1	160.5	306.0	437.8
CH_4 (*thousand tons*)	467.6	1,362.2	2,593.9	3,709.4
N_2O (*thousand tons*)	0.5	1.4	2.8	4.0
SO_2 (*thousand tons*)	102.9	299.8	571.3	817.3
NO_X (*thousand tons*)	15.0	43.8	84.3	121.1
Hg (*tons*)	0.1	0.3	0.6	0.8

As part of the analysis for this rulemaking, DOE estimated monetary benefits likely to result from the reduced emissions of CO_2 that DOE estimated for each of the considered TSLs for ESEMs. Section IV.L of this document discusses the SC–CO_2 values that DOE used. Table V–36 presents the value of CO_2 emissions reduction at each TSL for each of the SC–CO_2 cases. The time-series of annual values is presented for the proposed TSL in chapter 14 of the NOPR TSD.

TABLE V–36—PRESENT VALUE OF CO_2 EMISSIONS REDUCTION FOR ESEMS SHIPPED IN 2029–2058

TSL	SC–CO_2 case			
	Discount rate and statistics			
	5% Average	3% Average	2.5% Average	3% 95th percentile
	(billion 2022$)			
1	0.61	2.55	3.95	7.76
2	1.79	7.43	11.52	22.59
3	3.42	14.18	21.97	43.10
4	4.89	20.29	31.43	61.67

As discussed in section IV.L.2 of this document, DOE estimated the climate benefits likely to result from the reduced emissions of methane and N_2O that DOE estimated for each of the considered TSLs for ESEMs. Table V–37 presents the value of the CH_4 emissions reduction at each TSL, and Table V–38 presents the value of the N_2O emissions reduction at each TSL. The time-series of annual values is presented for the proposed TSL in chapter 14 of the NOPR TSD.

TABLE V–37—PRESENT VALUE OF METHANE EMISSIONS REDUCTION FOR ESEMS SHIPPED IN 2029–2058

TSL	SC–CH_4 case			
	Discount rate and statistics			
	5% Average	3% Average	2.5% Average	3% 95th percentile
	(billion 2022$)			
1	0.24	0.68	0.94	1.80
2	0.69	1.99	2.75	5.26
3	1.32	3.79	5.24	10.01
4	1.88	5.42	7.49	14.32

TABLE V–38—PRESENT VALUE OF NITROUS OXIDE EMISSIONS REDUCTION FOR ESEMS SHIPPED IN 2029–2058

TSL	SC–N_2O case			
	Discount rate and statistics			
	5% Average	3% Average	2.5% Average	3% 95th percentile
	(billion 2022$)			
1	0.002	0.008	0.012	0.022
2	0.006	0.024	0.036	0.063
3	0.012	0.045	0.070	0.121
4	0.017	0.065	0.100	0.173

DOE is well aware that scientific and economic knowledge about the contribution of CO_2 and other GHG emissions to changes in the future global climate and the potential resulting damages to the global and U.S. economy continues to evolve rapidly. DOE, together with other Federal agencies, will continue to review methodologies for estimating the monetary value of reductions in CO_2 and other GHG emissions. This ongoing review will consider the comments on this subject that are part of the public record for this and other rulemakings, as well as other methodological assumptions and issues. DOE notes that the proposed standards would be economically justified even without inclusion of monetized benefits of reduced GHG emissions.

DOE also estimated the monetary value of the health benefits associated with NO_X and SO_2 emissions reductions anticipated to result from the considered TSLs for ESEMs. The dollar-per-ton values that DOE used are discussed in section IV.L of this document. Table V–39 presents the present value for NO_X emissions reduction for each TSL calculated using 7-percent and 3-percent discount rates, and Table V–40 presents similar results for SO_2 emissions reductions. The results in these tables reflect application of EPA's low dollar-per-ton values, which DOE used to be conservative. The time-series of annual values is presented for the proposed TSL in chapter 14 of the NOPR TSD.

TABLE V–39—PRESENT VALUE OF NO_X EMISSIONS REDUCTION FOR ESEMS SHIPPED IN 2029–2058

TSL	7% Discount rate	3% Discount rate
	(million 2022$)	
1	2,249.3	5,221.7
2	6,551.5	15,211.6
3	12,497.5	29,002.1
4	17,883.3	41,492.7

TABLE V–40—PRESENT VALUE OF SO_2 EMISSIONS REDUCTION FOR ESEMS SHIPPED IN 2029–2058

TSL	3% Discount rate	7% Discount rate
	(million 2022$)	
1	467.5	1,065.7
2	1,362.5	3,106.6
3	2,624.4	5,981.4
4	3,767.9	8,586.2

Not all the public health and environmental benefits from the reduction of greenhouse gases, NO_X, and SO_2 are captured in the values above, and additional unquantified benefits from the reductions of those pollutants as well as from the reduction of direct PM and other co-pollutants may be significant. DOE has not included monetary benefits of the reduction of Hg emissions because the amount of reduction is very small.

7. Other Factors

The Secretary of Energy, in determining whether a standard is economically justified, may consider any other factors that the Secretary deems to be relevant. (42 U.S.C. 6316(a); 42 U.S.C. 6295(o)(2)(B)(i)(VII)) No other factors were considered in this analysis.

8. Summary of Economic Impacts

Table V–41 presents the NPV values that result from adding the estimates of the potential economic benefits resulting from reduced GHG and NO_X and SO_2 emissions to the NPV of consumer benefits calculated for each TSL considered in this proposed rulemaking. The consumer benefits are domestic U.S. monetary savings that occur as a result of purchasing the covered ESEMs and are measured for the lifetime of products shipped in 2029–2058. The climate benefits associated with reduced GHG emissions resulting from the proposed standards are global benefits and are also calculated based on the lifetime of ESEMs shipped in 2029–2058.

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

Category	TSL 1	TSL 2	TSL 3	TSL 4
Using 3% discount rate for Consumer NPV and Health Benefits (billion 2022$)				
5% Average SC–GHG case	21.2	65.8	90.1	93.7
3% Average SC–GHG case	23.6	72.8	103.4	112.7
2.5% Average SC–GHG case	25.2	77.6	112.6	125.9
3% 95th percentile SC–GHG case	29.9	91.2	138.6	163.1
Using 7% discount rate for Consumer NPV and Health Benefits (billion 2022$)				
5% Average SC–GHG case	10.0	31.4	40.8	39.7
3% Average SC–GHG case	12.4	38.3	54.1	58.7
2.5% Average SC–GHG case	14.1	43.2	63.4	71.9
3% 95th percentile SC–GHG case	18.7	56.8	89.3	109.1

C. Conclusion

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

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

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

1. Benefits and Burdens of TSLs Considered for ESEM Standards

Table V–42 and Table V–43 summarize the quantitative impacts estimated for each TSL for ESEMs. The national impacts are measured over the lifetime of ESEMs purchased in the 30-year period that begins in the anticipated year of compliance with new standards (2029–2058). The energy savings, emissions reductions, and value of emissions reductions refer to full-fuel-cycle results. The efficiency levels contained in each TSL are described in section V.A of this document.

TABLE V–42—SUMMARY OF ANALYTICAL RESULTS FOR ESEMS TSLS: NATIONAL IMPACTS

Category	TSL 1	TSL 2	TSL 3	TSL 4
Cumulative FFC National Energy Savings				
Quads	3.1	8.9	17.0	24.2
Cumulative FFC Emissions Reduction				
CO_2 (*million metric tons*)	55.1	160.5	306.0	437.8
CH_4 (*thousand tons*)	467.6	1,362.2	2,593.9	3,709.4
N_2O (*thousand tons*)	0.5	1.4	2.8	4.0
SO_2 (*thousand tons*)	102.9	299.8	571.3	817.3
NO_X (*thousand tons*)	15.0	43.8	84.3	121.1
Hg (*tons*)	0.1	0.3	0.6	0.8
Present Value of Benefits and Costs (*3% discount rate, billion 2022$*)				
Consumer Operating Cost Savings	18.7	54.7	107.0	154.5
Climate Benefits *	3.2	9.4	18.0	25.8
Health Benefits **	6.3	18.3	35.0	50.1
Total Benefits †	28.3	82.4	160.0	230.3
Consumer Incremental Equipment Costs ‡	4.7	9.7	56.7	117.7
Consumer Net Benefits	14.0	45.0	50.4	36.8
Total Net Benefits	23.6	72.8	103.4	112.7
Present Value of Benefits and Costs (*7% discount rate, billion 2022$*)				
Consumer Operating Cost Savings	8.94	26.10	51.09	73.76
Climate Benefits *	3.24	9.45	18.01	25.77
Health Benefits **	2.72	7.91	15.12	21.65
Total Benefits †	14.89	43.46	84.23	121.18
Consumer Incremental Equipment Costs ‡	2.49	5.14	30.12	62.52
Consumer Net Benefits	6.45	20.95	20.98	11.24
Total Net Benefits	12.41	38.31	54.11	58.66

Note: This table presents the costs and benefits associated with ESEMs shipped in 2029–2058. These results include consumer, climate, and health benefits which accrue after 2058 from the products shipped in 2029–2058.

* Climate benefits are calculated using four different estimates of the SC–CO_2, SC–CH_4 and SC–N_2O. Together, these represent the global SC–GHG. For presentational purposes of this table, the climate benefits associated with the average SC–GHG at a 3 percent discount rate are shown; however, DOE emphasizes the importance and value of considering the benefits calculated using all four sets of SC–GHG estimates. To monetize the benefits of reducing GHG emissions, this analysis uses the interim estimates presented in the *Technical Support Document: Social Cost of Carbon, Methane, and Nitrous Oxide Interim Estimates Under Executive Order 13990* published in February 2021 by the IWG.

** Health benefits are calculated using benefit-per-ton values for NO_X and SO_2. DOE is currently only monetizing (for NO_X and SO_2) $PM_{2.5}$ precursor health benefits and (for NO_X) ozone precursor health benefits, but will continue to assess the ability to monetize other effects such as health benefits from reductions in direct $PM_{2.5}$ emissions. The health benefits are presented at real discount rates of 3 and 7 percent. See section IV.L of this document for more details.

† Total and net benefits include consumer, climate, and health benefits. For presentation purposes, total and net benefits for both the 3-percent and 7-percent cases are presented using the average SC–GHG with 3-percent discount rate.

‡ Costs include incremental equipment costs.

TABLE V–43—SUMMARY OF ANALYTICAL RESULTS FOR ESEMS TSLS: MANUFACTURER AND CONSUMER IMPACTS

Category	TSL 1	TSL 2	TSL 3	TSL 4
Manufacturer Impacts				
Industry NPV (*million 2022$*) (No-new-standards case INPV = 2,019).	1,883 to 1,818	1,888 to 1,755	1,820 to 1,035	1,710 to 73.
Industry NPV (*% change*)	(6.7) to (9.9)	(6.5) to (13.1)	(9.9) to (48.7)	(15.3) to (96.4).
Consumer Average LCC Savings (2022$)				
ESEM—High/Medium Torque, 0.25 hp	55.6	51.3	(0.8)	(106.5).
ESEM—High/Medium Torque, 1 hp	116.1	137.7	20.8	(145.2).

TABLE V–43—SUMMARY OF ANALYTICAL RESULTS FOR ESEMS TSLS: MANUFACTURER AND CONSUMER IMPACTS—Continued

Category	TSL 1	TSL 2	TSL 3	TSL 4
ESEM—Low Torque, 0.25 hp	212.8	146.8	24.1	(16.7).
ESEM—Low Torque, 0.5 hp	41.2	99.6	77.8	72.5.
ESEM—Polyphase, 0.25 hp	31.9	26.2	(8.3)	(107.3).
AO–ESEM—High/Medium Torque, 0.25 hp	76.3	82.9	37.4	(61.4).
AO–ESEM—High/Medium Torque, 1 hp	121.9	160.3	37.1	(128.2).
AO–ESEM—Low Torque, 0.25 hp	217.2	121.3	31.6	(13.4)..
AO–ESEM—Low Torque, 0.5 hp	47.6	88.4	50.0	52.4.
AO–ESEM—Polyphase, 0.25 hp	35.1	39.9	12.7	(85.0).
Shipment-Weighted Average *	82.8	101.8	43.6	(9.6).
Consumer Simple PBP (years)				
ESEM—High/Medium Torque, 0.25 hp	0.5	1.5	5.3	10.0.
ESEM—High/Medium Torque, 1 hp	0.7	1.1	4.7	8.7.
ESEM—Low Torque, 0.25 hp	0.4	1.0	3.3	5.0.
ESEM—Low Torque, 0.5 hp	2.4	1.3	2.8	3.3.
ESEM—Polyphase, 0.25 hp	1.1	2.6	7.4	15.6.
AO–ESEM—High/Medium Torque, 0.25 hp	0.3	1.0	3.2	6.1.
AO–ESEM—High/Medium Torque, 1 hp	0.6	0.9	3.9	7.7.
AO–ESEM—Low Torque, 0.25 hp	0.4	1.1	3.1	4.9.
AO–ESEM—Low Torque, 0.5 hp	2.2	0.8	3.0	3.4.
AO–ESEM—Polyphase, 0.25 hp	1.1	2.0	5.1	10.8.
Shipment-Weighted Average *	1.5	1.2	3.6	5.7.
Percent of Consumers that Experience a Net Cost				
ESEM—High/Medium Torque, 0.25 hp	2%	17%	51%	86%.
ESEM—High/Medium Torque, 1 hp	3%	12%	54%	82%.
ESEM—Low Torque, 0.25 hp	0%	3%	52%	68%.
ESEM—Low Torque, 0.5 hp	11%	8%	30%	40%.
ESEM—Polyphase, 0.25 hp	1%	7%	59%	95%.
AO–ESEM—High/Medium Torque, 0.25 hp	1%	8%	36%	65%.
AO–ESEM—High/Medium Torque, 1 hp	2%	6%	44%	82%.
AO–ESEM—Low Torque, 0.25 hp	0%	4%	39%	68%.
AO–ESEM—Low Torque, 0.5 hp	2%	3%	34%	42%
AO–ESEM—Polyphase, 0.25 hp	3%	10%	49%	88%.
Shipment-Weighted Average *	5%	8%	41%	59%.

Parentheses indicate negative (−) values.
* Weighted by shares of each equipment class in total projected shipments in 2022.

DOE first considered TSL 4, which represents the max-tech efficiency levels. TSL 4 would save an estimated 24.2 quads of energy, an amount DOE considers significant. Under TSL 4, the NPV of consumer benefit would be $11.24 billion using a discount rate of 7 percent and $36.8 billion using a discount rate of 3 percent.

The cumulative emissions reductions at TSL 4 are 437.8 Mt of CO_2, 817.3 thousand tons of SO_2, 121.1 thousand tons of NO_X, 0.8 tons of Hg, 3,709.4 thousand tons of CH_4, and 4.0 thousand tons of N_2O. The estimated monetary value of the climate benefits from reduced GHG emissions (associated with the average SC–GHG at a 3-percent discount rate) at TSL 4 is $25.8 billion. The estimated monetary value of the health benefits from reduced SO_2 and NO_X emissions at TSL 4 is $21.7 billion using a 7-percent discount rate and $50.1 billion using a 3-percent discount rate.

Using a 7-percent discount rate for consumer benefits and costs, health benefits from reduced SO_2 and NO_X emissions, and the 3-percent discount rate case for climate benefits from reduced GHG emissions, the estimated total NPV at TSL 4 is $58.7 billion. Using a 3-percent discount rate for all benefits and costs, the estimated total NPV at TSL 4 is $112.7 billion. The estimated total NPV is provided for additional information, however DOE primarily relies upon the NPV of consumer benefits when determining whether a standard level is economically justified.

At TSL 4, the average LCC impact for non-air over ESEMs is a savings of −$107 and −$145 for high/medium torque ESEMs (0.25 and 1 hp, respectively); −$17 and $73 for low torque ESEMs (0.25 and 0.5 hp, respectively); and −$107 for Polyphase ESEMs. At TSL 4, the average LCC impact for AO–ESEMs is a savings of −$61 and −$128 for high/medium torque AO–ESEMs (0.25 and 1 hp, respectively); −$13 and $52 for low torque AO–ESEMs (0.25 and 0.5 hp, respectively); and −$85 for Polyphase AO–ESEMs. Overall, the shipments-weighted average LCC impact is a savings of −$10. The simple payback period for non-air-over ESEMs is 6.9 and 6.3 years for high/medium torque ESEMs (0.25 and 1 hp, respectively); 2.0 and 3.0 years for low torque ESEMs (0.25 and 0.5 hp, respectively); and 9.7 years for polyphase ESEMs. The simple payback period for AO–ESEMs is 4.3 and 5.1 years for high/medium torque AO–ESEMs (0.25 and 1 hp, respectively); 1.9 and 2.7 years for low torque AO–ESEMs (0.25 and 0.5 hp, respectively); and 8.3 years for polyphase AO–ESEMs. Overall, the shipments-weighted average PBP is 4.0 years. The fraction of consumers experiencing a net LCC cost for non-air-over ESEMs is 85.9 and 82.5 percent for high/medium torque ESEMs (0.25 and 1 hp, respectively); 67.7 and 40.1 percent for low torque ESEMs (0.25 and 0.5 hp, respectively); and 95.0 percent for polyphase ESEMs. The fraction of consumers experiencing a net LCC cost for AO–ESEMs is 64.6 and 81.9 percent for high/medium torque AO–ESEMs (0.25 and 1 hp, respectively); 67.9 and 42.2 percent for low torque AO–ESEMs (0.25 and 0.5 hp, respectively); and 87.8 percent for polyphase AO–ESEMs. Overall, the shipments-weighted average fraction of consumers experiencing a net LCC cost is 59.3 percent.

At TSL 4, the projected change in INPV ranges from a decrease of $1,946 million to a decrease of $309 million, which corresponds to decreases of 96.4 percent and 15.3 percent, respectively. DOE estimates that industry must invest $2,156 million to redesign almost all ESEM models and to purchase new lamination die sets, winding machines, frame casts, and assembly equipment as well as other retooling costs to manufacturer compliant ESEM models at TSL 4. An investment of $2,156 million in conversion costs represents over 3.3 times the sum of the annual free cash flows over the years between the expected publication of the final rule and the compliance year (*i.e.,* the time period that these conversion costs would be incurred) and represents over 100 percent of the entire no-new-standards case INPV over the 30-year analysis period.[100]

In the no-new-standards case, free cash flow is estimated to be $154 million in 2028, the year before the compliance date. At TSL 4, the estimated free cash flow is −$764 million in 2028. This represents a decrease in free cash flow of 595 percent, or a decrease of $919 million, in 2028. A negative free cash flow implies that most, if not all, manufacturers will need to borrow substantial funds to be able to make investments necessary to comply with energy conservation standards at TSL 4. The extremely large drop in free cash flows could cause some ESEM manufacturers to exit the ESEM market entirely, even though recovery may be possible over the 30-year analysis period. At TSL 4, models representing less than 1 percent of all ESEM shipments are estimated to meet the efficiency requirements at this TSL in the no-new-standards case by 2029, the compliance year. Therefore, models representing over 99 percent of all ESEM shipments will need be remodeled in the 4-year compliance period.

Manufacturers are unlikely to have the engineering capacity to conduct this massive redesign effort in 4 years. Instead, they will likely prioritize redesigns based on sales volume, which could leave market gaps in equipment offered by manufacturers and even the entire ESEMs industry. The resulting market gaps in equipment offerings could result in sub-optimal selection of ESEMs for some applications. Lastly, although DOE's analysis assumes that TSL 4 can be reached without significant increase in size, as discussed in sections IV.C.3 and IV.J.2.c of this NOPR and in the December 2022 Joint Recommendation, the Electric Motor Working group expressed that in order to meet the efficiency requirements at TSL 4, some manufacturers may choose to rely on design options that could significantly increase the physical size of ESEMs. This could result in a significant and widespread disruption to the OEM markets that used ESEMs as an embedded product, as those OEMs may have to make significant changes to their equipment that use ESEMs because those ESEMs could become larger in physical size.

DOE requests comment on if manufacturers would have the engineering capacity to conduct design efforts to be able to offer a full portfolio of complaint ESEM at TSL 4. If not, please provide any data or information on the potential impacts that could arise due to these market gaps in equipment offerings.

Under 42 U.S.C. 6316(a) and 42 U.S.C. 6295(o)(2)(B)(i), DOE determines whether a standard is economically justified after considering seven factors. Based on these factors, the Secretary tentatively concludes that at TSL 4 for ESEMs, the benefits of energy savings, positive NPV of consumer benefits, emission reductions, and the estimated monetary value of the emissions reductions would be outweighed by the economic burden on many consumers and the impacts on manufacturers, including the extremely large conversion costs (representing over 3.3 times the sum of the annual free cash flows during the time period that these conversion costs will be incurred and over 100 percent of the entire no-new-standards case INPV), profitability impacts that could result in a large reduction in INPV (up to a decrease of 96.4 percent), the large negative free cash flows in the years leading up to the compliance date (annual free cash flow is estimated to be −$764 million in the year before the compliance date), the lack of manufacturers currently offering equipment meeting the efficiency levels required at TSL 4 (models representing over 99 percent of shipments will need to be redesigned to meet this TSL), and the likelihood of the significant disruption in the ESEM market. Due to the limited amount of engineering resources each manufacturer has, it is unclear if most manufacturers will be able to redesign models representing on average 99 percent of their ESEM shipments covered by this rulemaking in the 4-year compliance period. Consequently, the Secretary has tentatively concluded that TSL 4 is not economically justified.

DOE then considered TSL 3, which represents efficiency level 3 for all equipment class groups. TSL 3 would save an estimated 17 quads of energy, an amount DOE considers significant. Under TSL 3, the NPV of consumer benefit would be $11.2 billion using a discount rate of 7 percent and $36.8 billion using a discount rate of 3 percent.

The cumulative emissions reductions at TSL 3 are 306.0 Mt of CO_2, 571.3 thousand tons of SO_2, 84.3 thousand tons of NO_X, 0.6 tons of Hg, 2,593.9 thousand tons of CH_4, and 2.8 thousand tons of N_2O. The estimated monetary value of the climate benefits from reduced GHG emissions (associated with the average SC–GHG at a 3-percent discount rate) at TSL 3 is $18.0 billion. The estimated monetary value of the health benefits from reduced SO_2 and NO_X emissions at TSL 3 is $15.1 billion using a 7-percent discount rate and $35.0 billion using a 3-percent discount rate.

Using a 7-percent discount rate for consumer benefits and costs, health benefits from reduced SO_2 and NO_X emissions, and the 3-percent discount rate case for climate benefits from reduced GHG emissions, the estimated total NPV at TSL 3 is $54.1 billion. Using a 3-percent discount rate for all benefits and costs, the estimated total NPV at TSL 3 is $103.4 billion. The estimated total NPV is provided for additional information, however DOE primarily relies upon the NPV of consumer benefits when determining whether a standard level is economically justified.

At TSL 3, the average LCC impact for non-air over ESEMs is a savings of −$1 and $21 for high/medium torque ESEMs (0.25 and 1 hp, respectively); $24 and $78 for low torque ESEMs (0.25 and 0.5 hp, respectively); and −$8 for Polyphase ESEMs. At TSL 3, the average LCC impact for AO–ESEMs is a savings of $37 and $37 for high/medium torque AO–ESEMs (0.25 and 1 hp, respectively); $32 and $50 for low

[100] The sum of annual free cash flows is estimated to be $636 million for 2025–2028 in the no-new-standards case and the no-new-standards case INPV is estimated to be $2,019 million.

torque AO ESEMs (0.25 and 0.5 hp, respectively); and $13 for Polyphase AO–ESEMs. Overall, the shipments-weighted average LCC impact is a savings of $44. The simple payback period for non-air-over ESEMs is 3.7 and 3.4 years for high/medium torque ESEMs (0.25 and 1 hp, respectively); 1.3 and 2.5 years for low torque ESEMs (0.25 and 0.5 hp, respectively); and 4.6 years for polyphase ESEMs. The simple payback period for AO–ESEMs is 2.3 and 2.7 years for high/medium torque AO–ESEMs (0.25 and 1 hp, respectively); 1.2 and 2.3 years for low torque AO–ESEMs (0.25 and 0.5 hp, respectively); and 3.9 years for polyphase AO–ESEMs. Overall, the shipments-weighted average PBP is 2.6 years. The fraction of consumers experiencing a net LCC cost, for non-air-over ESEMs is 51.2 and 53.5 percent for high/medium torque ESEMs (0.25 and 1 hp, respectively); 52.0 and 30.4 percent for low torque ESEMs (0.25 and 0.5 hp, respectively); and 58.6 percent for polyphase ESEMs. The fraction of consumers experiencing a net LCC cost, for AO–ESEMs is 36.0 and 44.4 percent for high/medium torque AO–ESEMs (0.25 and 1 hp, respectively); 39.1 and 34.4 percent for low torque AO–ESEMs (0.25 and 0.5 hp, respectively); and 48.6 percent for polyphase AO–ESEMs. Overall, the shipments-weighted average fraction of consumers experiencing a net LCC cost is 40.6 percent.

At TSL 3, the projected change in INPV ranges from a decrease of $1,035 million to a decrease of $199 million, which corresponds to decreases of 48.7 percent and 9.9 percent, respectively. DOE estimates that industry must invest $1,118 million to redesign the majority of ESEM models and to purchase new lamination die sets, winding machines, frame casts, and assembly equipment as well as other retooling costs to manufacturer compliant ESEM models at TSL 3. An investment of $1,118 million in conversion costs represents over 1.7 times the sum of the annual free cash flows over the years between the expected publication of the final rule and the compliance year (*i.e.,* the time period that these conversion costs would be incurred) and represents over 55 percent of the entire no-new-standards case INPV over the 30-year analysis period.[101]

In the no-new-standards case, free cash flow is estimated to be $154 million in 2028, the year before the compliance date. At TSL 3, the estimated free cash flow is −$313 million in 2028. This represents a decrease in free cash flow of 303 percent, or a decrease of $468 million, in 2028. A negative free cash flow implies that most, if not all, manufacturers will need to borrow substantial funds to be able to make investments necessary to comply with energy conservation standards at TSL 3. The extremely large drop in free cash flows could cause some ESEM manufacturers to exit the ESEM market entirely, even though recovery may be possible over the 30-year analysis period. At TSL 3, models representing approximately 9 percent of all ESEM shipments are estimated to meet the efficiency requirements at this TSL in the no-new-standards case by 2029, the compliance year. Therefore, models representing approximately 91 percent of all ESEM shipments will need be remodeled in the 4-year compliance period.

Manufacturers are unlikely to have the engineering capacity to conduct this massive redesign effort in 4 years. Instead, they will likely prioritize redesigns based on sales volume, which could leave market gaps in equipment offered by manufacturers and even the entire ESEMs industry. The resulting market gaps in equipment offerings could result in sub-optimal selection of ESEMs for some applications. Lastly, although DOE's analysis assumes that TSL 3 can be reached without significant increase in size, as discussed in sections IV.C.3 and IV.J.2.c of this NOPR and in the December 2022 Joint Recommendation, the Electric Motor Working group expressed that in order to meet the efficiency requirements at TSL 3, some manufacturers may choose to rely on design options that would significantly increase the physical size of ESEMs. This could result in a significant and widespread disruption to the OEM markets that used ESEMs as an embedded product, as those OEMs may have to make significant changes to their equipment that use ESEMs since those ESEMs could become larger in physical size.

DOE requests comment on if manufacturers would have the engineering capacity to conduct design efforts to be able to offer a full portfolio of compliant ESEMs at TSL 3. If not, please provide any data or information on the potential impacts that could arise due to these market gaps in equipment offerings.

Under 42 U.S.C. 6316(a) and 42 U.S.C. 6295(o)(2)(B)(i), DOE determines whether a standard is economically justified after considering seven factors. Based on these factors, the Secretary tentatively concludes that at TSL 3 for ESEMs, the benefits of energy savings, the economic benefit on many consumers, positive NPV of consumer benefits, emission reductions, and the estimated monetary value of the emissions reductions would be outweighed by the impacts on manufacturers, including the extremely large conversion costs (representing over 1.7 times the sum of the annual free cash flows during the time period that these conversion costs will be incurred and over 55 percent of the entire no-new-standards case INPV), profitability impacts that could result in a large reduction in INPV (up to a decrease of 48.7 percent), the large negative free cash flows in the years leading up to the compliance date (annual free cash flow is estimated to be −$313 million in the year before the compliance date), the lack of manufacturers currently offering equipment meeting the efficiency levels required at this TSL (models representing approximately 91 percent of shipments will need to be redesigned to meet this TSL), and the likelihood of the significant disruption in the ESEM market. Due to the limited amount of engineering resources each manufacturer has, it is unclear if most manufacturers will be able to redesign models representing on average 91 percent of their ESEM shipments covered by this rulemaking in the 4-year compliance period. Consequently, the Secretary has tentatively concluded that TSL 3 is not economically justified.

DOE then considered TSL 2, the standards level recommended in the December 2022 Joint Recommendation, which represents EL 2 for all equipment class groups. TSL 2 would save an estimated 8.9 quads of energy, an amount DOE considers significant. Under TSL 2, the NPV of consumer benefit would be $21.0 billion using a discount rate of 7 percent and $45.0 billion using a discount rate of 3 percent.

The cumulative emissions reductions at TSL 2 are 160.5 Mt of CO_2, 299.8 thousand tons of SO_2, 43.8 thousand tons of NO_X, 0.3 tons of Hg, 1,362.2 thousand tons of CH_4, and 1.4 thousand tons of N_2O. The estimated monetary value of the climate benefits from reduced GHG emissions (associated with the average SC–GHG at a 3-percent discount rate) at TSL 2 is $9.4 billion. The estimated monetary value of the health benefits from reduced SO_2 and NO_X emissions at TSL 2 is $7.9 billion using a 7-percent discount rate and $18.3 billion using a 3-percent discount rate.

[101] The sum of annual free cash flows is estimated to be $636 million for 2025–2028 in the no-new-standards case and the no-new-standards case INPV is estimated to be $2,019 million.

Using a 7-percent discount rate for consumer benefits and costs, health benefits from reduced SO_2 and NO_X emissions, and the 3-percent discount rate case for climate benefits from reduced GHG emissions, the estimated total NPV at TSL 2 is $38.3 billion. Using a 3-percent discount rate for all benefits and costs, the estimated total NPV at TSL 2 is $72.8 billion. The estimated total NPV is provided for additional information, however DOE primarily relies upon the NPV of consumer benefits when determining whether a standard level is economically justified.

At TSL 2, the average LCC impact for non-air over ESEMs is a savings of $51 and $138 for high/medium torque ESEMs (0.25 and 1 hp, respectively); $147 and $100 for low torque ESEMs (0.25 and 0.5 hp, respectively); and $26 for Polyphase ESEMs. At TSL 2, the average LCC impact for AO–ESEMs is a savings of $83 and $160 for high/medium torque AO–ESEMs (0.25 and 1 hp, respectively); $121 and $88 for low torque AO–ESEMs (0.25 and 0.5 hp, respectively); and $40 for Polyphase AO–ESEMs. Overall, the shipments-weighted average LCC impact is a savings of $102. The simple payback period for non-air-over ESEMs is 1.1 and 0.9 years for high/medium torque ESEMs (0.25 and 1 hp, respectively); 0.7 and 1.5 years for low torque ESEMs (0.25 and 0.5 hp, respectively); and 2.0 years for polyphase ESEMs. The simple payback period for AO–ESEMs is 0.8 and 0.8 years for high/medium torque AO–ESEMs (0.25 and 1 hp, respectively); 0.7 and 1.3 years for low torque AO–ESEMs (0.25 and 0.5 hp, respectively); and 1.8 years for polyphase AO–ESEMs. Overall, the shipments-weighted average PBP is 1.2 years. The fraction of consumers experiencing a net LCC cost, for non-air-over ESEMs is 16.7 and 11.7 percent for high/medium torque ESEMs (0.25 and 1 hp, respectively); 3.0 and 7.8 percent for low torque ESEMs (0.25 and 0.5 hp, respectively); and 7.2 percent for polyphase ESEMs. The fraction of consumers experiencing a net LCC cost for AO–ESEMs is 7.8 and 5.9 percent for high/medium torque AO–ESEMs (0.25 and 1 hp, respectively); 3.7 and 2.9 percent for low torque AO–ESEMs (0.25 and 0.5 hp, respectively); and 9.7 percent for polyphase AO–ESEMs. Overall, the shipments-weighted average fraction of consumers experiencing a net LCC cost is 7.8 percent.

At TSL 2, the projected change in INPV ranges from a decrease of $264 million to a decrease of $131 million, which corresponds to decreases of 13.1 percent and 6.5 percent, respectively. DOE estimates that industry must invest $339 million to comply with standards set at TSL 2. An investment of $339 million in conversion costs represents approximately 53 percent of the sum of the annual free cash flows over the years between the expected publication date of the final rule and the standards year (*i.e.,* the time period that these conversion costs would be incurred) and represents approximately 17 percent of the entire no-new-standards case INPV over the 30-year analysis period.[102]

Under 42 U.S.C. 6316(a) and 42 U.S.C. 6295(o)(2)(B)(i), DOE determines whether a standard is economically justified after considering seven factors. After considering the seven factors and weighing the benefits and burdens, the Secretary has tentatively concluded that standards set at TSL 2, the recommended TSL from the Electric Motors Working Group, for ESEMs would be economically justified. At this TSL, the average LCC savings for all equipment classes is positive. An estimated 7.8 percent of ESEM consumers experience a net cost. The FFC national energy savings are significant and the NPV of consumer benefits is positive using both a 3-percent and 7-percent discount rate. Notably, the benefits to consumers vastly outweigh the cost to manufacturers. At TSL 2, the NPV of consumer benefits, even measured at the more conservative discount rate of 7 percent is over 79 times higher than the maximum estimated manufacturers' loss in INPV. The proposed standard levels at TSL 2 are economically justified even without weighing the estimated monetary value of emissions reductions. When those emissions reductions are included—representing $9.4 billion in climate benefits (associated with the average SC–GHG at a 3-percent discount rate), and $18.3 billion (using a 3-percent discount rate) or $7.9 billion (using a 7-percent discount rate) in health benefits—the rationale becomes stronger still.

Accordingly, the Secretary has tentatively concluded that TSL 2, the TSL recommended by the Electric Motors Working Group, would offer the maximum improvement in efficiency that is technologically feasible and economically justified and would result in the significant conservation of energy. In addition, as discussed in section V.A of this document, DOE is establishing the TSLs by equipment class groups and aligning the AO–ESEM levels with the non-AO–ESEMs. Although results are presented here in terms of TSLs, DOE analyzes and evaluates all possible ELs for each equipment class in its analysis. For all equipment classes, TSL 2 is comprised of EL 2, and represents two levels below max-tech. The max tech efficiency levels (TSL 4) result in negative LCC savings for most equipment classes and a large percentage of consumers that experience a net LCC cost for most equipment classes, in addition to significant manufacturer impacts. The ELs one level below max tech (TSL 3) result in negative LCC savings for some equipment classes and a large percentage of consumers that experience a net LCC cost for most equipment classes. Additionally, the impact to manufacturers is significantly reduced at TSL 2. While manufacturers will have to invest $339 million to comply with standards at TSL 2, annual free cash flows remain positive for all years leading up to the modeled compliance date. DOE also estimates that most ESEM manufacturers will have the engineering capacity to complete these redesigns in a 4-year compliance period. Lastly, as discussed in the December 2022 Joint Recommendation,[103] TSL 2 would not result in ESEMs significantly increasing in physical size and therefore would not result in a significant and widespread disruption to the OEM markets that used ESEMs as an embedded product.

The ELs two levels below max-tech (TSL 2), which represents the proposed standard levels as recommended by the Electric Motors Working Group, result in positive LCC savings for all equipment classes, significantly reduce the number of consumers experiencing a net cost, and reduce the decrease in INPV and conversion costs to the point where DOE has tentatively concluded they are economically justified, as discussed for TSL 2 in the preceding paragraphs.

As presented in section V.A in this document, DOE developed TSLs that aligned the efficiency levels for air-over and non-air-over ESEMs because of the similarities in the manufacturing processes between air-over and non-air-over ESEMs. In some cases, an air-over ESEM could be manufactured on the same line as a non-air-over ESEM by omitting the steps of manufacturing associated with the fan of a motor.

While DOE did not explicitly analyze a TSL that would require TSL 3 efficiency levels for AO–ESEMs and

[102] The sum of annual free cash flows is estimated to be $636 million for 2025–2028 in the no-new-standards case and the no-new-standards case INPV is estimated to be $2,019 million.

[103] See EERE–2020–BT–STD–0007–0038 at p. 4.

TSL 2 efficiency levels for non-air over ESEMs, DOE may consider this alternative combination for any potential final rule. In that case, DOE seeks feedback on the potential consequences of adopting a more-efficient level of AO–ESEMs as compared to non-air over ESEMs. DOE seeks information about whether there would be any decrease in the shipments of AO–ESEMs (and a decrease in the potential benefits from a more efficient proposed standard at TSL 3 efficiency levels for AO–ESEMs) by shifting the market to predominantly non-air over ESEMs. In such a scenario, the savings associated with this TSL option may never be realized. In addition, while DOE did not consider a TSL that would require TSL 2 for all equipment classes except TSL3 efficiency levels for low torque ESEMs (both air-over and non-air-over) due to the uncertainties as to whether the size, fit and function would be maintained and potential significant and widespread disruption to the OEM markets, DOE seeks information related to potential size increase and impact on OEM markets at TSL 3 and above.

DOE seeks comment on these alternative proposed standard levels. DOE requests comment on the unintended market consequences and the changes industry would make as a result of standards that require the use of different motor technologies for non-air over and AO–ESEMs. In addition, if DOE were to consider a TSL that would require TSL 2 for all equipment classes except TSL3 efficiency levels for low torque ESEMs, DOE seeks information related to potential ESEM size increase and impact on OEM markets at TSL 3 and above.

As stated, DOE conducts the walk-down analysis to determine the TSL that represents the maximum improvement in energy efficiency that is technologically feasible and economically justified as required under EPCA. The walk-down is not a comparative analysis, as a comparative analysis would result in the maximization of net benefits instead of energy savings that are technologically feasible and economically justified, which would be contrary to EPCA. 86 FR 70892, 70908 (Dec. 12, 2021). Although DOE has not conducted a comparative analysis to select the proposed new energy conservation standards, DOE notes that as compared to TSL 3 and TSL 4, TSL 2 has higher average LCC savings for consumers, significantly smaller percentages of consumers experiencing a net cost, a lower maximum decrease in INPV, lower manufacturer conversion costs, and a significant decrease in the likelihood of a major disruption to the both the ESEM market and the OEM markets that use ESEMs as an embedded product in their equipment, as DOE does not anticipate gaps in ESEM equipment offerings or a significant increase in the physical size of ESEMs at TSL 2.

Although DOE considered proposing new standard levels for ESEMs by grouping the efficiency levels for each equipment class into TSLs, DOE evaluates all analyzed efficiency levels in its analysis. For all equipment classes, TSL 2 represents the maximum energy savings that does not result in significant negative economic impacts to ESEM manufacturers. At TSL 2, conversion costs are estimated to be $339 million, significantly less than at TSL 3 ($1,118 million) or at TSL 4 ($2,156 million). At TSL 2, conversion costs represent a significantly smaller size of the sum of ESEM manufacturers' annual free cash flows for 2025 to 2028 (53 percent), than at TSL 3 (176 percent) or at TSL 4 (339 percent) and a significantly smaller portion of ESEM manufacturers' no-new-standards case INPV (17 percent), than at TSL 3 (55 percent) or at TSL 4 (107 percent). At TSL 2, ESEM manufacturers will have to redesign a significantly smaller portion of their ESEM models to meet the ELs set at TSL 2 (models representing 55 percent of all ESEM shipments), than at TSL 3 (91 percent) or at TSL 4 (99 percent). Lastly, ESEM manufacturers' free cash flow remains positive at TSL 2 for all years leading up to the compliance date. Whereas at TSL 3 annual free cash flow is estimated to be −$313 million and at TSL 4 annual free cash flow is estimated to be −$764 million in 2028, the year before the compliance year. Additionally, the ELs at the proposed TSL result in average positive LCC savings for all equipment class groups and significantly reduce the number of consumers experiencing a net cost to the point where DOE has tentatively concluded they are economically justified, as discussed for TSL 2 in the preceding paragraphs.

Therefore, based on the previous considerations, DOE proposes to adopt the energy conservation standards for ESEMs at TSL 2, which was the recommended TSL by the Electric Motors Working Group. The proposed energy conservation standards for ESEMs, which are expressed as average full-load efficiency, are shown in Table V–44 through Table V–46.

TABLE V–44—PROPOSED ENERGY CONSERVATION STANDARDS FOR HIGH AND MEDIUM-TORQUE ESEMs

hp	Average full load efficiency							
	Open				Enclosed			
	2-pole	4-pole	6-pole	8-pole	2-pole	4-pole	6-pole	8-pole
0.25	59.5	59.5	57.5		59.5	59.5	57.5	
0.33	64.0	64.0	62.0	50.5	64.0	64.0	62.0	50.5
0.5	68.0	69.2	68.0	52.5	68.0	67.4	68.0	52.5
0.75	76.2	81.8	80.2	72.0	75.5	75.5	75.5	72.0
1	80.4	82.6	81.1	74.0	77.0	80.0	77.0	74.0
1.5	81.5	83.8			81.5	81.5	80.0	
2	82.9	84.5			82.5	82.5		
3	84.1				84.0			

TABLE V–45—PROPOSED ENERGY CONSERVATION STANDARDS FOR LOW-TORQUE ESEMs

hp	Average full load efficiency							
	Open				Enclosed			
	2-pole	4-pole	6-pole	8-pole	2-pole	4-pole	6-pole	8-pole
0.25	63.9	66.1	60.2	52.5	60.9	64.1	59.2	52.5
0.33	66.9	69.7	65.0	56.6	63.9	67.7	64.0	56.6
0.5	68.8	70.1	66.8	57.1	65.8	68.1	65.8	57.1
0.75	70.5	74.8	73.1	62.8	67.5	72.8	72.1	62.8
1	74.3	77.1	77.3	65.7	71.3	75.1	76.3	65.7
1.5	79.9	82.1	80.5	72.2	76.9	80.1	79.5	72.2
2	81.0	82.9	81.4	73.3	78.0	80.9	80.4	73.3
3	82.4	84.0	82.5	74.9	79.4	82.0	81.5	74.9

TABLE V–46—PROPOSED ENERGY CONSERVATION STANDARDS FOR POLYPHASE ESEMs

hp	Average full load efficiency							
	Open				Enclosed			
	2-pole	4-pole	6-pole	8-pole	2-pole	4-pole	6-pole	8-pole
0.25	65.6	69.5	67.5	62.0	66.0	68.0	66.0	62.0
0.33	69.5	73.4	71.4	64.0	70.0	72.0	70.0	64.0
0.5	73.4	78.2	75.3	66.0	72.0	75.5	72.0	66.0
0.75	76.8	81.1	81.7	70.0	75.5	77.0	74.0	70.0
1	77.0	83.5	82.5	75.5	75.5	77.0	74.0	75.5
1.5	84.0	86.5	83.8	77.0	84.0	82.5	87.5	78.5
2	85.5	86.5	....	86.5	85.5	85.5	88.5	84.0
3	85.5	86.9	....	87.5	86.5	86.5	89.5	85.5

2. Annualized Benefits and Costs of the Proposed Standards

The benefits and costs of the proposed standards can also be expressed in terms of annualized values. The annualized net benefit is (1) the annualized national economic value (expressed in 2022$) of the benefits from operating equipment that meet the proposed standards (consisting primarily of operating cost savings from using less energy, minus increases in equipment purchase costs, and (2) the annualized monetary value of the climate and health benefits from emission reductions.

Table V–47 shows the annualized values for ESEMs under TSL 2, expressed in 2022$. The results under the primary estimate are as follows.

Using a 7-percent discount rate for consumer benefits and costs and NO_X and SO_2 reduction benefits, and a 3-percent discount rate case for GHG social costs, the estimated cost of the proposed standards for ESEMs is $543 million per year in increased equipment costs, while the estimated annual benefits are $2,757 million in reduced product operating costs, $542 million in climate benefits, and $836 million in health benefits. In this case, the net benefit amounts to $3,592 million per year.

Using a 3-percent discount rate for all benefits and costs, the estimated cost of the proposed standards for ESEMs is $556 million per year in increased equipment costs, while the estimated annual benefits are $3,140 million in reduced operating costs, $542 million in climate benefits, and $1,052 million in health benefits. In this case, the net benefit amounts to $4,179 million per year.

TABLE V–47—ANNUALIZED MONETIZED BENEFITS AND COSTS OF PROPOSED STANDARDS FOR ESEMs

[Proposed TSL 2]

	Million 2022$/year		
	Primary estimate	Low-net-benefits estimate	High-net-benefits estimate
3% discount rate			
Consumer Operating Cost Savings	3,140	2,962	3,341
Climate Benefits *	542	526	562
Health Benefits **	1,052	1,021	1,089
Total Benefits †	4,734	4,509	4,992
Consumer Incremental Equipment Costs ‡	556	598	529
Net Benefits	4,179	3,911	4,464
Change in Producer Cashflow (INPV ††)	(25)–(13)	(25)–(13)	(25)–(13)
7% discount rate			
Consumer Operating Cost Savings	2,757	2,615	2,921

TABLE V–47—ANNUALIZED MONETIZED BENEFITS AND COSTS OF PROPOSED STANDARDS FOR ESEMS—Continued
[Proposed TSL 2]

	Million 2022$/year		
	Primary estimate	Low-net-benefits estimate	High-net-benefits estimate
Climate Benefits * (3% discount rate)	542	526	562
Health Benefits **	836	814	863
Total Benefits †	4,135	3,955	4,346
Consumer Incremental Equipment Costs ‡	543	578	520
Net Benefits	3,592	3,377	3,826
Change in Producer Cashflow (INPV ††)	(25)–(13)	(25)–(13)	(25)–(13)

Note: This table presents the costs and benefits associated with ESEMs shipped in 2029–2058. These results include consumer, climate, and health benefits which accrue after 2058 from the equipment shipped in 2029–2058. The Primary, Low Net Benefits, and High Net Benefits Estimates utilize projections of energy prices from the *AEO2023* Reference case, Low Economic Growth case, and High Economic Growth case, respectively. In addition, incremental equipment costs reflect a constant rate in the Primary Estimate, an increasing rate in the Low Net Benefits Estimate, and a declining rate in the High Net Benefits Estimate. The methods used to derive projected price trends are explained in sections IV.F.1 and IV.H.3 of this document. Note that the Benefits and Costs may not sum to the Net Benefits due to rounding.

* Climate benefits are calculated using four different estimates of the global SC–GHG (see section IV.L of this notice). For presentational purposes of this table, the climate benefits associated with the average SC–GHG at a 3 percent discount rate are shown, but DOE does not have a single central SC–GHG point estimate, and it emphasizes the importance and value of considering the benefits calculated using all four sets of SC–GHG estimates. To monetize the benefits of reducing GHG emissions, this analysis uses the interim estimates presented in the *Technical Support Document: Social Cost of Carbon, Methane, and Nitrous Oxide Interim Estimates Under Executive Order 13990* published in February 2021 by the IWG.

** Health benefits are calculated using benefit-per-ton values for NO_X and SO_2. DOE is currently only monetizing (for SO_2 and NO_X) $PM_{2.5}$ precursor health benefits and (for NO_X) ozone precursor health benefits, but will continue to assess the ability to monetize other effects such as health benefits from reductions in direct $PM_{2.5}$ emissions. See section IV.L of this document for more details.

† Total benefits for both the 3-percent and 7-percent cases are presented using the average SC–GHG with 3-percent discount rate, but DOE does not have a single central SC–GHG point estimate.

‡ Costs include incremental equipment costs.

†† Operating Cost Savings are calculated based on the life cycle costs analysis and national impact analysis as discussed in detail below. See sections IV.F and IV.H of this document. DOE's national impacts analysis includes all impacts (both costs and benefits) along the distribution chain beginning with the increased costs to the manufacturer to manufacture the equipment and ending with the increase in price experienced by the consumer. DOE also separately conducts a detailed analysis on the impacts on manufacturers (the MIA). See section IV.J of this document. In the detailed MIA, DOE models manufacturers' pricing decisions based on assumptions regarding investments, conversion costs, cashflow, and margins. The MIA produces a range of impacts, which is the rule's expected impact on the INPV. The change in INPV is the present value of all changes in industry cash flow, including changes in production costs, capital expenditures, and manufacturer profit margins. The annualized change in INPV is calculated using the industry weighted average cost of capital value of 9.1 percent that is estimated in the MIA (see chapter 12 of the NOPR TSD for a complete description of the industry weighted average cost of capital). For ESEMs, those values are −$25 million and −$13 million. DOE accounts for that range of likely impacts in analyzing whether a TSL is economically justified. See section V.C of this document. DOE is presenting the range of impacts to the INPV under two markup scenarios: the Preservation of Gross Margin scenario, which is the manufacturer markup scenario used in the calculation of Consumer Operating Cost Savings in this table, and the Preservation of Operating Profit Markup scenario, where DOE assumed manufacturers would not be able to increase per-unit operating profit in proportion to increases in manufacturer production costs. DOE includes the range of estimated annualized change in INPV in the above table, drawing on the MIA explained further in section IV.J of this document, to provide additional context for assessing the estimated impacts of this rule to society, including potential changes in production and consumption, which is consistent with OMB's Circular A–4 and E.O. 12866. If DOE were to include the INPV into the annualized net benefit calculation for this NOPR, the annualized net benefits would range from $4,154 million to $4,166 million at 3-percent discount rate and would range from $3,567 million to $3,579 million at 7-percent discount rate. Numbers in parentheses are negative numbers.

D. Reporting, Certification, and Sampling Plan

Manufacturers, including importers, must use equipment-specific certification templates to certify compliance to DOE. For currently regulated electric motors, the certification template is specified at 10 CFR 429.36. DOE is not proposing new product-specific certification reporting requirements for ESEMs. However, as discussed in section III.C of this document, DOE proposes to amend the determinations of represented values for ESEMs.

VI. Procedural Issues and Regulatory Review

A. Review Under Executive Orders 12866, 13563, and 14094

Executive Order (''E.O.'') 12866, ''Regulatory Planning and Review,'' as supplemented and reaffirmed by E.O. 13563, ''Improving Regulation and Regulatory Review,'' 76 FR 3821 (Jan. 21, 2011) and amended by E.O. 14094, ''Modernizing Regulatory Review,'' 88 FR 21879 (April 11, 2023), requires agencies, to the extent permitted by law, to (1) propose or adopt a regulation only upon a reasoned determination that its benefits justify its costs (recognizing that some benefits and costs are difficult to quantify); (2) tailor regulations to impose the least burden on society, consistent with obtaining regulatory objectives, taking into account, among other things, and to the extent practicable, the costs of cumulative regulations; (3) select, in choosing among alternative regulatory approaches, those approaches that maximize net benefits (including potential economic, environmental, public health and safety, and other advantages; distributive impacts; and equity); (4) to the extent feasible, specify performance objectives, rather than specifying the behavior or manner of compliance that regulated entities must adopt; and (5) identify and assess available alternatives to direct regulation, including providing economic incentives to encourage the desired behavior, such as user fees or marketable permits, or providing information upon which choices can be made by the public. DOE emphasizes as well that E.O. 13563 requires agencies to use the best available techniques to quantify anticipated present and future benefits and costs as accurately as possible. In its guidance, the Office of Information and Regulatory Affairs (''OIRA'') in the Office of Management and Budget (''OMB'') has emphasized that such techniques may include identifying changing future compliance costs that might result from technological innovation or anticipated behavioral changes. For the reasons stated in the preamble, this proposed regulatory action is consistent with these principles.

Section 6(a) of E.O. 12866 also requires agencies to submit ''significant regulatory actions'' to OIRA for review. OIRA has determined that this proposed regulatory action constitutes a ''significant regulatory action'' within the scope of section 3(f)(1) of E.O. 12866. Accordingly, pursuant to section 6(a)(3)(C) of E.O. 12866, DOE has provided to OIRA an assessment, including the underlying analysis, of benefits and costs anticipated from the proposed regulatory action, together with, to the extent feasible, a quantification of those costs; and an assessment, including the underlying analysis, of costs and benefits of potentially effective and reasonably feasible alternatives to the planned regulation, and an explanation why the planned regulatory action is preferable to the identified potential alternatives. These assessments are summarized in this preamble and further detail can be found in the technical support document for this proposed rulemaking.

B. Review Under the Regulatory Flexibility Act

The Regulatory Flexibility Act (5 U.S.C. 601 *et seq.*) requires preparation of an initial regulatory flexibility analysis (''IRFA'') for any rule that by law must be proposed for public comment, unless the agency certifies that the rule, if promulgated, will not have a significant economic impact on a substantial number of small entities. As required by E.O. 13272, ''Proper Consideration of Small Entities in Agency Rulemaking,'' 67 FR 53461 (Aug. 16, 2002), DOE published procedures and policies on February 19, 2003, to ensure that the potential impacts of its rules on small entities are properly considered during the rulemaking process. 68 FR 7990. DOE has made its procedures and policies available on the Office of the General Counsel's website (*www.energy.gov/gc/office-general-counsel*). DOE has prepared the following IRFA for the equipment that are the subject of this proposed rulemaking.

For manufacturers of ESEMs, the Small Business Administration (''SBA'') has set a size threshold, which defines those entities classified as ''small businesses'' for the purposes of the statute. DOE used the SBA's small business size standards to determine whether any small entities would be subject to the requirements of the rule. (See 13 CFR part 121.) The size standards are listed by North American Industry Classification System (''NAICS'') code and industry description and are available at *www.sba.gov/document/support-table-size-standards.* Manufacturing of ESEMs is classified under NAICS 335312, ''Motor and Generator Manufacturing.'' The SBA sets a threshold of 1,250 employees or fewer for an entity to be considered as a small business for this category.

1. Description of Reasons Why Action Is Being Considered

DOE previously established energy conservation standards for some types of electric motors at 10 CFR 431.25. These previous rulemakings did not establish energy conservation standards for ESEMs when establishing or amending energy conservation standards for other electric motors. In the March 2022 Preliminary Analysis, DOE analyzed potential efficiency levels for ESEMs. *See* 87 FR 11650 (March 2, 2022). On December 22, 2022, DOE received a joint recommendation for energy conservation standards for ESEMs. These standard levels were submitted jointly to DOE, by groups representing manufacturers, energy and environmental advocates, and consumer groups (the Electric Motors Working Group). The December 2022 Joint Recommendation recommends specific energy conservation standards for ESEMs.

2. Objectives of, and Legal Basis for, Rule

EPCA authorizes DOE to regulate the energy efficiency of a number of consumer products and certain industrial equipment. Title III, Part C of EPCA, added by Public Law 95–619, Title IV, section 441(a) (42 U.S.C. 6311–6317, as codified), established the Energy Conservation Program for Certain Industrial Equipment, which sets forth a variety of provisions designed to improve the energy efficiency of certain types of industrial equipment, including ESEMs, a category of electric motors, the subject of this notice. (42 U.S.C. 6311(1)(A)).

DOE must follow specific statutory criteria for prescribing new or amended standards for covered equipment, including electric motors. Any new or amended standard for covered equipment must be designed to achieve the maximum improvement in energy efficiency that the Secretary of Energy determines is technologically feasible and economically justified. (42 U.S.C. 6316(a); 42 U.S.C. 6295(o)(2)(A) and 42 U.S.C. 6295(o)(3)(B))

3. Description and Estimated Number of Small Entities Regulated

To estimate the number of companies that could be small business manufacturers of ESEMs covered by this rulemaking, DOE conducted a market survey using publicly available information. DOE's research involved DOE's publicly available Compliance Certification Database (''CCD''), industry trade association membership directories (including NEMA), and information from previous rulemakings. DOE also asked stakeholders and industry representatives if they were aware of any other small manufacturers during manufacturer interviews and DOE working groups. DOE used information from these sources to create a list of companies that potentially manufacture ESEMs covered by this proposed rulemaking. As necessary, DOE contacted companies to determine whether they met the SBA's definition of a small business manufacturer. DOE screened out companies that do not offer equipment covered by this proposed rulemaking, do not meet the definition of a ''small business,'' or are foreign owned and operated.

DOE initially identified approximately 74 unique potential manufacturers of ESEMs sold in the U.S that are covered by this proposed rulemaking. DOE screened out companies that had more than 1,250 employees or companies that were completely foreign-owned and operated. Of the 74 manufacturers that potentially manufacture ESEMs covered by this proposed rulemaking, DOE identified 3 companies that meet SBA's definition of a small business.

4. Description and Estimate of Compliance Requirements Including Differences in Cost, if Any, for Different Groups of Small Entities

In this NOPR, DOE is proposing new energy conservation standards for ESEMs. The primary value added by these 3 small businesses is creating ESEMs that serve an application specific purpose that the OEMs require. This includes combining an ESEM with specific mechanic couplings, weatherproofing, or controls to suit the OEM's needs. Most small businesses manufacture motor housing and couplings but do not manufacture the rotors and stators used in the ESEMs they sell. While these small businesses may have to create new ESEM housings and/or couplings if the ESEM characteristics change in response to the proposed energy conservation standards, DOE was not able to identify any small businesses that own their own lamination dies sets and winding machines that are used to manufacture rotors and stators for ESEMs.

The 3 small businesses identified do not manufacture the rotors and stators of their ESEMs and instead purchase these components from other manufacturers. Thus, they would not need to purchase the machinery necessary to manufacture these components (*i.e.,* would not need to purchase costly lamination dies sets and winding machines) nor would they need to spend R&D efforts to develop ESEM designs to meet energy conservation standards. Instead, these small manufacturers may have to create new moldings for ESEM housings (if the ESEM characteristics change in response to the proposed energy conservation standards).

DOE estimated conversion costs associated with redesigning an equipment line for ESEM housings. DOE estimates this will cost approximately $50,000 in molding equipment per ESEM housing; $37,330 in engineering design effort per ESEM housing; [104] and $10,000 in testing costs per ESEM housing. Based on these estimates, each ESEM housing that will need to be redesigned would cost a small business approximately $97,330.

DOE displays in Table VI–1 the estimated average conversion costs per small business compared to the annual revenue for each small business. DOE used D&B Hoovers [105] to estimate the annual revenue for each small business. Manufacturers will have 4 years between the expected publication of the final rule and the date of compliance with the proposed energy conservation standards. Therefore, DOE presents the estimated conversion costs and testing costs as a percent of the estimated 4 years of annual revenue for each small business.

TABLE VI–1—ESTIMATED CONVERSION COSTS AND ANNUAL REVENUE FOR EACH SMALL BUSINESS

Manufacturer	Number of ESEM housing that need to be redesigned	Total conversion costs	Estimated annual revenue	4 Years of annual revenue	Conversion costs as a % of 4 years of annual revenue
Small Business 1	27	$2,627,910	$6,270,000	$25,080,000	10.5
Small Business 2	19	1,849,270	10,120,00	40,480,000	4.6
Small Business 3	24	2,335,920	28,210,000	112,840,000	2.1
Average Small Business	23	2,271,033	14,866,667	59,466,667	3.8

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

As described in section IV.A. of this document, DOE believes the standards proposed in this NOPR would not impact manufacturers of consumer products. In commercial equipment, DOE identified the following equipment as potentially incorporating ESEMs: walk-in coolers and freezers, circulator pumps, air circulating fans, and commercial unitary air conditioning equipment. If the proposed energy conservation standards for these rules finalize as proposed, DOE has identified that these rules would all: (1) have a compliance year that is at or before the ESEM standard compliance year (2029) and/or (2) require a motor that is either outside of the scope of this rule (*e.g.,* an ECM) or an ESEM with an efficiency above the proposed ESEM standards, and therefore not be impacted by the proposed ESEM rule (*i.e.,* the ESEM rule would not trigger a redesign of these equipment).

6. Significant Alternatives to the Rule

The discussion in the previous section analyzes impacts on small businesses that would result from DOE's proposal to adopt standards represented by TSL 2. In reviewing alternatives to the proposed rule, DOE examined energy conservation standards set at lower efficiency levels. While TSL 1 would reduce the impacts on small business manufacturers, it would come at the expense of a reduction in energy savings and consumer NPV. TSL 1 achieves 65 percent lower energy savings and 69 percent lower consumer NPV compared to the energy savings at TSL 2.

Based on the presented discussion, proposing standards at TSL 2 balances the benefits of the energy savings at TSL 2 with the potential burdens placed on ESEM manufacturers, including small business manufacturers. Accordingly, DOE does not propose one of the other TSLs considered in the analysis, or the other policy alternatives examined as part of the regulatory impact analysis and included in chapter 17 of the NOPR TSD.

Additional compliance flexibilities may be available through other means. Manufacturers subject to DOE's energy efficiency standards may apply to DOE's Office of Hearings and Appeals for exception relief under certain circumstances. Manufacturers should refer to 10 CFR part 1003 for additional details.

C. Review Under the Paperwork Reduction Act

Manufacturers of expanded scope electric motors must test their equipment according to the DOE test procedures for ESEMs, including any amendments adopted for those test procedures, and use the results of the test procedure and applicable sampling plan if they choose to make representations of the energy efficiency or energy use of ESEMs. DOE has established regulations for recordkeeping requirements for all covered consumer products and commercial equipment, including ESEMs. (*See generally* 10 CFR part 429). The collection-of-information requirement for the testing and recordkeeping is subject to review and approval by OMB under the Paperwork Reduction Act (''PRA''). This requirement has been approved by OMB under OMB control number 1910–1400 and is in the process of being renewed. Public reporting burden is estimated to average 35 hours per response,

[104] DOE estimated that it would take approximately three months of engineering time to redesign each ESEM housing. Based on data from BLS, the mean hourly wage of an electrical engineer is $54.83 (*www.bls.gov/oes/current/oes172071.htm*) and wages comprise 70.5 percent of an employee's total compensation (*www.bls.gov/news.release/archives/ecec_06162023.pdf*).

$54.83 (hourly wage) ÷ 0.705 (wage as a percentage of total compensation) = $77.77 (fully burdened hourly labor rate).

$77.77 × 8 (hours in a workday) × 20 (working days in a month) × 3 (months) = $37,330

[105] *app.avention.com.*

including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. DOE does not currently have certification or labeling requirements for ESEMs and is not proposing to establish either of those as part of this proposed rule. Thus, DOE expects the recordkeeping requirements associated with testing and maintaining test data would be less than the average estimate per response for this paperwork package.

Currently, DOE is seeking comment on DOE's renewal of its paperwork reduction approval under OMB control number 1910–1400. *See* 88 FR 65994 (Sept. 26, 2023).

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

DOE is analyzing this proposed regulation in accordance with the National Environmental Policy Act of 1969 (''NEPA'') and DOE's NEPA implementing regulations (10 CFR part 1021). DOE's regulations include a categorical exclusion for rulemakings that establish energy conservation standards for consumer products or industrial equipment. 10 CFR part 1021, subpart D, appendix B5.1. DOE anticipates that this proposed rulemaking qualifies for categorical exclusion B5.1 because it is a rulemaking that establishes energy conservation standards for consumer products or industrial equipment, none of the exceptions identified in categorical exclusion B5.1(b) apply, no extraordinary circumstances exist that require further environmental analysis, and it otherwise meets the requirements for application of a categorical exclusion. *See* 10 CFR 1021.410. DOE will complete its NEPA review before issuing the final rule.

E. Review Under Executive Order 13132

E.O. 13132, ''Federalism,'' 64 FR 43255 (Aug. 10, 1999), imposes certain requirements on Federal agencies formulating and implementing policies or regulations that preempt state law or that have federalism implications. The Executive order requires agencies to examine the constitutional and statutory authority supporting any action that would limit the policymaking discretion of the states and to carefully assess the necessity for such actions. The Executive order also requires agencies to have an accountable process to ensure meaningful and timely input by state and local officials in the development of regulatory policies that have federalism implications. On March 14, 2000, DOE published a statement of policy describing the intergovernmental consultation process it will follow in the development of such regulations. 65 FR 13735. DOE has examined this proposed rule and has tentatively determined that it would not have a substantial direct effect on the states, on the relationship between the national government and the states, or on the distribution of power and responsibilities among the various levels of government. EPCA governs and prescribes Federal preemption of state regulations as to energy conservation for the equipment that are the subject of this proposed rule. States can petition DOE for exemption from such preemption to the extent, and based on criteria, set forth in EPCA. (*See* 42 U.S.C. 6316(a) and (b); 42 U.S.C. 6297) Therefore, no further action is required by Executive Order 13132.

F. Review Under Executive Order 12988

With respect to the review of existing regulations and the promulgation of new regulations, section 3(a) of E.O. 12988, ''Civil Justice Reform,'' imposes on Federal agencies the general duty to adhere to the following requirements: (1) eliminate drafting errors and ambiguity, (2) write regulations to minimize litigation, (3) provide a clear legal standard for affected conduct rather than a general standard, and (4) promote simplification and burden reduction. 61 FR 4729 (Feb. 7, 1996). Regarding the review required by section 3(a), section 3(b) of E.O. 12988 specifically requires that Executive agencies make every reasonable effort to ensure that the regulation: (1) clearly specifies the preemptive effect, if any, (2) clearly specifies any effect on existing Federal law or regulation, (3) provides a clear legal standard for affected conduct while promoting simplification and burden reduction, (4) specifies the retroactive effect, if any, (5) adequately defines key terms, and (6) addresses other important issues affecting clarity and general draftsmanship under any guidelines issued by the Attorney General. Section 3(c) of Executive Order 12988 requires Executive agencies to review regulations in light of applicable standards in section 3(a) and section 3(b) to determine whether they are met or it is unreasonable to meet one or more of them. DOE has completed the required review and determined that, to the extent permitted by law, this proposed rule meets the relevant standards of E.O. 12988.

G. Review Under the Unfunded Mandates Reform Act of 1995

Title II of the Unfunded Mandates Reform Act of 1995 (''UMRA'') requires each Federal agency to assess the effects of Federal regulatory actions on state, local, and Tribal governments and the private sector. Public Law 104–4, section 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 them. On March 18, 1997, DOE published a statement of policy on its process for intergovernmental consultation under UMRA. 62 FR 12820. DOE's policy statement is also available at *www.energy.gov/sites/prod/files/gcprod/documents/umra_97.pdf.*

Although this proposed rule does not contain a Federal intergovernmental mandate, it may require expenditures of $100 million or more in any one year by the private sector. Such expenditures may include: (1) investment in research and development and in capital expenditures by ESEM 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 ESEMs, starting at the compliance date for the applicable standard.

Section 202 of UMRA authorizes a Federal agency to respond to the content requirements of UMRA in any other statement or analysis that accompanies the 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 this NOPR and the TSD for this proposed rule respond to those requirements.

Under section 205 of UMRA, DOE is obligated to identify and consider a reasonable number of regulatory alternatives before promulgating a rule for which a written statement under section 202 is required. (2 U.S.C. 1535(a)) DOE is required to select from those alternatives the most cost-effective and least burdensome alternative that achieves the objectives of the proposed rule unless DOE publishes an explanation for doing otherwise, or the selection of such an alternative is inconsistent with law. As required by 42 U.S.C. 6316(a) and 42 U.S.C. 6295(o), this proposed rule would establish new energy conservation standards for that are designed to achieve the maximum improvement in energy efficiency that DOE has determined to be both technologically feasible and economically justified. A full discussion of the alternatives considered by DOE is presented in chapter 17 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

Pursuant to E.O. 12630, ''Governmental Actions and Interference with Constitutionally Protected Property Rights,'' 53 FR 8859 (Mar. 15, 1988), DOE has determined that this proposed rule would not result in any takings that might require compensation under the Fifth Amendment to the U.S. Constitution.

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

Section 515 of the Treasury and General Government Appropriations Act, 2001 (44 U.S.C. 3516 note) provides for Federal agencies to review most disseminations of information to the public under information quality guidelines established by each agency pursuant to general guidelines issued by OMB. OMB's guidelines were published at 67 FR 8452 (Feb. 22, 2002), and DOE's guidelines were published at 67 FR 62446 (Oct. 7, 2002). Pursuant to OMB Memorandum M–19–15, Improving Implementation of the Information Quality Act (April 24, 2019), DOE published updated guidelines which are available at *www.energy.gov/sites/prod/files/2019/12/f70/DOE%20Final%20Updated%20IQA%20Guidelines%20Dec%202019.pdf.* DOE has reviewed this 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

E.O. 13211, ''Actions Concerning Regulations That Significantly Affect Energy Supply, Distribution, or Use,'' 66 FR 28355 (May 22, 2001), requires Federal agencies to prepare and submit to OIRA at OMB, a Statement of Energy Effects for any 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 proposed regulatory action, which proposes new energy conservation standards for ESEMs, 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 this proposed rule.

L. Information Quality

On December 16, 2004, OMB, in consultation with the Office of Science and Technology Policy (''OSTP''), issued its Final Information Quality Bulletin for Peer Review (''the Bulletin''). 70 FR 2664 (Jan. 14, 2005). The Bulletin establishes that certain scientific information shall be peer reviewed by qualified specialists before it is disseminated by the Federal Government, including influential scientific information related to agency regulatory actions. The purpose of the bulletin is to enhance the quality and credibility of the Government's scientific information. Under the Bulletin, the energy conservation standards rulemaking analyses are ''influential scientific information,'' which the Bulletin defines as ''scientific information the agency reasonably can determine will have, or does have, a clear and substantial impact on important public policies or private sector decisions.'' 70 FR 2664, 2667.

In response to OMB's Bulletin, DOE conducted formal peer reviews of the energy conservation standards development process and the analyses that are typically used and has prepared a report describing that peer review.[106] Generation of this report involved a rigorous, formal, and documented evaluation using objective criteria and qualified and independent reviewers to make a judgment as to the technical/scientific/business merit, the actual or anticipated results, and the productivity and management effectiveness of programs and/or projects. Because available data, models, and technological understanding have changed since 2007, DOE has engaged with the National Academy of Sciences to review DOE's analytical methodologies to ascertain whether modifications are needed to improve DOE's analyses. DOE is in the process of evaluating the resulting report.[107]

VII. 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 document. If you plan to attend the public meeting, please notify the Appliance and Equipment Standards staff at (202) 287–1445 or *Appliance_Standards_Public_Meetings@ee.doe.gov.*

Please note that foreign nationals visiting DOE Headquarters are subject to advance security screening procedures which require advance notice prior to attendance at the public meeting. If a foreign national wishes to participate in the public meeting, please inform DOE of this fact as soon as possible by contacting Ms. Regina Washington at

[106] The 2007 ''Energy Conservation Standards Rulemaking Peer Review Report'' is available at the following website: *energy.gov/eere/buildings/downloads/energy-conservation-standards-rulemaking-peer-review-report-0* (last accessed October 10, 2023).

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

(202) 586–1214 or by email (*Regina.Washington@ee.doe.gov*) so that the necessary procedures can be completed.

DOE requires visitors to have laptops and other devices, such as tablets, checked upon entry into the Forrestal Building. Any person wishing to bring these devices into the building will be required to obtain a property pass. Visitors should avoid bringing these devices, or allow an extra 45 minutes to check in. Please report to the visitor's desk to have devices checked before proceeding through security.

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. DHS maintains an updated website identifying the state and territory driver's licenses that currently are acceptable for entry into DOE facilities at *www.dhs.gov/real-id-enforcement-brief.* A driver's licenses from a state or territory identified as not compliant by DHS will not be accepted for building entry and one of the alternate forms of ID listed below will be required. Acceptable alternate forms of Photo-ID include U.S. Passport or Passport Card; an Enhanced Driver's License or Enhanced ID-Card issued by states and territories as identified on the DHS website (Enhanced licenses issued by these states and territories are clearly marked Enhanced or Enhanced Driver's License); a military ID or other Federal Government-issued Photo-ID card.

In addition, you can 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 website at *www.eere.energy.gov/buildings/appliance_standards/product.aspx/productid/50.* 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 document. The request and advance copy of statements must be received at least one week before the public meeting and are to be emailed. 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. There shall not be discussion of proprietary information, costs or prices, market share, or other commercial matters regulated by U.S. anti-trust laws. After the public meeting, interested parties may submit further comments on the proceedings, as well as on any aspect of the proposed rulemaking, until the end of the comment period.

The public meeting will be conducted in an informal, conference style. DOE will present a general overview of the topics addressed in this rulemaking, allow time for prepared general statements by participants, and encourage all interested parties to share their views on issues affecting this proposed 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. 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 proposed 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 previous 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 document and will be accessible on the DOE website. 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 document.

Submitting comments via *www.regulations.gov.* The *www.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 *www.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 *www.regulations.gov* cannot be claimed as CBI. Comments received through the website will waive any CBI claims for the information submitted. For information on submitting CBI, see the Confidential Business Information section.

DOE processes submissions made through *www.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 *www.regulations.gov* provides after you have successfully uploaded your comment.

Submitting comments via email, hand delivery/courier, or postal mail. Comments and documents submitted via email, hand delivery/courier, or postal mail also will be posted to *www.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 postal mail or hand delivery/courier, please provide all items on a CD, if feasible, in which case it is not necessary to submit printed copies. No telefacsimiles (''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, that are written in English, and that 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. Pursuant 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 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. DOE will make its own determination about the confidential status of the information and treat it according to its determination.

It is DOE's policy that all comments may be included in the public docket, without change and as received, 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) DOE requests comments on the proposal to use a represented value of average full-load efficiency for ESEMs and proposed revisions to 10 CFR 429.64 and 429.70(j).

(2) DOE requests comment on the proposed equipment classes for this NOPR.

(3) DOE requests comment on the remaining technology options considered in this NOPR.

(4) DOE requests comment on the representative units used in this NOPR.

(5) DOE requests comment on the baseline efficiencies used in this NOPR.

(6) DOE requests comment on the proposal to constrain the frame size of all efficiency levels to that of the baseline unit.

(7) DOE requests comment on the assumption that higher ELs (particularly ELs 3 and 4) can be reached without significant increase in size.

(8) DOE requests comment on the potential for market disruption at higher ELs and if manufacturers could design motors at ELs 3 and 4 that do not increase in size, or if for the final rule, DOE should model motors larger than what is considered in this NOPR.

(9) DOE requests data and information to characterize the distribution channels for ESEMs and associated market shares.

(10) DOE requests data and information to characterize the distribution of ESEMs by sector (commercial, industrial, and residential sectors) as well as the distribution of ESEMs by application in each sector.

(11) DOE seeks data and additional information to characterize ESEM operating loads.

(12) DOE requests comment on the distribution of average annual operating hours by application and sector used to characterize the variability in energy use for ESEMs

(13) DOE seeks data and additional information to support the analysis of projected energy use impacts related to any increases in motor nominal speed.

(14) DOE requests data and information regarding the most appropriate price trend to use to project ESEM prices.

(15) DOE requests comment on whether any of the efficiency levels considered in this NOPR might lead to an increase in installation costs, and if so, DOE seeks supporting data regarding the magnitude of the increased cost per unit for each relevant efficiency level and the reasons for those differences.

(16) DOE requests comment on whether any of the efficiency levels considered in this NOPR might lead to an increase in maintenance and repair costs, and if so, DOE seeks supporting data regarding the magnitude of the increased cost per unit for each relevant efficiency level and the reasons for those differences.

(17) DOE requests comment on the equipment lifetimes (both in years and in mechanical hours) used for each representative unit considered in the LCC and PBP analyses

(18) DOE seeks information and data to help establish efficiency distribution in the no-new standards case for ESEMs. DOE requests data and information on any trends in the electric motor market that could be used to forecast expected trends in market share by efficiency levels for each equipment class.

(19) DOE requests comment and additional data on its 2020 shipments estimates for ESEMs. DOE seeks comment on the methodology used to project future shipments of ESEMs. DOE seeks information on other data sources that can be used to estimate future shipments.

(20) DOE requests comment and data regarding the potential increase in utilization of electric motors due to any increase in efficiency (''rebound effect'').

(21) DOE requests comment and data on the overall methodology used for the consumer subgroup analysis. DOE requests comment on whether additional consumer subgroups may be disproportionately affected by a new standard and warrant additional analysis in the final rule.

(22) DOE requests comment on how to address the climate benefits and non-monetized effects of the proposal.

(23) DOE requests comment on if manufacturers would have the engineering capacity to conduct design efforts to be able to offer a full portfolio of complaint ESEM at TSL 4. If not, please provide any data or information on the potential impacts that could arise due to these market gaps in equipment offerings.

(24) DOE requests comment on if manufacturers would have the engineering capacity to conduct design efforts to be able to offer a full portfolio of compliant ESEMs at TSL 3. If not, please provide any data or information

on the potential impacts that could arise due to these market gaps in equipment offerings.

(25) DOE seeks comment on these alternative proposed standard levels. DOE requests comment on the unintended market consequences and the changes industry would make as a result of standards that require the use of different motor technologies for non-air over and AO–ESEMs. In addition, if DOE were to consider a TSL that would require TSL 2 for all equipment classes except TSL3 efficiency levels for low torque ESEMs, DOE seeks information related to potential ESEM size increase and impact on OEM markets at TSL 3 and above.

Additionally, DOE welcomes comments on other issues relevant to the conduct of this proposed rulemaking that may not specifically be identified in this document.

VIII. Approval of the Office of the Secretary

The Secretary of Energy has approved publication of this notice of proposed rulemaking and announcement of public meeting.

List of Subjects

10 CFR Part 429

Administrative practice and procedure, Confidential business information, Energy conservation, Household appliances, Reporting and recordkeeping requirements.

10 CFR Part 431

Administrative practice and procedure, Confidential business information, Energy conservation test procedures, and Reporting and recordkeeping requirements.

Signing Authority

This document of the Department of Energy was signed on November 21, 2023, by Jeffrey Marootian, Principal Deputy Assistant Secretary for Energy Efficiency and Renewable Energy, pursuant to delegated authority from the Secretary of Energy. That document with the original signature and date is maintained by DOE. For administrative purposes only, and in compliance with requirements of the Office of the Federal Register, the undersigned DOE Federal Register Liaison Officer has been authorized to sign and submit the document in electronic format for publication, as an official document of the Department of Energy. This administrative process in no way alters the legal effect of this document upon publication in the **Federal Register**.

Signed in Washington, DC, on November 29, 2023.

Treena V. Garrett,

Federal Register Liaison Officer, U.S. Department of Energy.

For the reasons set forth in the preamble, DOE is proposing 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: 2 U.S.C. 6291–6317; 28 U.S.C. 2461 note.

■ 2. Amend § 429.64 by:

■ a. Revising paragraphs (a)(3) and (d)(2);

■ b. Revising paragraphs (e) introductory text and (e)(1)(iii);

■ c. Redesignating paragraph (e)(1)(iv) as paragraph (e)(1)(v);

■ d. Adding paragraph (e)(1)(iv); and

■ e. Revising paragraphs (e)(2) introductory text and (e)(2)(ii).

The revisions and addition read as follows:

§ 429.64 Electric motors.

(a) * * *

(3) On or after April 17, 2023, manufacturers of electric motors that are subject to the test procedures in appendix B of subpart B of part 431 but are not subject to the energy conservation standards in subpart B of part 431 of this subchapter, must, if they chose to voluntarily make representations of energy efficiency, follow the provisions in paragraph (e) of this section.

* * * * *

(d) * * *

(2) Testing was conducted using a laboratory other than an accredited laboratory that meets the requirements of paragraph (f) of this section, or the represented value of the electric motor basic model was determined through the application of an AEDM pursuant to the requirements of § 429.70(j), and a third-party certification organization that is nationally recognized in the United States under § 429.73 has certified the represented value of the electric motor basic model through issuance of a certificate of conformity for the basic model.

(e) *Determination of represented value.* Manufacturers of electric motors that are subject to energy conservation standards in subpart B of part 431 of this subchapter, and for which minimum values of nominal full-load efficiency are prescribed, must determine the represented value of nominal full-load efficiency (inclusive of the inverter for inverter-only electric motors) for each basic model of electric motor either by testing in conjunction with the applicable sampling provisions or by applying an AEDM as set forth in this section and in § 429.70(j). Manufacturers of electric motors that are subject to energy conservation standards in subpart B of part 431 of this subchapter, and for which minimum values of average full-load efficiency are prescribed, must determine the represented value of average full-load efficiency (inclusive of the inverter for inverter-only electric motors) for each basic model of electric motor either by testing in conjunction with the applicable sampling provisions or by applying an AEDM as set forth in this section and in § 429.70(j).

(1) * * *

(iii) *Nominal Full-load Efficiency.* Manufacturers of electric motors that are subject to energy conservation standards in subpart B of part 431 of this subchapter, and for which minimum values of nominal full-load efficiency are prescribed, must determine the nominal full-load efficiency by selecting an efficiency from the ''Nominal Full-load Efficiency'' table in appendix B that is no greater than the average full-load efficiency of the basic model as calculated in paragraph (e)(1)(ii) of this section.

(iv) *Represented value.* For electric motors subject to energy conservation standards in subpart B of part 431 of this subchapter and for which minimum values of nominal full-load efficiency are prescribed the represented value is the nominal full-load efficiency of a basic model of electric motor and is to be used in marketing materials and all public representations, as the certified value of efficiency, and on the nameplate. (See § 431.31(a) of this subchapter.) For electric motors subject to energy conservation standards in subpart B of part 431 of this subchapter and for which minimum values of average full-load efficiency are prescribed the represented value is the average full-load efficiency of a basic model of electric motor and is to be used in marketing materials and all public representations, as the certified value of efficiency, and on the nameplate. (See § 431.31(a) of this subchapter.)

* * * * *

(2) *Alternative efficiency determination methods.* In lieu of

testing, the represented value of a basic model of electric motor must be determined through the application of an AEDM pursuant to the requirements of § 429.70(j) and the provisions of this section, where:

* * * * *

(ii) For electric motors subject to energy conservation standards in subpart B of part 431 of this subchapter and for which minimum values of nominal full-load efficiency are prescribed the represented value is the nominal full-load efficiency of a basic model of electric motor and is to be used in marketing materials and all public representations, as the certified value of efficiency, and on the nameplate. (See § 431.31(a) of this subchapter) Determine the nominal full-load efficiency by selecting a value from the ''Nominal Full-Load Efficiency'' table in appendix B to subpart B of this part, that is no greater than the simulated full-load efficiency predicted by the AEDM for the basic model. For electric motors subject to energy conservation standards in subpart B of part 431 of this subchapter and for which minimum values of average full-load efficiency are prescribed the represented value is the average full-load efficiency of a basic model of electric motor and is to be used in marketing materials and all public representations, as the certified value of efficiency, and on the nameplate. (See § 431.31(a) of this subchapter.)

* * * * *

■ 3. Amend § 429.70 by revising paragraph (j)(2)(i)(D) to read as follows:

§ 429.70 Alternative methods for determining energy efficiency and energy use.

* * * * *

(j) * * *

(2) * * *

(i) * * *

(D) Each basic model must have the lowest represented value of nominal full-load efficiency or represented value of average full-load efficiency, as applicable, among the basic models within the same equipment class.

* * * * *

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

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

Authority: 42 U.S.C. 6291–6317; 28 U.S.C. 2461 note.

■ 5. Amend § 431.12 by adding in alphabetical order definitions for ''Capacitor start capacitor run motor'', ''Capacitor start induction run motor'', ''Permanent split capacitor motor'', ''Polyphase motor'', ''Shaded pole motor'', and ''Split-phase motor'' to read as follows:

§ 431.12 Definitions.

* * * * *

Capacitor start capacitor run motor means a single-phase induction electric motor equipped with a start capacitor to provide the starting torque, as well as a run capacitor to maintain a running torque while the motor is loaded.

Capacitor start induction run motor means a single-phase induction electric motor equipped with a start capacitor to provide the starting torque, which is capable of operating without a run capacitor.

* * * * *

Permanent split capacitor motor means a single-phase induction electric motor that has a capacitor permanently connected in series with the starting winding of the motor and is permanently connected in the circuit both at starting and running conditions of the motor.

* * * * *

Polyphase motor means an electric motor that has a stator containing multiple distinct windings per motor pole, driven by corresponding time-shifted sine waves.

* * * * *

Shaded pole motor means a self-starting single-phase induction electric motor with a copper ring shading one of the poles.

* * * * *

Split-phase motor means a single-phase induction electric motor that possesses two windings: a main/running winding, and a starting/auxiliary winding.

* * * * *

■ 6. Revise § 431.25 to read as follows:

§ 431.25 Energy conservation standards and effective dates.

(a) For purposes of determining the required minimum nominal full-load efficiency or minimum average full-load efficiency of an electric motor that has a horsepower or kilowatt rating between two horsepower or two kilowatt ratings listed in any table of energy conservation standards in paragraphs (b) through (d) of this section, each such electric motor shall be deemed to have a listed horsepower or kilowatt rating, determined as follows:

(1) A horsepower at or above the midpoint between the two consecutive horsepowers shall be rounded up to the higher of the two horsepowers;

(2) A horsepower below the midpoint between the two consecutive horsepowers shall be rounded down to the lower of the two horsepowers; or

(3) A kilowatt rating shall be directly converted from kilowatts to horsepower using the formula 1 kilowatt = ($1/0.746$) horsepower. The conversion should be calculated to three significant decimal places, and the resulting horsepower shall be rounded in accordance with paragraph (a)(1) or (a)(2) of this section, whichever applies.

(b) This section applies to electric motors manufactured (alone or as a component of another piece of equipment) on or after June 1, 2016, but before June 1, 2027, that satisfy the criteria in paragraph (b)(1)(i) of this section, with the exclusion listed in paragraph (b)(1)(ii) of this section.

(1) *Scope.* (i) The standards in paragraph (b)(2) of this section apply only to electric motors, including partial electric motors, that satisfy the following criteria:

(A) Are single-speed, induction motors;

(B) Are rated for continuous duty (MG 1) operation or for duty type S1 (IEC);

(C) Contain a squirrel-cage (MG 1) or cage (IEC) rotor;

(D) Operate on polyphase alternating current 60-hertz sinusoidal line power;

(E) Are rated 600 volts or less;

(F) Have a 2-, 4-, 6-, or 8-pole configuration,

(G) Are built in a three-digit or four-digit NEMA frame size (or IEC metric equivalent), including those designs between two consecutive NEMA frame sizes (or IEC metric equivalent), or an enclosed 56 NEMA frame size (or IEC metric equivalent),

(H) Produce at least one horsepower (0.746 kW) but not greater than 500 horsepower (373 kW); and

(I) Meet all of the performance requirements of one of the following motor types: A NEMA Design A, B, or C motor or an IEC Design N, NE, NEY, NY or H, HE, HEY, HY motor.

(ii) The standards in paragraph (b)(2) of this section do not apply to the following electric motors exempted by the Secretary, or any additional electric motors that the Secretary may exempt:

(A) Air-over electric motors;

(B) Component sets of an electric motor;

(C) Liquid-cooled electric motors;

(D) Submersible electric motors; and

(E) Inverter-only electric motors.

(2) *Standards.* (i) Each NEMA Design A motor, NEMA Design B motor, and IEC Design N (including NE, NEY, or NY variants) motor that is an electric motor meeting the criteria in paragraph (b)(1) of this section and with a power

rating from 1 horsepower through 500 horsepower, but excluding fire pump electric motors, shall have a nominal full-load efficiency of not less than the following:

TABLE 1 TO PARAGRAPH (b)(2)(i)—NOMINAL FULL-LOAD EFFICIENCIES OF NEMA DESIGN A, NEMA DESIGN B AND IEC DESIGN N, NE, NEY OR NY MOTORS (EXCLUDING FIRE PUMP ELECTRIC MOTORS) AT 60 Hz

Motor horsepower/standard kilowatt equivalent	Nominal full-load efficiency (%)							
	2 Pole		4 Pole		6 Pole		8 Pole	
	Enclosed	Open	Enclosed	Open	Enclosed	Open	Enclosed	Open
1/.75	77.0	77.0	85.5	85.5	82.5	82.5	75.5	75.5
1.5/1.1	84.0	84.0	86.5	86.5	87.5	86.5	78.5	77.0
2/1.5	85.5	85.5	86.5	86.5	88.5	87.5	84.0	86.5
3/2.2	86.5	85.5	89.5	89.5	89.5	88.5	85.5	87.5
5/3.7	88.5	86.5	89.5	89.5	89.5	89.5	86.5	88.5
7.5/5.5	89.5	88.5	91.7	91.0	91.0	90.2	86.5	89.5
10/7.5	90.2	89.5	91.7	91.7	91.0	91.7	89.5	90.2
15/11	91.0	90.2	92.4	93.0	91.7	91.7	89.5	90.2
20/15	91.0	91.0	93.0	93.0	91.7	92.4	90.2	91.0
25/18.5	91.7	91.7	93.6	93.6	93.0	93.0	90.2	91.0
30/22	91.7	91.7	93.6	94.1	93.0	93.6	91.7	91.7
40/30	92.4	92.4	94.1	94.1	94.1	94.1	91.7	91.7
50/37	93.0	93.0	94.5	94.5	94.1	94.1	92.4	92.4
60/45	93.6	93.6	95.0	95.0	94.5	94.5	92.4	93.0
75/55	93.6	93.6	95.4	95.0	94.5	94.5	93.6	94.1
100/75	94.1	93.6	95.4	95.4	95.0	95.0	93.6	94.1
125/90	95.0	94.1	95.4	95.4	95.0	95.0	94.1	94.1
150/110	95.0	94.1	95.8	95.8	95.8	95.4	94.1	94.1
200/150	95.4	95.0	96.2	95.8	95.8	95.4	94.5	94.1
250/186	95.8	95.0	96.2	95.8	95.8	95.8	95.0	95.0
300/224	95.8	95.4	96.2	95.8	95.8	95.8		
350/261	95.8	95.4	96.2	95.8	95.8	95.8		
400/298	95.8	95.8	96.2	95.8				
450/336	95.8	96.2	96.2	96.2				
500/373	95.8	96.2	96.2	96.2				

(ii) Each NEMA Design C motor and IEC Design H (including HE, HEY, or HY variants) electric motor meeting the criteria in paragraph (b)(1) of this section and with a power rating from 1 horsepower through 200 horsepower, shall have a nominal full-load efficiency that is not less than the following:

TABLE 2 TO PARAGRAPH (b)(2)(ii)—NOMINAL FULL-LOAD EFFICIENCIES OF NEMA DESIGN C AND IEC DESIGN H, HE, HEY OR HY MOTORS AT 60 Hz

Motor horsepower/standard kilowatt equivalent	Nominal full-load efficiency (%)					
	4 Pole		6 Pole		8 Pole	
	Enclosed	Open	Enclosed	Open	Enclosed	Open
1/.75	85.5	85.5	82.5	82.5	75.5	75.5
1.5/1.1	86.5	86.5	87.5	86.5	78.5	77.0
2/1.5	86.5	86.5	88.5	87.5	84.0	86.5
3/2.2	89.5	89.5	89.5	88.5	85.5	87.5
5/3.7	89.5	89.5	89.5	89.5	86.5	88.5
7.5/5.5	91.7	91.0	91.0	90.2	86.5	89.5
10/7.5	91.7	91.7	91.0	91.7	89.5	90.2
15/11	92.4	93.0	91.7	91.7	89.5	90.2
20/15	93.0	93.0	91.7	92.4	90.2	91.0
25/18.5	93.6	93.6	93.0	93.0	90.2	91.0
30/22	93.6	94.1	93.0	93.6	91.7	91.7
40/30	94.1	94.1	94.1	94.1	91.7	91.7
50/37	94.5	94.5	94.1	94.1	92.4	92.4
60/45	95.0	95.0	94.5	94.5	92.4	93.0
75/55	95.4	95.0	94.5	94.5	93.6	94.1
100/75	95.4	95.4	95.0	95.0	93.6	94.1
125/90	95.4	95.4	95.0	95.0	94.1	94.1
150/110	95.8	95.8	95.8	95.4	94.1	94.1
200/150	96.2	95.8	95.8	95.4	94.5	94.1

(iii) Each fire pump electric motor meeting the criteria in paragraph (b)(1) of this section and with a power rating of 1 horsepower through 500 horsepower, shall have a nominal full-load efficiency that is not less than the following:

TABLE 3 TO PARAGRAPH (b)(2)(iii)—NOMINAL FULL-LOAD EFFICIENCIES OF FIRE PUMP ELECTRIC MOTORS AT 60 Hz

Motor horsepower/standard kilowatt equivalent	Nominal full-load efficiency (%)							
	2 Pole		4 Pole		6 Pole		8 Pole	
	Enclosed	Open	Enclosed	Open	Enclosed	Open	Enclosed	Open
1/.75	75.5	....	82.5	82.5	80.0	80.0	74.0	74.0
1.5/1.1	82.5	82.5	84.0	84.0	85.5	84.0	77.0	75.5
2/1.5	84.0	84.0	84.0	84.0	86.5	85.5	82.5	85.5
3/2.2	85.5	84.0	87.5	86.5	87.5	86.5	84.0	86.5
5/3.7	87.5	85.5	87.5	87.5	87.5	87.5	85.5	87.5
7.5/5.5	88.5	87.5	89.5	88.5	89.5	88.5	85.5	88.5
10/7.5	89.5	88.5	89.5	89.5	89.5	90.2	88.5	89.5
15/11	90.2	89.5	91.0	91.0	90.2	90.2	88.5	89.5
20/15	90.2	90.2	91.0	91.0	90.2	91.0	89.5	90.2
25/18.5	91.0	91.0	92.4	91.7	91.7	91.7	89.5	90.2
30/22	91.0	91.0	92.4	92.4	91.7	92.4	91.0	91.0
40/30	91.7	91.7	93.0	93.0	93.0	93.0	91.0	91.0
50/37	92.4	92.4	93.0	93.0	93.0	93.0	91.7	91.7
60/45	93.0	93.0	93.6	93.6	93.6	93.6	91.7	92.4
75/55	93.0	93.0	94.1	94.1	93.6	93.6	93.0	93.6
100/75	93.6	93.0	94.5	94.1	94.1	94.1	93.0	93.6
125/90	94.5	93.6	94.5	94.5	94.1	94.1	93.6	93.6
150/110	94.5	93.6	95.0	95.0	95.0	94.5	93.6	93.6
200/150	95.0	94.5	95.0	95.0	95.0	94.5	94.1	93.6
250/186	95.4	94.5	95.0	95.4	95.0	95.4	94.5	94.5
300/224	95.4	95.0	95.4	95.4	95.0	95.4	....	....
350/261	95.4	95.0	95.4	95.4	95.0	95.4	....	....
400/298	95.4	95.4	95.4	95.4	....	....	....	....
450/336	95.4	95.8	95.4	95.8	....	....	....	....
500/373	95.4	95.8	95.8	95.8	....	....	....	....

(c) This section applies to electric motors manufactured (alone or as a component of another piece of equipment) on or after June 1, 2027, but before January 1, 2029, that satisfy the criteria in paragraph (c)(1)(i) of this section, with the exclusion listed in paragraph (c)(1)(ii) of this section.

(1) *Scope.* (i) The standards in paragraph (c)(2) of this section apply only to electric motors, including partial electric motors, that satisfy the following criteria:

(A) Are single-speed, induction motors;

(B) Are rated for continuous duty (MG 1) operation or for duty type S1 (IEC);

(C) Contain a squirrel-cage (MG 1) or cage (IEC) rotor;

(D) Operate on polyphase alternating current 60-hertz sinusoidal line power;

(E) Are rated 600 volts or less;

(F) Have a 2-, 4-, 6-, or 8-pole configuration,

(G) Are built in a three-digit or four-digit NEMA frame size (or IEC metric equivalent), including those designs between two consecutive NEMA frame sizes (or IEC metric equivalent), or an enclosed 56 NEMA frame size (or IEC metric equivalent), or have an air-over enclosure and a specialized frame size,

(H) Produce at least one horsepower (0.746 kW) but not greater than 750 horsepower (559 kW); and

(I) Meet all of the performance requirements of one of the following motor types: A NEMA Design A, B, or C motor or an IEC Design N, NE, NEY, NY or H, HE, HEY, HY motor.

(ii) The standards in paragraph (c)(2) of this section do not apply to the following electric motors exempted by the Secretary, or any additional electric motors that the Secretary may exempt:

(A) Component sets of an electric motor;

(B) Liquid-cooled electric motors;

(C) Submersible electric motors; and

(D) Inverter-only electric motors.

(2) *Standards.* (i) Each NEMA Design A motor, NEMA Design B motor, and IEC Design N (including NE, NEY, or NY variants) motor that is an electric motor meeting the criteria in paragraph (c)(1) of this section but excluding fire pump electric motors and air-over electric motors, and with a power rating from 1 horsepower through 750 horsepower, shall have a nominal full-load efficiency of not less than the following:

TABLE 4 TO PARAGRAPH (c)(2)(i)—NOMINAL FULL-LOAD EFFICIENCIES OF NEMA DESIGN A, NEMA DESIGN B AND IEC DESIGN N, NE, NEY OR NY MOTORS (EXCLUDING FIRE PUMP ELECTRIC MOTORS AND AIR-OVER ELECTRIC MOTORS) AT 60 Hz

Motor horsepower/standard kilowatt equivalent	Nominal full-load efficiency (%)							
	2 Pole		4 Pole		6 Pole		8 Pole	
	Enclosed	Open	Enclosed	Open	Enclosed	Open	Enclosed	Open
1/.75	77.0	77.0	85.5	85.5	82.5	82.5	75.5	75.5
1.5/1.1	84.0	84.0	86.5	86.5	87.5	86.5	78.5	77.0

TABLE 4 TO PARAGRAPH (c)(2)(i)—NOMINAL FULL-LOAD EFFICIENCIES OF NEMA DESIGN A, NEMA DESIGN B AND IEC DESIGN N, NE, NEY OR NY MOTORS (EXCLUDING FIRE PUMP ELECTRIC MOTORS AND AIR-OVER ELECTRIC MOTORS) AT 60 Hz—Continued

Motor horsepower/standard kilowatt equivalent	Nominal full-load efficiency (%)							
	2 Pole		4 Pole		6 Pole		8 Pole	
	Enclosed	Open	Enclosed	Open	Enclosed	Open	Enclosed	Open
2/1.5	85.5	85.5	86.5	86.5	88.5	87.5	84.0	86.5
3/2.2	86.5	85.5	89.5	89.5	89.5	88.5	85.5	87.5
5/3.7	88.5	86.5	89.5	89.5	89.5	89.5	86.5	88.5
7.5/5.5	89.5	88.5	91.7	91.0	91.0	90.2	86.5	89.5
10/7.5	90.2	89.5	91.7	91.7	91.0	91.7	89.5	90.2
15/11	91.0	90.2	92.4	93.0	91.7	91.7	89.5	90.2
20/15	91.0	91.0	93.0	93.0	91.7	92.4	90.2	91.0
25/18.5	91.7	91.7	93.6	93.6	93.0	93.0	90.2	91.0
30/22	91.7	91.7	93.6	94.1	93.0	93.6	91.7	91.7
40/30	92.4	92.4	94.1	94.1	94.1	94.1	91.7	91.7
50/37	93.0	93.0	94.5	94.5	94.1	94.1	92.4	92.4
60/45	93.6	93.6	95.0	95.0	94.5	94.5	92.4	93.0
75/55	93.6	93.6	95.4	95.0	94.5	94.5	93.6	94.1
100/75	95.0	94.5	96.2	96.2	95.8	95.8	94.5	95.0
125/90	95.4	94.5	96.2	96.2	95.8	95.8	95.0	95.0
150/110	95.4	94.5	96.2	96.2	96.2	95.8	95.0	95.0
200/150	95.8	95.4	96.5	96.2	96.2	95.8	95.4	95.0
250/186	96.2	95.4	96.5	96.2	96.2	96.2	95.4	95.4
300/224	95.8	95.4	96.2	95.8	95.8	95.8		
350/261	95.8	95.4	96.2	95.8	95.8	95.8		
400/298	95.8	95.8	96.2	95.8				
450/336	95.8	96.2	96.2	96.2				
500/373	95.8	96.2	96.2	96.2				
550/410	95.8	96.2	96.2	96.2				
600/447	95.8	96.2	96.2	96.2				
650/485	95.8	96.2	96.2	96.2				
700/522	95.8	96.2	96.2	96.2				
750/559	95.8	96.2	96.2	96.2				

(ii) Each NEMA Design A motor, NEMA Design B motor, and IEC Design N (including NE, NEY, or NY variants) motor that is an air-over electric motor meeting the criteria in paragraph (c)(1) of this section, but excluding fire pump electric motors, and with a power rating from 1 horsepower through 250 horsepower, built in a standard frame size, shall have a nominal full-load efficiency of not less than the following:

TABLE 5 TO PARAGRAPH (c)(2)(ii)—NOMINAL FULL-LOAD EFFICIENCIES OF NEMA DESIGN A, NEMA DESIGN B AND IEC DESIGN N, NE, NEY OR NY STANDARD FRAME SIZE AIR-OVER ELECTRIC MOTORS (EXCLUDING FIRE PUMP ELECTRIC MOTORS) AT 60 Hz

Motor horsepower/standard kilowatt equivalent	Nominal full-load efficiency (%)							
	2 Pole		4 Pole		6 Pole		8 Pole	
	Enclosed	Open	Enclosed	Open	Enclosed	Open	Enclosed	Open
1/.75	77.0	77.0	85.5	85.5	82.5	82.5	75.5	75.5
1.5/1.1	84.0	84.0	86.5	86.5	87.5	86.5	78.5	77.0
2/1.5	85.5	85.5	86.5	86.5	88.5	87.5	84.0	86.5
3/2.2	86.5	85.5	89.5	89.5	89.5	88.5	85.5	87.5
5/3.7	88.5	86.5	89.5	89.5	89.5	89.5	86.5	88.5
7.5/5.5	89.5	88.5	91.7	91.0	91.0	90.2	86.5	89.5
10/7.5	90.2	89.5	91.7	91.7	91.0	91.7	89.5	90.2
15/11	91.0	90.2	92.4	93.0	91.7	91.7	89.5	90.2
20/15	91.0	91.0	93.0	93.0	91.7	92.4	90.2	91.0
25/18.5	91.7	91.7	93.6	93.6	93.0	93.0	90.2	91.0
30/22	91.7	91.7	93.6	94.1	93.0	93.6	91.7	91.7
40/30	92.4	92.4	94.1	94.1	94.1	94.1	91.7	91.7
50/37	93.0	93.0	94.5	94.5	94.1	94.1	92.4	92.4
60/45	93.6	93.6	95.0	95.0	94.5	94.5	92.4	93.0
75/55	93.6	93.6	95.4	95.0	94.5	94.5	93.6	94.1
100/75	95.0	94.5	96.2	96.2	95.8	95.8	94.5	95.0
125/90	95.4	94.5	96.2	96.2	95.8	95.8	95.0	95.0
150/110	95.4	94.5	96.2	96.2	96.2	95.8	95.0	95.0
200/150	95.8	95.4	96.5	96.2	96.2	95.8	95.4	95.0

TABLE 5 TO PARAGRAPH (c)(2)(ii)—NOMINAL FULL-LOAD EFFICIENCIES OF NEMA DESIGN A, NEMA DESIGN B AND IEC DESIGN N, NE, NEY OR NY STANDARD FRAME SIZE AIR-OVER ELECTRIC MOTORS (EXCLUDING FIRE PUMP ELECTRIC MOTORS) AT 60 Hz—Continued

Motor horsepower/standard kilowatt equivalent	Nominal full-load efficiency (%)							
	2 Pole		4 Pole		6 Pole		8 Pole	
	Enclosed	Open	Enclosed	Open	Enclosed	Open	Enclosed	Open
250/186	96.2	95.4	96.5	96.2	96.2	96.2	95.4	95.4

(iii) Each NEMA Design A motor, NEMA Design B motor, and IEC Design N (including NE, NEY, or NY variants) motor that is an air-over electric motor meeting the criteria in paragraph (c)(1) of this section, but excluding fire pump electric motors, and with a power rating from 1 horsepower through 20 horsepower, built in a specialized frame size, shall have a nominal full-load efficiency of not less than the following:

TABLE 6 TO PARAGRAPH (c)(2)(iii)—NOMINAL FULL-LOAD EFFICIENCIES OF NEMA DESIGN A, NEMA DESIGN B AND IEC DESIGN N, NE, NEY OR NY SPECIALIZED FRAME SIZE AIR-OVER ELECTRIC MOTORS (EXCLUDING FIRE PUMP ELECTRIC MOTORS) AT 60 Hz

Motor horsepower/standard kilowatt equivalent	Nominal full-load efficiency (%)							
	2 Pole		4 Pole		6 Pole		8 Pole	
	Enclosed	Open	Enclosed	Open	Enclosed	Open	Enclosed	Open
1/.75	74.0	....	82.5	82.5	80.0	80.0	74.0	74.0
1.5/1.1	82.5	82.5	84.0	84.0	85.5	84.0	77.0	75.5
2/1.5	84.0	84.0	84.0	84.0	86.5	85.5	82.5	85.5
3/2.2	85.5	84.0	87.5	86.5	87.5	86.5	84.0	86.5
5/3.7	87.5	85.5	87.5	87.5	87.5	87.5	85.5	87.5
7.5/5.5	88.5	87.5	89.5	88.5	89.5	88.5	85.5	88.5
10/7.5	89.5	88.5	89.5	89.5	89.5	90.2	....	....
15/11	90.2	89.5	91.0	91.0	....	....	....	....
20/15	90.2	90.2	91.0	91.0	....	....	....	....

(iv) Each NEMA Design C motor and IEC Design H (including HE, HEY, or HY variants) electric motor meeting the criteria in paragraph (c)(1) of this section but excluding air-over electric motors and with a power rating from 1 horsepower through 200 horsepower, shall have a nominal full-load efficiency that is not less than the following:

TABLE 7 TO PARAGRAPH (c)(2)(iv)—NOMINAL FULL-LOAD EFFICIENCIES OF NEMA DESIGN C AND IEC DESIGN H, HE, HEY OR HY MOTORS (EXCLUDING AIR-OVER ELECTRIC MOTORS) AT 60 Hz

Motor horsepower/standard kilowatt equivalent	Nominal full-load efficiency (%)					
	4 Pole		6 Pole		8 Pole	
	Enclosed	Open	Enclosed	Open	Enclosed	Open
1/.75	85.5	85.5	82.5	82.5	75.5	75.5
1.5/1.1	86.5	86.5	87.5	86.5	78.5	77.0
2/1.5	86.5	86.5	88.5	87.5	84.0	86.5
3/2.2	89.5	89.5	89.5	88.5	85.5	87.5
5/3.7	89.5	89.5	89.5	89.5	86.5	88.5
7.5/5.5	91.7	91.0	91.0	90.2	86.5	89.5
10/7.5	91.7	91.7	91.0	91.7	89.5	90.2
15/11	92.4	93.0	91.7	91.7	89.5	90.2
20/15	93.0	93.0	91.7	92.4	90.2	91.0
25/18.5	93.6	93.6	93.0	93.0	90.2	91.0
30/22	93.6	94.1	93.0	93.6	91.7	91.7
40/30	94.1	94.1	94.1	94.1	91.7	91.7
50/37	94.5	94.5	94.1	94.1	92.4	92.4
60/45	95.0	95.0	94.5	94.5	92.4	93.0
75/55	95.4	95.0	94.5	94.5	93.6	94.1
100/75	95.4	95.4	95.0	95.0	93.6	94.1
125/90	95.4	95.4	95.0	95.0	94.1	94.1
150/110	95.8	95.8	95.8	95.4	94.1	94.1
200/150	96.2	95.8	95.8	95.4	94.5	94.1

(v) Each fire pump electric motor meeting the criteria in paragraph (c)(1) of this section, but excluding air-over electric motors, and with a power rating of 1 horsepower through 500 horsepower, shall have a nominal full-load efficiency that is not less than the following:

TABLE 8 TO PARAGRAPH (c)(2)(v)—NOMINAL FULL-LOAD EFFICIENCIES OF FIRE PUMP ELECTRIC MOTORS (EXCLUDING AIR-OVER ELECTRIC MOTORS) AT 60 HZ

Motor horsepower/standard kilowatt equivalent	Nominal full-load efficiency (%)							
	2 Pole		4 Pole		6 Pole		8 Pole	
	Enclosed	Open	Enclosed	Open	Enclosed	Open	Enclosed	Open
1/.75	75.5	....	82.5	82.5	80.0	80.0	74.0	74.0
1.5/1.1	82.5	82.5	84.0	84.0	85.5	84.0	77.0	75.5
2/1.5	84.0	84.0	84.0	84.0	86.5	85.5	82.5	85.5
3/2.2	85.5	84.0	87.5	86.5	87.5	86.5	84.0	86.5
5/3.7	87.5	85.5	87.5	87.5	87.5	87.5	85.5	87.5
7.5/5.5	88.5	87.5	89.5	88.5	89.5	88.5	85.5	88.5
10/7.5	89.5	88.5	89.5	89.5	89.5	90.2	88.5	89.5
15/11	90.2	89.5	91.0	91.0	90.2	90.2	88.5	89.5
20/15	90.2	90.2	91.0	91.0	90.2	91.0	89.5	90.2
25/18.5	91.0	91.0	92.4	91.7	91.7	91.7	89.5	90.2
30/22	91.0	91.0	92.4	92.4	91.7	92.4	91.0	91.0
40/30	91.7	91.7	93.0	93.0	93.0	93.0	91.0	91.0
50/37	92.4	92.4	93.0	93.0	93.0	93.0	91.7	91.7
60/45	93.0	93.0	93.6	93.6	93.6	93.6	91.7	92.4
75/55	93.0	93.0	94.1	94.1	93.6	93.6	93.0	93.6
100/75	93.6	93.0	94.5	94.1	94.1	94.1	93.0	93.6
125/90	94.5	93.6	94.5	94.5	94.1	94.1	93.6	93.6
150/110	94.5	93.6	95.0	95.0	95.0	94.5	93.6	93.6
200/150	95.0	94.5	95.0	95.0	95.0	94.5	94.1	93.6
250/186	95.4	94.5	95.0	95.4	95.0	95.4	94.5	94.5
300/224	95.4	95.0	95.4	95.4	95.0	95.4	....	....
350/261	95.4	95.0	95.4	95.4	95.0	95.4	....	....
400/298	95.4	95.4	95.4	95.4	....	....	....	....
450/336	95.4	95.8	95.4	95.8	....	....	....	....
500/373	95.4	95.8	95.8	95.8	....	....	....	....

(d) This section applies to electric motors manufactured (alone or as a component of another piece of equipment) on or after January 1, 2029.

(1) The standards in paragraph (d)(1)(ii) of this section apply only to electric motors that satisfy the criteria in paragraph (d)(1)(i)(A) of this section and with the exclusion listed in paragraph (d)(1)(i)(B) of this section.

(i) *Scope.* (A) The standards in paragraph (d)(1)(ii) of this section apply only to electric motors, including partial electric motors, that satisfy the following criteria:

(*1*) Are single-speed, induction motors;

(*2*) Are rated for continuous duty (MG 1) operation or for duty type S1 (IEC);

(*3*) Contain a squirrel-cage (MG 1) or cage (IEC) rotor;

(*4*) Operate on polyphase alternating current 60-hertz sinusoidal line power;

(*5*) Are rated 600 volts or less;

(*6*) Have a 2-, 4-, 6-, or 8-pole configuration,

(*7*) Are built in a three-digit or four-digit NEMA frame size (or IEC metric equivalent), including those designs between two consecutive NEMA frame sizes (or IEC metric equivalent), or an enclosed 56 NEMA frame size (or IEC metric equivalent), or have an air-over enclosure and a specialized frame size,

(*8*) Produce at least one horsepower (0.746 kW) but not greater than 750 horsepower (559 kW); and

(*9*) Meet all of the performance requirements of one of the following motor types: A NEMA Design A, B, or C motor or an IEC Design N, NE, NEY, NY or H, HE, HEY, HY motor.

(B) The standards in paragraph (d)(1)(ii) of this section do not apply to the following electric motors exempted by the Secretary, or any additional electric motors that the Secretary may exempt:

(*1*) Component sets of an electric motor;

(*2*) Liquid-cooled electric motors;

(*3*) Submersible electric motors; and

(*4*) Inverter-only electric motors.

(ii) *Standards.* (A) Each NEMA Design A motor, NEMA Design B motor, and IEC Design N (including NE, NEY, or NY variants) motor that is an electric motor meeting the criteria in paragraph (d)(1)(i) of this section but excluding fire pump electric motors and air-over electric motors, and with a power rating from 1 horsepower through 750 horsepower, shall have a nominal full-load efficiency of not less than the following:

TABLE 9 TO PARAGRAPH (d)(1)(ii)(A)—NOMINAL FULL-LOAD EFFICIENCIES OF NEMA DESIGN A, NEMA DESIGN B AND IEC DESIGN N, NE, NEY OR NY MOTORS (EXCLUDING FIRE PUMP ELECTRIC MOTORS AND AIR-OVER ELECTRIC MOTORS) AT 60 Hz

Motor horsepower/standard kilowatt equivalent	Nominal full-load efficiency (%)							
	2 Pole		4 Pole		6 Pole		8 Pole	
	Enclosed	Open	Enclosed	Open	Enclosed	Open	Enclosed	Open
1/.75	77.0	77.0	85.5	85.5	82.5	82.5	75.5	75.5
1.5/1.1	84.0	84.0	86.5	86.5	87.5	86.5	78.5	77.0
2/1.5	85.5	85.5	86.5	86.5	88.5	87.5	84.0	86.5
3/2.2	86.5	85.5	89.5	89.5	89.5	88.5	85.5	87.5
5/3.7	88.5	86.5	89.5	89.5	89.5	89.5	86.5	88.5
7.5/5.5	89.5	88.5	91.7	91.0	91.0	90.2	86.5	89.5
10/7.5	90.2	89.5	91.7	91.7	91.0	91.7	89.5	90.2
15/11	91.0	90.2	92.4	93.0	91.7	91.7	89.5	90.2
20/15	91.0	91.0	93.0	93.0	91.7	92.4	90.2	91.0
25/18.5	91.7	91.7	93.6	93.6	93.0	93.0	90.2	91.0
30/22	91.7	91.7	93.6	94.1	93.0	93.6	91.7	91.7
40/30	92.4	92.4	94.1	94.1	94.1	94.1	91.7	91.7
50/37	93.0	93.0	94.5	94.5	94.1	94.1	92.4	92.4
60/45	93.6	93.6	95.0	95.0	94.5	94.5	92.4	93.0
75/55	93.6	93.6	95.4	95.0	94.5	94.5	93.6	94.1
100/75	95.0	94.5	96.2	96.2	95.8	95.8	94.5	95.0
125/90	95.4	94.5	96.2	96.2	95.8	95.8	95.0	95.0
150/110	95.4	94.5	96.2	96.2	96.2	95.8	95.0	95.0
200/150	95.8	95.4	96.5	96.2	96.2	95.8	95.4	95.0
250/186	96.2	95.4	96.5	96.2	96.2	96.2	95.4	95.4
300/224	95.8	95.4	96.2	95.8	95.8	95.8		
350/261	95.8	95.4	96.2	95.8	95.8	95.8		
400/298	95.8	95.8	96.2	95.8				
450/336	95.8	96.2	96.2	96.2				
500/373	95.8	96.2	96.2	96.2				
550/410	95.8	96.2	96.2	96.2				
600/447	95.8	96.2	96.2	96.2				
650/485	95.8	96.2	96.2	96.2				
700/522	95.8	96.2	96.2	96.2				
750/559	95.8	96.2	96.2	96.2				

(B) Each NEMA Design A motor, NEMA Design B motor, and IEC Design N (including NE, NEY, or NY variants) motor that is an air-over electric motor meeting the criteria in paragraph (d)(1)(i) of this section, but excluding fire pump electric motors, and with a power rating from 1 horsepower through 250 horsepower, built in a standard frame size, shall have a nominal full-load efficiency of not less than the following:

TABLE 10 TO PARAGRAPH (d)(1)(ii)(B)—NOMINAL FULL-LOAD EFFICIENCIES OF NEMA DESIGN A, NEMA DESIGN B AND IEC DESIGN N, NE, NEY OR NY STANDARD FRAME SIZE AIR-OVER ELECTRIC MOTORS (EXCLUDING FIRE PUMP ELECTRIC MOTORS) AT 60 Hz

Motor horsepower/standard kilowatt equivalent	Nominal full-load efficiency (%)							
	2 Pole		4 Pole		6 Pole		8 Pole	
	Enclosed	Open	Enclosed	Open	Enclosed	Open	Enclosed	Open
1/.75	77.0	77.0	85.5	85.5	82.5	82.5	75.5	75.5
1.5/1.1	84.0	84.0	86.5	86.5	87.5	86.5	78.5	77.0
2/1.5	85.5	85.5	86.5	86.5	88.5	87.5	84.0	86.5
3/2.2	86.5	85.5	89.5	89.5	89.5	88.5	85.5	87.5
5/3.7	88.5	86.5	89.5	89.5	89.5	89.5	86.5	88.5
7.5/5.5	89.5	88.5	91.7	91.0	91.0	90.2	86.5	89.5
10/7.5	90.2	89.5	91.7	91.7	91.0	91.7	89.5	90.2
15/11	91.0	90.2	92.4	93.0	91.7	91.7	89.5	90.2
20/15	91.0	91.0	93.0	93.0	91.7	92.4	90.2	91.0
25/18.5	91.7	91.7	93.6	93.6	93.0	93.0	90.2	91.0
30/22	91.7	91.7	93.6	94.1	93.0	93.6	91.7	91.7
40/30	92.4	92.4	94.1	94.1	94.1	94.1	91.7	91.7
50/37	93.0	93.0	94.5	94.5	94.1	94.1	92.4	92.4
60/45	93.6	93.6	95.0	95.0	94.5	94.5	92.4	93.0
75/55	93.6	93.6	95.4	95.0	94.5	94.5	93.6	94.1
100/75	95.0	94.5	96.2	96.2	95.8	95.8	94.5	95.0
125/90	95.4	94.5	96.2	96.2	95.8	95.8	95.0	95.0

TABLE 10 TO PARAGRAPH (d)(1)(ii)(B)—NOMINAL FULL-LOAD EFFICIENCIES OF NEMA DESIGN A, NEMA DESIGN B AND IEC DESIGN N, NE, NEY OR NY STANDARD FRAME SIZE AIR-OVER ELECTRIC MOTORS (EXCLUDING FIRE PUMP ELECTRIC MOTORS) AT 60 Hz—Continued

Motor horsepower/standard kilowatt equivalent	Nominal full-load efficiency (%)							
	2 Pole		4 Pole		6 Pole		8 Pole	
	Enclosed	Open	Enclosed	Open	Enclosed	Open	Enclosed	Open
150/110	95.4	94.5	96.2	96.2	96.2	95.8	95.0	95.0
200/150	95.8	95.4	96.5	96.2	96.2	95.8	95.4	95.0
250/186	96.2	95.4	96.5	96.2	96.2	96.2	95.4	95.4

(C) Each NEMA Design A motor, NEMA Design B motor, and IEC Design N (including NE, NEY, or NY variants) motor that is an air-over electric motor meeting the criteria in paragraph (d)(1)(i) of this section, but excluding fire pump electric motors, and with a power rating from 1 horsepower through 20 horsepower, built in a specialized frame size, shall have a nominal full-load efficiency of not less than the following:

TABLE 11 TO PARAGRAPH (d)(1)(ii)(C)—NOMINAL FULL-LOAD EFFICIENCIES OF NEMA DESIGN A, NEMA DESIGN B AND IEC DESIGN N, NE, NEY OR NY SPECIALIZED FRAME SIZE AIR-OVER ELECTRIC MOTORS (EXCLUDING FIRE PUMP ELECTRIC MOTORS) AT 60 Hz

Motor horsepower/standard kilowatt equivalent	Nominal full-load efficiency (%)							
	2 Pole		4 Pole		6 Pole		8 Pole	
	Enclosed	Open	Enclosed	Open	Enclosed	Open	Enclosed	Open
1/.75	74.0	....	82.5	82.5	80.0	80.0	74.0	74.0
1.5/1.1	82.5	82.5	84.0	84.0	85.5	84.0	77.0	75.5
2/1.5	84.0	84.0	84.0	84.0	86.5	85.5	82.5	85.5
3/2.2	85.5	84.0	87.5	86.5	87.5	86.5	84.0	86.5
5/3.7	87.5	85.5	87.5	87.5	87.5	87.5	85.5	87.5
7.5/5.5	88.5	87.5	89.5	88.5	89.5	88.5	85.5	88.5
10/7.5	89.5	88.5	89.5	89.5	89.5	90.2	....	....
15/11	90.2	89.5	91.0	91.0	....	....	....	....
20/15	90.2	90.2	91.0	91.0	....	....	....	....

(D) Each NEMA Design C motor and IEC Design H (including HE, HEY, or HY variants) electric motor meeting the criteria in paragraph (d)(1)(i) of this section but excluding air-over electric motors and with a power rating from 1 horsepower through 200 horsepower, shall have a nominal full-load efficiency that is not less than the following:

TABLE 12 TO PARAGRAPH (d)(1)(ii)(D)—NOMINAL FULL-LOAD EFFICIENCIES OF NEMA DESIGN C AND IEC DESIGN H, HE, HEY OR HY MOTORS (EXCLUDING AIR-OVER ELECTRIC MOTORS) AT 60 Hz

Motor horsepower/standard kilowatt equivalent	Nominal full-load efficiency (%)					
	4 Pole		6 Pole		8 Pole	
	Enclosed	Open	Enclosed	Open	Enclosed	Open
1/.75	85.5	85.5	82.5	82.5	75.5	75.5
1.5/1.1	86.5	86.5	87.5	86.5	78.5	77.0
2/1.5	86.5	86.5	88.5	87.5	84.0	86.5
3/2.2	89.5	89.5	89.5	88.5	85.5	87.5
5/3.7	89.5	89.5	89.5	89.5	86.5	88.5
7.5/5.5	91.7	91.0	91.0	90.2	86.5	89.5
10/7.5	91.7	91.7	91.0	91.7	89.5	90.2
15/11	92.4	93.0	91.7	91.7	89.5	90.2
20/15	93.0	93.0	91.7	92.4	90.2	91.0
25/18.5	93.6	93.6	93.0	93.0	90.2	91.0
30/22	93.6	94.1	93.0	93.6	91.7	91.7
40/30	94.1	94.1	94.1	94.1	91.7	91.7
50/37	94.5	94.5	94.1	94.1	92.4	92.4
60/45	95.0	95.0	94.5	94.5	92.4	93.0
75/55	95.4	95.0	94.5	94.5	93.6	94.1
100/75	95.4	95.4	95.0	95.0	93.6	94.1
125/90	95.4	95.4	95.0	95.0	94.1	94.1
150/110	95.8	95.8	95.8	95.4	94.1	94.1
200/150	96.2	95.8	95.8	95.4	94.5	94.1

(E) Each fire pump electric motor meeting the criteria in paragraph (d)(1)(i) of this section, but excluding air-over electric motors, and with a power rating of 1 horsepower through 500 horsepower, shall have a nominal full-load efficiency that is not less than the following:

TABLE 13 TO PARAGRAPH (d)(1)(ii)(E)—NOMINAL FULL-LOAD EFFICIENCIES OF FIRE PUMP ELECTRIC MOTORS (EXCLUDING AIR-OVER ELECTRIC MOTORS) AT 60 Hz

Motor horsepower/standard kilowatt equivalent	Nominal full-load efficiency (%)							
	2 Pole		4 Pole		6 Pole		8 Pole	
	Enclosed	Open	Enclosed	Open	Enclosed	Open	Enclosed	Open
1/.75	75.5	....	82.5	82.5	80.0	80.0	74.0	74.0
1.5/1.1	82.5	82.5	84.0	84.0	85.5	84.0	77.0	75.5
2/1.5	84.0	84.0	84.0	84.0	86.5	85.5	82.5	85.5
3/2.2	85.5	84.0	87.5	86.5	87.5	86.5	84.0	86.5
5/3.7	87.5	85.5	87.5	87.5	87.5	87.5	85.5	87.5
7.5/5.5	88.5	87.5	89.5	88.5	89.5	88.5	85.5	88.5
10/7.5	89.5	88.5	89.5	89.5	89.5	90.2	88.5	89.5
15/11	90.2	89.5	91.0	91.0	90.2	90.2	88.5	89.5
20/15	90.2	90.2	91.0	91.0	90.2	91.0	89.5	90.2
25/18.5	91.0	91.0	92.4	91.7	91.7	91.7	89.5	90.2
30/22	91.0	91.0	92.4	92.4	91.7	92.4	91.0	91.0
40/30	91.7	91.7	93.0	93.0	93.0	93.0	91.0	91.0
50/37	92.4	92.4	93.0	93.0	93.0	93.0	91.7	91.7
60/45	93.0	93.0	93.6	93.6	93.6	93.6	91.7	92.4
75/55	93.0	93.0	94.1	94.1	93.6	93.6	93.0	93.6
100/75	93.6	93.0	94.5	94.1	94.1	94.1	93.0	93.6
125/90	94.5	93.6	94.5	94.5	94.1	94.1	93.6	93.6
150/110	94.5	93.6	95.0	95.0	95.0	94.5	93.6	93.6
200/150	95.0	94.5	95.0	95.0	95.0	94.5	94.1	93.6
250/186	95.4	94.5	95.0	95.4	95.0	95.4	94.5	94.5
300/224	95.4	95.0	95.4	95.4	95.0	95.4	....	....
350/261	95.4	95.0	95.4	95.4	95.0	95.4	....	....
400/298	95.4	95.4	95.4	95.4	....	....	....	....
450/336	95.4	95.8	95.4	95.8	....	....	....	....
500/373	95.4	95.8	95.8	95.8	....	....	....	....

(2) The standards in paragraph (d)(2)(ii) of this section apply only to electric motors that satisfy the criteria in paragraph (d)(2)(i)(A) of this section and with the exclusion listed in paragraph (d)(2)(i)(B) of this section

(i) *Scope.* (A) The standards in paragraph (d)(2)(ii) of this section apply only to electric motors, including partial electric motors, that satisfy the following criteria:

(*1*) Are not small electric motors, as defined at § 431.442 and are not a dedicated pool pump motors as defined at § 431.483; and do not have an air-over enclosure and a specialized frame size if the motor operates on polyphase power;

(*2*) Are rated for continuous duty (MG 1) operation or for duty type S1 (IEC);

(*3*) Operate on polyphase or single-phase alternating current 60-hertz (Hz) sinusoidal line power; or are used with an inverter that operates on polyphase or single-phase alternating current 60-hertz (Hz) sinusoidal line power;

(*4*) Are rated for 600 volts or less;

(*5*) Are single-speed induction motors capable of operating without an inverter or are inverter-only electric motors;

(*6*) Produce a rated motor horsepower greater than or equal to 0.25 horsepower (0.18 kW); and

(*7*) Are built in the following frame sizes: any two-, or three-digit NEMA frame size (or IEC equivalent) if the motor operates on single-phase power; any two-, or three-digit NEMA frame size (or IEC equivalent) if the motor operates on polyphase power, and has a rated motor horsepower less than 1 horsepower (0.75 kW); or a two-digit NEMA frame size (or IEC metric equivalent), if the motor operates on polyphase power, has a rated motor horsepower equal to or greater than 1 horsepower (0.75 kW), and is not an enclosed 56 NEMA frame size (or IEC metric equivalent).

(B) The standards in paragraph (d)(2)(ii) of this section do not apply to the following electric motors exempted by the Secretary, or any additional electric motors that the Secretary may exempt:

(*1*) Component sets of an electric motor;

(*2*) Liquid-cooled electric motors;

(*3*) Submersible electric motors; and

(*4*) Inverter-only electric motors.

(ii) *Standards.* (A) Each high-torque and medium-torque electric motor (*i.e.,* capacitor-start-induction-run (''CSIR''), capacitor-start-capacitor-run (''CSCR''), and split-phase motor) meeting the criteria in paragraph (d)(2)(i) of this section and with a power rating of greater than or equal to 0.25 horsepower and less than or equal to 3 horsepower, shall have an average full-load efficiency that is not less than the following:

TABLE 14 TO PARAGRAPH (d)(2)(ii)(A)—AVERAGE FULL-LOAD EFFICIENCIES OF HIGH AND MEDIUM-TORQUE ELECTRIC MOTOR (CSIR, CSCR, AND SPLIT-PHASE MOTORS) AT 60 Hz

Motor horsepower/standard kilowatt equivalent	Average full-load efficiency (%)							
	2 Pole		4 Pole		6 Pole		8 Pole	
	Enclosed	Open	Enclosed	Open	Enclosed	Open	Enclosed	Open
.25/.19	59.5	59.5	59.5	59.5	57.5	57.5	....	....
.33/.25	64.0	64.0	64.0	64.0	62.0	62.0	50.5	50.5
.5/.37	68.0	68.0	67.4	69.2	68.0	68.0	52.5	52.5
.75/.56	75.5	76.2	75.5	81.8	75.5	80.2	72.0	72.0
1/.75	77.0	80.4	80.0	82.6	77.0	81.1	74.0	74.0
1.5/1.1	81.5	81.5	81.5	83.8	80.0	....	....	....
2/1.5	82.5	82.9	82.5	84.5	....	....	....	....
3/2.2	84.0	84.1	....	....	....	....	....	....

(B) Each low-torque electric motor (*i.e.,* shaded pole and permanent split capacitor motor) meeting the criteria in paragraph (d)(2)(i) of this section and with a power rating of greater than or equal to 0.25 horsepower and less than or equal to 3 horsepower, shall have an average full-load efficiency of not less than the following:

TABLE 15 TO PARAGRAPH (d)(2)(ii)(B)—AVERAGE FULL-LOAD EFFICIENCIES OF LOW-TORQUE ELECTRIC MOTOR (SHADED POLE AND PERMANENT SPLIT CAPACITOR MOTORS) AT 60 Hz

Motor horsepower/standard kilowatt equivalent	Average full-load efficiency (%)							
	2 Pole		4 Pole		6 Pole		8 Pole	
	Enclosed	Open	Enclosed	Open	Enclosed	Open	Enclosed	Open
.25/.19	60.9	63.9	64.1	66.1	59.2	60.2	52.5	52.5
.33/.25	63.9	66.9	67.7	69.7	64.0	65.0	56.6	56.6
.5/.37	65.8	68.8	68.1	70.1	65.8	66.8	57.1	57.1
.75/.56	67.5	70.5	72.8	74.8	72.1	73.1	62.8	62.8
1/.75	71.3	74.3	75.1	77.1	76.3	77.3	65.7	65.7
1.5/1.1	76.9	79.9	80.1	82.1	79.5	80.5	72.2	72.2
2/1.5	78.0	81.0	80.9	82.9	80.4	81.4	73.3	73.3
3/2.2	79.4	82.4	82.0	84.0	81.5	82.5	74.9	74.9

(C) Each polyphase electric motor meeting the criteria in paragraph (d)(2)(i) of this section and with a power rating of greater than or equal to 0.25 horsepower and less than or equal to 3 horsepower, shall have an average full-load efficiency of not less than the following:

TABLE 16 TO PARAGRAPH (d)(2)(ii)(C)—AVERAGE FULL-LOAD EFFICIENCIES OF POLYPHASE ELECTRIC MOTOR AT 60 Hz

Motor horsepower/standard kilowatt equivalent	Average full-load efficiency (%)							
	2 Pole		4 Pole		6 Pole		8 Pole	
	Enclosed	Open	Enclosed	Open	Enclosed	Open	Enclosed	Open
.25/.19	66.0	65.6	68.0	69.5	66.0	67.5	62.0	62.0
.33/.25	70.0	69.5	72.0	73.4	70.0	71.4	64.0	64.0
.5/.37	72.0	73.4	75.5	78.2	72.0	75.3	66.0	66.0
.75/.56	75.5	76.8	77.0	81.1	74.0	81.7	70.0	70.0
1/.75	75.5	77.0	77.0	83.5	74.0	82.5	75.5	75.5
1.5/1.1	84.0	84.0	82.5	86.5	87.5	83.8	78.5	77.0
2/1.5	85.5	85.5	85.5	86.5	88.5	....	84.0	86.5
3/2.2	86.5	85.5	86.5	86.9	89.5	....	85.5	87.5

Appendix B to Subpart B of Part 431 [Amended]

■ 7. Appendix B to subpart B of part 431 is amended by:

■ a. In sections 1 and 1.2., removing the words ''Small, non-small-electric-motor electric motor'' wherever it appears, and adding in its place the words ''Expanded scope electric motor''.

■ b. In section 1.2, removing the term ''SNEM'' wherever it appears, and adding in its place ''ESEM''.

■ c. In sections 2.3, 2.3.1, and 2.3.3, removing the term ''SNEMs'' wherever it appears, and adding in its place ''ESEMs''.

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