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Energy Conservation Program: Energy Conservation Standards for Small, Large, and Very Large Air-Cooled Commercial Package Air Conditioning and Heating Equipment; Proposed Rule

DEPARTMENT OF ENERGY

10 CFR Part 431

[Docket Number EERE–2013–BT–STD–0007]

RIN 1904–AC95

Energy Conservation Program: Energy Conservation Standards for Small, Large, and Very Large Air-Cooled Commercial Package Air Conditioning and Heating Equipment

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

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

SUMMARY: The Energy Policy and Conservation Act of 1975 (EPCA), as amended, prescribes energy conservation standards for various consumer products and certain commercial and industrial equipment, including small, large, and very large air-cooled commercial package air conditioning and heating equipment. EPCA also requires the U.S. Department of Energy (DOE) to determine whether more-stringent, amended standards would be technologically feasible and economically justified, and would save a significant amount of energy. In this document, DOE proposes to amend the energy conservation standards for small, large, and very large air-cooled commercial package air conditioning and heating equipment. This document also announces a public meeting to receive comment on these proposed standards and associated analyses and results.

DATES: DOE will hold a public meeting on Thursday, November 6, 2014, from 9 a.m. to 4 p.m., in Washington, DC. The meeting will also be broadcast as a webinar. See section VII Public Participation for webinar registration information, participant instructions, and information about the capabilities available to webinar participants.

DOE will accept comments, data, and information regarding this notice of proposed rulemaking (NOPR) before and after the public meeting, but no later than December 1, 2014. See section VII Public Participation for details.

ADDRESSES: The public meeting will be held at the U.S. Department of Energy, Forrestal Building, Room 4A–104, 1000 Independence Avenue SW., Washington, DC 20585. To attend, please notify Ms. Brenda Edwards at (202) 586–2945. Please note that foreign nationals visiting DOE Headquarters are subject to advance security screening procedures. Any foreign national wishing to participate in the meeting should advise DOE as soon as possible by contacting Ms. Edwards to initiate the necessary procedures. Please also note that those wishing to bring laptops into the Forrestal Building will be required to obtain a property pass. Visitors should avoid bringing laptops, or allow an extra 45 minutes. Persons can attend the public meeting via webinar. For more information, refer to the Public Participation section VII.

Any comments submitted must identify the NOPR for Energy Conservation Standards for small, large, and very large air-cooled commercial package air conditioning and heating equipment, and provide docket number EE–2013–BT–STD–0007 and/or regulatory information number (RIN) number 1904–AC95. Comments may be submitted using any of the following methods:

1. *Federal eRulemaking Portal: www.regulations.gov.* Follow the instructions for submitting comments.
2. *Email: CommPkgACHP2013STD0007@ee.doe.gov.* Include the docket number and/or RIN in the subject line of the message.
3. *Mail:* Ms. Brenda Edwards, U.S. Department of Energy, Building Technologies Program, Mailstop EE–5B, 1000 Independence Avenue SW., Washington, DC 20585–0121. If possible, please submit all items on a CD. It is not necessary to include printed copies.
4. *Hand Delivery/Courier:* Ms. Brenda Edwards, U.S. Department of Energy, Building Technologies Program, 950 L'Enfant Plaza SW., Suite 600, Washington, DC 20024. Telephone: (202) 586–2945. If possible, please submit all items on a CD, in which case it is not necessary to include printed copies.

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

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

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

A link to the docket Web page can be found at: *http://www.regulations.gov/#!docketDetail;D=EERE-2013-BT-STD-0007.* This Web page will contain a link to the docket for this notice on the regulations.gov site. The regulations.gov Web page will contain simple instructions on how to access all documents, including public comments, in the docket. See section VII for further information on how to submit comments through *www.regulations.gov.*

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

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

Mr. Michael Kido, U.S. Department of Energy, Office of the General Counsel, Mailstop GC–71, 1000 Independence Avenue SW., Washington, DC 20585–0121. Telephone: (202) 586–8145. Email: *Michael.Kido@hq.doe.gov.*

SUPPLEMENTARY INFORMATION:

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I. Summary of the Proposed Rule

Title III, Part B[1] of the Energy Policy and Conservation Act of 1975 (EPCA or the Act), Public Law 94–163 (42 U.S.C. 6291–6309, as codified), established the Energy Conservation Program for Consumer Products Other Than Automobiles. Pursuant to EPCA, any new or amended energy conservation standard that DOE prescribes for certain equipment, such as small, large, and very large air-cooled commercial package air conditioning and heating equipment (also known as commercial unitary air conditioners and heat pumps), shall be designed to achieve the maximum improvement in energy efficiency that is technologically feasible and economically justified. (42 U.S.C. 6313(a)(6)(A)(ii)(II)). Furthermore, the new or amended standard must result in a significant conservation of energy. (42 U.S.C. 6313(a)(6)(A)(ii)(II)). In accordance with these and other statutory provisions discussed in this notice, including EPCA's requirement that DOE review its standards for this equipment every six years, DOE proposes amended energy conservation standards for small, large, and very large air-cooled commercial package air conditioning and heating equipment (also referred to in this notice as small, large, and very large air-cooled commercial unitary air conditioners and commercial unitary heat pumps). The proposed standards, which are collectively characterized as Trial Standard Level 3 (TSL 3), prescribe the minimum allowable efficiency level based on an integrated energy efficiency ratio (IEER) and, for air-cooled commercial unitary heat pumps, coefficient of performance (COP). These proposed levels are shown in Table I.1. These proposed standards, if adopted, would apply to all equipment listed in Table I.1 and manufactured in and intended for distribution and sale in the U.S., or imported into, the U.S. on or after the date three years after the publication of the final rule for this equipment.

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

TABLE I.1—PROPOSED ENERGY CONSERVATION STANDARDS FOR SMALL, LARGE, AND VERY LARGE COMMERCIAL PACKAGE AIR CONDITIONING AND HEATING EQUIPMENT

Equipment type		Heating type	Proposed energy conservation standard
Small Commercial Packaged Air Conditioners (AC) and Heat Pump (HP) (Air-Cooled)—≥65,000 Btu/h and <135,000 Btu/h Cooling Capacity.	AC	Electric Resistance Heating or No Heating	14.8 IEER.
		All Other Types of Heating	14.6 IEER.
	HP	Electric Resistance Heating or No Heating	14.1 IEER, 3.5 COP.
		All Other Types of Heating	13.9 IEER, 3.4 COP.
Large Commercial Packaged AC and HP (Air-Cooled)—≥135,000 Btu/h and <240,000 Btu/h Cooling Capacity.	AC	Electric Resistance Heating or No Heating	14.2 IEER.
		All Other Types of Heating	14.0 IEER.
	HP	Electric Resistance Heating or No Heating	13.4 IEER, 3.3 COP.
		All Other Types of Heating	13.2 IEER, 3.3 COP.
Very Large Commercial Packaged AC and HP (Air-Cooled)—≥240,000 Btu/h and <760,000 Btu/h Cooling Capacity.	AC	Electric Resistance Heating or No Heating	13.5 IEER.
		All Other Types of Heating	13.3 IEER.
	HP	Electric Resistance Heating or No Heating	12.5 IEER, 3.2 COP.
		All Other Types of Heating	12.3 IEER, 3.2 COP.

A. Benefits and Costs to Customers

Table I.2 presents DOE's evaluation of the economic impacts of the proposed standards on customers of small, large, and very large air-cooled commercial unitary air conditioners (CUAC), as measured by the average life-cycle cost (LCC) savings and the median payback period.[2] The average LCC savings are positive for all CUAC equipment classes, and the PBP is less than the average lifetime of the equipment, which is estimated to be 18.4 years. These classes account for approximately 90 percent of total shipments of small, large, and very large air-cooled CUAC and commercial unitary heat pumps (CUHP).[3]

TABLE I.2—IMPACTS OF PROPOSED STANDARDS ON CUSTOMERS OF SMALL, LARGE, AND VERY LARGE COMMERCIAL PACKAGE AIR CONDITIONING AND HEATING EQUIPMENT

Equipment class	Average LCC savings (2013$)	Median payback period (years)
Small Commercial Packaged Air Conditioners—≥65,000 Btu/h and <135,000 Btu/h Cooling Capacity	4,779	3.9
Large Commercial Packaged Air Conditioners—≥135,000 Btu/h and <240,000 Btu/h Cooling Capacity	3,469	6.6
Very Large Commercial Packaged Air Conditioners—≥240,000 Btu/h and <760,000 Btu/h Cooling Capacity	16,477	2.5

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

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 (2014) through the end of the analysis period (2048). Using a real discount rate of 6.2 percent, DOE estimates that the industry net present value for manufacturers is $1,261 million.[4] Under the proposed standards, DOE expects that INPV will be reduced by 7.02 to 24.71 percent, which is a reduction of approximately $88.55 to $311.58 million. Based on comments from manufacturers of covered equipment, the industry is currently going through an extended period of consolidation. It is possible that the proposed standards would contribute to continued consolidation.

DOE's analysis of the impacts of the proposed standards on manufacturers is described in section IV.J of this proposed rulemaking.

C. National Benefits and Costs

DOE's analyses indicate that the proposed standards would save a significant amount of energy. The lifetime savings for small, large, and very large air-cooled CUAC and CUHP purchased in the 30-year period that begins in the year of compliance with amended standards (2019–2048), in comparison to the base case without amended standards, amount to 11.7 quadrillion Btu of energy (quads).[5] This is a savings of 29 percent relative to the energy use of this equipment in the base case.[6]

The cumulative net present value (NPV) of total customer costs and savings of the proposed standards for small, large, and very large air-cooled CUAC and CUHP ranges from $16.5 billion to $50.8 billion for 7-percent and 3-percent discount rates, respectively. This NPV expresses the estimated total value of future operating-cost savings minus the estimated increased product costs for products purchased in 2019–2048.

In addition, the proposed standards would have significant environmental benefits.[7] The energy savings described

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[2] The payback period measures the amount of time it takes for savings in operating costs to equal the incremental cost increase.

[3] DOE did not analyze LCC impacts for small, large, and very large air-cooled CUHP because energy modeling was performed only for CUAC equipment. The reasons for this approach are discussed in section IV.C.4.

[4] All monetary values in this document are expressed in 2013 dollars and, where appropriate, are discounted to 2014 unless explicitly stated otherwise.

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

[6] The base case assumptions are described in section IV.H.

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

above are estimated to result in cumulative emission reductions of 1,085 million metric tons (Mt)[8] of carbon dioxide (CO_2), 3,072 thousand tons of methane (CH_4), 15.5 thousand tons of nitrous oxide (N_2O), 2,934 thousand tons of sulfur dioxide (SO_2), 1,021 thousand tons of nitrogen oxides (NO_X) and 3.57 tons of mercury (Hg).[9] The estimated CO_2 emissions reductions through 2030 amount to 64 Mt.[10] These projections are expected to change in light of recently available data from the estimated from the Annual Energy Outlook (AEO) 2014 data, which suggest a drop in potential emissions reductions over a similar period of time.

The value of the CO_2 reductions is calculated using a range of values per metric ton of CO_2 (otherwise known as the Social Cost of Carbon, or SCC) developed by an interagency process.[11] The derivation of the SCC values is discussed in section IV.L. Using discount rates appropriate for each set of SCC values (see Table I.3), DOE estimates the present monetary value of the CO_2 emissions reduction to be between $6.1 billion and $95.9 billion, with a value of $30.9 billion using the central SCC case represented by $40.5/t in 2015. Additionally, DOE estimates the present monetary value of the NO_X emissions reduction to be $343 million and $1,060 million at 7-percent and 3-percent discount rates, respectively.

Table I.3 summarizes the national economic costs and benefits expected to result from the proposed standards for small, large, and very large air-cooled CUAC and CUHP.

TABLE I.3—SUMMARY OF NATIONAL ECONOMIC BENEFITS AND COSTS OF PROPOSED ENERGY CONSERVATION STANDARDS FOR SMALL, LARGE, AND VERY LARGE COMMERCIAL PACKAGE AIR CONDITIONING AND HEATING EQUIPMENT *

Category	Present value *billion 2013$*	Discount rate (%)
Benefits		
Operating Cost Savings	20.6	7
	59.7	3
CO_2 Reduction Monetized Value ($12.0/t case) **	6.1	5
CO_2 Reduction Monetized Value ($40.5/t case) **	30.9	3
CO_2 Reduction Monetized Value ($62.4/t case) **	49.9	2.5
CO_2 Reduction Monetized Value ($119/t case) **	95.9	3
NO_X Reduction Monetized Value (at $2,684/ton) **	0.3	7
	1.1	3
Total Benefits †	51.9	7
	91.6	3
Costs		
Incremental Installed Costs	4.1	7
	8.8	3
Total Net Benefits		
Including Emissions Reduction Monetized Value †	47.8	7
	82.8	3

* This table presents the costs and benefits associated with small, large, and very large air-cooled CUAC and CUHP shipped in 2019–2048. These results include benefits to customers which accrue after 2048 from the products purchased in 2019–2048. The results account for the incremental variable and fixed costs incurred by manufacturers due to the standard, some of which may be incurred in preparation for the rule.

** The CO_2 values represent global monetized values of the SCC, in 2013$, in 2015 under several scenarios of the updated SCC values. The first three cases use the averages of SCC distributions calculated using 5%, 3%, and 2.5% discount rates, respectively. The fourth case represents the 95th percentile of the SCC distribution calculated using a 3% discount rate. The SCC time series used by DOE incorporate an escalation factor. The value for NO_X is the average of the low and high values found in the literature.[12]

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

The benefits and costs of today's proposed standards, for products sold in 2019–2048, can also be expressed in terms of annualized values. The annualized monetary values are the sum of (1) the annualized national economic

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December 31, 2012. Emissions factors based on the Annual Energy Outlook 2014 (AEO 2014), which became available too late for incorporation into this analysis, indicate that a significant decrease in the cumulative emission reductions of carbon dioxide, methane, nitrous oxide, sulfur dioxide, nitrogen oxides and mercury from the proposed standards can be expected if the projections of power plant utilization assumed in AEO 2014 are realized. For example, the estimated amount of cumulative emission reductions of CO2 are expected to decrease by 36% from DOE's current estimate (from 1,085 Mt to 697Mt) based on the projections in AEO 2014 relative to AEO 2013. The monetized benefits from GHG reductions would likely decrease by a comparable amount. DOE plans to use emissions factors based on the most recent AEO available for the next phase of this rulemaking, which may or may not be AEO 2014, depending on the timing of the issuance of the next rulemaking document.

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

[9] The reductions are measured over the period in which equipment purchased in 2019–2048 continue to operate.

[10] These results are based on emissions factors in *AEO 2013,* the most recent version available at the time of this analysis. Use of emissions factors in AEO 2014 would result in a 36% decrease in cumulative emissions reductions for CO_2 thus decreasing the estimate of 64 Mt of CO2 reductions through the year 2030 to 41 Mt. In the next phase of this rulemaking, DOE plans to use emissions factors based on the most recent *AEO* available, which may or may not be *AEO 2014,* depending on the timing of the issuance of the next rulemaking document.

[11] *Technical Update of the Social Cost of Carbon for Regulatory Impact Analysis Under Executive Order 12866.* Interagency Working Group on Social Cost of Carbon, United States Government. May 2013; revised November 2013. *http://www.whitehouse.gov/sites/default/files/omb/assets/inforeg/technical-update-social-cost-of-carbon-for-regulator-impact-analysis.pdf.*

[12] These results are based on emissions factors in *AEO 2013,* the most recent version available at the time of this analysis. Use of emissions factors in AEO 2014 would result in a significant decrease in cumulative emissions reductions for CO_2, SO_2, and Hg. For example, the estimated decrease for CO_2 emissions reductions is 36%. The monetized benefits from GHG reductions would likely decrease by a comparable amount. In the next phase of this rulemaking, DOE plans to use emissions factors based on the most recent *AEO* available, which may or may not be *AEO 2014,* depending on the timing of the issuance of the next rulemaking document.

value of the benefits from consumer operation of products that meet the proposed standards; consisting primarily of operating cost savings from using less energy, minus increases in equipment purchase and installation costs, which is another way of representing customer NPV, and (2) the annualized monetary value of the benefits of CO_2 and NO_X emission reductions.[13]

Although combining the values of operating savings and CO_2 emission reductions provides a useful perspective, two issues should be considered. First, the national operating savings are domestic U.S. consumer monetary savings that occur as a result of market transactions while the value of CO_2 reductions is based on a global value. Second, the assessments of operating cost savings and CO_2 savings are performed with different methods that use different time frames for analysis. The national operating cost savings is measured for the lifetime of small, large, and very large air-cooled CUAC and CUHP shipped in 2019–2048. The SCC values, on the other hand, reflect the present value of some future climate-related impacts resulting from the emission of one ton of carbon dioxide in each year. These impacts continue well beyond 2100.

Estimates of annualized benefits and costs of the proposed standards are shown in Table I.4. The results under the primary estimate are as follows. Using a 7-percent discount rate for benefits and costs other than CO_2 reduction, for which DOE used a 3-percent discount rate along with the average SCC series that uses a 3-percent discount rate, the cost of the standards proposed in today's rule is $430 million per year in increased equipment costs, while the benefits are $2,177 million per year in reduced equipment operating costs, $1,774 million in CO_2 reductions,[14] and $36 million in reduced NO_X emissions. In this case, the net benefit amounts to $3,558 million per year.[15] Using a 3-percent discount rate for all benefits and costs and the average SCC series, the cost of the standards proposed in today's rule is $507 million per year in increased equipment costs, while the benefits are $3,426 million per year in reduced operating costs, $1,774 million in CO_2 reductions,[16] and $61 million in reduced NO_X emissions. In this case, the net benefit amounts to $4,755 million per year.[17]

TABLE I.4—ANNUALIZED BENEFITS AND COSTS OF PROPOSED ENERGY CONSERVATION STANDARDS FOR SMALL, LARGE, AND VERY LARGE COMMERCIAL PACKAGE AIR CONDITIONING AND HEATING EQUIPMENT *

	Discount rate	Primary estimate	Low net benefits estimate	High net benefits estimate
		million 2013$/year		
Benefits				
Operating Cost Savings	7% 3%	2,177 3,426	1,984 3,127	2,407 3,781
CO_2 Reduction Monetized Value ($12.0/t case) **.	5%	484	467	505
CO_2 Reduction Monetized Value ($40.5/t case) **.	3%	1,774	1,714	1,846
CO_2 Reduction Monetized Value ($62.4/t case) **.	2.5%	2,632	2,543	2,737
CO_2 Reduction Monetized Value ($119/t case) **.	3%	5,504	5,317	5,727
NO_X Reduction Monetized Value (at $2,684/ton) **.	7% 3%	36.18 60.89	34.75 58.85	37.90 63.40
Total Benefits †	7% plus CO_2 range 7% 3% plus CO_2 range 3%	2,698 to 7,718 3,988 3,972 to 8,991 5,262	2,486 to 7,336 3,733 3,653 to 8,503 4,900	2,950 to 8,172 4,291 4,349 to 9,572 5,691
Costs				
Incremental Product Costs	7%	430	350	485

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[13] DOE used a two-step calculation process to convert the time-series of costs and benefits into annualized values. First, DOE calculated a present value in 2013, the year used for discounting the NPV of total customer costs and savings, for the time-series of costs and benefits using discount rates of three and seven percent for all costs and benefits except for the value of CO_2 reductions. For the latter, DOE used a range of discount rates, as shown in Table I.4. From the present value, DOE then calculated the fixed annual payment over a 30-year period (2019 through 2048) that yields the same present value. The fixed annual payment is the annualized value. Although DOE calculated annualized values, this does not imply that the time-series of cost and benefits from which the annualized values were determined is a steady stream of payments.

[14] These results are based on emissions factors in *AEO 2013,* the most recent version available at the time of this analysis. Use of emissions factors in AEO 2014 would result in a significant decrease in cumulative emissions reductions for CO_2, SO_2, and Hg. For example, the estimated decrease for CO_2 emissions reductions is 36%. The monetized benefits from GHG reductions would likely decrease by a comparable amount. In the next phase of this rulemaking, DOE plans to use emissions factors based on the most recent *AEO* available, which may or may not be *AEO 2014,* depending on the timing of the issuance of the next rulemaking document.

[15] These results are based on emissions factors in *AEO 2013,* the most recent version available at the time of this analysis. Use of emissions factors in AEO 2014 would result in a significant decrease in cumulative emissions reductions for CO_2, SO_2, and Hg. For example, the estimated decrease for CO_2 emissions reductions is 36%. In the next phase of this rulemaking, DOE plans to use emissions factors based on the most recent *AEO* available, which may or may not be *AEO 2014,* depending on the timing of the issuance of the next rulemaking document.

[16] These results are based on emissions factors in *AEO 2013,* the most recent version available at the time of this analysis. Use of emissions factors in AEO 2014 would result in a significant decrease in cumulative emissions reductions for CO_2, SO_2, and Hg. For example, the estimated decrease for CO_2 emissions reductions is 36%. In the next phase of this rulemaking, DOE plans to use emissions factors based on the most recent *AEO* available, which may or may not be *AEO 2014,* depending on the timing of the issuance of the next rulemaking document.

[17] These results are based on emissions factors in *AEO 2013,* the most recent version available at the time of this analysis. Use of emissions factors in AEO 2014 would result in a significant decrease in cumulative emissions reductions for CO_2, SO_2, and Hg. For example, the estimated decrease for CO_2 emissions reductions is 36%. In the next phase of this rulemaking, DOE plans to use emissions factors based on the most recent *AEO* available, which may or may not be *AEO 2014,* depending on the timing of the issuance of the next rulemaking document.

TABLE I.4—ANNUALIZED BENEFITS AND COSTS OF PROPOSED ENERGY CONSERVATION STANDARDS FOR SMALL, LARGE, AND VERY LARGE COMMERCIAL PACKAGE AIR CONDITIONING AND HEATING EQUIPMENT *—Continued

	Discount rate	Primary estimate	Low net benefits estimate	High net benefits estimate
	3%	507	433	550
		Net Benefits		
Total †	7% plus CO_2 range	2,268 to 7,288	2,135 to 6,986	2,465 to 7,687
	7%	3,558	3,383	3,806
	3%	4,755	4,468	5,140
	3% plus CO_2 range	3,465 to 8,484	3,220 to 8,071	3,799 to 9,021

* This table presents the annualized costs and benefits associated with small, large, and very large air-cooled CUAC and CUHP shipped in 2019 − 2048. These results include benefits to customers which accrue after 2048 from the products purchased in 2019–2048. The results account for the incremental variable and fixed costs incurred by manufacturers due to the standard, some of which may be incurred in preparation for the rule. The Primary, Low Benefits, and High Benefits Estimates utilize projections of energy prices from the *AEO2013* Reference case, Low Economic Growth case, and High Economic Growth case, respectively. In addition, incremental product costs reflect no change for projected product price trends in the Primary Estimate, an increasing trend for projected product prices in the Low Benefits Estimate, and a decreasing trend for projected product prices in the High Benefits Estimate. The methods used to derive projected price trends are explained in section IV.F.

** The CO_2 values represent global monetized values of the SCC, in 2013$, in 2015 under several scenarios of the updated SCC values. The first three cases use the averages of SCC distributions calculated using 5%, 3%, and 2.5% discount rates, respectively. The fourth case represents the 95th percentile of the SCC distribution calculated using a 3% discount rate. The SCC time series incorporate an escalation factor. The value for NO_X is the average of the low and high values used in DOE's analysis.[18]

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

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

DOE has tentatively concluded that the proposed standards represent the maximum improvement in energy efficiency that is technologically feasible and economically justified, and would result in the significant conservation of energy. DOE further notes that products achieving these standard levels are already commercially available for most of the equipment classes covered by this proposal. Based on the analyses described above, DOE has concluded that the benefits of the proposed standards to the Nation (energy savings, positive NPV of customer benefits, customer LCC savings, and emission reductions) would outweigh the burdens (loss of INPV for manufacturers and LCC increases for some customers).

DOE also considered more-stringent energy efficiency levels as trial standard levels, and is considering them in this rulemaking. However, DOE has 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 notice and related information collected and analyzed during the course of this rulemaking effort, DOE may adopt energy efficiency levels presented in this NOPR 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 proposal, as well as some of the relevant historical background related to the establishment of standards for small, large, and very large air-cooled CUAC and CUHP.

A. Authority

Title III, Part C[19] of the Energy Policy and Conservation Act of 1975 (EPCA or the Act), Public Law 94–163 (42 U.S.C. 6311–6317, as codified), was added by the National Energy Conservation Policy Act (Pub. L. 95–619 (Nov. 9, 1978). That law established the Energy Conservation Program for Certain Industrial Equipment, which includes provisions covering the commercial heating and air-conditioning equipment that is the subject of this notice.[20] In general, this program addresses the energy efficiency of certain types of commercial and industrial equipment. Relevant provisions of the Act include definitions (42 U.S.C. 6311), energy conservation standards (42 U.S.C. 6313), test procedures (42 U.S.C. 6314), labelling provisions (42 U.S.C. 6315), and the authority to require information and reports from manufacturers (42 U.S.C. 6316).

Section 342(a) of EPCA concerns energy conservation standards for small, large, and very large, air-cooled CUAC and CUHP. (42 U.S.C. 6313(a)) This category of equipment has a rated capacity between 64,000 Btu/h and 760,000 Btu/h. It is designed to heat and cool commercial buildings and is typically located on the building's rooftop. Section 5(b) of the American Energy Manufacturing Technical Corrections Act of 2012 (Pub. L. No. 112–210 (Dec. 18, 2012) (AEMTCA) amended Section 342(a)(6) of EPCA. Among other things, AEMTCA modified the manner in which DOE must amend the energy efficiency standards for certain types of commercial and industrial equipment. DOE is typically obligated either to adopt those standards developed by the American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE)—or to adopt levels more stringent than the ASHRAE levels if there is clear and convincing evidence in support of doing so (42 U.S.C. 6313(a)(6)(A)). AEMTCA added to this process a requirement that DOE initiate a rulemaking to consider amending the standards for any covered equipment as to which more than 6 years has elapsed since the issuance of

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[18] These results are based on emissions factors in *AEO 2013,* the most recent version available at the time of this analysis. Use of emissions factors in AEO 2014 would result in a significant decrease in cumulative emissions reductions for CO_2, SO_2, and Hg. For example, the estimated decrease for CO_2 emissions reductions is 36%. The monetized benefits from GHG reductions would likely decrease by a comparable amount. In the next phase of this rulemaking, DOE plans to use emissions factors based on the most recent *AEO* available, which may or may not be *AEO 2014,* depending on the timing of the issuance of the next rulemaking document.

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

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

the most recent final rule establishing or amending a standard for the equipment as of the date of AEMTCA's enactment, December 18, 2012. (42 U.S.C. 6313(a)(6)(C)(vi)) Under this new framework, DOE must issue either a notice of determination that the current standards do not need to be amended or a notice of proposed rulemaking (NOPR) containing proposed standards by December 31, 2013. See 42 U.S.C. 6313(a)(6)(C)(i) and (vi).[21] Today's NOPR satisfies the mandatory review process imposed by AEMTCA.

Pursuant to EPCA, DOE's energy conservation program for covered equipment consists essentially of four parts: (1) Testing; (2) labeling; (3) the establishment of Federal energy conservation standards; and (4) certification and enforcement procedures. Subject to certain criteria and conditions, DOE is required to develop test procedures to measure the energy efficiency, energy use, or estimated annual operating cost of covered equipment. (42 U.S.C. 6314) Manufacturers of covered equipment must use the prescribed DOE test procedure as the basis for certifying to DOE that their equipment comply with the applicable energy conservation standards adopted under EPCA and when making representations to the public regarding the energy use or efficiency of those equipment. (42 U.S.C. 6314(d)) Similarly, DOE must use these test procedures to determine whether the equipment comply with standards adopted pursuant to EPCA. *Id.* The DOE test procedures for small, large, and very large air-cooled CUAC and CUHP currently appear at 10 CFR 431.96.

When setting standards for the equipment addressed by this proposed rulemaking, EPCA prescribes specific statutory criteria for DOE to consider. See generally 42 U.S.C. 6313(a)(6)(A)–(C). As indicated above, any amended standard for covered equipment must be designed to achieve the maximum improvement in energy efficiency that is technologically feasible and economically justified. Furthermore, DOE may not adopt any standard that would not result in the significant conservation of energy. Moreover, DOE may not prescribe a standard for certain equipment, if (1) no test procedure has been established for the equipment, or (2) if DOE determines by rule that the proposed standard is not technologically feasible or economically justified. In deciding whether a proposed standard is economically justified, DOE must determine whether the benefits of the standard exceed its burdens. DOE must make this determination after receiving comments on the proposed standard, and by considering, to the greatest extent practicable, the following seven factors:

1. The economic impact of the standard on manufacturers and consumers of the equipment subject to the standard;
2. The savings in operating costs throughout the estimated average life of the covered equipment in the type (or class) compared to any increase in the price, initial charges, or maintenance expenses for the covered equipment that are likely to result from the imposition of the standard;
3. The total projected amount of energy, or as applicable, water, savings likely to result directly from the imposition of the standard;
4. Any lessening of the utility or the performance of the covered equipment likely to result from the imposition of the standard;
5. The impact of any lessening of competition, as determined in writing by the Attorney General, that is likely to result from the imposition of the standard;
6. The need for national energy and water conservation; and
7. Other factors the Secretary of Energy (Secretary) considers relevant. (42 U.S.C. 6313(a)(6)(B))

EPCA, as codified, also contains what is known as an ''anti-backsliding'' provision, which prevents the Secretary from prescribing any amended standard that either increases the maximum allowable energy use or decreases the minimum required energy efficiency of covered equipment. 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 of any covered equipment type (or class) of performance characteristics (including reliability), features, sizes, capacities, and volumes that are substantially the same as those generally available in the United States. (42 U.S.C. 6313(a)(6)(B)(iii))

Further, under EPCA's provisions for consumer products, there is a rebuttable presumption that a standard is economically justified if the Secretary finds that the additional cost to the consumer of purchasing equipment complying with an energy conservation standard level will be less than three times the value of the energy savings during the first year that the consumer will receive as a result of the standard, as calculated under the applicable test procedure. For this rulemaking, DOE considered the criteria for rebuttable presumption as part of its analysis.

Additionally, EPCA specifies requirements when promulgating a standard for a type or class of covered equipment that has two or more subcategories. DOE must specify a different standard level than that which applies generally to such type or class of equipment for any group of covered equipment that have the same function or intended use if DOE determines that equipment within such group (A) consume a different kind of energy from that consumed by other covered equipment within such type (or class); or (B) have a capacity or other performance-related feature which other equipment within such type (or class) do not have and such feature justifies a higher or lower standard. In determining whether a performance-related feature justifies a different standard for a group of equipment, DOE must consider such factors as the utility to the consumer of the feature and other factors DOE deems appropriate. Any rule prescribing such a standard must include an explanation of the basis on which such higher or lower level was established. DOE considered these criteria for this rulemaking.

Federal energy conservation requirements generally preempt State laws or regulations concerning energy conservation testing, labeling, and standards. DOE may, however, grant waivers of Federal preemption for particular State laws or regulations.

DOE has also reviewed this regulation pursuant to Executive Order 13563, issued on January 18, 2011. (76 FR 3281, Jan. 21, 2011). EO 13563 is supplemental to and explicitly reaffirms the principles, structures, and definitions governing regulatory review established in Executive Order 12866. To the extent permitted by law, agencies are required by Executive Order 13563 to: (1) Propose or adopt a regulation only upon a reasoned determination that its benefits justify its costs (recognizing that some benefits and costs are difficult to quantify); (2) tailor regulations to impose the least burden on society, consistent with obtaining regulatory objectives, taking into account, among other things, and to the extent practicable, the costs of cumulative regulations; (3) select, in choosing among alternative regulatory approaches, those approaches that maximize net benefits (including potential economic, environmental, public health and safety, and other advantages; distributive impacts; and equity); (4) to the extent feasible, specify performance objectives, rather than

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[21] Subparagraph (A) and subparagraph (B) refer to 42 U.S.C. 6313(a)(6).

specifying the behavior or manner of compliance that regulated entities must adopt; and (5) identify and assess available alternatives to direct regulation, including providing economic incentives to encourage the desired behavior, such as user fees or marketable permits, or providing information upon which choices can be made by the public.

DOE emphasizes as well that Executive Order (EO) 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 has emphasized that such techniques may include identifying changing future compliance costs that might result from technological innovation or anticipated behavioral changes. For the reasons stated in the preamble, DOE believes that this NOPR is consistent with these principles, including the requirement that, to the extent permitted by law, benefits justify costs and that net benefits are maximized. Consistent with EO 13563, and the range of impacts analyzed in this rulemaking, the energy efficiency standard proposed herein by DOE achieves maximum net benefits.

B. Background

1. Current Standards

DOE most recently issued amended standards for small, large, and very large, air-cooled CUAC and CUHP on October 18, 2005, which codified both the amended standards for small and large equipment and the new standards for very large equipment set by the Energy Policy Act of 2005 (EPAct 2005), Public Law 109–58, 70 FR 60407 (Aug. 8, 2005). The current standards are set forth in Table II.1.

TABLE II.1—MINIMUM COOLING AND HEATING EFFICIENCY LEVELS FOR SMALL, LARGE, AND VERY LARGE COMMERCIAL PACKAGE AIR CONDITIONING AND HEATING EQUIPMENT

Equipment type	Cooling capacity	Sub-category	Heating type	Efficiency level	Compliance date
Small Commercial Packaged Air-Conditioning and Heating Equipment (Air-Cooled).	≥65,000 Btu/h and <135,000 Btu/h.	AC	Electric Resistance Heating or No Heating.	EER = 11.2	1/1/2010
			All Other Types of Heating.	EER = 11.0	1/1/2010
		HP	Electric Resistance Heating or No Heating.	EER = 11.0 COP = 3.3	1/1/2010
			All Other Types of Heating.	EER = 10.8 COP = 3.3	1/1/2010
Large Commercial Packaged Air-Conditioning and Heating Equipment (Air-Cooled).	≥135,000 Btu/h and <240,000 Btu/h.	AC	Electric Resistance Heating or No Heating.	EER = 11.0	1/1/2010
			All Other Types of Heating.	EER = 10.8	1/1/2010
		HP	Electric Resistance Heating or No Heating.	EER = 10.6 COP = 3.2	1/1/2010
			All Other Types of Heating.	EER = 10.4 COP = 3.2	1/1/2010
Very Large Commercial Packaged Air-Conditioning and Heating Equipment (Air-Cooled).	≥240,000 Btu/h and <760,000 Btu/h.	AC	Electric Resistance Heating or No Heating.	EER = 10.0	1/1/2010
			All Other Types of Heating.	EER = 9.8	1/1/2010
		HP	Electric Resistance Heating or No Heating.	EER = 9.5 COP = 3.2	1/1/2010
			All Other Types of Heating.	EER = 9.3 COP = 3.2	1/1/2010

2. History of Standards Rulemaking for Small, Large, and Very Large Air-Cooled Commercial Package Air Conditioning and Heating Equipment

On October 29, 1999, the American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE)/Illuminating Engineering Society of North America (IESNA) adopted Standard 90.1–1999, ‘‘Energy Standard for Buildings Except Low-Rise Residential Building’’, which included amended efficiency levels for CUAC and CUHP. On June 12, 2001, the Department published a Framework Document that described a series of analytical approaches to evaluate energy conservation standards for air-cooled CUAC and CUHP with rated capacities between 65,000 Btu/h and 240,000 Btu/h, and presented this analytical framework to stakeholders at a public workshop. On July 29, 2004, DOE issued an Advance Notice of Proposed Rulemaking (ANOPR) (hereafter referred to as the 2004 ANOPR) to solicit public comments on its preliminary analyses for this equipment. 69 FR 45460. Subsequently, Congress enacted EPAct 2005, which, among other things, established amended standards for small and large CUAC and CUHP and new standards for very large air-cooled CUAC and CUHP. As a result, EPAct 2005 displaced the rulemaking effort that DOE had already begun. DOE codified these new statutorily-prescribed standards on October 18, 2005. 70 FR 60407.

Section 5(b) of AEMTCA amended Section 342(a)(6) of EPCA by requiring DOE to initiate a rulemaking to consider amending the standards for any covered equipment as to which more than 6 years has elapsed since the issuance of the most recent final rule establishing or amending a standard for the equipment as of the date of AEMTCA's enactment, December 18, 2012. (42 U.S.C. 6313(a)(6)(C)(vi)) Accordingly, DOE must issue either a notice of determination that the current standards for small, large, and very large, air cooled CUAC and CUHP do not need to be amended or a notice of proposed rulemaking containing proposed standards. DOE has, based on available data, chosen the latter.

On February 1, 2013, DOE published a request for information (RFI) and notice of document availability for small, large, and very large, air cooled CUAC and CUHP. 78 FR 7296. The notice sought to solicit information from the public to help DOE determine whether national standards more stringent than those that are currently in place would result in a significant amount of additional energy savings and whether those national standards would be technologically feasible and economically justified. Separately, DOE also sought information on the merits of adopting integrated energy efficiency ratio (IEER) as the energy efficiency descriptor for small, large, and very large air-cooled CUAC and CUHP (see section III.A for more details).

DOE received a number of comments from interested parties in response to the RFI. These commenters are summarized in Table II.2. DOE considered these comments in the preparation of this NOPR. Relevant comments, and DOE's responses, are provided in the appropriate sections of this proposed rulemaking.

TABLE II.2—INTERESTED PARTIES PROVIDING WRITTEN COMMENT ON THE RFI

Name	Abbreviation	Type
AAON Inc	AAON	M
Air-Conditioning, Heating and Refrigeration Institute	AHRI	IA
Appliance Standards Awareness Project, American Council for an Energy-Efficient Economy, Natural Resources Defense Council.	ASAP, ACEEE, NRDC (Joint Efficiency Advocates).	EA
EBM-Papst Inc	EBM-Papst	CS
Edison Electric Institute	EEI	UR
Ingersoll Rand	Ingersoll Rand	M
Lennox International Inc	Lennox	M
Lentz Engineering Associates	Lentz	I
Modine Manufacturing Co	Modine	M
New Buildings Institute	NBI	
Northwest Energy Efficiency Alliance	NEEA	EA
Pacific Gas and Electric Company, Southern California Gas Company, San Diego Gas and Electric, Southern California Edison, Sacramento Municipal Utility District, National Grid.	PG&E, SCGC, SDG&E, SCE, SMUD, National Grid (Joint Utilities).	U
Rheem Manufacturing Co	Rheem	M
UTC Climate, Controls & Security	Carrier	M
Whole Building Systems	Whole Building Systems	I

IR: Industry Representative; M: Manufacturer; EA: Efficiency/Environmental Advocate; CS: Component Supplier; I: Individual; U: Utility; UR: Utility Representative

III. General Discussion

A. Energy Efficiency Descriptor

The current energy conservation standards for small, large, and very large air-cooled CUAC and CUHP are based on energy efficiency ratio (EER) for cooling efficiency and COP for CUHP heating efficiency. 10 CFR 431.97(b)

Cooling Efficiency Metric

In the RFI, DOE noted that it was considering whether to replace the existing efficiency descriptor, EER, with a new energy-efficiency descriptor, IEER. Unlike the EER metric, which only uses the efficiency of the equipment operating at full load, the IEER metric factors in the efficiency of operating at part-loads of 75 percent, 50 percent, and 25 percent of capacity as well as the efficiency at full load. This is accomplished by weighting the full- and part-load efficiencies with the average amount of time operating at each loading point. The IEER metric incorporates part load efficiencies measured with outside temperatures appropriate for the load levels, i.e. at lower temperatures for lower load levels. 78 FR 7296, 7299 (Feb. 1, 2013). As part of a final rule published on May 16, 2012, DOE amended the test procedure for this equipment to incorporate by reference the Air-Conditioning, Heating and Refrigeration Institute (AHRI) Standard 340/360–2007, "Performance Rating of Commercial and Industrial Unitary Air-Conditioning and Heat Pump Equipment" (AHRI Standard 340/360–2007). 77 FR 28928. DOE notes that AHRI Standard 340/360–2007 already includes methods and procedures for testing and rating equipment with the IEER metric.

ASHRAE, through its Standard 90.1, includes requirements based on the part-load performance metric, IEER. These IEER requirements were first established in *Addenda* from the 2008 Supplement to Standard 90.1–2007, and became effective on January 1, 2010.[22]

DOE may establish "energy conservation standards" that set either a single performance standard or a single design requirement—not both. (42 U.S.C. 6311(18)) As such, DOE may prescribe an energy conservation standard based either on a single performance-based standard or design requirement. In the case of small, large, and very large air-cooled CUAC and CUHP, ASHRAE Standard 90.1–2010 specifies two performance requirements: EER and IEER. In selecting a new performance-based energy conservation standard, the statute prescribes that a single standard be used—in this case, either an improved EER or a new standard using IEER. DOE did not consider altering its energy conservation standard to be based on a single design requirement because performance-based standards will provide manufacturers with more flexibility in developing equipment that meets the standard levels rather than requiring a specific design. DOE notes that a change in metrics (*i.e.,* from EER to IEER) would necessitate an initial DOE determination that the new requirement would not result in backsliding when compared to

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[22] ASHRAE. ASHRAE Addenda. 2008 Supplement. *http://www.ashrae.org/File%20Library/docLib/Public/20090317_90_1_2007_supplement.pdf.*

the current standards. See 42 U.S.C. 6313(a)(6)(B)(iii)(I).

As part of the RFI, DOE conducted a review of the market to see if part-load performance is currently being used and accepted for rating CUAC and CUHP. On January 2, 2009, the Environmental Protection Agency (EPA) issued a draft ENERGY STAR specification for Light Commercial Air Conditioners and Heat Pumps equipment, *i.e.,* small and large air-cooled CUAC and CUHP, which proposed to adopt IEER as part of the minimum energy efficiency criteria.[23] The Air-Conditioning, Heating and Refrigeration Institute (AHRI) supported this change. DOE also noted in the RFI that the Consortium for Energy Efficiency (CEE), an organization for energy efficiency advocates, has adopted IEER for its Tier 0, 1, and 2 efficiencies for CUAC and CUHP, i.e., small, large, and very large air-, water-, and evaporatively-cooled air conditioners and air- and water-source heat pumps.[24] 78 FR 7296, 7299 (Feb. 1, 2013).

DOE also noted in the RFI that IEER has gained support through efforts such as DOE's Commercial Building Energy Alliance (CBEA) technology transfer program, which sponsors the High Performance Rooftop Unit Challenge (RTU Challenge). This program provides a market mechanism that reduces barriers for manufacturers to procure greater than 18–IEER 10-ton [25] equipment and encourages the private sector to commit to adopt energy-efficient equipment. A number of manufacturers are currently participating in the RTU Challenge, including Lennox, 7AC Technologies, Rheem, Carrier, and McQuay. Of these participants, both Carrier and McQuay have already begun producing AHRI-certified equipment meeting or exceeding 18 IEER. In conjunction with manufacturer support, fourteen CBEA-member private entities,[26] such as Target Corp., Macy's, Inc., McDonald's Corp., and others, have also signaled their support and indicated their strong interest in potentially purchasing high-efficiency rooftop units, a sign of their confidence in the RTU Challenge and its ability to use IEER to accurately portray the energy use of air-cooled CUAC and CUHP in the field. 78 FR 7296, 7299 (Feb. 1, 2013).

As part of the RFI, DOE conducted a market analysis to compare the two metrics based on publicly available ratings of existing equipment currently available in the market. DOE made a document available for comment that provided the methodology and results of the investigation of the relationship between IEER and EER for air-cooled CUAC and CUHP with cooling capacities between 65,000 Btu/hr and 760,000 Btu/hr (*i.e.,* 5 and 63 tons). In addition, DOE looked at the variance of heating efficiency (*i.e.,* COP) with IEER and EER.[27] In the RFI, DOE noted that if it decides to propose standards using the IEER metric, it would transition the existing Federal energy conservation standards that are based on the EER metric to the new IEER metric to determine baseline energy-efficiency levels to use in the analysis. DOE sought comments and data regarding its consideration of transitioning metrics and the analysis conducted on the currently available models. 78 FR 7296, 7299 (Feb. 1, 2013).

In response to the RFI, DOE received a number of comments from interested parties concerning which energy efficiency descriptor should be used for this equipment—i.e. EER or IEER. The Edison Electric Institute (EEI), New Buildings Institute (NBI), Northwest Energy Efficiency Alliance (NEEA), the Joint Utilities,[28] and the Joint Efficiency Advocates [29] commented that DOE should adopt standards for small, large, and very large air-cooled CUAC and CUHP using both the EER and IEER metrics. (EEI, No. 9 at p. 4; NBI, No. 12 at p. 2; NEEA, No. 15 at p. 1; Joint Utilities, No. 13 at p. 2; Joint Efficiency Advocates, No. 11 at p. 1)

EEI, NEEA, and the Joint Utilities expressed concern that if DOE eliminated the EER metric, which measures peak load efficiency, manufacturers would design their equipment to improve their IEER ratings, which could negatively impact peak load efficiency. (EEI, No. 9 at p. 5; NEEA, No. 15 at pp. 1–2; Joint Utilities, No. 13 at p. 3) NEEA commented that using only one metric leads to a bias of energy savings depending on the climate zone, with EER favoring hot-dry climates and IEER favoring milder climates. NEEA stated that maximizing EER tends to involve heat exchanger improvements, while IEER improvement involves staging of compressors, and that shifting costs between these two designs degrades either IEER or EER. NEEA noted that, based on their review of the AHRI certification database, a correlation between high IEER and high EER does not necessarily exist. NEEA noted that equipment with a high EER and high IEER exists, but may just reflect premium equipment available on the market that maximize both metrics. (NEEA, No. 15 at p. 1) EEI and the Joint Utilities commented that both the EER and IEER metrics should be used to prevent higher peak demands on utility grids and higher energy bills for customers in hot-dry climates, and to prevent equipment from being manufactured that is less efficient than the current standards. (EEI, No. 9 at p. 5; Joint Utilities, No. 13 at p. 3) NBI added that because the type of application and its emphasis on full-load versus part-load cannot be known beforehand, the cost-effectiveness of standards can only be assured by including both EER and IEER metrics. (NBI, No. 12 at pp. 1–2)

The Joint Utilities commented that the IEER metric, unlike the EER metric, accounts for potentially significant part-load energy savings from technologies such as inverter duty compressors, variable speed fans, and staged compressors. The Joint Utilities also indicated that continued growth and dependence on demand response programs is expected in California and New England, and that, during demand response events, controls may be used to restrict unit capacities and lower fan speeds. According to the Joint Utilities, if units have comparable EER values, the units with higher IEERs have the capability to use less energy when capacity is restricted and are more likely to have the capability of modifying compressor operation or reducing fan speed. (Joint Utilities, No. 13 at pp. 2–3) (Joint Utilities, No. 13 at p. 3)

The Joint Utilities commented that there is no additional testing burden associated with implementing both the IEER and EER metrics as compared to using only IEER because the EER test is

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[23] ENERGY STAR. Re: EPA Proposed Draft Energy Star Specification for Light Commercial HVAC Equipment. *http://www.energystar.gov/ia/partners/prod_development/revisions/downloads/lhvac/AHRI_Comments_D1.pdf.*

[24] Consortium for Energy Efficiency. CEE Commercial Unitary AC and HP Specification. *http://www.cee1.org/files/CEE_CommHVAC_UnitarySpec2012.pdf.*

[25] Air conditioning cooling capacity may be denoted in tons. An air conditioning ton is equivalent to 12,000 Btu/h of cooling capacity (or 3.5 kilowatts of cooling capacity).

[26] U.S. Department of Energy. Building Technologies Program. High Performance Rooftop Unit Challenge Fact Sheet. *http://apps1.eere.energy.gov/buildings/publications/pdfs/alliances/techspec_rtus.pdf.*

[27] The document is available at: *http://www1.eere.energy.gov/buildings/appliance_standards/product.aspx/productid/77.*

[28] A joint comment was submitted by the Pacific Gas and Electric Company (PG&E), Southern California Gas Company (SCGC), San Diego Gas and Electric (SDG&E), Southern California Edison (SCE), Sacramento Municipal Utility District (SMUD), and National Grid, which are referred to as the Joint Utilities.

[29] A Joint comment was submitted by the Appliance Standards Awareness Project (ASAP), American Council for an Energy-Efficient Economy (ACEEE), and Natural Resources Defense Council (NRDC), which are referred to as the Joint Efficiency Advocates.

part of the IEER metric. The Joint Utilities added that manufacturers have been reporting both EER and IEER values for AHRI certification since 2010. The Joint Utilities stated that, based on their review of the AHRI certification database, the nominal difference between the average IEER and EER values for each CUAC equipment class capacity range (*i.e.,* small, large, and very large) varied from 1.38 and 1.87. The Joint Utilities stated that if standards are based only on IEER and the average performance difference in IEER and EER remains the same, then equipment meeting an IEER-only standard could have EERs as low as 8.86 (which is approximately 10 percent to 21 percent lower than the current EER standards for air-cooled CUAC). (Joint Utilities, No. 13 at pp. 3–4, 6)

EEI, the Joint Utilities, and the Joint Efficiency Advocates commented that DOE has the authority to adopt two efficiency metrics. (EEI, No. 9 at p. 4; Joint Utilities, No. 13 at p. 3; Joint Efficiency Advocates, No. 11 at p. 1) EEI stated that if DOE must demonstrate that a standard measured using IEER is no less stringent than a standard measured using EER, then the two standards must have the same stringency. EEI stated that, as a result, using two different metrics does not contravene the requirement that DOE apply a single standard. (EEI, No. 9 at p. 4) EEI added that this two-metric approach is consistent with past precedent set in the direct final rule for residential split system air conditioners and packaged air conditioners (76 FR 37408 (June 27, 2011); 76 FR 67037 (Oct. 31, 2011)), which will require SEER and EER standards for equipment sold in the ''Southwest'' region of the United States. (EEI, No. 9 at p. 5) The Joint Utilities commented that, based on their understanding, DOE is considering using a multiple metric approach in other rulemakings (*e.g.,* commercial and industrial fans and blowers) and, as such, DOE should be able to do the same for this rulemaking. (Joint Utilities, No. 13 at p. 3)

According to the Joint Utilities, the intent of DOE's requirement to adopt ASHRAE or more stringent standard levels is for the ASHRAE levels to serve as the standards baseline. The Joint Utilities stated that ASHRAE Standard 90.1 has specified both IEER and EER metrics for this equipment since 2010 and that industry supports and recognizes the need for a two metric approach for their standards. The Joint Utilities stated that both metrics should be used to align with the industry standards approach. (Joint Utilities, No. 13 at p. 2)

As discussed above, EPCA requires that DOE establish energy conservation standards using either a single performance standard or a single design requirement—but not both. See 42 U.S.C. 6311(18). Consistent with this restriction, DOE is proposing an approach that would apply a single performance-based standard for manufacturers to follow. Although some commenters have suggested that DOE deviate from this requirement, none has suggested an approach that would sufficiently address the legal constraints that EPCA imposes on DOE's ability to set multiple metrics for the equipment at issue in this proposal. Accordingly, DOE is declining to adopt a multiple-metric approach for CUAC and CUHP equipment.

Modine Manufacturing Company (Modine) supported the use of the IEER metric to allow for the optimization of efficiency at part-load conditions. Modine stated that equipment designed to maximize EER at full-load conditions, which accounts for only 2 percent of cooling time, may be significantly less efficient at part-load conditions. Modine presented data showing that a unit that is optimized around EER had an EER of 12.5, but the overall IEER is only 11.46, whereas a unit optimized around IEER had an EER of 10.3, but an IEER of 12.6. Modine also presented data showing that only a 2-point improvement in IEER for a 15-ton unit and a 20- to 30-ton unit would improve the efficiency by 18 percent and 20 percent, respectively. (Modine, No. 5 at pp. 2, 7–9) The Joint Efficiency Advocates commented that if DOE concludes that they do not have the authority to adopt two metrics, DOE should replace EER with IEER to better reflect annual energy consumption and encourage the adoption of part-load technologies that can achieve significant energy savings in the field. (Joint Efficiency Advocates, No. 11 at pp. 1–2) Whole Building Systems also supported the use of the IEER metric to better reflect annual energy consumption. Whole Building Systems added that design engineers, contactors, and owners need an annual or seasonal part load performance metric to make more informed purchasing and life-cycle cost decisions. (Whole Building Systems, No. 4 at p. 1)

AAON and AHRI both recognized the benefits of using the IEER metric for representation of the equipment's overall cooling energy efficiency. However, AAON, AHRI, Carrier, Lennox and Ingersoll Rand noted the following concerns with relying solely on the IEER metric:

- DOE's definition of basic model will significantly increase the number of models that manufacturers are required to test and, in the collective view of AAON and AHRI, make the DOE test requirements impossible to achieve. (AAON, No. 8 at pp. 1–2; AHRI, No. 14 at p. 4)
- The rulemaking for the Alternative Efficiency Determination Method (AEDM) is still incomplete. The proposed requirement for the overall average of AEDM outputs is, in their view, far more stringent than the uncertainty of the AHRI Standard 340/360–2007 test method and any combined manufacturing or component tolerances. (AAON, No. 8 at p. 2; AHRI, No. 14 at p. 4)
- If the part-load IEER metric is used, then the sequence of operation of each subcomponent of the equipment has a great effect on the listed metric. This would result in many more basic models based on DOE's current definition. (AAON, No. 8 at p. 2; AHRI, No. 14 at p. 4)
- The uncertainty associated with modeling or testing (including assessment, compliance, and enforcement testing) equipment using the IEER metric is significantly greater than for the single EER test. AHRI Standard 340/360 currently has a 10 percent uncertainty allowance on the IEER metric because of the higher variability in results due to the multiple tests required, compared to a 5-percent uncertainty allowance on the single test EER metric. (AAON, No. 8 at p. 2; AHRI, No. 14 at pp. 4–5; Carrier, No. 7 at p. 1; Lennox, No. 6 at p. 1; Ingersoll Rand, No. 10 at p. 1)

AAON, AHRI, and Ingersoll Rand indicated that they would support replacing EER with IEER only if DOE resolves pending issues related to the AEDM, the basic model definition and the uncertainty in measurement testing. AAON and AHRI stated that DOE should implement the testing and rating requirements, including the uncertainty tolerances, referenced in AHRI Standard 340/360 in their entirety. AHRI added that the sampling plan in 10 CFR 429.43 will have to be revised and adjusted accordingly. (AAON, No. 8 at p. 3; AHRI, No. 14 at pp. 1, 4–5; Ingersoll Rand, No. 10 at pp. 1–2) Carrier also commented that DOE should limit the basic model definition to the base refrigeration system to avoid the requirement that equipment be tested with factory options, which may negatively impact cooling or heating rating point efficiency, but provide efficiency benefits when considered from a whole building perspective (*e.g.,* economizers and energy recovery ventilators). (Carrier, No. 7 at p. 1)

Rheem supported the use of one efficiency metric, but not multiple metrics. Rheem stated that if IEER is going to replace EER, a technical review must be conducted to highlight the advantage to the consumer versus the confusion in the market place and burden on the OEM. Rheem stated that other aspects of the energy conservation standards for this equipment are in transition and must be finalized before a constructive evaluation can be made of the benefits of a part-load efficiency metric. (Rheem, No. 17 at pp. 1–2)

Lennox commented that it has captured most of the achievable EER efficiency improvements with currently available technology, and that there are diminishing returns in requiring increasingly stringent EER levels. (Lennox, No. 6 at p. 3) However, Lennox supported the continued use of the EER metric due to the IEER test uncertainty issue discussed above. (Lennox, No. 6 at p. 1) Lennox commented that using the IEER metric now would require resolving the following issues: (1) Setting a baseline IEER for various equipment classes, (2) the ability to use the AEDMs, and (3) implementation and vetting of testing protocols. (Lennox, No. 6 at p. 2)

The Joint Utilities commented that if DOE is not willing to adopt standards using both metrics, DOE should use the current EER metric instead of IEER to provide a better approximation of heating, ventilation, and air-conditioning (HVAC) performance during peak loading conditions. According to the Joint Utilities, in California and New England, commercial air conditioning accounts for a disproportionately high fraction of seasonal peak demand as compared to commercial HVAC energy consumption as a fraction of annual energy consumption. (Joint Utilities, No. 13 at p. 4) The Joint Utilities also commented that a substantial fraction of U.S. cities have peak temperatures above 95 degrees Fahrenheit (°F) in the summer, and summer peak temperature has been increasing over time. The Joint Utilities stated that peak electricity demands have large effects on energy procurement and energy pricing, and that shifts in energy pricing rate structures, such as in California, will further increase electricity prices during peak conditions. The Joint Utilities stated that using an IEER-only metric would under-represent the condition that has the largest effect on peak energy demand and energy pricing. The Joint Utilities stated that an improved IEER metric that is representative of annual energy cost would place a heavier weighting on the 95 °F full-load test point, but absent that change the Joint Utilities would support retaining EER metric. (Joint Utilities, No. 13 at p. 4)

DOE notes that the issues related to the basic model definition and AEDM were addressed separately in DOE's Commercial Certification Working Group. DOE published a final rule on December 31, 2013, which incorporated requirements for the testing and tolerances for validation and verification of an AEDM, and also amended the basic model definition for small, large, and very large air-cooled CUAC and CUHP. 78 FR 79579. EPCA requires that test procedures be reasonably designed to produce test results that measure the energy efficiency of covered equipment during a representative average use cycle or period of use. (42 U.S.C. 6314(a)(2)) As discussed above, the IEER metric weights the efficiency of operating at different partial loads and full load based on usage patterns, which collectively provide a more representative measure of annual energy use than the EER metric. A manufacturer that was involved in the development of the IEER metric indicated that the usage pattern weights for the IEER metric were developed by analyzing equipment usage patterns of several buildings across the 17 ASHRAE Standard 90.1–2010 (appendix B) climate zones. (Docket ID: EERE–2013–BT–STD–0007–0018, Carrier, at p. 1) These usage patterns and climate zones were based on a comprehensive analysis performed by industry in assessing the manner in which CUAC and CUHP equipment operate in the field, both in terms of actual usage and the climatic conditions in which they are used. The weighting factors accounted for the hours of operation where mechanical cooling was active. *Id.* As a result, the IEER metric, as a whole, provides a more accurate representation of the annual energy use for this equipment than the EER metric, which only considers full load energy use. For these reasons, DOE is proposing energy conservation standards in this NOPR based on the IEER metric. DOE recognizes the issues regarding the uncertainty of IEER test measurements and welcomes additional data regarding the measurement uncertainties to develop appropriate sampling plans.

Because the weighting factors for the IEER metric are representative of field use and because DOE is unaware of any data indicating that changes to these weighting factors are warranted, DOE is not considering changing the weighting factors for the loading conditions specified in AHRI Standard 340/360–2007 for the IEER metric, as commented by the Joint Utilities. With regards to the Joint Utilities comment that an improved IEER metric that is representative of annual energy cost would place a heavier weighting on the full-load test point, DOE welcomes comment and data on whether the test procedure for air-cooled CUAC and CUHP should be amended to revise the weightings for the IEER metric to place a higher weighting value on the full-load efficiency.

Issue 2: DOE requests comment on whether the test procedure for air-cooled CUAC and CUHP should be amended to revise the weightings for the IEER metric to place a higher weighting value on the full-load efficiency. DOE also requests data to determine appropriate weighting factors for the full-load test condition and part-load test conditions (75 percent, 50 percent, and 25 percent of capacity).

With regards to the Joint Utilities comment that DOE should use the current EER metric instead of IEER to provide a better approximation of HVAC performance during peak loading conditions, DOE notes that, as discussed above, EPCA does not include provisions for dual metrics for this equipment. See 42 U.S.C. 6311(18). DOE also notes that because the IEER metric includes measurements at full load capacity, the metric already accounts for EER. Further, ASHRAE Standard 90.1 includes requirements for both EER and IEER. As a result, although DOE is considering energy conservation standards based on the IEER metric, utilities would still be able to evaluate EER ratings of equipment.

In response to the RFI, AHRI commented that the draft of addendum CL[30] to ASHRAE Standard 90.1–2010 (Draft Addendum CL) would amend the minimum IEER levels, but did not amend the minimum EER levels because the ASHRAE Standard 90.1 committee was unable to justify raising the full load efficiency standard. (AHRI, No. 14 at pp. 1–2) AHRI and Ingersoll Rand commented that full load efficiencies are approaching their thermodynamic limits, and that further improvements will be both very minimal and very costly. (AHRI, No. 14 at p. 2; Ingersoll Rand, No. 10 at p. 1) AHRI added that while energy efficiency gains in the 1970s were achieved at relatively low cost, the efficiency improvements realized recently resulted in significant increase in equipment cost. AHRI stated

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[30] ASHRAE periodically updates specifications in its Standard 90.1 through a public review process. The latest of these proposed changes is contained in Draft Addendum CL, which was made available for public review in October 2012. ''CL'' refers to the revision number.

that the industry is entering a phase where efficiency of equipment is becoming closer to the Carnot efficiency (i.e., the thermodynamic limit) and full load efficiency gains in the future will be minimal but very costly. (AHRI, No. 14 at p. 2) AHRI noted that the ASHRAE Standard 90.1 committee has recognized the increasing full load minimum efficiency standards for CUAC and CUHP has reached a point of diminishing returns in terms of energy savings, and instead focused efforts on other areas to reduce the energy consumption of this equipment, including the following design requirements:

- Mandatory use of economizers on equipment ≥54,000 Btu/h of cooling capacity in all climate zones at the exception of zones 1a and 1b,
- Modulation of economizer outdoor and return air dampers to provide up to 100 percent of the design supply air quantity as outdoor air for cooling,
- More stringent damper leakage requirements
- Additional requirements for supply air temperature reset and static pressure reset on variable air volume systems,
- Integrated economizer control and direct expansion (*i.e.,* the evaporator is in direct contact with the air stream) unit capacity staging requirements which necessitate two speed fans and two stages of mechanical cooling for constant volume systems or three or more stages for variable air volume systems, and
- Fan controls for both constant air volume and variable air volume units including extending the indoor fan part load power requirements down to ¼ horsepower. (AHRI, No. 14 at pp. 2–3)

AHRI stated that although these requirements significantly reduce the energy consumption of CUAC, most of the energy savings resulting from their implementation is not captured by the test procedure and cannot be translated in an EER improvement. AHRI stated that DOE should consider other factors beyond EER and/or COP when conducting its analysis and that by appropriately modeling this equipment, DOE will conclude that increasing the EER and COP is not a cost-effective way of improving the CUAC/CUHP efficiency. (AHRI, No. 14 at p. 3)

As discussed above, DOE determined that the IEER metric provides a more accurate representation of the annual energy use for this equipment than the EER metric, and is proposing standards based on IEER. DOE recognizes that raising the stringency of EER may not be a cost-effective way of improving the efficiency of this equipment. DOE reached this tentative conclusion based on the preliminary determination by the ASHRAE Standard 90.1 committee for Draft Addendum CL that raising the full load efficiency standard would not be cost-effective. DOE also takes note of the comments from interested parties that manufacturers are already reaching the thermodynamic limits with respect to full load efficiency for CUAC and CUHP equipment, which is limiting the potential for further full load efficiency improvements for these HVAC equipment. For these reasons, DOE is not considering standards based on the EER metric. Based on energy modeling of design changes consistent with equipment available on the market (by analyzing the efficiency at each loading condition, including full-load EER), as discussed in sections IV.A through IV.C, DOE notes that the proposed IEER-based standard levels presented in section I would not result in an EER rating less than the current standard levels. DOE discusses the use of the COP metric in the following section.

Heating Efficiency Metric

The current energy conservation standards for small, large, and very large air-cooled CUHP heating efficiency are based on the COP metric.[31] 10 CFR 431.97(b)

In response to the RFI, Ingersoll Rand commented that a performance metric does not exist that simulates part load performance in heating. (Ingersoll Rand, No. 6 at p. 4) Modine commented that DOE could consider creating a new metric for CUHP, an integrated COP that is based on heating weather bin data, to provide a more representative measure of energy efficiency during the heating mode. (Modine, No. 5 at p. 2)

DOE is not aware of any test procedures that have been developed that measure part load performance in heating mode for small, large, and very large air-cooled CUHP. In addition, DOE notes that Modine did not provide any data, nor is DOE aware of any data, regarding the annual usage for CUHP under part-load heating conditions to determine whether part-load heating hours are significant and would warrant the development of a part-load heating metric. As discussed in section IV.C.3, one manufacturer noted that CUHPs typically operate in full load heating mode and cycle the auxiliary heat on and off because heat pump capacity alone is inadequate to meet the building load. In addition, DOE is unaware of data regarding usage patterns for CUHP to determine appropriate test conditions under part-load heating conditions. Because DOE is unaware of any test procedures or usage data regarding part-load performance in heating mode for CUHP that shows that part-load heating hours are significant, DOE is not considering amendments to the test procedure to measure part-load heating efficiency at this time. For this NOPR, DOE is proposing standards for the heating efficiency based on the COP metric.

Regional Standards

In response to the RFI, NEEA and NBI stated that DOE should consider regional standards for small, large, and very large air-cooled CUAC and CUHP. (NEEA, No. 15 at p. 2; NBI, No. 12 at p. 2) NEEA commented that AHRI Standard 340/360 tends to favor certain climate zones and exclude or decrease savings by only having one efficiency value to characterize the 8 climate zones in the United States. NEEA also stated that the test procedure tends to under value fan energy as external static pressure values are optimistically low. According to NEEA and NBI, the use of regional efficiency standards would increase energy savings and reflect the equipment selection options for design engineers in selecting equipment for varying climatic zones. NEEA added that regional standards would increase and bolster technological development of air conditioning equipment for varying climate zones. NBI stated that, in particular, DOE should investigate regional standards for ''hot-dry'' climates to recognize the significant research and field experience that allows packaged air conditioners to cost-effectively achieve higher efficiencies in these climates. NBI stated that DOE has developed regional standards for other residential HVAC equipment (10 CFR 430.32(c)(5). NBI commented that DOE should consider adopting CCE Tier 2 ratings for ''hot-dry'' regional standards. (NEEA, No. 15 at p. 2; NBI, No. 12 at p. 2)

EPCA requires that any amended standard for small, large, and very large air-cooled CUAC and CUHP must be a uniform national standard. (42 U.S.C. 6313(a)(6)(A)) EPCA does not provide DOE with the authority to set regional standards for CUAC and CUHP equipment. As a result, DOE is not considering regional standards for small, large, and very large air-cooled CUAC and CUHP.

Issue 1: DOE requests comment on the use of IEER as the cooling efficiency metric and COP as the heating efficiency metric (for CUHP) for the proposed energy conservation standards, including additional data and input

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[31] COP is defined as the ratio of the produced heating effect to its net work input.

regarding the uncertainty of IEER test measurements.

B. Technological Feasibility

1. General

In each energy conservation standards rulemaking, DOE conducts a screening analysis based on information gathered on all current technology options and prototype designs that could improve the efficiency of the products or equipment that are the subject of the rulemaking. As the first step in such an analysis, DOE develops a list of technology options for consideration in consultation with manufacturers, design engineers, and other interested parties. DOE then determines which of those means for improving efficiency are technologically feasible. DOE considers technologies incorporated in commercially available equipment or in working prototypes to be technologically feasible. 10 CFR part 430, subpart C, appendix A, section 4(a)(4)(i).

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 equipment utility or availability; and (3) adverse impacts on health or safety. 10 CFR part 430, subpart C, appendix A, section 4(a)(4)(ii)–(iv). Section IV.B of this proposed rulemaking discusses the results of the screening analysis for small, large, and very large air-cooled CUAC and CUHP, particularly the designs DOE considered, those it screened out, and those that are the basis for the TSLs in this rulemaking. For further details on the screening analysis for this rulemaking, see chapter 4 of the NOPR Technical Support Document (TSD).

2. Maximum Technologically Feasible Levels

When DOE proposes to adopt an amended standard for a type or class of covered equipment, it must determine the maximum improvement in energy efficiency or maximum reduction in energy use that is technologically feasible for such equipment. Accordingly, in the engineering analysis, DOE determined the maximum technologically feasible (''max-tech'') improvements in energy efficiency for small, large, and very large air-cooled CUAC and CUHP, using the design parameters for the most efficient equipment available on the market or in working prototypes. (See chapter 5 of the NOPR TSD.) The max-tech levels that DOE determined for this rulemaking are described in section IV.C.3 of this proposed rule.

C. Energy Savings

1. Determination of Savings

For each TSL, DOE projected energy savings from the products that are the subject of this rulemaking purchased in the 30-year period that begins in the year of compliance with amended standards (2019–2048). The savings are measured over the entire lifetime of products purchased in the 30-year analysis period.[32] DOE quantified the energy savings attributable to each TSL as the difference in energy consumption between each standards case and the base case. The base case represents a projection of energy consumption in the absence of amended mandatory efficiency standards, and it considers market forces and policies that affect demand for more efficient products.

DOE used its national impact analysis (NIA) spreadsheet model to estimate energy savings from amended standards for the products that are the subject of this rulemaking. The NIA spreadsheet model (described in section IV.H of this proposed rule) calculates energy savings in site energy, which is the energy directly consumed by products at the locations where they are used. For electricity, DOE reports national energy savings in terms of the savings in the energy that is used to generate and transmit the site electricity. To calculate this quantity, DOE derives annual conversion factors from the model used to prepare the Energy Information Administration's (EIA) most recent *Annual Energy Outlook* (*AEO*).

DOE has begun to also estimate full-fuel-cycle energy savings, as discussed in DOE's statement of policy and notice of policy amendment. 76 FR 51281 (August 18, 2011), as amended at 77 FR 49701 (August 17, 2012). The full-fuel-cycle (FFC) metric includes the energy consumed in extracting, processing, and transporting primary fuels (i.e., coal, natural gas, petroleum fuels), and thus presents a more complete picture of the impacts of energy efficiency standards. DOE's evaluation of FFC savings is driven in part by the National Academy of Science's (NAS) report on FFC measurement approaches for DOE's Appliance Standards Program.[33] The NAS report discusses that the FFC metric was primarily intended for energy efficiency standards rulemakings where multiple fuels may be used by a particular product. In the case of this rulemaking, only a single fuel—electricity—is consumed by the equipment. DOE's approach is based on the calculation of an FFC multiplier for each of the energy types used by covered equipment. Although the addition of FFC energy savings in the rulemakings is consistent with the recommendations, the methodology for estimating FFC does not project how fuel markets would respond to this particular standard rulemaking. The FFC methodology simply estimates how much additional energy, and in turn how many tons of emissions, may be displaced if the estimated quantity of energy was not consumed by the equipment covered in this rulemaking. It is also important to note that inclusion of FFC savings does not affect DOE's choice of proposed standards.

For more information on FFC energy savings, see section IV.H.2.

2. Significance of Savings

To adopt national standards more stringent than the amended ASHRAE/IES Standard 90.1 for small, large, and very large air-cooled CUAC and CUHP, DOE must determine that such action would result in significant additional conservation of energy. (42 U.S.C. 6313(a)(6)(A)(ii)) Although the term ''significant'' is not defined in the Act, the U.S. Court of Appeals, in *Natural Resources Defense Council* v. *Herrington,* 768 F.2d 1355, 1373 (D.C. Cir. 1985), indicated that Congress intended ''significant'' energy savings in the context of EPCA to be savings that were not ''genuinely trivial.'' The energy savings for today's proposed standards (presented in section V.B) are nontrivial, and, therefore, DOE considers them ''significant'' within the meaning of section 325 of EPCA.

D. Economic Justification

1. Specific Criteria

EPCA provides seven factors to be evaluated in determining whether a more stringent standard for small, large, and very large air-cooled CUAC and CUHP is economically justified. (42 U.S.C. 6313(a)(6)(B)(ii)) The following sections discuss how DOE has

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[32] In the past DOE presented energy savings results for only the 30-year period that begins in the year of compliance. In the calculation of economic impacts, however, DOE considered operating cost savings measured over the entire lifetime of products purchased in the 30-year period. DOE has chosen to modify its presentation of national energy savings to be consistent with the approach used for its national economic analysis.

[33] ''Review of Site (Point-of-Use) and Full-Fuel-Cycle Measurement Approaches to DOE/EERE Building Appliance Energy-Efficiency Standards,'' (Academy report) was completed in May 2009 and included five recommendations. A copy of the study can be downloaded at: *http://www.nap.edu/catalog.php?record_id=12670.*

addressed each of those seven factors in this rulemaking.

a. Economic Impact on Manufacturers and Consumers

In determining the impacts of a potential amended standard on manufacturers, DOE conducts a manufacturer impact analysis (MIA), as discussed in section IV.J. DOE first uses an annual cash-flow approach to determine the quantitative impacts. This step includes both a short-term assessment—based on the cost and capital requirements during the period between when a regulation is issued and when entities must comply with the regulation—and a long-term assessment over a 30-year period. The industry-wide impacts analyzed include industry net present value (INPV), which values the industry on the basis of expected future cash flows; cash flows by year; changes in revenue and income; and other measures of impact, as appropriate. Second, DOE analyzes and reports the impacts on different types of manufacturers, including impacts on small manufacturers. Third, DOE considers the impact of standards on domestic manufacturer employment and manufacturing capacity, as well as the potential for standards to result in plant closures and loss of capital investment. Finally, DOE takes into account cumulative impacts of various DOE regulations and other regulatory requirements on manufacturers.

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

b. Savings in Operating Costs Compared to Increase in Price

EPCA requires DOE to consider the savings in operating costs throughout the estimated average life of the covered product compared to any increase in the price of the covered product that are likely to result from the imposition of the standard. (42 U.S.C. 6295(o)(2)(B)(i)(II)) DOE conducts this comparison in its LCC and PBP analysis.

The LCC is the sum of the purchase price of a product (including its installation) and the operating expense (including energy, maintenance, and repair expenditures) discounted over the lifetime of the product. To account for uncertainty and variability in specific inputs, such as product lifetime and discount rate, DOE uses a distribution of values, with probabilities attached to each value. For its analysis, DOE assumes that consumers will purchase the covered products in the first year of compliance with amended standards.

The LCC savings and the PBP for the considered efficiency levels are calculated relative to a base case that reflects projected market trends in the absence of amended standards. DOE identifies the percentage of consumers estimated to receive LCC savings or experience an LCC increase, in addition to the average LCC savings associated with a particular standard level. DOE's LCC and PBP analysis is discussed in further detail in section IV.F.

c. Energy Savings

Although significant conservation of energy is a separate statutory requirement for adopting an energy conservation standard, EPCA requires DOE, in determining the economic justification of a standard, to consider the total projected energy savings that are expected to result directly from the standard. (42 U.S.C. 6313(a)(6)(B)(ii)(III)) As discussed in section IV.H, DOE uses the NIA spreadsheet to project national energy savings.

d. Lessening of Utility or Performance of Products

In establishing classes of products, and in evaluating design options and the impact of potential standard levels, DOE evaluates standards that would not lessen the utility or performance of the considered products. (42 U.S.C. 6313(a)(6)(B)(ii)(IV)) Based on data available to DOE, the standards proposed in this document would not reduce the utility or performance of the products under consideration in this rulemaking.

e. Impact of Any Lessening of Competition

EPCA directs DOE to consider the impact of any lessening of competition, as determined in writing by the Attorney General, that is likely to result from a proposed standard. (42 U.S.C. 6313(a)(6)(B)(ii)(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. 6295(o)(2) (B)(ii)) DOE will transmit a copy of today's proposed rule to the Attorney General with a request that the Department of Justice (DOJ) provide its determination on this issue. DOE will address the Attorney General's determination in the final rule.

f. Need for National Energy Conservation

In evaluating the need for national energy conservation, DOE expects that 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.

The proposed standards also are likely to result in environmental benefits in the form of reduced emissions of air pollutants and greenhouse gases associated with energy production. DOE reports the emissions impacts from the proposed standards, and from each TSL it considered, in section V.B.6 of this proposed rulemaking. DOE also reports estimates of the economic value of emissions reductions resulting from the considered TSLs, as discussed in section IV.L.

g. Other Factors

EPCA allows the Secretary of Energy, in determining whether a standard is economically justified, to consider any other factors that the Secretary deems to be relevant. (42 U.S.C. 6313(a)(6)(B)(ii)(VII))

2. Rebuttable Presumption

As set forth in 42 U.S.C. 6295(o)(2)(B)(iii), EPCA creates a rebuttable presumption that an energy conservation standard is economically justified if the additional cost to the consumer of a product that meets the standard is less than three times the value of the first year's energy savings resulting from the standard, as calculated under the applicable DOE test procedure. DOE's LCC and PBP analyses generate values used to calculate the effects that proposed energy conservation standards would have on the payback period for consumers. These analyses include, but are not limited to, the 3-year payback period contemplated under the rebuttable-presumption test. In addition, DOE routinely conducts an economic analysis that considers the full range of impacts to consumers, manufacturers, the nation, and the environment, as required under 42 U.S.C. 6295(o)(2)(B)(i). The results of this analysis serve as the basis for DOE's evaluation of the economic justification for a potential standard level (thereby supporting or rebutting the results of any preliminary determination of economic justification). The rebuttable presumption payback calculation is discussed in section IV.F.12 of this proposed rule.

IV. Methodology and Discussion of Related Comments

DOE used four analytical tools to estimate the impact of today's proposed standards. The first tool is a spreadsheet that calculates LCCs and PBPs of potential new energy conservation standards. The second tool is a model that provides shipments forecasts, and the third tool is a spreadsheet that calculates national energy savings and net present value resulting from potential amended energy conservation standards. The fourth spreadsheet tool, the Government Regulatory Impact Model (GRIM), helped DOE to assess manufacturer impacts.

Additionally, DOE estimated the impacts of energy conservation standards for small, large, and very large air-cooled commercial package air conditioning and heating equipment on utilities and the environment. DOE used a version of EIA's National Energy Modeling System (NEMS) for the utility and environmental analyses. The NEMS model simulates the energy sector of the U.S. economy. EIA uses NEMS to prepare its *Annual Energy Outlook* (*AEO),* a widely known energy forecast for the United States. The version of NEMS used for appliance standards analysis is called NEMS–BT [34] and is based on the *AEO* version with minor modifications.[35] The NEMS–BT model offers a sophisticated picture of the effect of standards, because it accounts for the interactions between the various energy supply and demand sectors and the economy as a whole.

As discussed below, specifically in section IV.D on the markups analysis and section IV.E on the energy use analysis, DOE utilized methods developed for the 2004 ANOPR to conduct these analyses. In the case of the markups analysis, DOE utilized the same distribution channels as the 2004 ANOPR to characterize how small, large, and very large air-cooled CUAC equipment is distributed from the manufacturer to the end-user. In the case of the energy use analysis, building simulations performed for the 2004 ANOPR laid the basis for estimating the annual energy consumption of small, large, and very large air-cooled CUAC equipment. However, DOE incorporated several modifications to the simulations themselves as well as detailed performance data from the Engineering Analysis to estimate the energy consumption of equipment at the specific energy efficient levels evaluated in today's NOPR. DOE also notes that inputs to the LCC and PBP analysis, including the installation and maintenance costs, used the same data source as the 2004 ANOPR, but DOE updated the data to reflect the most recent version of the data source.

A. Market and Technology Assessment

1. General

For the market and technology assessment, DOE develops information that provides an overall picture of the market for the equipment concerned, including the purpose of the equipment, the industry structure, and market characteristics. This activity includes both quantitative and qualitative assessments, based primarily on publicly available information. The subjects addressed in the market and technology assessment for this rulemaking include scope of coverage, equipment classes, types of equipment sold and offered for sale, and technology options that could improve the energy efficiency of the equipment under examination. Chapter 3 of the NOPR TSD contains additional discussion of the market and technology assessment.

2. Scope of Coverage and Equipment Classes

The proposed energy conservation standards in today's NOPR cover small, large, and very large, air-cooled CUAC and CUHP under section 342(a) of EPCA. (42 U.S.C. 6313(a)) This category of equipment has a rated capacity between 65,000 Btu/h and 760,000 Btu/h. It is designed to heat and cool commercial buildings. In the case of single-package units, which house all of the components (i.e., compressor, condenser and evaporator coils and fans, and associated operating and control devices) within a single cabinet, these units are typically located on the building's rooftop. In the case of split-system units, the compressor and condenser coil and fan (or in the case of CUHP, the outdoor coil and fan) are housed in a cabinet typically located on the outside of the building, and the evaporator coil and fan (or in the case of CUHP, the indoor coil and fan) are housed in a cabinet typically located inside the building.

When evaluating and establishing energy conservation standards, DOE divides covered equipment into equipment classes by the type of energy used or by capacity or other performance-related features that would justify a different standard. In determining whether a performance-related feature would justify a different standard, DOE considers such factors as the utility to the consumer of the feature and other factors DOE determines are appropriate.

The current equipment classes that EPAct 2005 established for small, large, and very large air-cooled CUAC and CUHP divide this equipment into twelve classes characterized by rated cooling capacity, equipment type (air conditioner versus heat pump), and heating type. Table IV.1 shows the current equipment class structure.

TABLE IV.1—PROPOSED EQUIPMENT CLASSES

Equipment class	Equipment type	Cooling capacity	Sub-category	Heating type
1	Small Commercial Packaged Air-Conditioning and Heating Equipment (Air-Cooled).	≥65,000 Btu/h and <135,000 Btu/h.	AC	Electric Resistance Heating or No Heating.
2				All Other Types of Heating.
3			HP	Electric Resistance Heating or No Heating.

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[34] BT stands for DOE's Building Technologies Program.

[35] The EIA allows the use of the name "NEMS" to describe only an AEO version of the model without any modification to code or data. Because the present analysis entails some minor code modifications and runs the model under various policy scenarios that deviate from AEO assumptions, the name "NEMS–BT" refers to the model as used here. For more information on NEMS, refer to The National Energy Modeling System: An Overview, DOE/EIA–0581 (98) (Feb.1998), available at: *http://tonto.eia.doe.gov/FTPROOT/forecasting/058198.pdf.*

TABLE IV.1—PROPOSED EQUIPMENT CLASSES—Continued

Equipment class	Equipment type	Cooling capacity	Sub-category	Heating type
4				All Other Types of Heating.
5	Large Commercial Packaged Air-Conditioning and Heating Equipment (Air-Cooled).	≥135,000 Btu/h and <240,000 Btu/h.	AC	Electric Resistance Heating or No Heating.
6				All Other Types of Heating.
7			HP	Electric Resistance Heating or No Heating.
8				All Other Types of Heating.
9	Very Large Commercial Packaged Air-Conditioning and Heating Equipment (Air-Cooled).	≥240,000 Btu/h and <760,000 Btu/h.	AC	Electric Resistance Heating or No Heating.
10				All Other Types of Heating.
11			HP	Electric Resistance Heating or No Heating.
12				All Other Types of Heating.

AC = Air conditioner; HP = Heat pump.

In the RFI, DOE stated that it planned to continue using these classes, which are also provided in Table 1 of 10 CFR 431.97. DOE requested feedback on the current equipment classes and sought information regarding other equipment classes it should consider for inclusion in its analysis 78 FR 7296, 7300 (Feb. 1, 2013).

Modine, Carrier, and AAON supported the equipment class structures presented in the RFI. (Modine, No. 5 at p. 1; Carrier, No. 7 at p. 2; AAON, No. 8 at p. 3) AHRI disagreed with DOE's determination that every equipment category for which there is a minimum energy conservation standard is an equipment class. AHRI stated that equipment classes should be delineated based on cooling capacity and on whether the unit is an air conditioner or a heat pump. AHRI commented that the same equipment class could have two different efficiency levels (*e.g.,* one for equipment with electric resistance heat (or none) and the other for equipment with all other types of heating element). (AHRI, No. 14 at p. 5)

As discussed above, EPCA specifies the criteria for separation into different equipment classes: (1) Type of energy used, or (2) capacity or other performance-related features such as those that provide utility to the consumer or others the Secretary determines are appropriate that would justify the establishment of a separate energy conservation standard. DOE notes that considering two different efficiency levels for different equipment types, as asserted by AHRI, would create two separate equipment classes because a performance-related feature (*e.g.,* type of heating) inherently affects the efficiency and warrants establishing a separate energy conservation standard. For these reasons, DOE is proposing energy conservation standards in this NOPR based on the existing equipment class structure provided in Table 1 of 10 CFR 431.97, as shown in Table IV.1.

United CoolAir Corporation (UCA) submitted a request for exemption for a specific type of air conditioning equipment (''double-duct air-cooled air conditioner''). See UCA, EERE–2013–BT–STD–0007–0020. These units are designed for indoor installation in constrained spaces using ducting to an outside wall for the supply and discharge of condenser air to the condensing unit. The sizing of these units is constrained both by the space available in the installation location and the available openings in the building through which the unit's sections must be moved to reach the final installation location. These size constraints, coupled with the higher power required by the condenser fan to provide sufficient pressure to move the condenser air through the supply and return ducts, affect the energy efficiency of these types of systems. More conventional designs that use outdoor units or condenser sections of packaged commercial air conditioners do not require this more complex ductwork and can more easily move condenser air using direct-driven propeller fans.

Currently, double-ducted air conditioners are tested and rated under the same test conditions as single-duct air conditioners, without any ducting connected to, or an external static pressure applied on, the condenser side. This would provide more favorable conditions for testing and rating equipment efficiency in terms of IEER than typically experienced in the field. UCA has asserted that the double-duct design provides customer utility in that it allows interior field installations in existing buildings in circumstances where spacing constraints make an outdoor unit impractical to use. Id. DOE recognizes that the design features associated with the described dual-duct designs may affect energy use while providing justifiable customer utility. However, DOE also questions how much of an efficiency impact, in terms of IEER, the dual-duct design may provide when tested under the current test conditions discussed above compared to single-duct air conditioners and welcomes additional data regarding the impact on the measured IEER.

Issue 3: DOE requests comments on whether separate equipment classes should be considered for dual-duct air-conditioners. DOE further requests detailed comments regarding the definition of such equipment, and any detailed information, such as test data, test conditions, key component design details, fan power consumption, as well as other relevant information that may help DOE evaluate potential alternative equipment class standard levels.

3. Technology Options

As part of the market and technology assessment, DOE uses information about existing and past technology options and prototype designs to help identify technologies that manufacturers could use to improve energy efficiency. Initially, these technologies encompass all those that DOE believes are technologically feasible. Chapter 3 of the NOPR TSD includes the detailed list and descriptions of all technology options identified for this equipment.

In the RFI, DOE stated that it planned to consider the specific technology options presented in Table IV.2. 78 FR 7296, 7300 (Feb. 1, 2013).

TABLE IV.2—RFI TECHNOLOGY OPTIONS

- Heat transfer improvements:
    - Electro-hydrodynamic enhancement.
- Alternative refrigerants.
- Condenser and evaporator fan and fan motor improvements:
    - Larger fan diameters.
    - More efficient fan blades (e.g., air foil centrifugal evaporator fans, backward-cured centrifugal evaporator fans, high efficiency propeller condenser fans).
    - High efficiency motors (e.g., copper rotor motor, high efficiency induction, permanent magnet, electronically commutated).
- Larger heat exchangers.
- Microchannel heat exchangers.
- Reduce air leakage paths within the unit.
- Low-pressure-loss filters.
- Compressor Improvements:
    - High efficiency compressors.
    - Multiple compressors.
- Thermostatic expansion valves.
- Electronic expansion valves.
- High-side solenoid valve or discharge line check-valve to minimize pressure equalization.
- Heat-pipes (for high latent loads).
- Sub-coolers.
- Reduced indoor fan belt loss:
    - Synchronous (toothed) belts.
    - Direct-drive fans.
- Demand-control ventilation strategy.

The RFI sought comment from interested parties on these, as well as other options that DOE had not listed. Carrier commented that, in general, many of the technologies presented by DOE in the RFI are already used in equipment. (Carrier, No. 7 at p. 2) DOE agrees that many of the technologies are used in equipment currently available on the market. As a result, DOE continued to consider such technologies for improving the efficiency above the baseline level for this NOPR. DOE also notes that for the majority of the identified technology options, DOE considered designs in its analyses that are generally consistent with existing equipment on the market (*e.g.,* heat exchanger sizes, fan and fan motor types, controls, air flow).

The following sections discuss comments from interested parties on specific technology options.

Heat Exchanger Size

Increasing the heat transfer surface area of the heat exchangers can be achieved by increasing their width, height, or depth. These measures can improve heat transfer effectiveness, which can reduce the condensing temperature and increase the evaporating temperature needed to transfer the cooling (or heating) load. Such temperature adjustments reduce the compressor's compression ratio and hence its required power input. Lennox indicated that evaporator coil area is already near the maximum for optimum efficiency and latent heat removal. Lennox stated that increasing the coil area leads to higher evaporating temperatures, lessening the ability of the coil to remove moisture from the air, which could lead to humidity control problems in hot humid regions. (Lennox, No. 6 at p. 2) Lennox also commented that adding coil rows increases costs proportional to the number of rows, but provides less than proportional efficiency gain. (Lennox, No. 6 at p. 2)

DOE agrees with Lennox that increasing the evaporator size may lead to a decrease in latent heat removal. Based on a review of currently available equipment literature and DOE's energy modeling analyses, DOE determined that, for a given capacity, the heat exchanger sizes varied significantly, with larger coil sizes generally correlating to higher IEER levels (see chapter 5 of the NOPR TSD for additional information).[36] As part of the engineering analysis, the design options DOE considered for different IEER levels include the variation of evaporator coil size, and DOE's analysis considered evaporator coil sizes consistent with equipment available on the market.

Fans and Fan Motors

As stated above, DOE proposed several improvements to the indoor and outdoor fan motors, including copper rotor motors, higher efficiency motors, and direct-drive fans, and synchronous belts.

Manufacturing more efficient copper rotor motors requires using copper instead of aluminum for critical components of an induction motor's rotor (*e.g.,* conductor bars and end rings). By using copper in these motor components, the efficiency of the motor can improve significantly because the electrical conductivity of this material, relative to other materials commonly used in rotor construction (*e.g.* aluminum) is much higher (*i.e.,* lower electrical resistance). With this higher level of conductivity, the electrical losses that might otherwise present themselves during operation in a given motor are significantly reduced. However, using a copper-cast rotor in an electric motor presents a variety of production challenges. For example, copper melts at higher temperatures than aluminum, so the casting process becomes more difficult (*due to* higher thermal stress on the die mold) and is likely to increase both production time and cost for manufacturing a motor. EBM-Papst Inc. (EBM-Papst) commented that copper rotor motors provide marginally increased efficiency

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[36] The following are examples of the equipment literature DOE reviewed:

(1) United Technologies Corporation. ''Carrier 50TC Cooling Only/Electric Heat, Packaged Rooftop, 3 to 15 Nominal Tons: Product Data.'' Available online at: *http://www.docs.hvacpartners.com/idc/groups/public/documents/techlit/50tc-19pd.pdf* (Accessed on Sept. 12, 2013).

(2) Lennox International Inc. ''Lennox Packaged Electric/Electric LCH Energence® Rooftop Units: Product Specifications.'' Available online at: *http://tech.lennoxintl.com/C03e7o14l/3rEpIb5d/ehb_lch_bbox_1306_210556_020.pdf* (Accessed on Sept. 12, 2013).

(3) Ingersoll Rand. ''Trane Product Catalog: Packaged Rooftop Air Conditioners, Voyager™ Cooling and Gas/Electric, 12½–25 Tons, 60Hz'' Available online at: *http://www.trane.com/CPS/Uploads/UserFiles/DXUnitarySystems/Light%20Rooftops/RT-PRC028-EN_08022013.pdf* (Accessed on Sept. 12, 2013).

over aluminum and aluminum alloy rotor motors. EBM-Papst noted that the torque characteristic of copper rotor motors is very stiff, so that copper rotor motors cannot control speed based on voltage and, as a result, variable speed copper rotor motors would require variable frequency drives. EBM-Papst also indicated that casting of copper requires very high temperatures and very specialized tools. (EBM-Papst, No. 16, p. 1)

DOE agrees with EBP-Papst that copper rotor motors are more difficult to manufacture than aluminum rotor motors due to the high temperatures required for casting. However, as part of the previous rulemaking for this equipment, DOE noted that in the case of motor rotors for similar horsepower motors, copper rotors can reduce the electric motor total energy losses by between 15 percent and 23 percent as compared to aluminum rotors.[37] DOE also notes that, based on a review of equipment literature, equipment is available on the market that offers variable speed indoor fan motors using variable frequency drives. As a result, DOE considered copper rotor motors as a technology option.

High-efficiency electric motors that drive evaporator and condenser fans can increase efficiency and reduce overall energy use in air-cooled CUAC and CUHP. EBM-Papst stated that high-efficiency permanent magnet motors are available with ferrite magnets. EBM-Papst indicated that external rotor permanent magnet motors with completely integrated drive electronics are available up to a 6 kilowatt (kW) (8 horsepower) electrical input. EBM-Papst stated that versions with 7.5 kW and 12 kW (10 horsepower and 15 horsepower), which DOE notes may be applicable for very large air-cooled CUAC and CUHP indoor fan motors, will become available in 2013 and 2014, respectively. In light of EBM-Papst's information, DOE decided to consider higher efficiency permanent magnet motors as part of its list of technology options because they may reduce the energy consumption compared to motors currently used by manufacturers for CUAC and CUHP equipment. As discussed above, DOE's analysis considered fan motors consistent with equipment available on the market.

Direct-drive fans connect the fan blade/wheel directly to the motor shaft, thereby eliminating drive belt energy loss. EBM-Papst also commented that direct-drive fans prevent friction power losses that can be found in fans with mechanical transmission components even when these components are perfectly aligned with properly-tightened high-quality belts. (EBM-Papst, No. 16 at p. 2) DOE notes that certain air-cooled CUAC and CUHP currently available on the market already incorporate direct-drive fans in higher efficiency equipment. As a result, DOE proposes to keep direct-drive fans on the list of technologies.

Another option to improve efficiency would be to increase the diameter of the outdoor fan, which reduces the discharge velocity of the air leaving the condenser fan. The energy associated with the discharge velocity is dissipated and cannot be recovered, hence, a lower discharge velocity reduces this loss and reduces fan power input. Regarding increasing the outdoor fan diameter, EBM-Papst commented that fan efficiency varies significantly with the fan's duty point. EBM-Papst noted that many fans are selected with the operating point very far to the right of the point of peak efficiency (*i.e.,* fans are designed for higher flow rates and are sized smaller than is optimal for efficiency) and that such selections yield lower first cost and smaller equipment size. EBM-Papst stated that fan selections that match the duty point closer with the fan's peak efficiency are usually larger. Moreover, EBM-Papst commented that despite the potential increase in operational fan efficiency, a larger fan—while operating at lower rotational speed—can require a slightly higher motor torque, which results in the need for a larger motor frame size. (EBM-Papst, No. 16, p. 2) (Larger frame-sized motors provide higher horsepower and torque levels.) Lennox also commented that fan efficiency increases with fan diameter, but that cabinet size and shipping dimensions constrain the ability of manufacturers to increase fan diameters much beyond the current sizes. (Lennox, No. 6 at p. 2)

With respect to these comments, DOE recognizes that fan efficiency can play a role in improving CUAC/CUHP efficiency. DOE also realizes that fan diameter size is limited by cabinet sizes and shipping dimensions. DOE has incorporated fan diameter and motor sizes consistent with existing equipment available on the market to ensure that components are appropriately sized.

EBM-Papst suggested that DOE consider that company's HyBlade® axial fan and AxiTop diffuser for axial fans as technology options for improving condenser fan efficiency. (EBM-Papst, No. 16 at p. 3) EBM-Papst stated that the HyBlade® axial fan uses a blade with a metal core for structural strength and motor heat dissipation, while using injection molded blade surfaces for advanced geometries that allow for optimized aerodynamic shape, resulting in increased efficiency compared to conventional fan blades. (EBM-Papst, No. 16 Appendix 4 at p. 2) According to EBM-Papst, the Axitop diffuser reduces discharge losses due to stripping and back-flow of air and, as a result, boosts the pressure increase of the fan. This increases the efficiency of the fan and allows the fan speed to be reduced (*i.e.,* fan motors may run at lower power) while producing the same air volume, resulting in a decrease in energy use of the overall system. EBM-Papst noted that in one customer application (at constant air volume), energy consumption was reduced by 27 percent using this technology. (EBM-Papst, No. 16 Appendix 3 at pp. 1–2) DOE notes that both of these technologies are patented by EBM-Papst. DOE does not intend to consider energy conservation standards that would necessitate the use of any proprietary designs or patented technologies, which could allow a single manufacturer to monopolize the market. As a result, DOE is not considering EBM-Papst's HyBlade® axial fan and AxiTop diffuser as technology options in this NOPR. However, DOE notes that the proposed energy conservation standards would not prohibit the use of these technologies.

EBM-Papst made several comments regarding indoor fan energy use and available design options to improve their efficiency—which, by extension, would improve overall CUAC/CUHP efficiency. EBM-Papst commented that unnecessary electrical consumption by indoor fans impacts the energy efficiency doubly, because of the additional heat load on the conditioned space. DOE recognizes that the heat load caused by the indoor motor may result in added energy consumption to cool the air heated by the motor. DOE notes that the energy modeling tool used in the engineering analyses is already designed to account for the heat load caused by the indoor fan motor as part of the overall system performance.

An airfoil centrifugal fan is a type of fan that has blades shaped like air foils that are inclined such that the blade trailing edge is angled away from the rotation direction. The best airfoil fans can operate at efficiencies near 90 percent.[38] Utilizing this type of fan for

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[37] See chapter 4 of the TSD for the July 2004 ANOPR, available online at: *http://www.regulations.gov/#!documentDetail;D=EERE-2006-STD-0103-0078.*

[38] United States Army. December 9, 2005. Maintenance of Mechanical and Electrical Equipment At Command, Control,

indoor fan applications can improve the efficiency of the CUAC/CUHP system. Regarding specific indoor fan types, EBM-Papst stated that airfoil centrifugal fans are known for low sound. Additionally, EBM-Papst stated that the efficiency benefits of airfoil impellers over backward curved impellers (which have the tips of its blades inclined away from the direction of the airflow, enabling it to move air at higher pressures) should be examined closely. (EBM-Papst, No. 16 at p. 2) Although EBM-Papst did not provide details regarding the low sound feature, DOE recognizes that the airfoil centrifugal fan has less friction losses during operation, which produces less noise, and also results in lower power consumption.

DOE acknowledges that manufacturers may offer features that are beneficial to consumers, like low sound fans, but do not impact efficiency. A number of manufacturers indicated that airfoil centrifugal fans and backward curved centrifugal fans (i.e., similar to airfoil fans, but they have simpler blades and cannot attain comparable efficiencies) may improve IEER due to lower fan power consumption. As a result, DOE proposes to include these fan types on the list of technology options. As discussed above, DOE considered technology options and designs that are generally consistent with existing equipment on the market. Additionally, as part of the reverse engineering analysis (see section IV.C.1), DOE considered fan curves and test data to account for the performance of the fans as part of the air-cooled CUAC and CUHP.

EBM-Papst also provided the following comments on other fan and fan motor efficiency improving technologies:

- Lower air-speed results in lower fan energy losses and EBM-Papst recommended imposing an upper limit for air speed inside of the commercial package equipment, referenced to air inlet area, the air outlet area, and/or air filter area. Air-speed of less than 2.5 meters/second would be ideal.
- Optimize the air path in the unit to minimize airflow impedance.
- Optimize the fan selection in terms of fan diameter, and fan type (axial, centrifugal forward curved, centrifugal backward curved, cross flow, mixed flow) so that the fan duty point of its peak efficiency is: (1) Close to the actual fan duty point required by the commercial package equipment, and (2) that the chosen fan type enhances the air path in the unit.
- Fine-tune the fan design (blade angle, number of blades, impeller width) so that the fan's operational efficiency in the unit matches the fan peak efficiency exactly.
- Some electronic motor speed controllers can cause structure-borne noise. A better controller potentially avoids the need for sound attenuation, which in turn, frees up the air path for increased air-side efficiency.
- Improve the combination of fans with motors and speed controllers. A regulation harmonized with EN 13053:2006+A1 would limit the maximum permitted electrical power consumption of the motorized fan. Equation (6) in EN 13053 determines a reference power input based on fan static pressure and on airflow. The resulting product is compared against a table which categorizes the equipment in class P1 (best) through class P7 (worst). (EBM-Papst, No. 16 at p. 3)

DOE agrees that reducing the air speed can reduce fan power consumption and included variable or staged air flow as a technology option. DOE also recognizes that optimizing fan type and fan design may decrease the fan power consumption and thus improve the efficiency of the air-cooled CUAC and CUHP. As a result, DOE is including these designs on the list of technology options. DOE also agrees that appropriately matching the fan with the fan motor improves efficiency. However, DOE proposes to evaluate air-cooled CUAC and CUHP as a whole and does not propose to set separate performance requirements for the fan assembly. With regards to EBM-Papst's comments concerning optimizing air paths and better motor controllers, DOE's analyses considered air flow paths and control systems consistent with existing equipment available on the market.

Electronic Expansion Valves

Expansion valves are refrigerant metering devices that control the amount of refrigerant flowing to the evaporator coil, decreasing the temperature and pressure of the refrigerant, which creates the driving force to move heat out of the conditioned space and into the evaporator. Electronic expansion valves use an electronic control system and sensors that measure suction line temperature and pressure to maintain more precise control of superheat over a wide range of operating conditions and, as a result, may increase energy efficiency under varying load conditions when paired with modulating systems.

Lennox stated that electronic expansion valves are very costly and not economically justified because they provide little full load benefit. (Lennox, No. 6 at p. 2) As explained in section III.A, DOE proposes to transition to IEER, a part load efficiency metric, and electronic expansion valves are beneficial for partial loads because they can precisely control the expansion process which leads to lower power consumption, and therefore, a higher IEER. DOE recognizes that that electronic expansion valves may be more expensive that other expansion devices, like capillary tubes or thermostatic expansion valves, but DOE already considers the costs of design options separately as part of the engineering analyses, which means that these devices may be screened out once costs are factored into the analysis. As a result, DOE is continuing to consider electronic expansion valves as a technology option for purposes of its engineering analysis.

Part-Load Technology Options

Variable-capacity or multiple-tandem compressors provide the ability to modulate the cooling capacity, allowing equipment to better match the cooling load than single speed compressors that can only operate by cycling on and off. The effectiveness of the heat exchangers is greater during operation with reduced mass flow at part load, thus reducing the condensing temperature and increasing the evaporating temperature required to transfer the load—this in turn reduces the compressor's operating pressure ratio and its power input. As a result, using variable capacity or multiple-tandem compressors may improve the overall system efficiency by matching part-load operating conditions (and reducing energy consumption) more closely than units using single speed compressors. Variable speed fans/motors can also improve CUAC and CUHP efficiency by varying fan speed to reduce air flow rate at part load. If the indoor/outdoor heat exchangers of a unit are served by a variable-capacity compressor or by a tandem compressor set, less air flow is needed to transfer the load. Overall system efficiency can be improved by reducing the indoor or outdoor air flow and reducing indoor/outdoor fan power.

DOE's consideration of a shift to an IEER-based standard generated a number of comments. Ingersoll Rand commented that moving to an IEER metric will require manufacturers to optimize around part load performance, likely in the form of improved heat

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Communications, Computers, Intelligence, Surveillance, and Reconnaissance (C4isr) Facilities, HQUSACE/OCE Army Technical Manuals [Online Report]. DOE documented this report in the rulemaking docket as docket ID EERE–2013–BT–STD–0007–0019.

transfer and airflow. (Ingersoll Rand, No. 10 at p. 3) Whole Building Systems, LLC, commented that DOE should include variable-capacity compressors, along with variable speed condenser and evaporator fans. It noted that these technologies are already being adopted by manufacturers. (Whole Building Systems, No. 4 at p. 1) Carrier added that compressor staging (multiple or variable capacity-compressors) and indoor and outdoor fan speed control would increase IEER efficiency, but would not impact EER. (Carrier, No. 7 at p. 2)

DOE agrees with Whole Building Systems, Carrier, and Ingersoll Rand that variable-capacity compressors, compressor staging, and variable speed fans improve IEER because they provide the ability to modulate the cooling capacity and reduce the overall system power consumption under part-load conditions. Based on DOE's review of manufacturer equipment literature, these design elements are already being used in equipment currently available on the market. Accordingly, DOE included these design elements in the list of technology options considered for this NOPR.

Modine commented that DOE should also consider the intelligent interactive modulation head pressure control, a technology option developed by Airedale International Air Conditioning (Airedale) to improve off peak load efficiencies. (Modine, No. 5 at pp. 1–2) DOE notes that Modine did not provide any details regarding this technology or the associated efficiency improvement. DOE also notes that Airedale was acquired by Modine in 2005. DOE does not consider proprietary technologies as part of its analyses and, as a result, did not consider the intelligent interactive modulation head pressure control developed by Airedale as a separate technology option. However, DOE recognizes that different equipment manufacturers may take different approaches for part-load operation control strategies.

Technology Options That Do Not Impact IEER

DOE laid out a number of technology options for comment that have no impact on IEER but that could have an overall impact on energy usage that would not be fully captured by the use of this proposed metric. Demand-control ventilation strategies monitor the indoor space occupancy and conditions (*e.g.,* using CO_2 sensors) to deliver the required ventilation as needed (based on building air quality requirements). In contrast, conventional systems that do not employ these strategies may provide fixed amounts of ventilated air based on assumed conditions. By comparison, demand-control ventilation strategies would more accurately control the amount of outdoor air required for ventilation that needs to be conditioned by the equipment.

Lennox and Ingersoll Rand commented that demand-control ventilation strategy does not benefit either EER or IEER ratings. (Lennox, No. 6 at p. 3; Ingersoll Rand, No. 10 at p. 3) Carrier also commented that many units on the market have capabilities for demand management, and with the development of smart meters and the smart grid, there are more effective ways to control peak power for this class of equipment than the technology options identified by DOE. Carrier stated that these features are not captured in EER or IEER metrics. (Carrier, No. 7 at p. 2) Lentz Engineering Associates, Inc. commented that DOE should consider a technology option where the primary function of the air handling systems is to efficiently process or manage ventilation and where the primary heating and cooling plants rely on recovered energy instead of expending new energy assets. Lentz Engineering stated that this can result in energy use reductions in HVAC systems on the order of 85 to 90 percent. (Lentz, No. 3 at p. 1)

DOE also considered the implementation of a high-side solenoid valve. A high-side solenoid valve (*i.e.,* a solenoid valve located in the high-pressure-refrigerant line) and a discharge line check valve (*i.e.,* a check valve located in the compressor discharge line) can be installed in a refrigeration system to minimize pressure equalization between the high-pressure and low-pressure sides. Lennox commented that these valves do not benefit either EER or IEER ratings, but no further details were provided in their comments. (Lennox, No. 6 at p. 3)

Another option could also be used. Heat pipes are used in hot humid climates to increase dehumidification. Refrigerant inside the heat pipe pre-cools incoming supply air by absorbing the heat from it. The evaporator cools the supply air further, and is able to extract more water vapor than a conventional evaporator would. After the refrigerant in the tubes changes into a vapor, it flows to the condensing section at the other end of the system, releasing its heat and flowing back to the evaporator end of the pipe to begin the cycle again. Lennox also commented that heat-pipes for high latent loads do not benefit either EER or IEER ratings. (Lennox, No. 6 at p. 3)

In addition to the items describe above, AAON noted several other technologies that DOE did not initially consider that can improve efficiency. These technologies include capacity modulation (*i.e.,* modulate system capacity output for part load conditions by various means to reduce overall energy consumption), economizers (*i.e.,* an automatic system that enables a cooling system to supply outdoor air to reduce or eliminate the need for mechanical cooling during mild or cold weather), heat recovery (*i.e.,* a process that preconditions outdoor air entering the equipment through direct or indirect thermal and/or moisture exchange with the exhaust air) and energy efficient control sequences (*e.g.,* single zone variable-air-volume) are outside the scope of AHRI Standard 340/360–2007 and beyond the lab facilities capabilities to test. AAON added that although energy can be saved annually by using any one of these options, the full load EER ratings would be decreased due to the higher pressure drop incurred with many of these features. AAON stated that rating system modifications exist to account for the energy savings of some of these technologies, such as those contained in AHRI Guideline V for energy recovery systems. (AAON, No. 8 at p. 3)

DOE recognizes that technologies such as demand-control strategies, economizers, energy recovery, high-side solenoid valves or discharge line check-valves and heat pipes may result in annual building energy savings. However, DOE is not aware of any data showing that these technologies improve IEER based on the current DOE test procedure. As a result, DOE is not proposing to include these technologies in its analyses. However, DOE notes that the IEER metric for this equipment already accounts for both capacity modulation and energy efficient control sequences. In addition, based on a review of equipment literature, DOE notes that both capacity modulation and energy efficient control sequences are used to improve part-load performance for this equipment. As a result, DOE included these technology options as part of the analyses.

Based on manufacturer comments and DOE's review of equipment literature, DOE is declining to include low pressure drop filters and air leakage paths within the unit from the list of technology options. Comments from several manufacturers during manufacturer interviews and public meetings held as part of the Commercial HVAC, Water Heating, and Refrigeration Certification Working Group (Commercial Certification Working

Group), indicated that most manufacturers test their systems without filters installed or use disposable filters that produce minimal pressure drops when used. Additionally, the filter type used in a system is a feature specified by the customer based on the needs of the installation. For example, a unit installed in a hospital will require filters with a high Minimum Efficiency Reporting Value (MERV) rating,[39] which may cause an increase in pressure drop depending on the density of the filter material and an accompanying increase in fan power and energy use of the unit. DOE proposes to remove air leakage paths from the list of technology options because several manufacturers indicated during interviews that air leakage paths are already eliminated during design of air-cooled CUAC and CUHP.

Based on these assertions and supplemental follow-up work performed, DOE considered the following technology options listed in Table IV.3 in formulating its proposed standards:

TABLE IV.3—PROPOSED TECHNOLOGY OPTIONS

Heat transfer improvements:
- Electro-hydrodynamic enhancement.

Alternative refrigerants.
Condenser and evaporator fan and fan motor improvements:
- Larger fan diameters.
- More efficient fan blades (e.g., air foil centrifugal evaporator fans, backward-cured centrifugal evaporator fans, high efficiency propeller condenser fans).
- High efficiency motors (e.g., copper rotor motor, high efficiency induction, permanent magnet, electronically commutated).
- Variable speed fans/motors.

Larger heat exchangers.
Microchannel heat exchangers.
Compressor Improvements:
- High efficiency compressors.
- Multiple compressor staging.
- Multiple-tandem or variable-capacity compressors.

Thermostatic expansion valves.
Electronic expansion valves.
Subcoolers.
Reduced indoor fan belt loss:
- Synchronous (toothed) belts.
- Direct-drive fans.

Issue 4: DOE requests comment and data regarding additional design options or variants of the considered design options that can increase the range of considered efficiency improvements, including design options that may not yet be found on the market.

B. Screening Analysis

After DOE identified the technologies that might improve the energy efficiency of electric motors, DOE conducted a screening analysis. The purpose of the screening analysis is to determine which options to consider further and which to screen out. DOE consulted with industry, technical experts, and other interested parties in developing a list of design options. DOE then applied the following set of screening criteria to determine which design options are unsuitable for further consideration in the rulemaking:

- *Technological Feasibility:* DOE will consider only those technologies incorporated in commercial equipment or in working prototypes to be technologically feasible.
- *Practicability to Manufacture, Install, and Service:* If mass production of a technology in commercial equipment and reliable installation and servicing of the technology could be achieved on the scale necessary to serve the relevant market at the time of the effective date of the standard, then DOE will consider that technology practicable to manufacture, install, and service.
- *Adverse Impacts on Equipment Utility or Equipment Availability:* DOE will not further consider a technology if DOE determines it will have a significant adverse impact on the utility of the equipment to significant subgroups of customers. DOE will also not further consider a technology that will result in the unavailability of any covered equipment type with performance characteristics (including reliability), features, sizes, capacities, and volumes that are substantially the same as equipment generally available in the United States at the time.
- *Adverse Impacts on Health or Safety:* DOE will not further consider a technology if DOE determines that the technology will have significant adverse impacts on health or safety.

Technologies that pass through the screening analysis are referred to as ‘‘design options’’ in the engineering analysis. Details of the screening analysis are in chapter 4 of the NOPR TSD. In view of the above factors, DOE screened out the following design options.

Electro-Hydrodynamic Enhanced Heat Transfer

Electro-hydrodynamic enhancement of heat transfer increases the net heat transfer coefficient by applying a high-voltage electrostatic potential field across a heat transfer fluid to destabilize the thermal boundary layer and incite fluid mixing. The improved heat transfer of the evaporator and condenser coils may improve a given system's overall efficiency. DOE notes, however, that this technology is still in the research stage. In response to the RFI, Lennox commented that locating an electrode between each of the hundreds/thousands of heat exchanger fins (which would be the likely method for applying this option) has not been adequately demonstrated for commercial deployment. (Lennox, No. 6 at p. 2)

Although the technique has been shown to improve heat transfer in laboratory testing, DOE is not aware of any commercially available equipment

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[39] ASHRAE Standard 52.2–2007, ‘‘Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size,’’ establishes the MERV rating, which is the standard comparison of the efficiency of an air filter, ranging from 1 (least efficient) to 16 (most efficient), and measures a filter's ability to remove particles from 0.3 to 10 microns in size.

or working prototypes that use electro-hydrodynamic heat transfer. As a result, DOE does not believe at this time that this option meets the screening criterion of technological feasibility. In addition, DOE agrees with Lennox that this technology has not been adequately demonstrated for commercial deployment and, as a result, does not meet the criterion of practicability to install and service on a scale necessary to serve the relevant market at the time of the compliance date of a new standard. For these reasons, DOE did not consider electro-hydrodynamic heat transfer further in the NOPR analyses.

Alternative Refrigerants

DOE considered ammonia, carbon dioxide, and various hydrocarbons (such as propane and isobutane) as alternative refrigerants to those that are currently in use, such as R–410A. In response to the February 2013 RFI, Lennox stated that virtually all equipment is designed with R–410A as the refrigerant, and that because of the lengthy qualification process to develop a new refrigerant and the components that would need to be redesigned to use it, it is not reasonable to expect a new refrigerant in the timeframe for new energy conservation standards. (Lennox, No. 6 at p. 2) DOE notes that safety concerns need to be taken into consideration when using ammonia and hydrocarbons in air-conditioning systems. EPA created the Significant New Alternatives Policy (SNAP) Program to evaluate alternatives to ozone-depleting substances. Substitutes are reviewed on the basis of ozone depletion potential, global warming potential, toxicity, flammability, and exposure potential. DOE notes that ammonia (in vapor compression cycles), carbon dioxide, and hydrocarbons have been approved or are being considered under SNAP for certain uses, but these or other low GWP alternatives are not yet listed as acceptable substitutes for this equipment.[40] DOE is also not aware of any other more efficient refrigerant options that are SNAP-approved. Because these alternative refrigerants have not yet been approved for this equipment, DOE did not consider alternate refrigerants for further analysis.

Sub-Coolers

A sub-cooler is a device located between the condenser coil outlet and the expansion device inlet used to further cool the refrigerant exiting the condenser in order to achieve a higher cooling/heating capacity for a unit. In response to the RFI, Lennox added that sub-coolers do not provide a benefit at comfort air conditioning operating conditions. (Lennox, No. 6 at p. 3) DOE notes that air-cooled CUAC and CUHP units typically sub-cool the refrigerant in the condensing coil (by further decreasing the temperature of the refrigerant). DOE also notes that additional mechanical sub-cooling from smaller, secondary vapor-compression circuits has not been incorporated in commercial equipment or in working prototypes. As a result, DOE does not believe sub-cooling meets the criterion of technological feasibility and did not consider it for further analysis.

Based on the screening analysis, DOE considered the design options listed in Table IV.4.

TABLE IV.4—DESIGN OPTIONS RETAINED FOR ENGINEERING ANALYSIS

Condenser and evaporator fan and fan motor improvements:
  - Larger fan diameters.
  - More efficient fan blades (e.g., air foil centrifugal evaporator fans, backward-cured centrifugal evaporator fans, high efficiency propeller condenser fans).
  - High efficiency motors (e.g., copper rotor motor, high efficiency induction, permanent magnet, electronically commutated).
  - Variable speed fans/motors.

Larger heat exchangers.
Microchannel heat exchangers.
Compressor Improvements:
  - High efficiency compressors.
  - Multiple compressor staging.
  - Multiple- or variable-capacity compressors.

Thermostatic expansion valves.
Electronic expansion valves.
Reduced indoor fan belt loss:
  - Synchronous (toothed) belts.
  - Direct-drive fans.

C. Engineering Analysis

The engineering analysis estimates the cost-efficiency relationship of equipment at different levels of increased energy efficiency. This relationship serves as the basis for the cost-benefit calculations for commercial customers, manufacturers, and the Nation. In determining the cost-efficiency relationship, DOE estimates the increase in manufacturer cost associated with increasing the efficiency of equipment above the baseline up to the maximum technologically feasible (''max-tech'') efficiency level for each equipment class.

1. Methodology

DOE has identified three basic methods for generating manufacturing costs: (1) The design-option approach, which provides the incremental costs of adding design options to a baseline model that will improve its efficiency (*i.e.,* lower its energy use); (2) the efficiency-level approach, which provides the incremental costs of moving to higher energy efficiency levels, without regard to the particular design option(s) used to achieve such increases; and (3) the reverse-engineering (or cost-assessment) approach, which provides ''bottom-up'' manufacturing cost assessments for achieving various levels of increased efficiency, based on teardown analyses (or physical teardowns) providing detailed data on costs for parts and material, labor, shipping/packaging, and investment for models that operate at particular efficiency levels. A supplementary method called a catalog

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[40] On July 9, 2014, EPA proposed to list certain hydrocarbons and R–32 for residential self-contained A/C appliances as acceptable subject to use conditions to address safety concerns (See 79 FR 38811). EPA is also evaluating new refrigerants for other A/C applications, including commercial A/C. Additional information regarding EPA's SNAP Program is available online at: *http://www.epa.gov/ozone/snap/.*

teardown uses published manufacturer catalogs and supplementary component data to estimate the major physical differences between a piece of equipment that has been physically disassembled and another piece of similar equipment for which catalog data are available to determine the cost of the latter equipment.

In the RFI, DOE stated that in order to create the cost-efficiency relationship, it anticipated having to structure its engineering analysis using the reverse-engineering approach, including physical and catalog teardowns. DOE requested comments on using a reverse engineering approach supplemented with catalog teardowns and comments on what the appropriate representative capacities would be for each equipment class. 78 FR 7300.

AAON commented that it is inappropriate and unethical for DOE to use proprietary information and trade secrets provided during manufacturer interviews to reverse engineer equipment supplemented by the catalog teardowns. AAON stated that disclosing trade secrets in a public forum, accessible worldwide, undermines U.S. manufacturing and damages the free enterprise system. (AAON, No. 8 at p. 4) DOE notes that it does not publicly disclose proprietary information obtained from individual manufacturers. Instead, as part of the manufacturer interviews, DOE aggregates all manufacturer responses to prevent disclosing of proprietary information and trade secrets.

AAON commented that DOE's methodology is flawed because all models are weighted equally. AAON indicated that models with higher efficiency and cost are sold in much lower quantities than models with lower efficiency and cost. AAON added that models with higher efficiency and cost may not be economically justified and are only sold to consumers that want the highest efficiency regardless of economic justification. (AAON, No. 8 at p. 3) DOE intends to conduct a full analysis to determine the economic justification of higher efficiency levels, including developing incremental manufacturing costs for higher efficiency equipment based on energy modeling, reverse engineering analyses, and catalog teardowns. Although manufacturers may currently sell higher efficiency models at lower quantities, DOE's analysis considers the incremental manufacturing costs if energy conservation standards are set at a particular efficiency level and assumes that market share will shift to the new standard level.

Carrier commented that reverse engineering of a few selected samples will not provide an accurate picture of manufacturing costs, which depend on volume, tooling approach (dedicated versus flexible) and assembly processes and procedures for which reverse engineering will not provide insight. Carrier recommended that DOE should work with AHRI and industry to obtain costs using a blind survey, with each manufacturer providing estimates for the cost increases related to the proposed standards. (Carrier, No. 7 at p. 3) DOE notes that it supplemented its reverse engineering analyses with manufacturer interviews and solicited feedback on the volume, tooling, and processes used to manufacture equipment and the manufacturing costs required to meet each efficiency level for each equipment class. As a result, DOE believes that the manufacturing cost-efficiency results from the engineering analyses are sufficiently representative of the manufacturing processes used for this equipment.

Ingersoll Rand commented that DOE should analyze the following categories to adequately represent variation in equipment types: (1) 7.5-ton cooling and heat pump, (2) 15-ton cooling and heat pump, (3) 40-ton cooling only. (Ingersoll Rand, No. 10 at p. 3) Lennox added that DOE should select equipment from manufacturers that have equipment with baseline and higher efficiency in the same platform. (Lennox, No. 6 at p. 3)

For this NOPR, DOE conducted the engineering analyses using the reverse-engineering approach and analyzed three specific capacities to represent each of the three cooling capacity categories (*i.e.,* small, large, and very large). Based on a review of manufacturer equipment offerings and information obtained from manufacturer interviews, DOE selected representative capacities of 90,000 Btu/h (7.5 tons) for the ≥65,000 to <135,000 Btu/h capacity range, 180,000 Btu/h (15 tons) for the ≥135,000 to <240,000 Btu/h capacity range, and 360,000 Btu/h (30 tons) for the ≥240,000 to <760,000 Btu/h capacity range. DOE noted in the 2004 ANOPR that 7.5 tons and 15 tons represent volume shipment points in their respective capacity range. 69 FR 45469. These capacities are near the center of their respective equipment class capacity ranges. Additionally, DOE interviewed several equipment manufacturers as part of the current rulemaking and found that the majority of manufacturers interviewed agreed that the 7.5-ton, 15-ton, and 30-ton capacities adequately represent the three equipment class capacity ranges.

Where feasible, DOE selected models for reverse engineering with low and high efficiencies from a given manufacturer that are built on the same platform. DOE also supplemented the teardown analysis by conducting catalog teardowns for equipment spanning the full range of capacities and efficiencies from all manufacturers selling equipment in the United States.

2. Baseline Efficiency Levels

The baseline model is used as a reference point for each equipment class in the engineering analysis and the life-cycle cost and payback-period analyses. Typically, DOE would consider equipment that just meets the minimum energy conservation standard as baseline equipment. However, as discussed in section III.A, DOE is proposing to replace the current cooling performance energy efficiency descriptor, EER, with IEER, and a single EER level can correspond to a range of IEERs. As a result, DOE must establish a baseline IEER for each equipment class. As part of the RFI, DOE requested comment on approaches that it should consider when determining a baseline IEER as well as an appropriate baseline IEER for each equipment class. 78 FR 7300–7301 (Feb. 1, 2013).

Modine commented that DOE should continue to use ASHRAE Standard 90.1 and ASHRAE Standard 189.1, ''Standard for the Design of High-Performance Green Buildings,'' (ASHRAE Standard 189.1)[41] for establishing baseline IEER levels because current technology makes it readily possible to achieve the ASHRAE Standard 189.1 minimum IEER standards. (Modine, No. 5 at p. 2) The IEER levels specified in ASHRAE Standard 189.1 are 0.2 to 1.1 IEER higher than the ASHRAE Standard 90.1 levels.

As discussed in section II.A, DOE is typically obligated either to adopt those standards developed by ASHRAE or to adopt levels more stringent than the ASHRAE levels if there is clear and convincing evidence in support of doing so. (42 U.S.C. 6313(a)(6)(A)) DOE notes that ASHRAE Standard 90.1–2010 specifies minimum efficiency requirements using both the EER and IEER metrics. As discussed in the RFI, DOE evaluated the relationship between EER and IEER by considering models that are rated at the current DOE standard levels based on the EER metric

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[41] ASHRAE Standard 189.1 provides minimum requirements for the siting, design, construction, and plan for operation of high-performance green buildings. Available online at: *https://www.ashrae.org/resources-publications/bookstore/standard-189-1.*

for each equipment class (as presented in section II.B.1). DOE then analyzed the distribution of corresponding rated IEER values for each equipment class. DOE notes that the lowest IEER values associated with the current DOE standards for EER generally correspond with the ASHRAE Standard 90.1–2010 minimum efficiency requirements. 78 FR 7296, 7299 (Feb. 1, 2013); EERE–2013–BT–STD–0007–0001. Based on this evaluation, because DOE is considering energy conservation standards based on the IEER metric, DOE proposes to use the ASHRAE Standard 90.1–2010 minimum IEER requirements to characterize the baseline cooling efficiency for each equipment class. DOE also notes that equipment is available on the market that is at or near the ASHRAE Standard 90.1–2010 minimum IEER requirements. As a result, DOE is not considering higher IEER levels for the baseline.

For CUHP, DOE is considering heating efficiency standards based on the COP metric. As discussed in section II.B.1, EPAct 2005 established minimum COP levels for small, large, and very large air-cooled CUHP, which DOE codified in a final rule on October 18, 2005. 70 FR 60407. DOE proposes to use these current COP standard levels to characterize the baseline heating efficiency for each equipment class.

The baseline efficiency levels for each equipment class are presented below in Table IV.5.

TABLE IV.5—BASELINE EFFICIENCY LEVELS

Equipment type		Heating type	Baseline efficiency level
Small Commercial Packaged AC and HP (Air-Cooled)—≥65,000 Btu/h and <135,000 Btu/h Cooling Capacity.	AC	Electric Resistance Heating or No Heating	11.4 IEER.
		All Other Types of Heating	11.2 IEER.
	HP	Electric Resistance Heating or No Heating	11.2 IEER, 3.3 COP.
		All Other Types of Heating	11.0 IEER, 3.3 COP.
Large Commercial Packaged AC and HP (Air-Cooled)—≥135,000 Btu/h and <240,000 Btu/h Cooling Capacity.	AC	Electric Resistance Heating or No Heating	11.2 IEER.
		All Other Types of Heating	11.0 IEER.
	HP	Electric Resistance Heating or No Heating	10.7 IEER, 3.2 COP.
		All Other Types of Heating	10.5 IEER, 3.2 COP.
Very Large Commercial Packaged AC and HP (Air-Cooled)—≥240,000 Btu/h and <760,000 Btu/h Cooling Capacity.	AC	Electric Resistance Heating or No Heating	10.1 IEER.
		All Other Types of Heating	9.9 IEER.
	HP	Electric Resistance Heating or No Heating	9.6 IEER, 3.2 COP.
		All Other Types of Heating	9.4 IEER, 3.2 COP.

3. Incremental Efficiency Levels

For each equipment class, DOE analyzes several efficiency levels and determines the incremental cost at each of these levels. For this NOPR, DOE developed efficiency levels based on a review of industry standards and available equipment. For efficiency level 1, DOE used the IEER levels specified in Draft Addendum CL.[42] For the higher efficiency levels, DOE initially determined the levels for CUAC equipment classes with electric resistance heating or no heating based on the range of efficiency levels associated with equipment listed in the AHRI certification database and the California Energy Commission's (CEC) database. DOE evaluated the full range of capacities for the small, large, and very large equipment classes with a specific focus on 7.5-ton, 15-ton, and 30-ton as the representative cooling capacities. DOE chose efficiency levels for CUAC with all other types of heating equal to the efficiency levels for equipment with electric resistance heating or no heating, minus the differences in the IEER specifications for these pairs of equipment classes prescribed in the Draft Addendum CL. DOE believes these decreases in IEER appropriately reflect the additional power required for furnace pressure drop.

Similarly, for the CUHP equipment classes, DOE developed cooling mode efficiency levels equal to the CUAC efficiency levels minus the difference in IEER specifications for these two equipment types prescribed in the Draft Addendum CL. DOE believes that these decreases in IEER are representative of the efficiency differences that occur due to losses from the reversing valve and coil circuitry required in heat pumps for both heating and cooling operation.

As part of the RFI, DOE requested information on the max-tech efficiency levels achievable in the market. 78 FR 7301. The Joint Efficiency Advocates commented that, based on models in the AHRI certification database, the maximum-available IEER levels are 25 to 82 percent higher than the ASHRAE Standard 90.1–2010 levels depending on equipment category. The Joint Efficiency Advocates stated that the maximum-available efficiency levels may not represent the maximum technologically feasible levels since there may be technology options that can improve efficiency that have not been employed in the most-efficient models currently available. (Joint Efficiency Advocates, No. 11 at p. 2) AAON commented that the max-tech efficiency levels can be assumed to be slightly above the current CEE Tier 2 levels.[43] (AAON, No. 8 at p. 4)

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[42] The Draft Addendum CL was the latest available version at the time DOE conducted the analyses for today's NOPR. DOE notes that ASHRAE has more recently finalized Addendum CL, with minor modifications to the IEER levels for large air-cooled CUAC and CUHP (*i.e.,* cooling capacity of >=135,000 Btu/h and <240,000 Btu/h).

[43] The CEE Commercial Unitary Air Conditioner and Heat Pump Specification can be found online at: *http://library.cee1.org/content/cee-commercial-unitary-ac-and-hp-specification-0.* DOE notes that the CEE Tier 2 levels represent an 18-percent to 23-percent increase in IEER over the proposed baseline levels.

DOE notes that its maximum-available efficiency levels rely on the performance of recently introduced models. DOE evaluated available equipment literature and energy use information on these maximum-available efficiency models and conducted energy modeling to determine the feasibility of achieving these efficiency levels. For the ≥65,000 Btu/h and <135,000 Btu/h capacity CUAC with electric resistance heating or no heating equipment classes, DOE noted, based on its review of the AHRI certification and CEC equipment databases, that the maximum-available unit was rated at 20.9 IEER. However, sufficient information allowing correlation of incremental efficiency gains with specific design options and incremental manufacturing costs was not available to properly evaluate this unit. DOE also notes that a different manufacturer currently offers a 7.5-ton model rated at 19.9 IEER and a 10-ton model rated at 20.8 IEER. DOE notes that there is also uncertainty regarding the way the design differences contribute to the added efficiency of the 10-ton model, making it difficult to accurately estimate the incremental cost associated with this efficiency gain. As a result, DOE is proposing to use 19.9 IEER as the maximum-available efficiency level representative of this equipment class. DOE is not aware of data showing that energy efficiency can be increased beyond these levels. As a result, DOE is proposing to use the maximum-available efficiency levels as the max-tech levels for the NOPR analyses.

For the CUHP equipment classes, DOE is proposing heating efficiency levels based on a variation of COP with IEER. In the 2004 ANOPR, DOE proposed to address the energy efficiency of air-cooled CUHP by developing functions relating COP to EER. 69 FR 45468. DOE also noted that this method was also used by industry to establish minimum performance requirements for ASHRAE Standard 90.1–1999. *Id.* AHRI supplied the ASHRAE Standard 90.1–1999 committee with curves relating the COP as a function of EER. Using this information, the committee then set the minimum COP levels to the COP corresponding to the selected minimum EER level. *Id.* DOE stated in the February 2013 RFI that since this method was generally accepted by industry and interested parties involved in the development of ASHRAE Standard 90.1–1999, it was considering a similar approach for this rulemaking. DOE indicated that if it transitions to IEER as the cooling mode energy efficiency descriptor, DOE may establish minimum COP levels based on the variation of COP with IEER. As part of the RFI, DOE requested information on issues related to using IEER as the cooling performance metric when developing a correlation between COP and IEER. 78 FR 7301.

AAON, Carrier, Ingersoll Rand, and Lennox commented that there is no direct correlation between the part-load metric, IEER, and the full load metric, COP. (AAON, No. 8 at p. 4; Carrier, No. 7 at p. 4; Ingersoll Rand, No. 6 at p. 4; Lennox, No. 6 at p. 3) Lennox indicated that in commercial applications, CUHP's typically operate in full load heating mode and cycle the auxiliary heat on and off because heat pump capacity alone is inadequate to meet the building load. Lennox stated that a higher IEER does not translate to a higher COP because design techniques that improve part load IEER performance do not improve COP. (Lennox, No. 6 at p. 3) Carrier noted that, based on information from the AHRI certification database, units with the same COP have significantly different IEER values. Carrier added that heating efficiency is much less a factor for overall energy usage than cooling efficiency because commercial equipment operates for many more hours in cooling mode than heating mode, indicating that internal building loads lead to high cooling loads and cooling energy use and significantly less heating energy use. Carrier stated that a separate analysis should be used for developing heating COP levels and that this process be completed through a consensus process working with AHRI and the manufacturers. (Carrier, No. 7 at pp. 3–4)

To determine COP efficiency levels, DOE evaluated AHRI and CEC data for small, large, and very large air-cooled CUHP units with electric resistance heat or no heat to analyze the relationship between COP and both IEER and EER. DOE's review of data showed that the correlations between COP and IEER using linear regressions are no less strong than the correlations between COP and EER for each cooling capacity range. Details of this evaluation can be found in chapter 5 of the NOPR TSD. Based on this evaluation, DOE is proposing to use the functions relating COP to IEER based on AHRI and CEC data to establish COP efficiency levels. For each CUHP equipment class, DOE selected COP levels corresponding to each incremental IEER level.

The efficiency levels for each equipment class that DOE considered for the NOPR analyses are presented in Table IV.6.

TABLE IV.6—INCREMENTAL EFFICIENCY LEVELS

Equipment type		Efficiency levels					
		Heating type	Baseline	EL1	EL2	EL3	EL4 (Max-Tech)
Small Commercial Packaged AC and HP (Air-Cooled)—≥65,000 Btu/h and <135,000 Btu/h Cooling Capacity.	AC	Electric Resistance Heating or No Heating.	11.4 IEER	12.9 IEER	14 IEER	14.8 IEER	19.9 IEER.
		All Other Types of Heating.	11.2 IEER	12.7 IEER	13.8 IEER	14.6 IEER	19.7 IEER.
	HP	Electric Resistance Heating or No Heating.	11.2 IEER, 3.3 COP	12.2 IEER, 3.3 COP	13.3 IEER, 3.4 COP	14.1 IEER, 3.5 COP	19.2 IEER, 3.7 COP.
		All Other Types of Heating.	11.0 IEER, 3.3 COP	12 IEER, 3.3 COP	13.1 IEER, 3.4 COP	13.9 IEER, 3.4 COP	19.0 IEER, 3.6 COP.
Large Commercial Packaged AC and HP (Air-Cooled)—≥135,000 Btu/h and <240,000 Btu/h Cooling Capacity.	AC	Electric Resistance Heating or No Heating.	11.2 IEER	12.2 IEER	13.2 IEER	14.2 IEER	18.4 IEER.

TABLE IV.6—INCREMENTAL EFFICIENCY LEVELS—Continued

		All Other Types of Heating.	11.0 IEER	12.0 IEER	13.0 IEER	14.0 IEER	18.2 IEER.
	HP	Electric Resistance Heating or No Heating.	10.7 IEER, 3.2 COP	11.4 IEER, 3.2 COP	12.4 IEER, 3.3 COP	13.4 IEER, 3.3 COP	17.6 IEER, 3.3 COP.
		All Other Types of Heating.	10.5 IEER, 3.2 COP	11.2 IEER, 3.2 COP	12.2 IEER, 3.3 COP	13.2 IEER, 3.3 COP	17.4 IEER, 3.3 COP.
Very Large Commercial Packaged AC and HP (Air-Cooled)—≥240,000 Btu/h and <760,000 Btu/h Cooling Capacity.	AC	Electric Resistance Heating or No Heating.	10.1 IEER	11.6 IEER	12.5 IEER	13.5 IEER	15.5 IEER.
		All Other Types of Heating.	9.9 IEER	11.4 IEER	12.3 IEER	13.3 IEER	15.3 IEER.
	HP	Electric Resistance Heating or No Heating.	9.6 IEER, 3.2 COP	10.6 IEER, 3.2 COP	11.5 IEER, 3.2 COP	12.5 IEER, 3.2 COP	14.5 IEER, 3.2 COP.
		All Other Types of Heating.	9.4 IEER, 3.2 COP	10.4 IEER, 3.2 COP	11.3 IEER, 3.2 COP	12.3 IEER, 3.2 COP	14.3 IEER, 3.2 COP.

Issue 5: DOE seeks comment on the incremental and max-tech efficiency levels identified for the analyses, including whether the efficiency levels identified by DOE can be achieved using the technologies screened-in during the screening analysis (see section IV.B), and whether higher efficiencies are achievable using technologies that were screened-in during the screening analysis. Also, DOE seeks comment on the approach of extrapolating the efficiency levels from the small, large, and very large CUAC with electric resistance heating or no heating equipment classes to the remaining equipment classes using the IEER differentials in ASHRAE Standard 90.1–2010 draft addendum CL. In addition, input and data on the approach for determining the COP levels for the heat pump equipment classes using the relationship between IEER and COP.

4. Equipment Testing, Reverse Engineering, Energy Modeling, and Cost-Efficiency Results

As discussed above, for the engineering analysis, DOE specifically analyzed representative capacities of 7.5 tons, 15 tons, and 30 tons to develop incremental cost-efficiency relationships. DOE selected four 7.5-ton, two 15-ton, and one 30-ton air-cooled CUAC models. The models were selected to develop a representative sample of the market at different efficiency levels. DOE based the selection of units for testing and reverse engineering on the efficiency data available in the AHRI certification database and the CEC equipment database. DOE also selected one 7.5-ton CUHP model to evaluate the design differences between CUAC units and CUHP units. Details of the key features of the tested units are presented in chapter 5 of the NOPR TSD.

Because DOE is considering adopting energy conservation standards based on the IEER metric, DOE conducted testing on each unit according to the IEER test method specified in AHRI Standard 340/360–2007. DOE then conducted physical teardowns on each test unit to develop a manufacturing cost model and to evaluate key design features (e.g., heat exchangers, compressors, fan/fan motors, control strategies, etc.). Because DOE was only able to conduct testing and physical teardowns on a limited sample of equipment, DOE supplemented these data by conducting catalog teardowns on 346 models spanning the full range of capacities from all manufacturers selling equipment in the United States. DOE based the catalog teardowns on information provided in equipment literature and experience from the physical teardowns.

For air-cooled CUAC, DOE conducted energy modeling using the modeling tools developed by the Center for Environmental Energy Engineering from the University of Maryland at College Park. The tools include a detailed heat exchanger modeling program and a refrigeration cycle modeling program. The refrigeration cycle modeling program can integrate the heat exchanger and compressor models to perform a refrigeration cycle model. If a CUAC/CUHP unit was tested, system control power (*i.e.,* control circuit power and any auxiliary loads), indoor and outdoor fan power were obtained from actual laboratory testing. If a unit was not tested, fan power energy usage was estimated from manufacturer specification sheets at the rated air flow rates and static pressures. The system control power is estimated from other tested units with similar capacities and system configurations.

Applying the key design features identified during physical equipment teardowns, DOE used the energy modeling tool to generate detailed performance data (e.g. capacity and EER) and validated them against the results obtained from laboratory testing at each IEER capacity level (25, 50, 75, and 100 percent), or with the published performance data. With the validated energy models, DOE expanded the modeling tasks with various system design options and identified the key design features (consistent with equipment available on the market) required for 7.5-ton, 15-ton, and 30-ton air-cooled CUAC units with electric resistance heating or no heating to achieve each efficiency level. Details of the design features for each efficiency level are presented in chapter 5 of the NOPR TSD. DOE also generated energy use profiles for air-cooled CUAC, which included wattage inputs for key components (*i.e.,* compressor, indoor and outdoor fan motors, and controls) at each operating load level measured for the IEER test method, for each efficiency level to serve as inputs for the energy use analysis (discussed in section IV.E). DOE then used these design features developed by the energy modeling to determine the incremental manufacturing costs for each efficiency level for 7.5-ton, 15-ton and 30-ton air-cooled CUAC units.

Issue 6: DOE requests comments, information, and data that would inform adjustment of energy modeling input and/or results that would allow more accurate representation of the energy use impacts of design options using the modeling tools developed by the Center for Environmental Energy Engineering from the University of Maryland at College Park.

DOE did not, however, conduct similar modeling for CUHP units. DOE notes that CUHP shipments represent a very small portion of industry shipments compared to CUAC shipments (9 percent versus 91 percent). In addition, because CUHP represent a small portion of shipments, DOE noted, based on equipment teardowns and review of equipment literature, that manufacturers use the same basic design/platform for equivalent CUAC and CUHP models. DOE observed that equivalent CUAC and CUHP models used the same package size, core heat exchangers (the same face area and depth, but different circuiting), and indoor/outdoor fan systems (along with other elements), but used additional components to allow for heat pump operation (*e.g.,* reversing valves, refrigerant accumulators, refrigerant circuiting). As a result, DOE believes that the proposed approach of adjusting between the cooling efficiencies of CUAC and CUHP to reflect the drop in efficiency resulting from the CUHP design (as discussed above in section IV.C.3) is consistent with the market. For these same reasons, DOE believes that it is appropriate to set heating efficiencies for CUHP based on the relationship between cooling efficiency and heating efficiency rather than conduct a full separate analysis of heating efficiency. For these reasons, DOE focused energy modeling solely on CUAC equipment. Although not considered in the engineering and LCC and PBP analyses, DOE did analyze CUHP equipment in the NIA. From this analysis, DOE believes the energy modeling conducted for CUAC equipment provides a good estimate of CUHP cooling performance and provides the necessary information to estimate the magnitude of the national energy savings from increases in CUHP equipment efficiency.

Based on the analyses discussed above, DOE developed the cost-efficiency results shown in Table IV.7 through Table IV.9 for each cooling capacity range. DOE notes that the incremental manufacturing production and shipping costs would be equivalent for each of the equipment classes within a given cooling capacity range (*i.e.,* CUAC units with electric resistance heating or no heat, CUAC units with all other types of heating, CUHP units with electric resistance heating or no heat, CUHP units with all other types of heating). Details of the cost-efficiency analysis, including descriptions of the technologies DOE analyzed for each efficiency level to develop incremental costs, are presented in chapter 5 of the NOPR TSD.

TABLE IV.7—SMALL AIR-COOLED CUAC AND CUHP COST-EFFICIENCY RELATIONSHIPS

Efficiency level	Incremental manufacturing production cost	Incremental shipping cost
Baseline		
EL1	$115.93	
EL2	583.47	
EL3	788.88	
EL4 (Max-Tech)	1,277.04	$102.86

TABLE IV.8—LARGE AIR-COOLED CUAC AND CUHP COST-EFFICIENCY RELATIONSHIPS

Efficiency level	Incremental manufacturing production cost	Incremental shipping cost
Baseline		
EL1	$419.16	
EL2	792.76	$192.86
EL3	1,236.98	192.86
EL4 (Max-Tech)	1,554.26	192.86

TABLE IV.9—VERY LARGE AIR-COOLED CUAC AND CUHP COST-EFFICIENCY RELATIONSHIPS

Efficiency level	Incremental manufacturing production cost	Incremental shipping cost
Baseline		
EL1	$542.65	
EL2	1,296.41	
EL3	1,834.67	
EL4 (Max-Tech)	2,753.32	$444.00

Issue 7: DOE requests input and data on the estimated incremental manufacturing costs, including the extrapolation of incremental costs for equipment classes not fully analyzed, in particular for heat pump equipment classes.

D. Markups Analysis

The markups analysis develops appropriate markups in the distribution chain to convert the estimates of manufacturer selling price derived in the engineering analysis to customer prices. (''Customer'' refers to purchasers of the equipment being regulated.) DOE calculates overall baseline and incremental markups based on the equipment markups at each step in the distribution chain. The incremental markup relates the change in the manufacturer sales price of higher efficiency models (the incremental cost increase) to the change in the customer price.

In its 2004 ANOPR, DOE used three types of distribution channels to describe how the equipment passes from the manufacturer to the customer. See, e.g. 69 FR 45460, 45476 (describing distribution channels used as part of DOE's prior CUAC/CUHP standards rulemaking effort). In the new construction market, the manufacturer sells the equipment to a wholesaler. The wholesaler sells the equipment to a mechanical contractor, who sells it to a general contractor, who in turn sells the equipment to the customer or end user as part of the building. In the replacement market, the manufacturer sells to a wholesaler, who sells to a mechanical contractor, who in turn sells the equipment to the customer or end user. In the third distribution channel, used in both the new construction and replacement markets, the manufacturer sells the equipment directly to the customer through a national account.

In the RFI, DOE requested input from stakeholders on whether the distribution channels described above remain relevant for small and large CUAC/CUHP and whether they are also relevant for very large air-cooled equipment. Carrier stated that the distribution channels outlined in the NOPR are relevant for all products, including very large air-cooled equipment. (Carrier, No. 7 at p. 4) It added that, for very large air-cooled equipment, there is an additional channel that consists of factory employees selling directly to end customers and mechanical contractors. Ingersoll Rand stated that the selling process, as described, is still relevant for these product classes. (Ingersoll Rand, No. 10 at p. 4) Modine stated that there are distribution paths in addition to those listed in the RFI, namely, manufacturer to distributor to mechanical contractor to end user, manufacturer to mechanical contractor to general contractor to end user, and manufacturer to mechanical contractor to end user. (Modine, No. 5 at p. 3)

For today's NOPR, DOE used the three distribution channels described previously, which were used in the 2004 ANOPR. Although it was not listed in the RFI, DOE did include a channel of manufacturer to distributor to mechanical contractor to end user (for replacement applications). As for the channels without a distributor cited by Modine, DOE was not able to determine whether these channels account for a meaningful share of shipments. Modine provide no supporting data indicating that these non-distributor channels accounted for a significant share of shipments. Because other parties commented that the three distribution channels described in the RFI are still relevant, DOE retained the channels included in the RFI but decline to include the non-distributor channels suggested by Modine for the NOPR analysis.

For the 2004 ANOPR, based on information that equipment manufacturers provided, commercial customers were estimated to purchase 50 percent of the covered equipment through small mechanical contractors, 32.5 percent through large mechanical contractors, and the remaining 17.5 percent through national accounts. According to the Air Conditioning Contractors of America's financial analysis of the heating, ventilation, air-conditioning, and refrigeration (HVACR) contracting industry, markups used by small contractors tend to be larger than those used by large contractors. See 69 FR 45476.

In the RFI, DOE requested input on the percentage of equipment being distributed through the various types of distribution channels and whether the share of equipment shipped through each channel varies based on equipment capacity. Ingersoll Rand stated that, while the percentages differ among the equipment capacities, the relative levels are as suggested by DOE. (Ingersoll Rand, No. 10 at p. 4) Based on this feedback, for this NOPR, DOE is continuing to use the same percentages that were used in its ANOPR analysis.

DOE had also previously utilized several sources in preparation of its ANOPR to help develop markups for the parties involved in the distribution of the equipment, including: (1) The Air-conditioning & Refrigeration Wholesalers Association's 1998 wholesaler profit survey report to develop wholesaler markups; (2) the Air Conditioning Contractors of America's (ACCA) financial analysis for the HVACR contracting industry to develop mechanical contractor markups; and (3) U.S. Census Bureau economic data for the commercial and institutional building construction industry to develop general contractor markups.

Carrier recommended that DOE conduct a blind survey through AHRI to determine the markups for all parties in the channel. As an alternative to this approach, DOE utilized updated versions of the sources mentioned previously, namely: (1) The Heating, Air Conditioning & Refrigeration Distributors International *2010 Profit Report* to develop wholesaler markups; (2) the Air Conditioning Contractors of America's (ACCA) *2005 Financial Analysis for the HVACR Contracting Industry* to develop mechanical contractor markups; and (3) U.S. Census Bureau economic data for the commercial and institutional building construction industry to develop general contractor markups.[44] By following this alternative approach, DOE obtained updated data that enabled it to develop a more accurate picture of the markups currently being used by the various parties involved in the distribution channel.

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

E. Energy Use Analysis

The energy use analysis provides estimates of the annual energy consumption of small, large, and very large air-cooled CUAC equipment at the considered efficiency levels. DOE uses these values in the LCC and PBP analyses and in the NIA. DOE did not analyze CUHP equipment because the energy modeling discussed in section IV.C.4 was performed only for CUAC equipment.

DOE developed energy consumption estimates only for the CUAC equipment classes that have electric resistance heating or no heating. For equipment classes with all other types of heating, the incremental change in IEER for each efficiency level is identical to that for the equipment classes with electric resistance heating or no heating. Therefore, DOE estimated that the energy savings for any efficiency level relative to the baseline would be identical for both sets of equipment classes. In turn, the energy savings estimates for the efficiency levels associated with the equipment classes that have electric resistance heating or no heating (see Table IV.1) were used by DOE in the LCC and PBP analysis and the NIA to represent both sets of equipment classes.

The energy use analysis for this NOPR consists of two related parts. In the first part, DOE calculated energy savings for small, large, and very large air-cooled CUAC at the considered efficiency levels based on modifications to the energy use simulations conducted for the 2004 ANOPR. These building simulation data are based on the 1995 Commercial Building Energy Consumption Survey (CBECS). Because the simulation data reflect the building stock in 1995 that uses air-cooled CUAC equipment, in the second part, DOE developed a "generalized building sample" to represent the current installation conditions for the equipment covered in this rulemaking. This part involved making adjustments to update the building simulation data to reflect the building stock that uses air-cooled CUAC equipment in 2011.

1. Energy Use Simulations

The simulation database from the 2004 ANOPR includes hourly profiles for more than 1,000 commercial buildings, which were based on building characteristics from the 1995 CBECS for the subset of buildings that uses air-cooled CUAC equipment. Each building was assigned to a specific location along with a typical meteorological year (TMY) hourly weather file (referred to as TMY2) to represent local weather. The simulations capture variability in cooling loads due to factors such as building activity, schedule, occupancy, local weather, and shell characteristics.

DOE received comments on the RFI regarding how best to model equipment performance. AAON stated that full building and equipment modeling are required to get a credible estimate for a given building, equipment set, and control sequence. (AAON, No. 8 at p. 6) Carrier noted that EER alone cannot be used to determine energy use at part-load conditions, as it is a measure of full-load efficiency and is tied more closely to the peak kilowatt (kW). (Carrier, No. 7 at p. 4) DOE's simulation modeling approach is based on full building and equipment modeling, and takes into account equipment performance at part-load conditions to establish the annual energy use.

For the NOPR, DOE modified the energy use simulations conducted for the 2004 ANOPR to improve the modeling of equipment performance. The modifications that DOE performed included changes to the ventilation rates and economizer usage assumptions, the default part-load performance curve, and the minimum saturated condensing temperature limit.

Although ventilation rates and economizer usage do not affect equipment performance per se, they do impact how often the equipment needs to operate, whether at full or part load. The building simulations for the 2004 ANOPR used ventilation rates based on ASHRAE Standard 62–1999.[45] Because a report prepared by the National Institute for Standards and Testing

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[44] U.S. Census Bureau, 2007 Economic Census, Construction Industry Series and Wholesale Trade Subject Series. *http://www.census.gov/econ/census07/.*

[45] American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. *ANSI/ASHRAE Standard 62–1999 Ventilation for Acceptable Indoor Air Quality,* 1999. Atlanta, Georgia.

(NIST) on field measurements indicated that these ventilation rates were too high,[46] DOE reduced the rates as part of the modified energy use simulations. In the case of economizer usage, the building simulations for the 2004 ANOPR assumed all economizers operated without fault. Various field studies have demonstrated that economizer usage is far from perfect, so in the modified simulations DOE assigned a 30-percent probability to each building modeled that the economizer would be non-operational. With regard to changes made to how the equipment was modeled, DOE developed a modified part-load performance curve for the direct-expansion condenser unit model so that the overall performance would be more representative of a multi-compressor system. In addition, DOE lowered a parameter representing the minimum saturated condensing temperature allowed for the refrigerant. Both of these parameters affect the system performance under part-load and off-design conditions. A more detailed description of the simulation model modifications can be found in appendix 7–A of the NOPR TSD.

DOE used a two-step process to represent the performance of equipment at baseline and higher efficiency levels. First, DOE calculated the hourly cooling loads and hourly fan operation for each building from the compressor and fan energy consumption results that were generated from the modified building simulations based on CUAC equipment at efficiency of 11 EER. It was estimated that these simulated cooling loads had to be met by the CUAC equipment for every hour of the year that the equipment operates. Then DOE coupled the hourly cooling loads and fan operation with equipment performance data, developed from laboratory and modeled IEER testing conducted according to AHRI Standard 340/360–2007, to generate the hourly energy consumption of baseline and more efficient CUAC equipment.

DOE received additional comments on the RFI regarding how to scale equipment energy use as a function of capacity for a given cooling load. Carrier stated that capacity is highly dependent on differences in product design for performance at full- and part-load conditions, control strategies, air distribution method, and applications. (Carrier, No. 7 at p. 5) AAON stated that full modeling is required to determine how equipment energy use scales as a function of capacity. (AAON, No. 8 at p. 6)

DOE's use of the laboratory and modeled IEER test data allowed it to specifically address how capacity and control strategies vary with outdoor temperature and building load. The laboratory and modeled IEER test data were used to calculate the compressor efficiency (COP) and capacity at varying outdoor temperatures (see section IV.4 of this NOPR for further discussion.) The IEER rating test consists of measuring the net capacity, compressor power, condenser fan power, indoor fan power, and control power at three to five different rating conditions. The number of rated conditions the equipment is tested at is determined by the capabilities of and the control strategies used by the equipment. The net capacity and COP of the compressor(s) as a linear function of outdoor temperature was calculated from those test results. If the indoor or outdoor fan was variable speed, its power consumption was also calculated as a linear function of outdoor temperature. The power for controls is a constant, but may vary by staging.

The COP and capacity of the equipment for each hour of the year was calculated based on the outdoor temperature for the simulated buildings. The cooling capacity was calculated such that it met the simulated building cooling load for each hour. For multi-stage equipment, the staging for each hour was selected to ensure the equipment could meet the simulated building cooling load. When the cooling capacity exceeded the simulated building cooling load, the efficiency was adjusted for cyclic performance using the degradation coefficient and load factor as calculated according to section 6.2, Part-Load Rating, of AHRI 340/360, using the above described IEER rating test data. The analysis accounted for the fact that the building cooling load includes the heat generated by the fan. The total amount of cooling the compressor must provide varies as the fan efficiency improves with different efficiency levels.

The hourly fan run time was set equal to the indoor fan run time of the simulated building for each hour of the year. Energy use was calculated separately for the compressor, condenser fan, indoor fan, and controls for each hour of the year for the simulated building. Compressor and condenser fan energy were summed to reflect cooling energy use. Indoor fan and control energy were combined into a single category to represent indoor fan energy use.

The calculations provided the annual hourly cooling and fan energy use profiles for each building. The incremental energy savings between the baseline equipment and the equipment at higher efficiency levels was calculated for every hour for each of the 1,033 simulated buildings.

The RFI requested comment on whether the building simulations developed for small and large air-conditioning equipment are applicable to very large equipment (i.e., equipment with capacities between 240,000 Btu/h and 760,000 Btu/h). AAON stated that the simulation model should be applicable regardless of equipment size. (AAON, No. 8 at p. 6) Carrier stated that building models appropriate to the equipment size should be used. It noted that special equipment models will be needed to properly model the part-load intensive equipment and changes in IEER. It suggested that DOE should work with the AHRI Unitary Large Equipment Section to define the modeling approach and obtain the equipment models for the various IEER and EER levels as considerable work has already been done. (Carrier, No. 7 at p. 5)

As described above, DOE used the simulations to obtain hourly building cooling loads, fan operating hours, and associated outdoor temperatures and applied the IEER rating test data to determine the hourly performance of the equipment. Because DOE relied on the IEER rating test data to come up with the hourly performance of the equipment, it believes that this method provides a good representation of very large equipment performance as well as small and large equipment performance. Therefore, additional building simulation modeling for very large units does not appear necessary.

Issue 8: DOE requests comments, information, and data that could be used to modify the proposed method for using laboratory and modeled IEER test data, which were developed in accordance to AHRI Standard 340/360–2007, to calculate the performance of CUAC equipment at part-load conditions.

2. Generalized Building Sample

The NOPR analysis used a "generalized building sample" (GBS) to represent the installation conditions for the equipment covered in this rulemaking. The GBS was developed based on data from the 2003 CBECS[47] and from the Commercial Demand Module of the National Energy

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[46] Persily, A. and J. Gorfain. 2004. "Analysis of Ventilation Data from the U.S. Environmental Protection Agency Building Assessment Survey and Evaluation (BASE) Study". NISTIR 7145.

[47] CBECS 2012 is currently in development but will not be available in time for this rulemaking.

Modeling System version distributed with *AEO2013.*

Only floor space cooled by the covered equipment is included in the sample. Conceptually, the main difference between the GBS and the sample of specific commercial buildings compiled in CBECS is that the GBS aggregates all building floor space associated with a particular set of building characteristics into a single category. The set of characteristics that is used to define a category includes all building features that are expected to influence either (1) the cooling load and energy use or (2) the energy costs. The set of building characteristics, and the specific values these characteristics can take, are listed in Table IV.10.

TABLE IV.10—LIST OF CHARACTERISTICS AND THE ASSOCIATED VALUES USED TO DEFINE THE GENERALIZED BUILDING SAMPLE

Characteristic	Number of values	Range of values
Region	10	9 census divisions with Pacific sub-divided into north and south.
Building Activity	7	assembly, education, food service, small office, large office, mercantile, warehouse.
Size (based on annual energy consumption).	3	small: <100,000 kWh. medium: 100,000 to 1,000,000 kWh. large: >1,000,000 kWh.
Vintage	3	category 1: before 1950. category 2: 1950–1979. category 3: 1980 and later.

The region in which the building is located affects both the cooling loads (through the weather) and the cost of electricity. The building activity affects building schedules and occupancy, which in turn influence the demand for cooling. The building activity categories are the same as those used in the NEMS commercial building energy demand module, limited to those building types that use the equipment covered in this rule. The building size influences the cost of electricity, because larger facilities tend to have lower marginal prices. The building vintage may influence shell characteristics that can affect the cooling loads. The combination of 10 regions, 7 building types, 3 sizes, and 3 vintages leads to a set of 630 independent categories in the GBS.

The amount of floor space allocated to each category for buildings built in or before 2003 was taken from the 2003 CBECS. To update the building floor space to 2013, the commercial building data included with the 2013 version of NEMS were used. This dataset includes a historical component, starting in 2004, and provides both existing floor space and new floor space additions by year, census division, and building activity. The floor space additions between 2004 and 2013 were added to the floor space in vintage category 3.

Load profiles for each of the 630 generalized buildings were developed from the simulation data just described. For each equipment class, a subset of the 1,033 buildings was used to develop the cooling energy use profiles. The subset included all buildings with a capacity requirement equal to or greater than 90 percent of the capacity of the particular representative unit. For each GBS type, a weighted average energy use profile, along with energy savings from the considered efficiency levels, was compiled from the simulated building subset. The average was taken over all buildings in the subset that have the same region, building type, size, and vintage category as the GBS category. This average was weighted by the number of units required to meet each building's cooling load. For some of the GBS categories, no simulation data were available. In these cases, the weighted-average energy use profile for the same building type and a nearby region or vintage were used.

Updating the sample to 2013 required some additional adjustments to the energy use data. The 1,033 building simulations used TMY2 weather data. The TMY2 weather data files were updated to TMY3 in 2008. A comparison of the two datasets showed that total annual cooling degree-days (CDD) increased by 5 percent at all locations used in this analysis. This is accounted for by increasing the energy use (for all efficiency levels) by 5 percent at all locations.

Changes to building shell characteristics and internal loads in recent construction can lead to a change in the energy required to meet a given cooling load. The NEMS commercial demand module accounts for these trends by adjusting the cooling energy use with a factor that is a function of region and building activity. In the GBS, these same factors were used to adjust the cooling energy use for floor space constructed after 1999.

Issue 9: DOE requests comments on the use of a ''generalized building sample'' to characterize the energy consumption of CUAC equipment in the commercial building stock. Specifically, whether there are any data or information that could improve the method for translating the results from the 1,033 simulated buildings to the generalized building sample.

F. Life-Cycle Cost and Payback Period Analysis

The purpose of the LCC and PBP analysis is to analyze the effects of potential amended energy conservation standards on customers of small, large, and very large air-cooled commercial package air conditioning and heating equipment by determining how a potential amended standard affects their operating expenses (usually decreased) and their total installed costs (usually increased).

The LCC is the total customer expense over the life of the equipment, consisting of equipment and installation costs plus operating costs over the lifetime of the equipment (expenses for energy use, maintenance, and repair). DOE discounts future operating costs to the time of purchase using customer discount rates. The PBP is the estimated amount of time (in years) it takes customers to recover the increased total installed cost (including equipment and installation costs) of a more efficient type of equipment through lower operating costs. DOE calculates the PBP by dividing the change in total installed cost (normally higher) due to a standard by the change in annual operating cost (normally lower) that results from the standard.

For any given efficiency level, DOE measures the PBP and the change in LCC relative to an estimate of the base-case efficiency level. The base-case estimate reflects the market in the absence of amended energy conservation standards, including the market for equipment that exceeds the current energy conservation standards.

The RFI described how DOE would analyze the potential for variability and uncertainty by performing the LCC and PBP calculations on a representative sample of individual commercial buildings. The approach utilizes the sample of buildings developed for the energy use analysis and the corresponding simulations results. Within a given building, one or more air-conditioning units may serve the building's space-conditioning needs, depending on the cooling load requirements of the building. As a result, DOE would express the LCC and PBP results as the number of units experiencing economic impacts of different magnitudes. DOE models both the uncertainty and the variability in the inputs to the LCC and PBP analysis using Monte Carlo simulation and probability distributions.[48] As a result, the LCC and PBP results are displayed as distributions of impacts compared to the base case conditions.

The RFI requested comment from stakeholders on the overall method for conducting the LCC and PBP analysis. Carrier stated that DOE should use the procedures as developed by the ASHRAE 90.1 committee and PNNL for evaluating changes to the ASHRAE 90.1 standard. (Carrier, No. 7 at p. 5) The procedures referred to by Carrier, while potentially appropriate in other circumstances, such as in the development of building codes for new construction, are not ideal in the context of analyzing the potential impacts that would be likely to result from the imposition of new energy conservation standards. DOE's LCC and PBP analysis, rather than focusing solely on the impacts on new buildings (as would Carrier's suggested approach would do), seeks to evaluate the impacts of potential standards for small, large, and very large air-cooled commercial package air conditioning and heating equipment for all affected customers. Such an evaluation requires a broader framework than the more narrow approach suggested by Carrier.

DOE conducted an LCC and PBP analysis for the CUAC equipment classes. As mentioned in section IV.E, the energy savings estimates for the efficiency levels associated with the equipment classes that have electric resistance heating or no heating were used in the LCC and PBP analysis to represent the equipment classes with all other types of heating. DOE did not perform an LCC and PBP analysis for the CUHP equipment for the reasons discussed in section IV.C.4.

Inputs to the LCC and PBP analysis are categorized as: (1) Inputs for establishing the total installed cost and (2) inputs for calculating the operating expense. The following sections contain brief discussions of comments on the inputs and key assumptions of DOE's LCC and PBP analysis and explain how DOE took these comments into consideration.

1. Equipment Costs

In the LCC and PBP analysis, the equipment costs faced by small, large, and very large air-cooled commercial package air conditioning and heating equipment purchasers are derived from the MSPs estimated in the engineering analysis and the overall markups estimated in the markups analysis.

To develop an equipment price trend for the NOPR, DOE derived an inflation-adjusted index of the producer price index (PPI) for ''unitary air-conditioners, except air source heat pumps'' from 1978 to 2013.[49] Although the PPI index shows a long-term declining trend, data for the last decade have shown a flat-to-slightly rising trend. Given the uncertainty as to which of the trends will prevail in coming years, DOE chose to apply a constant price trend (2013 levels) for the NOPR. For the NIA, DOE also analyzed the sensitivity of results to alternative price forecasts.

2. Installation Costs

In the RFI, DOE discussed developing installation costs for the current rulemaking using the most recent RS Means data available. AAON agreed that it is appropriate to use RS Means. (AAON, No. 8 at p. 6)

For today's NOPR, DOE derived installation costs for CUAC equipment from current RS Means data.[50] Based on these data, DOE tentatively concluded that data for 7.5-ton, 15-ton, and 30-ton rooftop air conditioners would be sufficiently representative of the installation costs for the ≥65,000 Btu/h to <135,000 Btu/h, ≥135,000 Btu/h to <240,000 Btu/h, and ≥240,000 Btu/h to <760,000 Btu/h air-conditioning equipment classes, respectively. Because labor rates vary significantly in each region of the country, DOE used RS Means data to identify how installation costs vary among regions and incorporated these costs into the analysis.

For the 2004 ANOPR, DOE varied installation cost as a function of equipment weight. Because weight tends to increase with equipment efficiency, installation cost increased with equipment efficiency. 69 FR 45481. In the RFI, DOE envisioned using a similar approach for this rulemaking. Carrier recommended that RS Means Mechanical Cost Data be used to estimate installed cost based on unit tonnage rather than unit weight. (Carrier, No. 7 at p. 5)

For this NOPR, DOE is using a specific cost from RS Means for each of the tonnage classes listed previously. Within a given capacity (equipment class), DOE chose to vary installation costs in direct proportion to the physical weight of the equipment. The weight of the equipment in each class and efficiency level was determined through the engineering analysis.

3. Unit Energy Consumption

The calculation of annual per-unit energy consumption at each considered efficiency level is described in section IV.E.

4. Electricity Prices and Electricity Price Trends

For the 2004 ANOPR, DOE determined electricity prices based on tariffs from a representative sample of electric utilities. 69 FR 45481–45482. This approach calculates energy expenses based on actual electricity prices that customers are paying. The RFI discussed retaining the tariff-based approach and plans to update electricity prices based on recent or current tariffs. Carrier agreed with the tariff-based approach and that the most recent price data should be used. (Carrier, No. 7 at p. 6) Similarly, the Joint Efficiency Advocates asserted that the tariff-based approach was appropriate for capturing actual electricity prices paid by customers. (Joint Efficiency Advocates, No. 11 at p. 2)

For this NOPR, the tariff data used for the ANOPR were used to develop marginal and average prices for each member of the GBS, which were then scaled to approximate 2013 prices. The approach uses tariff data that have been processed into commercial building marginal and average electricity prices.[51]

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[48] The Monte Carlo process statistically captures input variability and distribution without testing all possible input combinations. Therefore, while some atypical situations may not be captured in the analysis, DOE believes the analysis captures an adequate range of situations in which small, large, and very large air-cooled commercial package air conditioning and heating equipment operate.

[49] The PPP index for heat pumps covered too short a time period to provide a useful picture of pricing trends for this equipment.

[50] *http://www.rsmeansonline.com;* Accessed March 27, 2013.

[51] Coughlin, K., C. Bolduc, R. Van Buskirk, G. Rosenquist and J. E. McMahon. Tariff-based

Continued

The CBECS 1992 and CBECS 1995 surveys provide monthly electricity consumption and demand for a large sample of buildings. DOE used these values to help develop usage patterns associated with various building types. Using these monthly values in conjunction with the tariff data, DOE calculated monthly electricity bills for each building. The average price of electricity is defined as the total electricity bill divided by total electricity consumption. Two marginal prices are defined, one for electricity demand (in $/kW) and one for electricity consumption (in $/kWh). These marginal prices are calculated by applying a 5 percent decrement to the CBECS demand or consumption data and recalculating the electricity bill.

Using the prices derived from the above method, an average price and a marginal price were assigned to each building in the GBS. For each member of the GBS, these prices were calculated as the average, weighted by floor space and survey sample weight, of all buildings in the CBECS 1992 and 1995 data meeting the set of characteristics defining the generalized building (i.e., region, vintage, building activity, and building energy consumption). As most tariffs are seasonal, average and marginal prices are calculated separately for summer (May–September) and winter.

The average summer or winter electricity price multiplied by the baseline summer or winter electricity consumption for equipment of a given capacity defines the baseline LCC. For each efficiency level, the operating cost savings are calculated by multiplying the electricity consumption savings (relative to the baseline) by the marginal consumption price and the electricity demand reduction by the marginal demand price. The consumer's electricity bill is only affected by the electricity demand reduction that is coincident with the building's monthly peak load. Air-conditioning loads are strongly, but not perfectly, peak-coincident. Divergences between the building peak and the air-conditioning peak were accounted for by multiplying the electricity demand reduction by a random factor drawn from a triangular distribution centered at 0.9 +/− 0.1.

The tariff-based prices were updated to 2013 using the commercial electricity price index published in the *AEO* (editions 2009 through 2012). An examination of data published by the Edison Electric Institute [52] indicates that the rate of increase of marginal and average prices is not significantly different, so the same factor was used for both pricing estimates. DOE projected future electricity prices using trends in average commercial electricity price from *AEO 2013.*

For further discussion of electricity prices, see chapter 8 of the NOPR TSD.

5. Maintenance Costs

Maintenance costs are costs associated with general maintenance of the equipment (e.g., checking and maintaining refrigerant charge levels and cleaning heat-exchanger coils). For the 2004 ANOPR, DOE developed maintenance costs from RS Means data, and DOE estimated that maintenance costs do not vary with equipment efficiency. 69 FR 45485. The RFI discussed developing maintenance costs for the current rulemaking using the most recent RS Means data available, and using the same assumption that maintenance costs do not vary with equipment efficiency. AAON stated that it is appropriate to use RS Means. (AAON, No. 8 at p. 6)

Carrier stated that RS Means might serve as a reasonable guide to assist in developing maintenance costs, but it expects that maintenance costs vary with efficiency due to the higher replacement cost of new, more complex components, and the technology required to achieve the higher efficiency levels. (Carrier, No. 7 at p. 6) Repair or replacement of components that have failed is considered a repair cost. DOE is not aware of information on why general maintenance would be higher as a result of the technology used to achieve higher efficiency levels. Thus, DOE retained the assumption that maintenance costs do not vary with equipment efficiency.

For this NOPR, DOE derived annualized maintenance costs for commercial air conditioners from RS Means data.[53] These data provided estimates of person-hours, labor rates, and materials required to maintain commercial air-conditioning equipment. The estimated annualized maintenance cost is $298 for a commercial unitary air conditioner rated between 36,000 Btu/h and 288,000 Btu/h, and $408 for a unit rated between 288,000 Btu/h and 600,000 Btu/h.

6. Repair Costs

Repair costs are associated with repairing or replacing components that have failed. For the 2004 ANOPR, DOE estimated that repair costs vary as function of equipment price. 69 FR 45485. In the RFI, DOE requested comment as to whether repair costs vary as a function of equipment price, as well as any data or information on developing repair costs. AAON stated that it is appropriate to estimate repair costs as a function of equipment costs. (AAON, No. 8 at p. 7) Carrier stated that while it does not see repair costs increasing as a direct result of higher equipment prices, the higher material and component costs necessary to achieve higher efficiency levels (which result in higher equipment prices) may also drive higher repair costs. (Carrier, No. 7 at p. 6)

For this NOPR, DOE assumed that any routine or minor repairs are included in the annualized maintenance costs. As a result, repair costs are not explicitly modeled in the LCC and PBP analysis. Instead, DOE incorporated a one-time cost for major repair (compressor replacement) as a primary input to the repair/replace customer choice model in the shipments analysis, which models the decision between repairing a broken unit and replacing it (see section IV.G). In the repair/replace customer choice model, DOE used repair costs that vary in direct proportion with the price of the equipment, which approximates the relationship between repair costs and efficiency described by Carrier.

Issue 10: DOE requests comments on whether using RS Means cost data to develop maintenance, repair, and installation costs for CUAC and CUHP equipment is appropriate, and if not, what data should be used.

7. Lifetime

Equipment lifetime is the age at which the equipment is retired from service. For the 2004 ANOPR, DOE based equipment lifetime on a retirement function, which was based on the use of a Weibull probability distribution, with a resulting median lifetime of 15 years. 69 FR 45486. In the RFI, DOE sought comment on how it characterized equipment lifetime. DOE also requested any data or information regarding the accuracy of its 15-year lifetime and whether equipment lifetime varies based on equipment class.

The Joint Efficiency Advocates encouraged DOE to reevaluate the estimated lifetime of commercial air-cooled air conditioners and heat pumps for this rulemaking. They noted that ASHRAE maintains a public database

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Analysis of Commercial Building Electricity Prices. 2008. Lawrence Berkeley National Laboratory: Berkeley, CA. Report No. LBNL–55551.

[52] Edison Electric Institute. EEI Typical Bills and Average Rates Report (bi-annual, 2007–2012). Washington, DC.

[53] *http://www.rsmeansonline.com;* Accessed March 26, 2013.

that provides information on the service life of HVAC equipment. Although the ASHRAE database does not currently contain a separate category for commercial package air conditioners and heat pumps, it does contain information on ''other cooling equipment.'' In this category, there are data on 365 units that were in service at the time of the data collection. Of these 365 units, the median equipment age was 20 years. (Joint Efficiency Advocates, No. 11 at p. 3) NEEA also encouraged DOE to review actual equipment lifetime for determining the life-cycle cost of equipment. (NEEA, No. 15 at p. 2) AAON stated that equipment lifetime should not be impacted by equipment class. (AAON, No. 8 at p. 7)

DOE reviewed the ASHRAE database and determined that the data support an increase in lifetime relative to what DOE used for the ANOPR. In the category ''Packaged DX unit, rooftop'' (which corresponds to CUAC), of the 215 units in service, the mean age is 15.6 years and the median is 16 years.[54] The five units that had been replaced had a median age of 22 years. These data strongly suggest that the median lifetime of 15 years used in the ANOPR is too short. For this NOPR, DOE updated its CUAC lifetime to a median of 18.7 years and a mean of 18.4 years.

The category ''heat pump, air-to-air'' (which corresponds to CUHP) in the ASHRAE database has 1,296 units (and only one that had been retired) with a median age of 14 years. These data suggest that the 15-year lifetime used in the 2004 ANOPR remains reasonable. For the NOPR, DOE used a slightly updated CUHP lifetime with a median of 15.4 years and a mean of 15.2 years.

DOE used the same lifetime distribution for each set of CUAC and CUHP equipment classes.

Issue 11: DOE requests comments, information and data on the equipment lifetimes developed for CUAC and CUHP equipment; specifically, any information that would indicate whether the retirement functions yielding median lifetimes of 18.7 years and 15.4 years for CUAC and CUHP equipment, respectively, are reasonable.

8. Discount Rate

The discount rate is the rate at which future expenditures are discounted to estimate their present value. The cost of capital commonly is used to estimate the present value of cash flows to be derived from a typical company project or investment. Most companies use both debt and equity capital to fund investments, so the cost of capital is the weighted-average cost to the firm of equity and debt financing. DOE uses the capital asset pricing model (CAPM) to calculate the equity capital component, and financial data sources to calculate the cost of debt financing.

For the 2004 ANOPR, DOE derived the discount rates by estimating the cost of capital of companies that purchase air-cooled air-conditioning equipment. 69 FR 45486–45487. For the current rulemaking, DOE updated its data sources for calculating this cost. More details regarding DOE's estimates of customer discount rates are provided in chapter 8 of the NOPR TSD.

9. Base Case Market Efficiency Distribution

For the LCC analysis, DOE analyzes the considered efficiency levels relative to a base case (i.e., the case without amended energy efficiency standards). This analysis requires an estimate of the distribution of product efficiencies in the base case (i.e., what consumers would have purchased in the compliance year in the absence of amended standards). DOE refers to this distribution of product energy efficiencies as the base case efficiency distribution.

The RFI requested data on current small, large, and very large air-cooled commercial package air conditioning and heating equipment efficiency market shares (of shipments) by equipment class, and also similar historical data. DOE also requested information on expected trends in efficiency over the next five years. Carrier stated that these data is not readily available for the industry as a whole, but a joint industry, AHRI and DOE working group should be able to develop an estimate based on a collection of individual manufacturer's data. (Carrier, No. 7 at p. 6)

Given the statutory deadlines described earlier, the formation of a working group as suggested by Carrier was not feasible. The only available data showing air-cooled commercial package air conditioning and heating equipment efficiency market shares are from 1999–2001 and may not be representative of current market shares or the shares expected in the near future. Rather than rely solely on these older data, for this NOPR, DOE used a consumer choice model to estimate efficiency market shares in the expected compliance year (assumed to be 2019, as discussed below). The consumer choice model considers customer sensitivity to total installation cost and annual operating cost. DOE used the efficiency market share data for 1999–2001 to develop the parameters of the consumer choice model in the shipments analysis, as discussed in section IV.G.1. Using the parameters, the model estimates the shipments at each IEER level based on the installed cost and operating cost at each efficiency level. Table IV.11 presents the estimated base case efficiency market shares for each air-cooled CUAC equipment class.

TABLE IV.11—BASE CASE EFFICIENCY MARKET SHARES IN 2019 FOR SMALL, LARGE, AND VERY LARGE AIR-COOLED COMMERCIAL PACKAGE AIR CONDITIONING AND HEATING EQUIPMENT

Small commercial packaged AC (Air-Cooled)—≥65,000 Btu/h and <135,000 Btu/h cooling capacity		Large commercial packaged AC (Air-Cooled)—≥135,000 Btu/h and <240,000 Btu/h cooling capacity		Very large commercial packaged AC (Air-Cooled)—≥240,000 Btu/h and <760,000 Btu/h cooling capacity	
IEER	Market share (%)	IEER	Market share (%)	IEER	Market share (%)
11.4	61	11.2	78	10.1	63
12.9	39	12.2	20	11.6	24
14.0	0	13.2	2	12.5	7
14.8	1	14.2	0	13.5	4
19.9	0	18.4	0	15.5	1

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[54] See *http://xp20.ashrae.org/publicdatabase/system_service_life.asp?c_region=0&state=NA&building_function=NA&c_size=0&c_age=0&c_height=0&c_class=0&c_location=0&selected_system_type=1&c_equipment_type=NA*

Issue 12: DOE requests comments, information and data on the base case efficiency distributions of CUAC equipment. Given that historical market share efficiency data from 1999–2001 were used to inform a consumer choice model in the shipments analysis to develop estimated base case efficiency distributions in the compliance year (2019), DOE seeks more recent historical market share efficiency data would be useful for validating the estimated base case efficiency distributions.

10. Compliance Date

DOE calculated the LCC and PBP for all customers as if each were to purchase new equipment in the year that compliance with amended standards is required. EPCA directs DOE to publish a final rule amending the standard for the products covered by this NOPR not later than 2 years after a notice of proposed rulemaking is issued. (42 U.S.C. 6313(a)(6)(C)(iii)) At the time of preparation of the NOPR analysis, the expected issuance date was December 2013, leading to a final rule publication in December 2015. EPCA also states that amended standards prescribed under this subsection shall apply to products manufactured after a date that is the later of—(I) the date that is 3 years after publication of the final rule establishing a new standard; or (II) the date that is 6 years after the effective date of the current standard for a covered product. (42 U.S.C. 6313(a)(6)(C)(iv)) The date under clause (I), currently projected to be December 2018, is later than the date under clause (II). For purposes of its analysis, DOE used 2019 as the first year of compliance with amended standards.

11. Payback Period Inputs

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

The inputs to the PBP calculation are the total installed cost of the product to the customer for each efficiency level and the average annual operating expenditures for each efficiency level. The PBP calculation uses the same inputs as the LCC analysis, except that discount rates are not needed.

12. Rebuttable-Presumption Payback Period

EPCA establishes a rebuttable presumption that a standard is economically justified if the Secretary finds that the additional cost to the consumer of purchasing a product complying with an energy conservation standard level will be less than three times the value of the energy (and, as applicable, water) savings during the first year that the consumer will receive as a result of the standard, as calculated under the test procedure in place for that standard. For each considered efficiency level, DOE determines the value of the first year's energy savings by calculating the quantity of those savings in accordance with the applicable DOE test procedure, and multiplying that amount by the average energy price forecast for the year in which compliance with the amended standards would be required.

G. Shipments Analysis

DOE uses projections of product shipments to calculate the national impacts of standards on energy use, NPV, and future manufacturer cash flows. DOE develops shipment projections based on historical data and an analysis of key market drivers for each product. Historical shipments data are used to build up an equipment stock and also to calibrate the shipments model.

The RFI requested comment on DOE's approach in developing the shipments model and forecasts. Carrier recommended forming a working group with AHRI to discuss shipment forecast modeling techniques for this rulemaking. (Carrier, No. 7 at p. 7) As indicated earlier, this option was not feasible in light of the statutory time constraints. Instead, DOE developed a shipments model that includes three market segments: (1) Existing buildings replacing broken equipment, (2) new commercial buildings acquiring equipment, and (3) existing buildings acquiring new equipment for the first time.

1. Shipments by Market Segment

For existing buildings replacing broken equipment, the shipments model uses a stock accounting framework. Given the equipment entering the stock in each year and a retirement function based on the lifetime distribution developed in the LCC analysis, the model predicts how many units reach the end of their lifetime in each year. DOE typically refers to new shipments intended to replace retired units as ''replacement'' shipments. Such shipments are usually the largest part of total shipments.

For CUAC and CUHP, end of lifetime is generally associated with compressor failure. Installing a new compressor, while possible, is costly. This fact leads customers to typically replace the entire CUAC/CUHP unit rather than simply replace the compressor. A new unit is more expensive than compressor replacement, but it may be more energy-efficient than the existing unit, which means it would have lower operating costs. If standards significantly increase the cost of new equipment, one would expect that the repair option would become more attractive.

For the small and large CUAC and CUHP equipment classes, DOE modeled the repair vs. replacement decision, as described below. If the unit is repaired (*i.e.,* with a new compressor), its life is extended by another lifetime, based on the retirement function. If a unit encounters a second failure within the analysis period, the model assumes that the customer replaces the unit with a new one. For the very large CUAC and CUHP equipment classes, DOE assumed that all customers repair the unit at the first failure because the total installed cost of a new unit is very high relative to the cost of repair. If a unit encounters a second failure within the analysis period, DOE assumed that the customer replaces the unit with a new one, as further repair of very old equipment is not likely to occur.

To model the repair vs. replacement decision, DOE developed a consumer choice model that estimates customer sensitivity to total installation cost. A sensitivity parameter was calculated using efficiency market share data for years 1999–2001, along with estimates of equipment prices and installation costs by efficiency level (the data sources are described below). DOE applied this sensitivity to the difference between the total installed cost of a new unit and the repair cost of the existing unit.

The replacement cost at each efficiency level is the total installed cost derived in the LCC analysis. For repair cost, DOE developed its own estimates of the material costs for compressors. (DOE examined RS Means material costs for compressors and concluded that they were inaccurate for all size classes, as several of the estimates exceeded the costs for an entire new unit.) For labor and non-compressor material costs, DOE used data in RS Means *Facilities Maintenance & Repair Cost Data, 2013.*[55] Within each equipment class, DOE used repair costs that increase in direct proportion with the price of the equipment and with IEER level.

DOE recognizes that the decision to repair or replace equipment is not solely

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[55] RS Means Facilities Maintenance & Repair Cost Data 2013. *http://www.rsmeansonline.com.*

a function of the difference between the total installed cost of a new unit and the repair cost of the existing unit. The difference in operating costs may also play a role, as may general economic conditions and other factors. DOE did not have sufficient information to incorporate these factors explicitly into its model, so it developed an alternative approach that assumes that the factors influencing the repair or replace decision will be similar in the future as they were in the past. DOE estimated an historical average repair rate by minimizing the difference between actual historical shipments and model-predicted shipments in a ''no-repairs'' scenario. DOE developed a time series for historical shipments using data provided by AHRI in 2001 for the small and large CUAC and CUHP equipment classes for the years 1980 to 2001, combined with Census data on manufacturer shipments[56] as the basis for shipments in earlier and later years, and for very large CUAC and CUHP. Chapter 9 of the NOPR TSD discusses in more detail the AHRI and Census data and its use by DOE.

The repair/replace model is a binary choice model with two parameters, ''alpha'' and ''gamma.'' ''Alpha'' represents customer sensitivity to the efficiency-weighted average cost difference between total installed cost of replacement and repair costs. DOE assumed that the ''alpha'' is equal to the parameter used in the customer choice model to represent customer sensitivity to total installed cost. (The customer choice model is described in section IV.G.1.) ''Gamma'' is a scenario parameter that limits the number of repairs and can be thought of as representing ''unknown replacements.'' Since ''alpha'' is assumed to be known, DOE estimated ''gamma'' by minimizing the difference between the historical average repair rate and the repair probability predicted by the repair/replace model. This approach ensures that the estimated repair rate in each forecast year in the base case is close to the historical average rate. In the standards cases, which have higher installed costs, the repair rate is higher. Chapter 9 of the NOPR TSD describes the repair/replace decision model in more detail.

For existing buildings acquiring new equipment for the first time, DOE first estimated saturation values (percentages of total floor space served by different cooling capacities or types of equipment) for the stock. CBECS provides overall CUAC and CUHP saturation values. To derive percentages of floor space served by different cooling capacities or types of equipment, DOE used shipments data from the Census. DOE derived the approximate historical floor space saturations for each of the CUAC and CUHP equipment classes by multiplying the CUAC and CUHP saturation values from CBECS by the shipment shares from the Census. DOE used a logistic regression procedure to fit the CBECS historical stock saturations to produce a smooth time series of saturation estimates for the analysis period.

Shipments for existing buildings acquiring new equipment for the first time in each future year are estimated by multiplying the difference in projected stock saturation values between the future year and the previous year with the estimated floor space without CUAC and CUHP equipment in the previous year. In other words, the shipments account for the incremental increase in stock saturation.

For new commercial buildings acquiring equipment, shipments are estimated by multiplying new construction floor space in each future year by saturation values (percentages of new floor space served by different cooling capacities or types of equipment). The shipments model relies on *AEO 2013* for forecasts of new construction floor space. It assumes that the saturation value in new commercial buildings is the same as the stock-average saturation for each year.

Issue 13: DOE requests comments, information and data on the methods and key assumptions used to model the repair vs. replacement decision, which is based on estimates of the cost of repair vs. the cost of new equipment. Field data for repair costs and how they vary with equipment first cost and age would allow DOE to refine its shipments forecasting by more precisely modeling the repair vs. replace decision sensitivity to the difference in repair and replacement equipment costs.

Issue 14: DOE requests comments, information and data regarding the lifetime of repaired equipment. DOE's analysis considered major repair consisting of replacement of the compressor and miscellaneous materials associated with the compressor; DOE estimated that repaired equipment would last as long as new replacement equipment. Information is requested to determine whether this estimate is reasonable.

Issue 15: DOE requests comments, information, and data on the repair of CUACs and CUHPs in the ≥240,000 Btu/h and <760,000 Btu/h equipment classes. For this equipment, the shipments analysis estimated that any equipment experiencing their first failure would be repaired rather than replaced. Information is requested to determine whether this estimate is reasonable.

2. Shipment Market Shares by Efficiency Level

The approach described in the preceding section provides total shipments in each equipment class for each year. To estimate the market shares of the considered efficiency levels in future shipments, DOE developed a customer choice model. The model was calibrated by estimating values for two parameters, representing customer sensitivity to total installation cost and annual operating cost. To calibrate the model, DOE used EER market share data for small and large CUAC equipment classes provided by AHRI for the previous rulemaking. These market shares are for 1999–2001. DOE used the equipment prices by EER level from the 2004 ANOPR to assign equipment prices to each EER bin, along with the installation costs and maintenance costs developed for this NOPR. DOE derived unit energy consumption (UEC) values for each of the EER bins using the UEC to EER relationships presented in the 2004 ANOPR TSD, and then applied historic electricity prices to calculate annual energy costs.

To estimate values for the parameters, DOE used a non-linear regression approach that minimized the sum of the squared difference between historical market shares and the predicted values at each efficiency level for the small and large CUAC equipment classes. Starting in 2013, application of the parameters, along with data on the installed cost and operating cost at each efficiency level under consideration, determines the market shares of each efficiency level. The same parameters were used to estimate market shares for each equipment class. The details of this approach can be found in chapter 9 of the NOPR TSD.

H. National Impact Analysis

The NIA assesses the national energy savings (NES) and the national NPV of total customer costs and savings that would be expected to result from amended standards at specific efficiency levels.

To make the analysis more accessible and transparent to all interested parties, DOE used an MS Excel spreadsheet model to calculate the energy savings and the national customer costs and

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[56] U.S.Census Bureau. Current Industrial Reports for Refrigeration, Air Conditioning, and Warm Air Heating Equipment, MA333M. Note that the current industrial reports were discontinued in 2010, so more recent data are not available.

savings from each TSL.[57] The NIA calculations are based on the annual energy consumption and total installed cost data from the energy use analysis and the LCC analysis. DOE forecasted the lifetime energy savings, energy cost savings, equipment costs, and NPV of customer benefits for each equipment class for equipment sold from 2019 through 2048.

DOE evaluated the impacts of potential new and amended standards for small, large, and very large air-cooled commercial package air conditioning and heating equipment by comparing base-case projections with standards-case projections. The base-case projections characterize energy use and customer costs for each equipment class in the absence of new and amended energy conservation standards. DOE compared these projections with those characterizing the market for each equipment class if DOE were to adopt amended standards at specific energy efficiency levels (i.e., the standards cases) for that class.

TABLE IV.12—INPUTS FOR THE NATIONAL IMPACT ANALYSIS

Input	Description
Shipments	Annual shipments from shipments model.
Compliance date of standard	January 1, 2019.
Base case efficiencies	Estimated by customer choice model.
Standards case efficiencies	Estimated by customer choice model.
Annual energy consumption per unit.	Calculated for each efficiency level and equipment class based on inputs from the energy use analysis.
Total installed cost per unit	Calculated equipment prices by efficiency level using manufacturer selling prices and weighted-average overall markup values. Installation costs vary in direct proportion to the weight of the equipment.
Electricity expense per unit	Annual energy use for each equipment class is multiplied by the corresponding average energy price.
Escalation of electricity prices	*AEO 2013* forecasts (to 2040) and extrapolation beyond 2040.
Electricity site-to-primary energy conversion.	A time series conversion factor; includes electric generation, transmission, and distribution losses.
Discount rates	3% and 7% real.
Present year	2013.

1. Efficiency Trends

A key component of DOE's estimates of NES and NPV are the equipment energy efficiencies forecasted over time for the base case and for each of the standards cases. For the 2004 ANOPR, DOE used a combination of historical commercial and residential equipment efficiency data to forecast efficiencies for the base case. To estimate the impact that standards would have in the year compliance becomes required, DOE used a ''roll-up'' scenario, which assumes that equipment efficiencies in the base case that do not meet the standard level under consideration would ''roll up'' to meet the new standard level and equipment shipments at efficiencies above the standard level under consideration are not affected. 69 FR 45489–45490.

The Joint Efficiency Advocates encouraged DOE to consider a ''shift'' scenario (one in which efficiencies above the standard level under consideration are affected in a standards case) for the national impact analysis. (Joint Efficiency Advocates, No. 11 at p. 3) DOE did not have sufficient data on current efficiency market shares or information on market behavior to be able to develop a ''shift'' scenario.

The RFI requested information on expected trends in efficiency over the long run, but DOE did not receive comments. For this NOPR, DOE used the customer choice model in the shipments analysis to estimate efficiency market shares in each year of the shipments projection period. For each standards case, the efficiency levels that are below the standard are removed from the possible choices available to customers. The base case shows a slight increasing trend for small CUAC, but the shares are fairly constant for large and very large CUAC. The estimated efficiency trends in the base case and standards cases are described in chapter 9 of the NOPR TSD.

2. National Energy Savings

For each year in the forecast period, DOE calculates the national energy savings for each standard level by multiplying the shipments of small, large, and very large air-cooled CUAC and CUHP by the per-unit annual energy savings. Cumulative energy savings are the sum of the annual energy savings over the lifetime of all equipment shipped during 2019–2048.

For small, large, and very large air-cooled CUAC, the per-unit annual energy savings for each considered efficiency level come from the energy use analysis, which estimated energy consumption for 2019. For later years, DOE adjusted the per-unit annual site energy use to account for changes in climate based on projections in *AEO 2013.*

For small, large, and very large air-cooled CUHP, DOE did not conduct an energy use analysis. Because the cooling-side performance of CUHP is nearly identical to that of CUAC, DOE used the energy consumption estimates developed for CUACs to characterize the cooling-side performance of CUHP of the same size. To characterize the heating-side performance, DOE analyzed CBECS 2003 data to develop a national-average annual energy use per square foot for buildings that use CUHPs. DOE assumed that the average COP of the CUHP was 2.9.[58] DOE converted the energy use per square foot value to annual energy use per ton using a ton per square foot relationship derived from the energy use analysis for CUAC. This value is different for each equipment class. Because equipment energy use is a function of efficiency, DOE assumed that the annual heating energy consumption of a unit scales proportionally with its heating COP efficiency level. Finally, to determine

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[57] DOE understands that MS Excel is the most widely used spreadsheet calculation tool in the United States and there is general familiarity with its basic features. Thus, DOE's use of MS Excel as the basis for the spreadsheet models provides interested parties with access to the models within a familiar context. In addition, the TSD and other documentation that DOE provides during the rulemaking help explain the models and how to use them, and interested parties can review DOE's analyses by changing various input quantities within the spreadsheet.

[58] A heating efficiency of 2.9 COP corresponds to the existing minimum heating efficiency standard for CUHP, a value which the Department believes is representative of the heat pump stock characterized by CBECS.

the COPs of units with given IEERs, DOE correlated COP to IEER based on the AHRI Certified Equipment Database.[59] Thus, for any given cooling efficiency of a CUHP unit, DOE was able to establish the corresponding heating efficiency, and, in turn, the associated annual heating energy consumption.

For CUAC and CUHP, DOE did not adjust its estimate of energy savings to account for a rebound effect. A direct rebound effect occurs when an increase in efficiency is accompanied by more intensive use of the equipment. DOE is not aware of any evidence to support the notion that commercial customers would run more efficient equipment longer or more frequently. The operation of CUAC and CUHP is generally matched to the indoor comfort needs of the building, regardless of the equipment efficiency.

Issue 16: DOE requests comments on its decision to not include a rebound effect for more-efficient CUAC and CUHP.

DOE calculates the total annual site energy savings for a given standards case by subtracting total energy use in the standards case from total energy use in the base case. Part of the reduction in a standards case is due to decreasing shipments resulting from customers choosing to repair than replace broken equipment. The NES calculation also includes the estimated energy use of units that are repaired rather than replaced. The units repaired in each year are from a number of different vintages (year built). For each vintage, DOE estimated an average efficiency based on an estimated historical trend, and estimated the average energy use by scaling the energy use for baseline units in 2013 according to the estimated efficiency in each year. The average energy use of units that are repaired in each year is weighted by the number of units in each vintage.

DOE converted the site electricity consumption and savings to primary energy (power sector energy consumption) using annual conversion factors derived from the *AEO 2013* version of the NEMS. Cumulative energy savings are the sum of the NES for each year in which equipment shipped during 2019–2048 continue to operate.

DOE has historically presented NES in terms of primary energy savings. 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 Science, DOE announced its intention to use full-fuel-cycle (FFC) measures of energy use and greenhouse gas and other emissions in the national impact analyses and emissions analyses included in future energy conservation standards rulemakings. 76 FR 51281 (August 18, 2011). While DOE stated in that notice that it intended to use the Greenhouse Gases, Regulated Emissions, and Energy Use in Transportation (GREET) model to conduct the analysis, it also said it would review alternative methods, including the use of EIA's National Energy Modeling System (NEMS). After evaluating both models and the approaches discussed in the August 18, 2011 notice, DOE published a statement of amended policy in the **Federal Register** in which DOE explained its determination that NEMS is a more appropriate tool for this specific use. 77 FR 49701 (August 17, 2012). Therefore, DOE is using NEMS to conduct FFC analyses. The approach used for this NOPR, and the FFC multipliers that were applied, are described in appendix 10–A of the NOPR TSD.

3. Net Present Value of Customer Benefit

The inputs for determining the NPV of the total costs and benefits experienced by customers of the considered equipment are: (1) Total annual installed cost; (2) total annual savings in operating costs; and (3) a discount factor. DOE calculates the lifetime net savings for equipment shipped each year as the difference between the base case and each standards case in total lifetime savings in lifetime operating costs and total lifetime increases in installed costs. DOE calculates lifetime operating cost savings over the life of each small, large, and very large air-cooled commercial package air conditioning and heating equipment shipped during the forecast period.

a. Total Annual Installed Cost

The total installed cost includes both the equipment price and the installation cost. For each equipment class, DOE calculated equipment prices by efficiency level using manufacturer selling prices and weighted-average overall markup values (weights based on shares of the distribution channels used). Installation costs vary in direct proportion to the weight of the equipment. Because DOE calculated the total installed cost as a function of equipment efficiency, it was able to determine annual total installed costs based on the annual shipment-weighted efficiency levels determined in the shipments model.

For small, large, and very large air-cooled CUHPs, to estimate the cost at higher efficiency levels, DOE applied the same incremental equipment costs that were developed for the comparable CUAC efficiency levels for each equipment class (see section IV.C.4).

As noted in section IV.F.1, DOE assumed no change in small, large, and very large air-cooled CUAC and CUHP prices over the analysis period. However, DOE conducted sensitivity analyses using alternative price trends: one in which prices decline after 2013, and one in which prices rise. These price trends, and the NPV results from the associated sensitivity cases, are described in appendix 10–B of the NOPR TSD.

The NPV calculation includes the repair cost of units that are repaired rather than replaced. The approach used to estimate such costs is described in section IV.G.

b. Total Annual Operating Cost Savings

DOE calculates the total annual operating cost savings for a given standards case relative to operating costs in the base case. Part of the operating cost savings in a standards case is due to a decrease in shipments resulting from customers choosing to repair than replace broken equipment. The NPV calculation includes the estimated operating costs of units that are repaired rather than replaced. These costs were estimated based on the average energy use of such units and the average electricity price in each year.

The per-unit energy savings were derived as described in section IV.H.2. To calculate future electricity prices, DOE applied the projected trend in national-average commercial electricity price from the *AEO 2013* Reference case, which extends to 2040, to the tariff-based prices derived in the LCC and PBP analysis. DOE used the trend from 2030 to 2040 to extrapolate beyond 2040. In addition, DOE analyzed scenarios that used the trends in the *AEO 2013* Low Economic Growth and High Economic Growth cases. These cases have higher and lower energy price trends compared to the Reference case. These price trends, and the NPV results from the associated cases, are described in appendix 10–C of the NOPR TSD.

DOE estimated that annual maintenance costs (including minor repairs) do not vary with efficiency within each equipment class, so they do not figure into the annual operating cost savings for a given standards case. In addition, as noted previously, DOE included major repair costs in its shipments model rather than developing

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[59] *http://www.ahridirectory.org/ahridirectory/pages/homeM.aspx.*

annualized repair costs. As a result, repair costs do not factor directly into the determination of total operating cost savings for shipments.

In calculating the NPV, DOE multiplies the net savings in future years by a discount factor to determine their present value. DOE estimates the NPV using both a 3-percent and a 7-percent real discount rate, in accordance with guidance provided by the Office of Management and Budget (OMB) to Federal agencies on the development of regulatory analysis.[60] The discount rates for the determination of NPV are in contrast to the discount rates used in the LCC analysis, which are designed to reflect a consumer's perspective. The 7-percent real value is an estimate of the average before-tax rate of return to private capital in the U.S. economy. The 3-percent real value represents the ''social rate of time preference,'' which is the rate at which society discounts future consumption flows to their present value.

I. Customer Subgroup Analysis

In analyzing the potential impacts of new or amended standards, DOE evaluates impacts on identifiable groups (i.e., subgroups) of customers that may be disproportionately affected by a national standard. For the NOPR, DOE evaluated impacts on a small business subgroup using the LCC spreadsheet model. The customer subgroup analysis is discussed in detail in chapter 11 of the NOPR TSD.

J. Manufacturer Impact Analysis

1. Overview

DOE performed an MIA to determine the financial impact of amended energy conservation standards on manufacturers of CUAC and to estimate the potential impact of such standards on employment and manufacturing capacity. The MIA has both quantitative and qualitative aspects. The quantitative part of the MIA primarily relies on the Government Regulatory Impact Model (GRIM), an industry cash-flow model with inputs specific to this rulemaking. The key GRIM inputs are data on the industry cost structure, equipment costs, shipments, and assumptions about markups and conversion expenditures. The key output is the industry net present value (INPV). Different sets of assumptions (markup scenarios) will produce different results. The qualitative part of the MIA addresses factors such as product characteristics, impacts on particular subgroups of firms, and important market and product trends. 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 CUAC and CUHP industry that includes a top-down manufacturer cost analysis of manufacturers used to derive preliminary financial inputs for the GRIM (*e.g.,* sales, general, and administration (SG&A) expenses; research and development (R&D) expenses; and tax rates). DOE used public sources of information, including company SEC 10–K filings,[61] corporate annual reports, the U.S. Census Bureau's Economic Census,[62] and Hoover's reports.[63]

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

In Phase 3 of the MIA, DOE conducted structured, detailed interviews with a representative cross-section of manufacturers. During these interviews, DOE discussed engineering, manufacturing, procurement, and financial topics to validate assumptions used in the GRIM and to identify key issues or concerns. See section IV.J.2 for a description of the key issues manufacturers raised during the interviews.

Additionally, in Phase 3, DOE 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. For example, small manufacturers, niche players, or manufacturers exhibiting a cost structure that largely differs from the industry average could be more negatively affected. DOE identified one subgroup (*i.e.,* small manufacturers) for a separate impact analysis.

DOE applied the small business size standards published by the Small Business Administration (SBA) to determine whether a company is considered a small business. 65 FR 30836, 30848 (May 15, 2000), as amended at 65 FR 53533, 53544 (Sept. 5, 2000) and codified at 13 CFR part 121. To be categorized as a small business under North American Industry Classification System (NAICS) code 333415, ''Air-Conditioning and Warm Air Heating Equipment and Commercial and Industrial Refrigeration Equipment Manufacturing,'' a CUAC and CUHP manufacturer and its affiliates may employ a maximum of 750 employees. The 750-employee threshold includes all employees in a business's parent company and any other subsidiaries. Based on this classification, DOE identified at least two manufacturers that qualify as small businesses. The small manufacturer subgroup is discussed in section VI.B of this notice and in chapter 12 of the NOPR TSD.

2. Government Regulatory Impact Model

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 analysis uses a standard, annual 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 an amended energy conservation standard. The GRIM spreadsheet uses the inputs to arrive at a series of annual cash flows, beginning in 2014 (the base year of the analysis) and continuing to 2048. DOE calculated INPVs by summing the stream of annual discounted cash flows during this period. For CUAC and CUHP manufacturers, DOE used a real discount rate of 6.2 percent, which was derived from industry financials and then modified according to feedback received during manufacturer interviews.

The GRIM calculates cash flows using standard accounting principles and compares changes in INPV between a base case and each standards case. The difference in INPV between the base case and a standards case represents the financial impact of the amended energy conservation standard on manufacturers. As discussed previously, DOE collected this information on the critical GRIM inputs from a number of sources, including publicly-available data and interviews with a number of manufacturers (described in the next section). The GRIM results are shown in

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

[61] U.S. Securities and Exchange Commission. Annual 10–K Reports. Various Years. *http://sec.gov.*

[62] U.S. Census Bureau, Annual Survey of Manufacturers: General Statistics: Statistics for Industry Groups and Industries. *http://factfinder2.census.gov/faces/nav/jsf/pages/searchresults.xhtml?refresh=t.*

[63] Hoovers Inc. Company Profiles. Various Companies. *http://www.hoovers.com.*

section V.B.2. Additional details about the GRIM, the discount rate, and other financial parameters can be found in chapter 12 of the NOPR TSD.

a. Government Regulatory Impact Model Key Inputs

Manufacturer Production Costs

Manufacturing higher-efficiency 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 manufacturer production costs (MPCs) of the analyzed equipment can affect the revenues, gross margins, and cash flow of the industry, making these equipment cost data key GRIM inputs for DOE's analysis.

In the MIA, DOE used the MPCs for each considered efficiency level calculated in the engineering analysis, as described in section IV.C.3 and further detailed in chapter 5 of the NOPR TSD. In addition, DOE used information from its teardown analysis, described in chapter 5 of the TSD, to disaggregate the MPCs into material, labor, and overhead costs. To calculate the MPCs for equipment above the baseline, DOE added the incremental material, labor, and overhead costs from the engineering cost-efficiency curves to the baseline MPCs. These cost breakdowns and product markups were validated and revised with manufacturers during manufacturer interviews.

Shipments Forecasts

The GRIM estimates manufacturer revenues based on total unit shipment forecasts and the distribution of these values 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 forecasts derived from the shipments analysis from 2014 (the base year) to 2048 (the end year of the analysis period). The NIA shipments forecasts are, in part, based on a consumer choice model that estimates customer sensitivity to total installed cost as well as operating costs. See section IV.G. above and chapter 9 of the NOPR TSD for additional details.

Product and Capital Conversion Costs

An amended energy conservation standard would cause manufacturers to incur one-time conversion costs to bring their production facilities and product designs into compliance. DOE evaluated the level of conversion-related expenditures that would be needed to comply with each considered efficiency level in each equipment class. For the MIA, DOE classified these conversion costs into two major groups: (1) Capital conversion costs; and (2) product conversion costs. Capital conversion costs are one-time 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. Product conversion costs are one-time investments in research, development, testing, marketing, and other non-capitalized costs necessary to make product designs comply with the amended energy conservation standard. These expenditures are made between the announcement year of the standard and the effective date of the standard.

To evaluate the level of capital conversion expenditures manufacturers would likely incur to comply with amended energy conservation standards, DOE used manufacturer interviews to gather data on the anticipated level of capital investment that would be required at each efficiency level. DOE supplemented manufacturer comments with estimates of capital expenditure requirements derived from the product teardown analysis and engineering analysis described in chapter 5 of the TSD.

DOE assessed the product conversion costs at each considered efficiency level by integrating data from quantitative and qualitative sources. DOE considered market-share-weighted feedback regarding the potential costs of each efficiency level from multiple manufacturers to estimate product conversion costs and validated those numbers against engineering estimates of redesign efforts. Additionally, DOE incorporated estimates of the incremental Certification, Compliance & Enforcement (CC&E) testing costs that would result from the proposed test procedure change. This results in product conversion costs which occur even at the baseline because manufacturers would need to re-rate all existing basic models.

The testing costs that occur at baseline total $12.7M for the industry. This value is based the 6,366 product listings found in the AHRI database at the time of analysis. DOE assumed that the 29 brands in the industry would each need to run 2 validation tests for each of the 12 equipment classes, resulting in 696 physical tests at an average cost of $10,000 per test, which includes the cost of the test units. Additionally, the industry would likely use AEDMs to determine the IEER rating of all remaining basic models. While simulation times ranged from 6 to 24 hours of engineering time, depending on the size and complexity of the equipment being modeled, DOE estimated the average AEDM calculation required 13.8 hrs of engineering time to complete. The cost of physically testing 696 units totaled $6.96M and the cost of using AEDMs to determine the rating of the 6,366 product listings would total $5.76M.

Issue 17: DOE requests comments, information, and data that would inform adjustment of the DOE's estimate of $12.7M in conversion costs that occurs in the base case.

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

b. Government Regulatory Impact Model Scenarios

Markup Scenarios

As discussed above, 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 the uncertainty regarding the potential impacts on prices and profitability for manufacturers following the implementation of amended energy conservation standards: (1) A preservation of gross margin percentage markup scenario; and (2) a preservation of per unit operating profit markup scenario. These scenarios lead to different markups values that, when applied to the inputted MPCs, result in varying revenue and cash flow impacts.

Under the preservation of gross margin percentage scenario, DOE applied a single uniform ''gross margin percentage'' markup 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. As production costs increase with efficiency, this scenario implies that the absolute dollar markup will increase as well. Based on publicly-available financial information for manufacturers of small, large, and very large air-cooled CUAC and CUHP as well as comments from manufacturer interviews, DOE assumed the average non-production cost markup—which includes SG&A expenses, R&D expenses, interest, and profit—to be the following for each CUAC and CUHP equipment class:

TABLE IV.13—BASE CASE MARKUPS

Equipment	Markup
Small Commercial Packaged Air-Conditioners (Air-Cooled)—≥65,000 Btu/h and <135,000 Btu/h	1.3
Small Commercial Packaged Heat Pumps (Air-Cooled)—≥65,000 Btu/h and <135,000 Btu/h	1.3
Large Commercial Packaged Air-Conditioners (Air-Cooled)—≥135,000 Btu/h and <240,000 Btu/h	1.34
Large Commercial Packaged Heat Pumps (Air-Cooled)—≥135,000 Btu/h and <240,000 Btu/h	1.34
Very Large Commercial Packaged Air-Conditioners (Air-Cooled)—≥240,000 Btu/h and <760,000 Btu/h	1.41
Very Large Commercial Packaged Heat Pumps (Air-Cooled)—≥240,000 Btu/h and <760,000 Btu/h	1.41

Because this markup scenario assumes that manufacturers would be able to maintain their gross margin percentage markups as production costs increase in response to an amended energy conservation standard, it represents a high bound to industry profitability.

In the preservation of per unit operating profit scenario, manufacturer markups are set so that operating profit one year after the compliance date of the amended energy conservation standard is the same as in the base case on a per unit basis. Under this scenario, as the costs of production increase under a standards case, manufacturers are generally required to reduce their markups to a level that maintains base-case operating profit per unit. The implicit assumption behind this markup scenario is that the industry can only maintain its operating profit in absolute dollars per unit after compliance with the new standard is required. Therefore, operating margin in percentage terms is reduced between the base case and standards case. DOE adjusted the manufacturer markups in the GRIM at each TSL to yield approximately the same earnings before interest and taxes in the standards case as in the base case. This markup scenario represents a low bound to industry profitability under an amended energy conservation standard.

c. Manufacturer Interviews

DOE interviewed manufacturers representing approximately 97 percent of the market by revenue. The information gathered during these interviews enabled DOE to tailor the GRIM to reflect the unique financial characteristics of the small, large, and very large air-cooled CUAC and CUHP industry. In interviews, DOE asked manufacturers to describe their major concerns with potential rulemaking involving CUAC and CUHP equipment. The following sections highlight manufacturers' statements that helped shape DOEs understanding of potential impacts of an amended standard on the industry. Manufacturers raised a range of general issues for DOE to consider, including CC&E, repair and replacement rates, and alignment with ASHRAE standards. Below, DOE summarizes these issues, which were informally raised in manufacturer interviews, in order to obtain public comment and related data.

Certification, Compliance, and Enforcement

Nearly all manufacturers expressed concern over certification, compliance, and enforcement (CC&E) costs. In particular, confusion over the definition of ''basic model,'' ''equipment class,'' and the still-pending implementation of alternative efficiency determination methods (AEDMs) has made it difficult for some manufacturers to anticipate their total testing needs and total testing costs. These issues, depending on how they are addressed by DOE, will impact the number of models to require testing.

Additionally, manufacturers noted that the replacement of the current EER standard with the proposed IEER standard would introduce additional testing complications. IEER testing necessitates four data points, at 25%, 50%, 75%, and 100% capacity, which introduces additional cumulative uncertainty. Accordingly, manufacturers expressed the need for additional increases in the testing tolerance. Manufacturers noted that the confidence limits currently required by the CC&E regulations at 10 CFR 429.43 are more stringent than current laboratory capabilities as well as current industry standard practice.

Repair and Replacement Rates

During interviews, most manufacturers expressed concerns that an increase in standards may make customers more likely to repair an old unit rather than replace it with a new one. Manufacturers noted that more efficient units tend to be larger, and customers may need to make significant alterations to roofs in existing buildings in order to accommodate larger equipment. The high cost of redesigning, reconstructing, or possibly replacing a roof to hold a new unit could deter customers from purchasing one. According to manufacturers, another reason an amended standard may lead to a drop in shipments is the price sensitivity of end users. More efficient units tend to be more expensive. The lower cost of fixing an old unit, versus purchasing a new unit, may be a more attractive option for some customers. Furthermore, manufacturers indicated that there could be a reduction in energy savings from a higher standard due to the increase in the number of older, less efficient units that are repaired rather than replaced with newer, more efficient units. Manufacturers expressed concern over a potential contraction in market size resulting from amended standards.

Alignment With ASHRAE Standards

Several manufacturers suggested during interviews that DOE standards should be aligned with other industry standards set by ASHRAE and AHRI. A few standards, such as ASHRAE 37, ASHRAE 41, and AHRI 340/360 are currently being revised, and manufacturers believe that a coordination of standards between DOE and industry organizations would be a practical way to reduce the amount of time they need to spend on redesigning products and meeting multiple regulations.

K. Emissions Analysis

In the emissions analysis, DOE estimated the reduction in power sector emissions of carbon dioxide (CO_2), nitrogen oxides (NO_X), sulfur dioxide (SO_2), and mercury (Hg) from potential energy conservation standards for small, large, and very large air-cooled commercial package air conditioning and heating equipment. In addition, DOE estimates emissions impacts in production activities (extracting, processing, and transporting fuels) that provide the energy inputs to power plants. These are referred to as ''upstream'' emissions. Together, these emissions account for the full-fuel-cycle (FFC). In accordance with DOE's FFC Statement of Policy (76 FR 51282 (Aug. 18, 2011)), the FFC analysis includes impacts on emissions of methane (CH_4) and nitrous oxide (N_2O), both of which are recognized as greenhouse gases.

DOE conducted the emissions analysis using emissions factors that were derived from data in the Energy Information Agency's (EIA's) *Annual Energy Outlook 2013* (*AEO 2013*), supplemented by data from other sources.[64] DOE developed separate emissions factors for power sector emissions and upstream emissions. The method that DOE used to derive emissions factors is described in chapter 13 of the NOPR TSD.

For CH_4 and N_2O, DOE calculated emissions reduction in tons and also in terms of units of carbon dioxide equivalent (CO_2eq). Gases are converted to CO_2eq by multiplying by the gas' global warming potential (GWP) over a 100-year time horizon. Based on the Fourth Assessment Report of the Intergovernmental Panel on Climate Change,[65] DOE used GWP values of 25 for CH_4 and 298 for N_2O.

EIA prepares the *Annual Energy Outlook* using the National Energy Modeling System (NEMS). Each annual version of NEMS incorporates the projected impacts of existing air quality regulations on emissions. *AEO 2013* generally represents current legislation and environmental regulations, including recent government actions, for which implementing regulations were available as of December 31, 2012.

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 (D.C.). SO_2 emissions from 28 eastern states and D.C. were also limited under the Clean Air Interstate Rule (CAIR; 70 FR 25162 (May 12, 2005)), which created an allowance-based trading program that operates along with the Title IV program. CAIR was remanded to the U.S. Environmental Protection Agency (EPA) by the U.S. Court of Appeals for the District of Columbia Circuit but it remained in effect. See *North Carolina* v. *EPA,* 550 F.3d 1176 (D.C. Cir. 2008); *North Carolina* v. *EPA,* 531 F.3d 896 (D.C. Cir. 2008). On July 6, 2011 EPA issued a replacement for CAIR, the Cross-State Air Pollution Rule (CSAPR). 76 FR 48208 (August 8, 2011). On August 21, 2012, the D.C. Circuit issued a decision to vacate CSAPR. See EME Homer City Generation, LP v. EPA, No. 11–1302, 2012 WL 3570721 at *24 (D.C. Cir. Aug. 21, 2012). The court ordered EPA to continue administering CAIR. The *AEO 2013* emissions factors used for this NOPR assumes that CAIR remains a binding regulation through 2040.

The attainment of emissions caps is typically flexible among EGUs and is enforced through the use of emissions allowances and tradable permits. Under existing EPA regulations, any excess SO_2 emissions allowances resulting from the lower electricity demand caused by the adoption of an efficiency standard could be used to permit offsetting increases in SO_2 emissions by any regulated EGU. In past rulemakings, DOE recognized that there was uncertainty about the effects of efficiency standards on SO_2 emissions covered by the existing cap-and-trade system, but it concluded that negligible reductions in power sector SO_2 emissions would occur as a result of standards.

Beginning in 2015, however, SO_2 emissions will fall as a result of the Mercury and Air Toxics Standards (MATS) for power plants, which were announced by EPA on December 21, 2011. 77 FR 9304 (Feb. 16, 2012). In the final MATS rule, EPA established a standard for hydrogen chloride as a surrogate for acid gas hazardous air pollutants (HAP), and also established a standard for SO_2 (a non-HAP acid gas) as an alternative equivalent surrogate standard for acid gas HAP. The same controls are used to reduce HAP and non-HAP acid gas; thus, SO_2 emissions will be reduced as a result of the control technologies installed on coal-fired power plants to comply with the MATS requirements for acid gas. *AEO 2013* assumes that, in order to continue operating, coal plants must have either flue gas desulfurization or dry sorbent injection systems installed by 2015. Both technologies, which are used to reduce acid gas emissions, also reduce SO_2 emissions. Under the MATS, NEMS shows a reduction in SO_2 emissions when electricity demand decreases (e.g., as a result of energy efficiency standards). Emissions will be far below the cap established by CAIR, so it is unlikely that excess SO_2 emissions allowances resulting from the lower electricity demand would be needed or used to permit offsetting increases in SO_2 emissions by any regulated EGU. Therefore, DOE believes that efficiency standards will reduce SO_2 emissions in 2015 and beyond.

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

The MATS limit mercury emissions from power plants, but they do not include emissions caps and, as such, DOE's energy conservation standards would likely reduce Hg emissions. DOE estimated mercury emissions reduction using emissions factors based on *AEO 2013,* which incorporates the MATS.

L. Monetizing Carbon Dioxide and Other Emissions Impacts

As part of the development of this proposed rule, DOE considered the estimated monetary benefits from the reduced emissions of CO_2 and NO_X that are expected to result from each of the TSLs considered. In order to make this calculation similar to the calculation of the NPV of consumer benefit, DOE considered the reduced emissions expected to result over the lifetime of equipment shipped in the forecast period for each TSL. This section

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[64] Emissions factors based on the Annual Energy Outlook 2014 (AEO 2014), which became available too late for incorporation into this analysis, indicate that a significant decrease in the cumulative emission reductions of carbon dioxide, methane, nitrous oxide, sulfur dioxide, nitrogen oxides and mercury from the proposed standards can be expected if the projections of power plant utilization assumed in AEO 2014 are realized. For example, the estimated amount of cumulative emission reductions of CO2 are expected to decrease by 36% from DOE's current estimate (from 1,085 Mt to 697Mt) based on the projections in AEO 2014 relative to AEO 2013. The monetized benefits from GHG reductions would likely decrease by a comparable amount. DOE plans to use emissions factors based on the most recent AEO available for the next phase of this rulemaking, which may or may not be AEO 2014, depending on the timing of the issuance of the next rulemaking document.

[65] Forster, P., V. Ramaswamy, P. Artaxo, T. Berntsen, R. Betts, D.W. Fahey, J. Haywood, J. Lean, D.C. Lowe, G. Myhre, J. Nganga, R. Prinn, G. Raga, M. Schulz and R. Van Dorland. 2007: Changes in Atmospheric Constituents and in Radiative Forcing. In *Climate Change 2007: The Physical Science Basis.* Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. S. Solomon, D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M.Tignor and H.L. Miller, Editors. 2007. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA. p. 212.

summarizes the basis for the monetary values used for each of these emissions and presents the values considered in this rulemaking.

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

1. Social Cost of Carbon

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

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

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

a. Monetizing Carbon Dioxide Emissions

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

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

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

b. Development of Social Cost of Carbon Values

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

c. Current Approach and Key Assumptions

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

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

In 2010, the interagency group selected four sets of SCC values for use in regulatory analyses.[66] Three sets of values are based on the average SCC from three integrated assessment models, at discount rates of 2.5 percent,

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

3 percent, and 5 percent. The fourth set, which represents the 95th-percentile SCC estimate across all three models at a 3-percent discount rate, is included to represent higher-than-expected impacts from climate change further out in the tails of the SCC distribution. The values grow in real terms over time. Additionally, the interagency group determined that a range of values from 7 percent to 23 percent should be used to adjust the global SCC to calculate domestic effects, although preference is given to consideration of the global benefits of reducing CO_2 emissions. Table IV.14 presents the values in the 2010 interagency group report, which is reproduced in appendix 14–A of the NOPR TSD.

TABLE IV.14—ANNUAL SCC VALUES FROM 2010 INTERAGENCY REPORT, 2010–2050

[In 2007 dollars per metric ton CO_2]

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

The SCC values used for this NOPR were generated using the most recent versions of the three integrated assessment models that have been published in the peer-reviewed literature.[67] Table IV.15 shows the updated sets of SCC estimates from the 2013 interagency update in five-year increments from 2010 to 2050. Appendix 14–B of the NOPR TSD provides the full set of values and a discussion of the revisions made in 2013. The central value that emerges is the average SCC across models at 3-percent discount rate. However, for purposes of capturing the uncertainties involved in regulatory impact analysis, the interagency group emphasizes the importance of including all four sets of SCC values.

TABLE IV.15—ANNUAL SCC VALUES FROM 2013 INTERAGENCY UPDATE, 2010–2050

[In 2007 dollars per metric ton CO_2]

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

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

In summary, in considering the potential global benefits resulting from reduced CO_2 emissions resulting from this proposed rule, DOE used the values from the 2013 interagency report, adjusted to 2013$ using the Gross Domestic Product price deflator. For each of the four SCC cases specified, the values used for emissions in 2015 were

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[67] *Technical Update of the Social Cost of Carbon for Regulatory Impact Analysis Under Executive Order 12866.* Interagency Working Group on Social Cost of Carbon, United States Government, May 2013; revised November 2013. *http://www.whitehouse.gov/sites/default/files/omb/assets/inforeg/technical-update-social-cost-of-carbon-for-regulator-impact-analysis.pdf.*

$12.0, $40.5, $62.4, and $119 per metric ton avoided (values expressed in 2013$). DOE derived values after 2050 using the relevant growth rates for the 2040–2050 period in the interagency update.

DOE multiplied the CO_2 emissions reduction estimated for each year by the SCC value for that year in each of the four cases. To calculate a present value of the stream of monetary values, DOE discounted the values in each of the four cases using the specific discount rate that had been used to obtain the SCC values in each case.

DOE solicits comment on the application of the new SCC values used to determine the social benefits of CO_2 emissions reductions over the rulemaking analysis period. In particular, the agency solicits comment on its derivation of SCC values after 2050, where the agency applied the average annual growth rate of the SCC estimates in 2040–2050 associated with each of the four sets of values.

Issue 18: DOE solicits comment on the application of the new SCC values used to determine the social benefits of CO_2 emissions reductions over the rulemaking analysis period. In particular, the agency solicits comment on its derivation of SCC values after 2050, where the agency applied the average annual growth rate of the SCC estimates in 2040–2050 associated with each of the four sets of values.

2. Valuation of Other Emissions Reductions

As noted above, DOE has taken into account how new or amended energy conservation standards would reduce NO_X emissions in those 22 states not affected by the CAIR. DOE estimated the monetized value of NO_X emissions reductions resulting from each of the TSLs considered for this NOPR based on estimates found in the relevant scientific literature. Estimates of monetary value for reducing NO_X from stationary sources range from $476 to $4,893 per ton in 2013$.[68] DOE calculated monetary benefits using a medium value for NO_X emissions of $2,684 per short ton (in 20123), and real discount rates of 3-percent and 7-percent.

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

M. Utility Impact Analysis

The utility impact analysis estimates several effects on the power generation industry that would result from the adoption of new or amended energy conservation standards. In the utility impact analysis, DOE analyzes the changes in installed electricity capacity and generation that would result for each trial standard level. The utility impact analysis uses a variant of NEMS,[69] which is a public domain, multi-sectored, partial equilibrium model of the U.S. energy sector. DOE uses a variant of this model, referred to as NEMS–BT,[70] to account for selected utility impacts of new or amended energy conservation standards. DOE's analysis consists of a comparison between model results for the most recent *AEO* Reference Case and for cases in which energy use is decremented to reflect the impact of potential standards. The energy savings inputs associated with each TSL come from the NIA. Chapter 15 of the NOPR TSD describes the utility impact analysis in further detail.

N. Employment Impact Analysis

Employment impacts from new or amended energy conservation standards include direct and indirect impacts. Direct employment impacts are any changes in the number of employees of manufacturers of the equipment subject to standards; the MIA addresses those impacts. Indirect employment impacts are changes in national employment that occur due to the shift in expenditures and capital investment caused by the purchase and operation of more efficient equipment. Indirect employment impacts from standards consist of the jobs created or eliminated in the national economy, other than in the manufacturing sector being regulated, due to: (1) Reduced spending by end users on energy; (2) reduced spending on new energy supply by the utility industry; (3) increased consumer spending on the purchase of new equipment; and (4) the effects of those three factors throughout the economy.

One method for assessing the possible effects on the demand for labor of such shifts in economic activity is to compare sector employment statistics developed by the Labor Department's Bureau of Labor Statistics (BLS). BLS regularly publishes its estimates of the number of jobs per million dollars of economic activity in different sectors of the economy, as well as the jobs created elsewhere in the economy by this same economic activity. Data from BLS indicate that expenditures in the utility sector generally create fewer jobs (both directly and indirectly) than expenditures in other sectors of the economy. There are many reasons for these differences, including wage differences and the fact that the utility sector is more capital-intensive and less labor-intensive than other sectors. Energy conservation standards have the effect of reducing consumer utility bills. Because reduced consumer expenditures for energy likely lead to increased expenditures in other sectors of the economy, the general effect of efficiency standards is to shift economic activity from a less labor-intensive sector (i.e., the utility sector) to more labor-intensive sectors (e.g., the retail and service sectors). Thus, based on the BLS data alone, DOE believes net national employment may increase because of shifts in economic activity resulting from amended standards.

For the standard levels considered in the NOPR, DOE estimated indirect national employment impacts using an input/output model of the U.S. economy called Impact of Sector Energy Technologies, Version 3.1.1 (ImSET). ImSET is a special-purpose version of the ''U.S. Benchmark National Input-Output'' (I–O) model, which was designed to estimate the national employment and income effects of energy-saving technologies. The ImSET software includes a computer-based I–O model having structural coefficients that characterize economic flows among the 187 sectors. ImSET's national economic I–O structure is based on a 2002 U.S. benchmark table, specially aggregated to the 187 sectors most relevant to industrial, commercial, and residential building energy use. DOE notes that ImSET is not a general equilibrium forecasting model, and understands the uncertainties involved in projecting employment impacts, especially changes in the later years of the analysis. Because ImSET does not incorporate price changes, the employment effects predicted by ImSET may over-estimate actual job impacts over the long run. For the NOPR, DOE used ImSET only to estimate short-term employment impacts.

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[68] U.S. Office of Management and Budget, Office of Information and Regulatory Affairs, *2006 Report to Congress on the Costs and Benefits of Federal Regulations and Unfunded Mandates on State, Local, and Tribal Entities,* Washington, DC.

[69] For more information on NEMS, refer to the U.S. Department of Energy, Energy Information Administration documentation. A useful summary is *National Energy Modeling System: An Overview 2003,* DOE/EIA–0581 (2003) (March, 2003).

[70] DOE/EIA approves use of the name NEMS to describe only an official version of the model without any modification to code or data. Because this analysis entails some minor code modifications and the model is run under various policy scenarios that are variations on DOE/EIA assumptions, DOE refers to it by the name ''NEMS–BT'' (''BT'' is DOE's Building Technologies Program, under whose aegis this work has been performed).

For more details on the employment impact analysis, see chapter 16 of the NOPR TSD.

V. Analytical Results

A. Trial Standard Levels

At the NOPR stage, DOE develops Trial Standard Levels (TSLs) for consideration. TSLs are formed by grouping different efficiency levels, which are potential standard levels for each equipment class. DOE analyzed the benefits and burdens of the TSLs developed for this proposed rule. DOE examined four TSLs for small, large, and very large air-cooled commercial package air conditioning and heating equipment.

Table V.1 presents the TSLs analyzed and the corresponding efficiency level for each equipment class. The efficiency levels in each TSL can be characterized as follows: TSL 4 is comprised of the max-tech efficiency level, which is efficiency level 4 for each equipment class. TSL 3 is comprised of efficiency level 3 for each equipment class. TSL 2 is comprised of efficiency level 2 for each equipment class, and TSL 1 is comprised of efficiency level 1 for each equipment class.

TABLE V.1—SUMMARY OF TSLS FOR SMALL, LARGE, AND VERY LARGE AIR-COOLED COMMERCIAL PACKAGE AIR CONDITIONING AND HEATING EQUIPMENT

Equipment class	TSL 1	TSL 2	TSL 3	TSL 4
	Efficiency level *			
Small Commercial Packaged Air Conditioners—≥65,000 Btu/h and <135,000 Btu/h Cooling Capacity	1	2	3	4
Large Commercial Packaged Air Conditioners—≥135,000 Btu/h and <240,000 Btu/h Cooling Capacity	1	2	3	4
Very Large Commercial Packaged Air Conditioners—≥240,000 Btu/h and <760,000 Btu/h Cooling Capacity	1	2	3	4
Small Commercial Packaged Heat Pumps—≥65,000 Btu/h and <135,000 Btu/h Cooling Capacity	1	2	3	4
Large Commercial Packaged Heat Pumps—≥135,000 Btu/h and <240,000 Btu/h Cooling Capacity	1	2	3	4
Very Large Commercial Packaged Heat Pumps—≥240,000 Btu/h and <760,000 Btu/h Cooling Capacity	1	2	3	4

* For the IEERs that correspond to efficiency levels 1 through 4, see Table IV.6.

B. Economic Justification and Energy Savings

As discussed in section II.A, EPCA provides seven factors to be evaluated in determining whether a more stringent standard for small, large, and very large air-cooled CUAC and CUHP is economically justified. (42 U.S.C. 6313(a)(6)(B)(ii)) The following sections generally discuss how DOE is addressing each of those factors in this rulemaking.

1. Economic Impacts on Individual Customers

DOE analyzed the economic impacts on small, large, and very large air-cooled commercial package air conditioning and heating equipment customers by looking at the effects standards would have on the LCC and PBP. DOE also examined the impacts of potential standards on customer subgroups. These analyses are discussed below.

a. Life-Cycle Cost and Payback Period

To evaluate the net economic impact of standards on small, large, and very large air-cooled CUAC customers, DOE conducted LCC and PBP analyses for each TSL. In general, higher-efficiency equipment would affect customers in two ways: (1) Annual operating expense would decrease, and (2) purchase price would increase. Section IV.F of this notice discusses the inputs DOE used for calculating the LCC and PBP. As stated there, DOE did not do an LCC and PBP analysis for the CUHP equipment classes because energy modeling was performed only for CUAC equipment.

For each representative unit, the key outputs of the LCC analysis are a mean LCC savings and a median PBP relative to the base case, as well as the fraction of customers for which the LCC will decrease (net benefit), increase (net cost), or exhibit no change (no impact) relative to the base-case product forecast. No impacts occur when the base-case efficiency equals or exceeds the efficiency at a given TSL. Table V.2 through Table V.4 show the key results for each representative unit.

TABLE V.2—SUMMARY LIFE-CYCLE COST AND PAYBACK PERIOD RESULTS FOR SMALL COMMERCIAL PACKAGE AIR CONDITIONERS

[7.5 ton, ≥65,000 Btu/h and <135,000 Btu/h Cooling Capacity]

Trial standard level	1	2	3	4
Efficiency Level	1	2	3	4
IEER	12.9	14.0	14.8	19.9
Total Installed Cost	$8,535	$9,923	$10,323	$12,166
Mean LCC Savings ($)	$1,094	$937	$4,779	$6,771
Customers with LCC Increase (Cost) (%) *	0%	27%	0%	0%
Customers with LCC Decrease (Benefit) (%) *	61%	72%	99%	100%
Customers with No Change in LCC (%) *	39%	1%	0%	0%
Median PBP (Years)	2.2	8.0	3.9	4.7

* Rounding may cause some items to not total 100 percent.

TABLE V.3—SUMMARY LIFE-CYCLE COST AND PAYBACK PERIOD RESULTS FOR LARGE COMMERCIAL PACKAGE AIR CONDITIONERS

[15 ton, ≥135,000 Btu/h and <240,000 Btu/h]

Trial standard level	1	2	3	4
Efficiency Level	1	2	3	4
IEER	12.2	13.2	14.2	18.4
Total Installed Cost	$14,935	$16,858	$17,753	$18,975
Mean LCC Savings ($)	$1,038	$2,214	$3,469	$7,508
Customers with LCC Increase (Cost) (%) *	3%	8%	6%	2%
Customers with LCC Decrease (Benefit) (%) *	74%	90%	93%	98%
Customers with No Change in LCC (%) *	22%	2%	0%	0%
Median PBP (Years)	6.0	7.2	6.6	5.1

* Rounding may cause some items to not total 100 percent.

TABLE V.4—SUMMARY LIFE-CYCLE COST AND PAYBACK PERIOD RESULTS FOR VERY LARGE COMMERCIAL PACKAGE AIR CONDITIONERS

[30 ton, ≥240,000 Btu/h and <760,000 Btu/h]

Trial standard level	1	2	3	4
Efficiency Level	1	2	3	4
IEER	11.6	12.5	13.5	15.5
Total Installed Cost	$29,385	$31,738	$32,828	$36,200
Mean LCC Savings ($)	$4,103	$4,801	$16,477	$19,842
Customers with LCC Increase (Cost) (%) *	2%	12%	3%	5%
Customers with LCC Decrease (Benefit) (%) *	62%	76%	92%	94%
Customers with No Change in LCC (%) *	36%	13%	6%	1%
Median PBP (Years)	2.6	5.5	2.5	3.5

* Rounding may cause some items to not total 100 percent.

b. Customer Subgroup Analysis

In the customer subgroup analysis, DOE estimated the impacts of the considered TSLs on small business customers. The LCC savings and payback periods for small business customers are similar to the impacts for all customers. Chapter 11 of the NOPR TSD presents detailed results of the customer subgroup analysis.

c. Rebuttable Presumption Payback

As discussed in section III.E.2, EPCA establishes a rebuttable presumption that an energy conservation standard is economically justified if the increased purchase cost for equipment that meets the standard is less than three times the value of the first-year energy savings resulting from the standard. DOE calculated a rebuttable-presumption PBP for each TSL to determine whether DOE could presume that a standard at that level is economically justified.

DOE based the calculations on average usage profiles. As a result, DOE calculated a single rebuttable-presumption payback value, and not a distribution of PBPs, for each TSL. Table V.5 shows the rebuttable-presumption PBPs for the considered TSLs. The rebuttable presumption is fulfilled in those cases where the PBP is three years or less. However, DOE routinely conducts an economic analysis that considers the full range of impacts to the customer, manufacturer, Nation, and environment, as required by EPCA. 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 three-year PBP analysis). Section V.C addresses how DOE considered the range of impacts to select today's proposed standards.

TABLE V.5—REBUTTABLE-PRESUMPTION PAYBACK PERIODS (YEARS) FOR SMALL, LARGE, AND VERY LARGE AIR-COOLED COMMERCIAL PACKAGE AIR CONDITIONING AND HEATING EQUIPMENT

Trial standard level	1	2	3	4
Efficiency Level	1	2	3	4
Small Commercial Packaged Air Conditioners—≥65,000 Btu/h and <135,000 Btu/h Cooling Capacity	2.2	8.0	3.9	4.7
Large Commercial Packaged Air Conditioners—≥135,000 Btu/h and <240,000 Btu/h Cooling Capacity	6.0	7.2	6.6	5.1
Very Large Commercial Packaged Air Conditioners—≥240,000 Btu/h and <760,000 Btu/h Cooling Capacity	2.6	5.5	2.5	3.5

2. Economic Impacts on Manufacturers

As noted above, DOE performed an MIA to estimate the impact of amended energy conservation standards on manufacturers of small, large, and very large air-cooled commercial package air conditioning and heating equipment. 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

Table V.6 and Table V.7 depict the financial impacts (represented by changes in INPV) of amended energy standards on manufacturers of small, large, and very large air-cooled commercial package air conditioning and heating equipment, as well as the conversion costs that DOE expects manufacturers would incur for all equipment classes at each TSL. To evaluate the range of cash flow impacts on the commercial packaged air conditioner and heat pump industry, DOE modeled two different mark-up scenarios using different assumptions that correspond to the range of anticipated market responses to amended energy conservation standards: (1) The preservation of gross margin percentage; and (2) the preservation of per unit operating profit. Each of these scenarios is discussed immediately below.

To assess the lower (less severe) end of the range of potential impacts, DOE modeled a preservation of gross margin percentage markup scenario, in which a uniform ''gross margin percentage'' markup is applied across all potential efficiency levels. In this scenario, DOE assumed that a manufacturer's absolute dollar markup would increase as production costs increase in the standards case.

To assess the higher (more severe) end of the range of potential impacts, DOE modeled the preservation of per unit operating profit markup scenario, which assumes that manufacturers would not be able to greater operating profit on a per unit basis in the standards case. Rather, as manufacturers make the necessary investments required to convert their facilities to produce new standards-compliant products and incur higher costs of goods sold, their percentage markup decreases. Operating profit does not change in absolute dollars and decreases as a percentage of revenue.

As noted in the MIA methodology discussion (see IV.J.2), in addition to markup scenarios, the MPC, shipments, and conversion cost assumptions also affect INPV results. Of particular note in this rulemaking is the decline in cumulative shipments as the TSL increases that is forecasted in the NIA shipments. This change in shipments is summarized in Table V.10.

The set of results below shows potential INPV impacts for small, large, and very large air-cooled commercial package air conditioning and heating equipment manufacturers; Table V.6 reflects the lower bound of impacts, and Table V.7 represents the upper bound.

Each of the modeled scenarios results in a unique set of cash flows and corresponding industry values at each TSL. In the following discussion, the INPV results refer to the difference in industry value between the base case and each standards case that results from the sum of discounted cash flows from the base year 2014 through 2048, the end of the analysis period.

To provide perspective on the short-run cash flow impact, DOE includes in the discussion of the results below a comparison of free cash flow between the base case and the standards case at each TSL in the year before new standards would take effect. This figure provides an understanding of the magnitude of the required conversion costs relative to the cash flow generated by the industry in the base case.

TABLE V.6—INDUSTRY VALUATION AND FINANCIAL IMPACTS—PRESERVATION OF GROSS MARGIN PERCENTAGE MARKUP SCENARIO *

	Units	Base case	Trial standard level			
			1	2	3	4
INPV	$M	1,260.91	1,249.47	1,208.04	1,172.36	1,142.78
Change in INPV	$M		(11.45)	(52.87)	(88.55)	(118.13)
	%		(0.91)	(4.19)	(7.02)	(9.37)
Product Conversion Costs	$M	12.72	38.73	58.52	120.90	210.96
Capital Conversion Costs	$M		14.94	39.23	105.54	113.31
Total Conversion Costs	$M	12.72	53.68	97.75	226.44	324.28
Free Cash Flow (2018)	$M	73.38	58.19	40.82	(9.32)	(42.13)
Free Cash Flow (2018)	% Change		(20.70)	(44.37)	(112.70)	(157.42)

TABLE V.7—INDUSTRY VALUATION AND FINANCIAL IMPACTS—PRESERVATION OF PER UNIT OPERATING PROFIT MARKUP SCENARIO *

	Units	Base case	Trial standard level			
			1	2	3	4
INPV	$M	1,260.91	1,187.02	1,015.61	949.34	822.75
Change in INPV	$M		(73.89)	(245.30)	(311.58)	(438.16)
	%		(5.86)	(19.45)	(24.71)	(34.75)
Product Conversion Costs	$M	12.72	38.73	58.52	120.90	210.96
Capital Conversion Costs	$M	-	14.94	39.23	105.54	113.31
Total Conversion Costs	$M	12.72	53.68	97.75	226.44	324.28
Free Cash Flow (2018)	$M	73.38	58.19	40.82	(9.32)	(42.13)
Free Cash Flow (2018)	% Change		(20.70)	(44.37)	(112.70)	(157.42)

* Values in parentheses are negative values.

Base case conversion costs of $12.72 million are attributed to CC&E costs associated with new product certification under the proposed test procedure. This amount consists of modeling and equipment testing costs incurred to recertify currently available products.

TSL 1 represents EL 1 for all equipment classes. At TSL 1, DOE estimates impacts on INPV for commercial packaged air conditioning manufacturers to range from −5.86 percent to −0.91 percent, or a change in INPV of −$73.89 million to −$11.45

million. At this potential standard level, industry free cash flow is estimated to decrease by approximately 20.70 percent to $58.19, compared to the base-case value of $73.38 million in the year before the compliance date (2018).

At TSL 1, the industry is likely to face a small contraction. Industry wide shipments drop by approximately 5.04% in the standard year (2019), relative to the base case. In addition, manufacturers incur conversion costs totaling $53.68 million due to CC&E requirements, product redesigns for the Very Large equipment classes, and new tooling associated with their highest capacity equipment offerings. While impacts on the industry as a whole are relatively mild, small manufacturers may have greater difficulty with re-rating their products to an IEER metric since they generally do not have the testing capacity or engineering resources of larger competitors.

TSL 2 represents EL 2 across all equipment classes. At TSL 2, DOE estimates impacts on INPV for commercial packaged air conditioning manufacturers to range from −19.45 percent to −4.19 percent, or a change in INPV of −$245.30 million to −$52.87 million. At this potential standard level, industry free cash flow is estimated to decrease by approximately 44.37 percent to $40.82 million, compared to the base-case value of $73.38 million in the year before the compliance date (2018).

At TSL 2, industry-wide shipments drop by 28.32% in the standard year (2019) relative to the base case. Additionally, DOE anticipates conversion costs to increase to $97.75 million for the industry as roughly 67% of equipment listed in the AHRI directory would need to be redesigned in order to meet the higher proposed efficiency levels. Given the industry's existing trend of consolidation, DOE expects further consolidation at TSL 2. Manufacturers with limited market share may choose to sell off their small, large, and very large air-cooled commercial package air conditioning and heating equipment business to larger competitors.

TSL 3 represents EL 3 for all equipment classes. At TSL 3, DOE estimates impacts on INPV for commercial packaged air conditioning manufacturers to range from −24.71 percent to −7.02 percent, or a change in INPV of −$311.58 million to −$88.55 million., Industry-wide shipments drop by 28.76% relative to the base case in the standards year. DOE anticipates large capital conversion costs at TSL 3, as redesigns necessitate additional investments in tooling for cabinets and heat exchangers to meet amended efficiency standards. Roughly 81% of equipment listings would require changes to meet the standard. Conversion costs total $226.44 million for the industry. A key indicator of impact on the industry is the industry free cash flow, which is estimated to decrease by approximately 112.70 percent to −$9.32 relative to the base case value of $73.38 million in the year before the compliance date (2018). The negative free cash flow indicates that players in the industry would need to access cash reserves or borrow money from capital markets to cover conversion costs. Given expectation for a shrinking market and high conversion costs, some manufacturers indicated they would move production to lower-cost foreign markets at this level.

TSL 4 represents max tech across all equipment classes. At TSL 4, DOE estimates impacts on INPV for commercial packaged air conditioning manufacturers to range from −34.75 percent to −9.37 percent, or a change in INPV of −$438.16 million to −$118.13 million. At this potential standard level, industry free cash flow is estimated to decrease by approximately 157.42 percent relative to the base-case value of $73.38 million in the year before the compliance date (2018).

At max-tech, DOE estimates a 35.12% drop in shipments in the standards years, a maximum loss of over 34.75% of industry value over the analysis period, and conversion costs approaching $650 million for the industry. Only 2% of equipment listings could meet this trial standard level today. Manufacturers voiced concerns over the lack of product differentiation and the commoditization at upper TSLs. TSL 4 would leave no room for product differentiation based on efficiency. Furthermore, given the level of R&D and production line modifications necessary at this level, it is unclear whether the industry could make the necessary changes in the allotted conversion period. At TSL 4, most manufacturers would re-evaluate their role in the industry. Those that do remain would strongly consider all cost cutting measures, including relocation to foreign countries.

Issue 19: DOE requests comment on the capital conversion costs and product conversion costs estimated for each TSL. In particular, DOE seeks comment on the conversion costs at max-tech, at TSL 4.

b. Impacts on Direct Employment

To quantitatively assess the impacts of energy conservation standards on direct employment in the small, large, and very large air-cooled commercial package air conditioning and heating equipment industry, DOE used the GRIM to estimate the domestic labor expenditures and number of employees in the base case and at each TSL from 2015 through 2048. DOE used statistical data from the U.S. Census Bureau's 2011 Annual Survey of Manufacturers (ASM),[71] the results of the engineering analysis, and interviews with manufacturers to determine the inputs necessary to calculate industry-wide labor expenditures and domestic employment levels. Labor expenditures related to manufacturing of the product are a function of the labor intensity of the product, the sales volume, and an assumption that wages remain fixed in real terms over time. The total labor expenditures in each year are calculated by multiplying the MPCs by the labor percentage of MPCs.

The total labor expenditures in the GRIM were then converted to domestic production employment levels by dividing production labor expenditures by the annual payment per production worker (production worker hours times the labor rate found in the U.S. Census Bureau's 2011 ASM). The estimates of production workers in this section cover workers, including line-supervisors who are directly involved in fabricating and assembling a product within the manufacturing facility. Workers performing services that are closely associated with production operations, such as materials handling tasks using forklifts, are also included as production labor. DOE's estimates only account for production workers who manufacture the specific products covered by this rulemaking. The total direct employment impacts calculated in the GRIM are the changes in the number of production workers resulting from the amended energy conservation standards for small, large, and very large air-cooled commercial package air conditioning and heating equipment, as compared to the base case. In general, more efficient equipment is larger, more complex, and more labor intensive to build. Per unit labor requirements and production time requirements increase with a higher energy conservation standard. As a result, the total labor calculations described in this paragraph are considered an upper bound to direct employment forecasts.

On the other hand, the domestic HVAC industry has had a track record of consolidation over the past decade. See, e.g. *Daikin Acquires Goodman,*

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

Daikin Corporate News (Aug. 29, 2012); *Ingersoll Rand to Acquire Trane Inc. for Approximately $10.1 Billion,* Trane Press Release (Dec. 17, 2007); and *JCI Buys Pennsylvania Firm,* Grand Rapids Press, C6 (Aug. 26, 2005) (noting purchase of York International by Johnson Controls, Inc.). DOE recognizes the potential for industry consolidation and its concomitant impacts on employment levels, especially at higher TSLs. As shipments drop and conversion costs increase, some manufacturers may choose not to make the necessary investments to meet the amended standard for all equipment classes. Alternatively, they may choose to relocate production facilities where conversion costs and production costs are lower. To establish a lower bound to negative employment impacts, DOE estimated the maximum potential job loss due to manufacturers either leaving the industry or moving production to foreign locations as a result of an amended standard. These lower bound estimates were based on GRIM results, conversion cost estimates, and content from manufacturers interviews. The lower bound of employment is presented in Table V.8 below.

DOE estimates that in the absence of amended energy conservation standards, there would be 1,085 domestic production workers for small, large, and very large air-cooled commercial package air conditioning and heating equipment. DOE estimates that 50 percent of small, large, and very large air-cooled commercial package air conditioning and heating equipment sold in the United States are manufactured domestically. Table V.8 shows the range of the impacts of potential amended energy conservation standards on U.S. production workers of small, large, and very large air-cooled commercial package air conditioning and heating equipment.

TABLE V.8—POTENTIAL CHANGES IN THE TOTAL NUMBER OF SMALL, LARGE, AND VERY LARGE AIR-COOLED COMMERCIAL PACKAGE AIR CONDITIONING AND HEATING EQUIPMENT PRODUCTION WORKERS IN 2019

	Trial standard level *				
	Base case	1	2	3	4
Potential Changes in Domestic Production Workers in 2019 (relative to a base case employment of 1,085).	....	(181) to (10) ..	(482) to (69) ..	(543) to (27) ..	(1,085) to (31).

* Parentheses indicate negative values.

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

c. Impacts on Manufacturing Capacity

According to the commercial packaged air conditioning manufacturers interviewed, amended energy conservation standards could lead to higher fabrication labor hours. However, manufacturers noted that industry shipments are down 40% from their peak in the 2007–2008 timeframe. Excess capacity in the industry today and any drop in shipments that result from higher prices could offset the additional production times. In the long-term, no manufacturers interviewed expected to have capacity constraints.

Manufacturers did note concerns about engineering and testing capacity in the time period between the announcement year and the effective year of the proposed standard. Manufacturers worried about the level of technical resources required to redesign and test all products at higher TSLs. The engineering analysis shows increasingly complex components and control strategies are required as standard levels increase. Manufacturers noted in interviews that the industry would need to add electrical engineering and control systems engineering talent beyond current staffing to meet the redesign requirements of higher TSLs. Additional training might be needed for manufacturing engineers, laboratory technicians, and service personnel if variable speed components are broadly adopted. Furthermore, as standards increase, units tend to grow in size, requiring more lab resources and time to test. Some manufacturers were concerned that an amended standard would trigger the need for construction of new test lab facilities, which require significant lead time.

Issue 20: DOE requests comments and data on capacity constraints at each TSL—including production capacity constraints, engineering resource constraints, and testing capacity constraints that are directly related to an amended standard for small, large, and very large CUAC and CUHP. In particular, DOE requests comment on whether the proposed effective date allows for a sufficient conversion period to make the equipment design and facility updates necessary to meet an amended standard.

d. Impacts on Subgroups of Manufacturers

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

For the commercial packaged air conditioner and heat pump industry, DOE identified and evaluated the impact of amended energy conservation standards on one subgroup—small manufacturers. The SBA defines a ‘‘small business’’ as having 750 employees or less for NAICS 333415, ‘‘Air-Conditioning and Warm Air Heating Equipment and Commercial and Industrial Refrigeration Equipment Manufacturing.’’ Based on this definition, DOE identified three manufacturers in the commercial packaged air conditioning industry that qualify as small businesses. For a discussion of the impacts on the small manufacturer subgroup, see the regulatory flexibility analysis in section VI.B of this notice and chapter 12 of the NOPR TSD.

e. Cumulative Regulatory Burden

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

For the cumulative regulatory burden analysis, DOE looks at other regulations that could affect small, large, and very large air-cooled commercial package air conditioning and heating equipment manufacturers that will take effect approximately three years before or after the 2019 compliance date of amended energy conservation standards for these products. In interviews, manufacturers cited Federal regulations on equipment other than small, large, and very large air-cooled commercial package air conditioning and heating equipment that contribute to their cumulative regulatory burden. The compliance years and expected industry conversion costs of relevant amended energy conservation standards are indicated in the table below. Included in the table are Federal regulations that have compliance dates beyond the three year range of DOE's analysis. Those regulations were cited multiple times by manufacturers in interviews and written comments, and are included here for reference.

TABLE V.9—COMPLIANCE DATES AND EXPECTED CONVERSION EXPENSES OF FEDERAL ENERGY CONSERVATION STANDARDS AFFECTING SMALL, LARGE, AND VERY LARGE AIR-COOLED COMMERCIAL PACKAGE AIR CONDITIONING AND HEATING EQUIPMENT MANUFACTURERS

Federal energy conservation standards	Approximate compliance date	Estimated total industry conversion expense
2007 Residential Furnaces & Boilers 72 FR 65136 (Nov. 19, 2007)	2015	* $88M (2006$)
2011 Residential Furnaces 76 FR 37408 (June 27, 2011); 76 FR 67037 (Oct. 31, 2011)	2015	** $2.5M (2009$)
2011 Residential Central Air Conditioners and Heat Pumps 76 FR 37408 (June 27, 2011); 76 FR 67037 (Oct. 31, 2011)	2015	** $ 26.0M (2009$)
2010 Gas Fired and Electric Storage Water Heaters 75 FR 20112 (April 16, 2010)	2015	$95.4M (2009$)
Walk-in Coolers and Freezers	2017	$33.6.0M (2012$)
Furnace Fans	2019	$40.6M (2012$)
Packaged Terminal Air Conditioners and Heat Pumps ***	TBD	TBD
Commercial and Industrial Fans and Blowers ***	TBD	TBD

* Conversion expenses for manufacturers of oil-fired furnaces and gas- and oil-fired boilers associated with the November 2007 final rule for residential furnaces and boilers are excluded from this figure. The 2011 direct final rule for residential furnaces sets a higher standard and earlier compliance date for oil furnaces than the 2007 final rule. As a result, manufacturers will be required design to the 2011 direct final rule standard. The conversion costs associated with the 2011 direct final rule are listed separately in this table. EISA 2007 legislated higher standards and earlier compliance dates for residential boilers than were in the November 2007 final rule. As a result, gas-fired and oil-fired boiler manufacturers were required to design to the EISA 2007 standard beginning in 2012. The conversion costs listed for residential gas-fired and oil-fired boilers in the November 2007 residential furnaces and boilers final rule analysis are not included in this figure.

** Estimated industry conversion expense and approximate compliance date reflect a court-ordered May 1, 2013 stay of the residential non-weatherized and mobile home gas furnaces standards set in the 2011 Energy Conservation Standards for Residential Furnaces and Residential Central Air Conditioners and Heat Pumps.

*** The final rule for this energy conservation standard has not been published. The compliance date and analysis of conversion costs are estimates and have not been finalized at this time.

In addition to Federal energy conservation standards, DOE identified other regulatory burdens that would affect manufacturers of small, large, and very large air-cooled commercial package air conditioning and heating equipment:

DOE Certification, Compliance, and Enforcement (CC&E) Rule

Any amended standard that DOE would also require accompanying CC&E requirements for manufacturers of small, large, and very large air-cooled commercial package air conditioning equipment to follow. DOE conducted a rulemaking to expand AEDM coverage to commercial HVAC, including the equipment covered by this rulemaking, and issued a final rule on December 31, 2013. (78 FR 79579) An AEDM is a computer modeling or mathematical tool that predicts the performance of non-tested basic models. In the final rule, DOE is allowing manufacturers of small, large, and very large air-cooled commercial package air conditioning equipment to rate basic models using AEDMs, reducing the need for sample units and reducing burden on manufacturers. The final rule establishes revised verification tolerances for small, large, and very large air-cooled commercial package air conditioning equipment manufacturers. More information can be found at *http://www1.eere.energy.gov/buildings/appliance_standards/implement_cert_and_enforce.html.*

EPA Phase-Out of Hydrochlorofluorocarbons (HCFCs)

The U.S. is obligated under the Montreal Protocol to limit production and consumption of HCFCs through incremental reductions, culminating in a complete phase-out of HCFCs by 2030.[72] On December 15, 2009, EPA published the ''2010 HCFC Allocation Rule,'' which allocates production and consumption allowances for HCFC–22 for each year between 2010 and 2014. 74 FR 66412. The rule also prohibited the manufacture of new appliances using virgin HCFC–22, effective January 1, 2010, with limited exceptions. On April 3, 2013, EPA published the ''2012–2014 HCFC Allocation Proposed Rule,'' which lifted the regulatory ban on the production and consumption of HCFC–22 (following a court decision[73] in August 2010 to vacate a portion of the ''2010 HCFC Allocation Rule'') by establishing company-by-company HCFC–22 baselines and allocating allowances for 2012–2014. 78 FR 20004. On December 24, 2013, EPA published the ''2015–2019 HCFC Allocation Proposed Rule,'' which would provide HCFC allowances, including HCFC–22, through 2019. 78 FR 78072. Effective January 1, 2020, there will be no new production or import of virgin HCFC–22.

Manufacturers of small, large, and very large air-cooled commercial package air conditioning equipment must comply with the allowances

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[72] ''Montreal Protocol.'' *United Nations Environment Programme.* Web. 26 Aug. 2010. *http://ozone.unep.org/new_site/en/montreal_protocol.php.*

[73] *See Arkema* v. *EPA,* 618 F.3d 1 (D.C. Cir. 2010).

established by the allocation rule as well as the prohibition on manufacture of new HFC–22 appliances that took effect January 1, 2010. As such, no covered manufacturers offer R–22 products today. The MPCs used for the baseline and higher efficiency design options account for the move away from R–22 and the changes in production costs that resulted from the shift to HFC refrigerants.

Issue 21: DOE requests comment on the identified regulations and their contribution to cumulative regulatory burden. Additionally, DOE requests feedback on product-specific regulations that take effect between 2016 and 2022 that were not listed, including identification of the specific regulations and data quantifying the associated burdens.

3. National Impact Analysis

For small, large, and very large air-cooled commercial package air conditioning and heating equipment, projections of shipments are an important part of the NIA. As discussed in section IV.G, DOE applied a repair/replace decision model to estimate how many units coming to the end of their lifetime would be repaired rather than replaced with a new unit. Because the decision is very sensitive to the installed cost of new equipment, the impact of standards on shipments increases with the minimum efficiency required. Table V.10 presents the estimated cumulative shipments in 2019–2048 in the base case and under each TSL.

TABLE V.10—PROJECTED CUMULATIVE SHIPMENTS OF SMALL, LARGE, AND VERY LARGE AIR-COOLED COMMERCIAL PACKAGE AIR CONDITIONING AND HEATING EQUIPMENT IN 2019–2048

	Million units	Percent reduction from base case (%)
Base Case	9.7	N/A
TSL 1	9.2	4.8
TSL 2	7.5	22.5
TSL 3	7.5	22.8
TSL 4	7.1	27.0

a. Significance of Energy Savings

For each TSL, DOE projected energy savings for small, large, and very large air-cooled commercial package air conditioning and heating equipment purchased in the 30-year period that begins in the year of anticipated compliance with amended standards (2019–2048). The savings are measured over the entire lifetime of equipment purchased in the 30-year period. DOE quantified the energy savings attributable to each TSL as the difference in energy consumption between each standards case and the base case. Table V.11 presents the estimated primary energy savings for each considered TSL, and Table V.12 presents the estimated FFC energy savings for each TSL. The approach for estimating national energy savings is further described in section IV.H.

TABLE V.11—CUMULATIVE PRIMARY ENERGY SAVINGS FOR SMALL, LARGE, AND VERY LARGE AIR-COOLED COMMERCIAL PACKAGE AIR CONDITIONING AND HEATING EQUIPMENT TRIAL STANDARD LEVELS FOR UNITS SOLD IN 2019–2048

Equipment class	Trial standard level			
	1	2	3	4
	quads			
Small Commercial Packaged Air Conditioners—≥65,000 Btu/h and <135,000 Btu/h Cooling Capacity	1.2	4.3	5.4	8.3
Large Commercial Packaged Air Conditioners—≥135,000 Btu/h and <240,000 Btu/h Cooling Capacity	0.8	1.8	2.6	3.8
Very Large Commercial Packaged Air Conditioners—≥240,000 Btu/h and <760,000 Btu/h Cooling Capacity	0.7	1.5	2.7	3.4
Small Commercial Packaged Heat Pumps—≥65,000 Btu/h and <135,000 Btu/h Cooling Capacity	0.1	0.5	0.7	1.0
Large Commercial Packaged Heat Pumps—≥135,000 Btu/h and <240,000 Btu/h Cooling Capacity	0.0	0.1	0.1	0.2
Very Large Commercial Packaged Heat Pumps—≥240,000 Btu/h and <760,000 Btu/h Cooling Capacity	0.0	0.1	0.1	0.2
Total All Classes	2.9	8.3	11.7	16.8

TABLE V.12—CUMULATIVE FULL-FUEL-CYCLE ENERGY SAVINGS FOR SMALL, LARGE, AND VERY LARGE AIR-COOLED COMMERCIAL PACKAGE AIR CONDITIONING AND HEATING EQUIPMENT TRIAL STANDARD LEVELS FOR UNITS SOLD IN 2019–2048

Equipment class	Trial standard level			
	1	2	3	4
	quads			
Small Commercial Packaged Air Conditioners—≥65,000 Btu/h and <135,000 Btu/h Cooling Capacity	1.2	4.3	5.5	8.4
Large Commercial Packaged Air Conditioners—≥135,000 Btu/h and <240,000 Btu/h Cooling Capacity	0.8	1.8	2.6	3.8
Very Large Commercial Packaged Air Conditioners—≥240,000 Btu/h and <760,000 Btu/h Cooling Capacity	0.8	1.6	2.7	3.5
Small Commercial Packaged Heat Pumps—≥65,000 Btu/h and <135,000 Btu/h Cooling Capacity	0.1	0.5	0.7	1.0
Large Commercial Packaged Heat Pumps—≥135,000 Btu/h and <240,000 Btu/h Cooling Capacity	0.0	0.1	0.1	0.2
Very Large Commercial Packaged Heat Pumps—≥240,000 Btu/h and <760,000 Btu/h Cooling Capacity	0.0	0.1	0.1	0.2
Total All Classes	3.0	8.4	11.8	17.1

For this rulemaking, DOE undertook a sensitivity analysis using nine rather than 30 years of equipment shipments. The choice of a nine-year period is a proxy for the timeline in EPCA for the review of certain energy conservation standards and potential revision of and compliance with such revised standards.[74] This timeframe may not be statistically relevant with regard to the equipment lifetime, equipment manufacturing cycles or other factors specific to small, large, and very large air-cooled commercial package air conditioning and heating equipment. Thus, this information is presented for informational purposes only and is not indicative of any change in DOE's analytical methodology. The NES results based on a 9-year analytical period are presented in Table V.13. The impacts are counted over the lifetime of small, large, and very large air-cooled commercial package air conditioning and heating equipment purchased in 2019–2027.

TABLE V.13—CUMULATIVE PRIMARY ENERGY SAVINGS FOR SMALL, LARGE, AND VERY LARGE AIR-COOLED COMMERCIAL PACKAGE AIR CONDITIONING AND HEATING EQUIPMENT TRIAL STANDARD LEVELS FOR UNITS SOLD IN 2019–2027

Equipment class	Trial standard level			
	1	2	3	4
	quads			
Small Commercial Packaged Air Conditioners—≥65,000 Btu/h and <135,000 Btu/h Cooling Capacity	0.3	0.7	0.9	1.4
Large Commercial Packaged Air Conditioners—≥135,000 Btu/h and <240,000 Btu/h Cooling Capacity	0.2	0.4	0.5	0.7
Very Large Commercial Packaged Air Conditioners—≥240,000 Btu/h and <760,000 Btu/h Cooling Capacity	0.1	0.2	0.3	0.3
Small Commercial Packaged Heat Pumps—≥65,000 Btu/h and <135,000 Btu/h Cooling Capacity	0.0	0.1	0.2	0.2
Large Commercial Packaged Heat Pumps—≥135,000 Btu/h and <240,000 Btu/h Cooling Capacity	0.0	0.0	0.0	0.0
Very Large Commercial Packaged Heat Pumps—≥240,000 Btu/h and <760,000 Btu/h Cooling Capacity	0.0	0.0	0.0	0.0
Total All Classes	0.6	1.4	1.9	2.7

Issue 22: For this rulemaking, DOE analyzed the effects of potential standards on equipment purchased over a 30-year period, and it undertook a sensitivity analysis using 9 years rather than 30 years of product shipments. The choice of a 30-year period of shipments is consistent with the DOE analysis for other products and commercial equipment. 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 amended standards. DOE is seeking

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[74] EPCA requires DOE to review its standards at least once every 6 years, and requires, for certain products, a 3-year period after any new standard is promulgated before compliance is required, except that in no case may any new standards be required within 6 years of the compliance date of the previous standards. While adding a 6-year review to the 3-year compliance period adds up to 9 years, DOE notes that it may undertake reviews at any time within the 6 year period and that the 3-year compliance date may yield to the 6-year backstop. A 9-year analysis period may not be appropriate given the variability that occurs in the timing of standards reviews and the fact that for some consumer products, the compliance period is 5 years rather than 3 years.

input on ways to refine the analytic timeline.

b. Net Present Value of Customer Costs and Benefits

DOE estimated the cumulative NPV of the total costs and savings for customers that would result from the TSLs considered for small, large, and very large air-cooled commercial package air conditioning and heating equipment. In accordance with OMB's guidelines on regulatory analysis,[75] DOE calculated the NPV using both a 7-percent and a 3-percent real discount rate. The 7-percent rate is an estimate of the average before-tax rate of return on private capital in the U.S. economy, and reflects the returns on real estate and small business capital as well as corporate capital. This discount rate approximates the opportunity cost of capital in the private sector (OMB analysis has found the average rate of return on capital to be near this rate). The 3-percent rate reflects the potential effects of standards on private consumption (*e.g.,* through higher prices for equipment and reduced purchases of energy). This rate represents the rate at which society discounts future consumption flows to their present value. It can be approximated by the real rate of return on long-term government debt (*i.e.,* yield on United States Treasury notes), which has averaged about 3 percent for the past 30 years.

Table V.14 shows the customer NPV results for each TSL considered for small, large, and very large air-cooled commercial package air conditioning and heating equipment. In each case, the impacts cover the lifetime of equipment purchased in 2019–2048.

TABLE V.14—NET PRESENT VALUE OF CUSTOMER BENEFITS FOR SMALL, LARGE, AND VERY LARGE AIR-COOLED COMMERCIAL PACKAGE AIR CONDITIONING AND HEATING EQUIPMENT TRIAL STANDARD LEVELS FOR UNITS SOLD IN 2019–2048

Equipment class	Discount rate %	Trial standard level			
		1	2	3	4
		billion 2012$			
Small Commercial Packaged Air Conditioners—≥65,000 Btu/h and <135,000 Btu/h Cooling Capacity	3	6.9	20.7	26.0	36.2
Large Commercial Packaged Air Conditioners—≥135,000 Btu/h and <240,000 Btu/h Cooling Capacity		3.0	6.8	9.7	15.6
Very Large Commercial Packaged Air Conditioners—≥240,000 Btu/h and <760,000 Btu/h Cooling Capacity		3.4	6.4	11.0	13.5
Small Commercial Packaged Heat Pumps—≥65,000 Btu/h and <135,000 Btu/h Cooling Capacity		0.8	2.3	3.1	4.2
Large Commercial Packaged Heat Pumps—≥135,000 Btu/h and <240,000 Btu/h Cooling Capacity		0.2	0.3	0.5	0.8
Very Large Commercial Packaged Heat Pumps—≥240,000 Btu/h and <760,000 Btu/h Cooling Capacity		0.2	0.3	0.6	0.7
Total All Classes		14.4	36.9	50.8	71.0
Small Commercial Packaged Air Conditioners—≥65,000 Btu/h and <135,000 Btu/h Cooling Capacity	7	2.5	7.1	9.0	11.8
Large Commercial Packaged Air Conditioners—≥135,000 Btu/h and <240,000 Btu/h Cooling Capacity		0.9	2.0	2.9	4.8
Very Large Commercial Packaged Air Conditioners—≥240,000 Btu/h and <760,000 Btu/h Cooling Capacity		1.0	1.8	3.3	3.9
Small Commercial Packaged Heat Pumps—≥65,000 Btu/h and <135,000 Btu/h Cooling Capacity		0.3	0.8	1.1	1.5
Large Commercial Packaged Heat Pumps—≥135,000 Btu/h and <240,000 Btu/h Cooling Capacity		0.1	0.1	0.2	0.3
Very Large Commercial Packaged Heat Pumps—≥240,000 Btu/h and <760,000 Btu/h Cooling Capacity		0.1	0.1	0.2	0.2
Total All Classes		4.8	11.9	16.5	22.5

The NPV results based on the aforementioned nine-year analytical period are presented in Table V.15. The impacts are counted over the lifetime of equipment purchased in 2019–2027. As mentioned previously, this information is presented for informational purposes only and is not indicative of any change in DOE's analytical methodology or decision criteria.

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

TABLE V.15—NET PRESENT VALUE OF CUSTOMER BENEFITS FOR SMALL, LARGE, AND VERY LARGE AIR-COOLED COMMERCIAL PACKAGE AIR CONDITIONING AND HEATING EQUIPMENT TRIAL STANDARD LEVELS FOR UNITS SOLD IN 2019–2027

Equipment class	Discount rate %	Trial standard level			
		1	2	3	4
		billion 2013$			
Small Commercial Packaged Air Conditioners—≥65,000 Btu/h and <135,000 Btu/h Cooling Capacity	3	2.1	5.0	6.3	8.2
Large Commercial Packaged Air Conditioners—≥135,000 Btu/h and <240,000 Btu/h Cooling Capacity		0.9	1.7	2.4	3.7
Very Large Commercial Packaged Air Conditioners—≥240,000 Btu/h and <760,000 Btu/h Cooling Capacity		0.4	0.8	1.4	1.7
Small Commercial Packaged Heat Pumps—≥65,000 Btu/h and <135,000 Btu/h Cooling Capacity		0.2	0.6	0.9	1.0
Large Commercial Packaged Heat Pumps—≥135,000 Btu/h and <240,000 Btu/h Cooling Capacity		0.0	0.1	0.1	0.2
Very Large Commercial Packaged Heat Pumps—≥240,000 Btu/h and <760,000 Btu/h Cooling Capacity		0.0	0.0	0.1	0.1
Total All Classes		3.7	8.3	11.3	14.9
Small Commercial Packaged Air Conditioners—≥65,000 Btu/h and <135,000 Btu/h Cooling Capacity	7	1.1	2.7	3.3	4.1
Large Commercial Packaged Air Conditioners—≥135,000 Btu/h and <240,000 Btu/h Cooling Capacity		0.4	0.7	1.0	1.7
Very Large Commercial Packaged Air Conditioners—≥240,000 Btu/h and <760,000 Btu/h Cooling Capacity		0.2	0.4	0.7	0.8
Small Commercial Packaged Heat Pumps—≥65,000 Btu/h and <135,000 Btu/h Cooling Capacity		0.1	0.3	0.5	0.5
Large Commercial Packaged Heat Pumps—≥135,000 Btu/h and <240,000 Btu/h Cooling Capacity		0.0	0.0	0.1	0.1
Very Large Commercial Packaged Heat Pumps—≥240,000 Btu/h and <760,000 Btu/h Cooling Capacity		0.0	0.0	0.0	0.0
Total All Classes		1.8	4.1	5.6	7.3

c. Indirect Impacts on Employment

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

The results suggest that the proposed standards are likely to have 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.

4. Impact on Utility or Performance

DOE believes that the standards it is proposing today will not lessen the utility or performance of small, large, and very large air-cooled commercial package air conditioning and heating equipment.

5. Impact of Any Lessening of Competition

DOE considers any lessening of competition that is likely to result from amended standards. The Attorney General determines the impact, if any, of any lessening of competition likely to result from a proposed standard, and transmits such determination to the Secretary, together with an analysis of the nature and extent of such impact.

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

6. Need of the Nation to Conserve Energy

Enhanced energy efficiency, where economically justified, improves the Nation's energy security, strengthens the economy, and reduces the environmental impacts or 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. As a measure of this reduced demand, chapter 15 in the NOPR TSD presents the estimated reduction in generating capacity for the TSLs that DOE considered in this rulemaking.

Energy savings from standards for small, large, and very large air-cooled commercial package air conditioning and heating equipment could also produce environmental benefits in the form of reduced emissions of air pollutants and greenhouse gases associated with electricity production. Table V.16 provides DOE's estimate of cumulative emissions reductions projected to result from the TSLs considered in this rulemaking. For the proposed standards (TSL 3), the upstream emissions reduction accounts for 3 percent of total CO_2 emissions, 48 percent of total NO_X emissions, and 0.3 percent of total SO_2 emissions.[76] DOE reports annual emissions reductions for each TSL in chapter 13 of the NOPR TSD.

TABLE V.16—CUMULATIVE EMISSIONS REDUCTION ESTIMATED FOR SMALL, LARGE, AND VERY LARGE AIR-COOLED COMMERCIAL PACKAGE AIR CONDITIONING AND HEATING EQUIPMENT TRIAL STANDARD LEVELS *

	Trial Standard Level			
	1	2	3	4
Power Sector Emissions				
CO_2 (million metric tons)	262	745	1,049	1,514
NO_X (thousand tons)	129	375	528	767
SO_2 (thousand tons)	725	2,077	2,927	4,232
Hg (tons)	0.88	2.52	3.55	5.13
N_2O (thousand tons)	3.73	10.74	15.13	21.90
CH_4 (thousand tons)	19.2	54.4	76.7	110.6
Upstream Emissions				
CO_4 (million metric tons)	8.98	25.4	35.8	51.5
NO_X (thousand tons)	124	350	492	710
SO_2 (thousand tons)	1.92	5.44	7.66	11.04
Hg (tons)	0.00	0.01	0.02	0.03
N_2 (thousand tons)	0.09	0.25	0.36	0.52
CH_4 (thousand tons)	753	2,127	2,996	4,317
Total Emissions				
CO_2 (million metric tons)	271	770	1,085	1,565
NO_X (thousand tons)	252	725	1,021	1,477
SO_2 (thousand tons)	727	2,083	2,934	4,243
Hg (tons)	0.89	2.53	3.57	5.16
N_2O (thousand tons)	3.82	10.99	15.48	22.41
N_2O (thousand tons CO_2eq) **	1,138	3,275	4,614	6,679
CH_4 (thousand tons)	772	2,181	3,072	4,427
CH_2 (million tons CO_2eq) **	19.3	54.5	76.8	110.7

* The reduction is measured over the period in which equipment purchased in 2019–2048 continue to operate.

** CO_2eq is the quantity of CO_2 that would have the same global warming potential (GWP).

These results are based on emissions factors in *AEO 2013,* the most recent version available at the time of this analysis. Use of emissions factors in AEO 2014 would result in a significant decrease in cumulative emissions reductions for CO_2, SO_2, and Hg. For example, the estimated decrease for CO_2 emissions reductions is 36%. In the next phase of this rulemaking, DOE plans to use emissions factors based on the most recent *AEO* available, which may or may not be *AEO 2014,* depending on the timing of the issuance of the next rulemaking document.

As mentioned in section I, emissions factors based on the *Annual Energy Outlook 2014* (*AEO 2014*), which became available too late for incorporation into this analysis, show a significant decrease in the cumulative emissions reductions from the proposed standards. For CO_2, the emissions reduction at TSL 3, the proposed standards, is 697 Mt rather than 1,085 Mt.

As part of the analysis for this rule, DOE estimated monetary benefits likely to result from the reduced emissions of CO_2 and NO_X that DOE estimated for each of the TSLs considered. As discussed in section IV.L, DOE used the most recent values for the SCC developed by an interagency process. The four sets of SCC values resulting from that process (expressed in 2013$) are represented by $12.0/metric ton (the average value from a distribution that uses a 5-percent discount rate), $40.5/metric ton (the average value from a distribution that uses a 3-percent discount rate), $62.4/metric ton (the average value from a distribution that uses a 2.5-percent discount rate), and $119/metric ton (the 95th-percentile value from a distribution that uses a 3-percent discount rate). These values correspond to the value of emission reductions in 2015; the values for later years are higher due to increasing damages as the projected magnitude of climate change increases.

Table V.17 presents the global value of CO_2 emissions reductions at each TSL. For each of the four cases, DOE calculated a present value of the stream of annual values using the same discount rate as was used in the studies upon which the dollar-per-ton values are based. DOE calculated domestic values as a range from 7 percent to 23 percent of the global values, and these results are presented in chapter 14 of the NOPR TSD.

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[76] The upstream share of the total reduction for NOx is high because power sector emissions are capped in many States and because changes in the projected power plant mix cause NOx emissions to increase in some years under the standards case.

TABLE V.17—ESTIMATES OF GLOBAL PRESENT VALUE OF CO_2 EMISSIONS REDUCTION UNDER SMALL, LARGE, AND VERY LARGE AIR-COOLED COMMERCIAL PACKAGE AIR CONDITIONING AND HEATING EQUIPMENT TRIAL STANDARD LEVELS

TSL	SCC Case*			
	5% discount rate, average*	3% discount rate, average*	2.5% discount rate, average*	3% discount rate, 95th percentile*
	Billion 2013$			
Power Sector Emissions				
1	1.51	7.55	12.17	23.41
2	4.21	21.21	34.25	65.80
3	5.92	29.88	48.24	92.67
4	8.50	42.99	69.45	133.36
Upstream Emissions				
1	0.05	0.26	0.42	0.81
2	0.15	0.73	1.18	2.26
3	0.20	1.03	1.65	3.18
4	0.29	1.47	2.38	4.57
Total Emissions				
1	1.56	7.81	12.59	24.22
2	4.35	21.94	35.43	68.06
3	6.13	30.90	49.90	95.86
4	8.79	44.47	71.83	137.93

* For each of the four cases, the corresponding SCC value for emissions in 2015 is $12.0, $40.5, $62.4, and $119 per metric ton (2013$).[77]

DOE is well aware that scientific and economic knowledge about the contribution of CO_2 and other greenhouse gas (GHG) emissions to changes in the future global climate and the potential resulting damages to the world economy continues to evolve rapidly. Thus, any value placed on reducing CO_2 emissions in this rulemaking is subject to change. DOE, together with other Federal agencies, will continue to review various methodologies for estimating the monetary value of reductions in CO_2 and other GHG emissions. This ongoing review will consider the comments on this subject that are part of the public record for this and other rulemakings, as well as other methodological assumptions and issues. However, consistent with DOE's legal obligations, and taking into account the uncertainty involved with this particular issue, DOE has included in this proposed rule the most recent values and analyses resulting from the interagency process.

DOE also estimated the cumulative monetary value of the economic benefits associated with NO_X emissions reductions anticipated to result from amended standards for small, large, and very large air-cooled commercial package air conditioning and heating equipment. The dollar-per-ton values that DOE used are discussed in section IV.L. Table V.18 presents the cumulative present values for each TSL calculated using seven-percent and three-percent discount rates.

TABLE V.18—ESTIMATES OF PRESENT VALUE OF NO_X EMISSIONS REDUCTION UNDER SMALL, LARGE, AND VERY LARGE AIR-COOLED COMMERCIAL PACKAGE AIR CONDITIONING AND HEATING EQUIPMENT TRIAL STANDARD LEVELS[78]

TSL	3% discount rate	7% discount rate
	Million 2013$	
Power Sector Emissions		
1	128	36.7
2	369	105.5
3	520	148
4	753	215
Upstream Emissions		
1	139	52.0
2	384	138
3	540	194

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[77] These results are based on emissions factors in *AEO 2013,* the most recent version available at the time of this analysis. Use of emissions factors in AEO 2014 would result in a significant decrease in cumulative emissions reductions for CO_2, SO_2, and Hg. For example, the estimated decrease for CO_2 emissions reductions is 36%. The monetized benefits from GHG reductions would likely decrease by a comparable amount. In the next phase of this rulemaking, DOE plans to use emissions factors based on the most recent *AEO* available, which may or may not be *AEO 2014,* depending on the timing of the issuance of the next rulemaking document.

TABLE V.18—ESTIMATES OF PRESENT VALUE OF NO_X EMISSIONS REDUCTION UNDER SMALL, LARGE, AND VERY LARGE AIR-COOLED COMMERCIAL PACKAGE AIR CONDITIONING AND HEATING EQUIPMENT TRIAL STANDARD LEVELS[78]—Continued

TSL	3% discount rate	7% discount rate
4	773	275
Total Emissions		
1	267	88.7
2	753	243
3	1060	343
4	1527	490

7. Summary of National Economic Impacts

The NPV of the monetized benefits associated with emissions reductions can be viewed as a complement to the NPV of the customer savings calculated for each TSL considered in this rulemaking. Table V.19 presents the NPV values that result from adding the estimates of the potential economic benefits resulting from reduced CO_2 and NO_X emissions in each of four valuation scenarios to the NPV of customer savings calculated for each TSL considered in this rulemaking, at both a seven-percent and three-percent discount rate. The CO_2 values used in the columns of each table correspond to the four sets of SCC values discussed above.

TABLE V.19—NET PRESENT VALUE OF CUSTOMER SAVINGS COMBINED WITH PRESENT VALUE OF MONETIZED BENEFITS FROM CO_2 AND NO_X EMISSIONS REDUCTIONS

TSL	Customer NPV at 3% discount rate added with:			
	SCC Case \$12.0/metric ton CO_2*	SCC Case \$40.5/metric ton CO_2*	SCC Case \$62.4/metric ton CO_2*	SCC Case \$119/metric ton CO_2*
	Billion 2013$			
1	16.0	22.5	27.2	39.1
2	41.3	59.5	73.0	106.3
3	57.2	82.8	101.8	148.6
4	80.1	117.0	144.4	211.7
TSL	Customer NPV at 7% Discount Rate added with:			
	SCC Case \$12.0/metric ton CO_2*	SCC Case \$40.5/metric ton CO_2*	SCC Case \$62.4/metric ton CO_2*	SCC Case \$119/metric ton CO_2*
	Billion 2013$			
1	6.4	12.7	17.5	29.2
2	16.3	34.1	47.6	80.4
3	22.7	47.8	66.8	113.0
4	31.4	67.5	94.8	161.3

* These label values represent the global SCC in 2015, in 2013$. For NO_X emissions, each case uses the medium value, which corresponds to \$2,684 per ton.[79]

Although adding the value of customer savings to the values of emission reductions provides a valuable perspective, two issues should be considered. First, the national operating cost savings are domestic U.S. customer monetary savings that occur as a result of market transactions, while the value of CO_2 reductions is based on a global value. Second, the assessments of operating cost savings and the SCC are performed with different methods that use different time frames for analysis. The national operating cost savings is measured for the lifetime of equipment shipped in 2019–2048. The SCC values, on the other hand, reflect the present value of future climate-related impacts resulting from the emission of one metric ton of CO_2 in each year. These impacts continue well beyond 2100.

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[78] These results are based on emissions factors in *AEO 2013,* the most recent version available at the time of this analysis. Use of emissions factors in AEO 2014 would result in a significant decrease in cumulative emissions reductions for CO_2, SO_2, and Hg. For example, the estimated decrease for CO_2 emissions reductions is 36%. In the next phase of this rulemaking, DOE plans to use emissions factors based on the most recent *AEO* available, which may or may not be *AEO 2014,* depending on the timing of the issuance of the next rulemaking document.

[79] These results are based on emissions factors in *AEO 2013,* the most recent version available at the time of this analysis. Use of emissions factors in AEO 2014 would result in a significant decrease in cumulative emissions reductions for CO_2, SO_2, and Hg. For example, the estimated decrease for CO_2 emissions reductions is 36%. The monetized benefits from GHG reductions would likely decrease by a comparable amount. In the next phase of this rulemaking, DOE plans to use emissions factors based on the most recent *AEO* available, which may or may not be *AEO 2014,* depending on the timing of the issuance of the next rulemaking document.

8. 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. 6313(a)(6)(B)(ii)(VII)) No other factors were considered in this analysis.

C. Proposed Standards

To adopt national standards more stringent than the amended ASHRAE/IES Standard 90.1 for small, large, and very large air-cooled CUAC and CUHP, DOE must determine that such action would result in significant additional conservation of energy and is technologically feasible and economically justified. (42 U.S.C. 6313(a)(6)(A)(ii)). As discussed previously, EPCA provides seven factors to be evaluated in determining whether a more stringent standard for small, large, and very large air-cooled CUAC and CUHP is economically justified. (42 U.S.C. 6313(a)(6)(B)(ii)).

For this NOPR, DOE considered the impacts of standards at each TSL, beginning with the most energy-efficient level, to determine whether that level was economically justified. Where the most energy-efficient 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 technologically feasible, economically justified and saves a significant amount of energy.

To aid the reader in understanding the benefits and/or burdens of each TSL, tables in this section summarize the quantitative analytical results for each TSL, based on the assumptions and methodology discussed herein. The efficiency levels contained in each TSL are described in section V.A. In addition to the quantitative results presented in the tables, DOE also considers other burdens and benefits that affect economic justification. These include the impacts on identifiable subgroups of customers who may be disproportionately affected by a national standard (see section V.B.1.b), and impacts on employment. DOE discusses the impacts on employment in small, large, and very large air-cooled commercial package air conditioning and heating equipment manufacturing in section V.B.2, and discusses the indirect employment impacts in section V.B.3.c.

1. Benefits and Burdens of Trial Standard Levels Considered for Small, Large, and Very Large Air-Cooled Commercial Package Air Conditioning and Heating Equipment

Table V.20 and Table V.21 summarize the quantitative impacts estimated for each TSL for small, large, and very large air-cooled commercial package air conditioning and heating equipment.

TABLE V.20—SUMMARY OF ANALYTICAL RESULTS FOR SMALL, LARGE, AND VERY LARGE AIR-COOLED COMMERCIAL PACKAGE AIR CONDITIONING AND HEATING EQUIPMENT: NATIONAL IMPACTS [80]

Category	TSL 1	TSL 2	TSL 3	TSL 4
National FFC Energy Savings quads				
	3.0	8.4	11.8	17.1
NPV of Customer Benefits 2013$ billion				
3% discount rate	14.4	36.9	50.8	71.0
7% discount rate	4.8	11.9	16.5	22.5
Cumulative Emissions Reduction (Total FFC Emissions)				
CO_2 *million metric tons*	271	770	1,085	1,565
NO_X *thousand tons*	252	725	1,021	1,477
SO_2 *thousand tons*	727	2,083	2,934	4,243
Hg *tons*	0.89	2.53	3.57	5.16
N_2O *thousand tons*	3.82	10.99	15.48	22.41
N_2O *thousand tons* CO_2eq *	1,138	3,275	4,614	6,679
CH_4 *thousand tons*	772	2,181	3,072	4,427
CH_4 *million tons* CO_2*eq**	19.3	54.5	76.8	110.7
Value of Emissions Reduction (Total FFC Emissions)				
CO_2 *2013$ billion***	1.56 to 24.2	4.35 to 68.1	6.13 to 95.9	8.79 to 138
NO_X—3% discount rate *2013$ million*	267	753	1060	1,527
NO_X—7% discount rate *2013$ million*	88.7	243	343	490

* CO_2eq is the quantity of CO_2 that would have the same global warming potential (GWP).

** Range of the economic value of CO_2 reductions is based on estimates of the global benefit of reduced CO_2 emissions.

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[80] These results are based on emissions factors in *AEO 2013,* the most recent version available at the time of this analysis. Use of emissions factors in AEO 2014 would result in a significant decrease in cumulative emissions reductions for CO_2, SO_2, and Hg. For example, the estimated decrease for CO_2 emissions reductions is 36%. The monetized benefits from GHG reductions would likely decrease by a comparable amount. In the next phase of this rulemaking, DOE plans to use emissions factors based on the most recent *AEO* available, which may or may not be *AEO 2014,* depending on the timing of the issuance of the next rulemaking document.

TABLE V.21—SUMMARY OF ANALYTICAL RESULTS FOR SMALL, LARGE, AND VERY LARGE AIR-COOLED COMMERCIAL PACKAGE AIR CONDITIONING AND HEATING EQUIPMENT: MANUFACTURER AND CONSUMER IMPACTS

Category	TSL 1	TSL 2	TSL 3	TSL 4
Manufacturer Impacts				
Change in Industry NPV (*$ million*) †	(73.89) to (11.45).	(245.30) to (52.87).	(311.58) to (88.55).	(438.16) to (118.13).
Change in Industry NPV (*%*) †	(5.86) to (0.91)	(19.45) to (4.19)	(24.71) to (7.02)	(34.75) to (9.37).
Customer Mean LCC Savings 2013$				
Small Commercial Packaged Air Conditioners—≥65,000 Btu/h and <135,000 Btu/h Cooling Capacity.	1,094	937	4,779	6,711.
Large Commercial Packaged Air Conditioners—≥135,000 Btu/h and <240,000 Btu/h Cooling Capacity.	1,038	2,214	3,469	7,508.
Very Large Commercial Packaged Air Conditioners—≥240,000 Btu/h and <760,000 Btu/h Cooling Capacity.	4,103	4,801	16,477	19,842.
Weighted Average *	1,257	1,472	5,150	7,675.
Customer Median PBP years				
Small Commercial Packaged Air Conditioners—≥65,000 Btu/h and <135,000 Btu/h Cooling Capacity.	2.2	8.0	3.9	4.7.
Large Commercial Packaged Air Conditioners—≥135,000 Btu/h and <240,000 Btu/h Cooling Capacity.	6.0	7.2	6.6	5.1.
Very Large Commercial Packaged Air Conditioners—≥240,000 Btu/h and <760,000 Btu/h Cooling Capacity.	2.6	5.5	2.5	3.5.
Weighted Average *	3.1	7.7	4.5	4.7.
Small CUAC—≥65,000 Btu/h and <135,000 Btu/h: **				
Customers with Net Cost *%*	0%	27%	0%	0%.
Customers with Net Benefit *%*	61%	72%	99%	100%.
Customers with No Impact *%*	39%	1%	0%	0%.
Large CUAC—≥135,000 Btu/h and <240,000 Btu/h: **				
Customers with Net Cost *%*	3%	8%	6%	2%.
Customers with Net Benefit *%*	74%	90%	93%	98%.
Customers with No Impact *%*	22%	2%	0%	0%.
Very Large CUAC—≥240,000 Btu/h and <760,000 Btu/h: **				
Customers with Net Cost (%)	2%	12%	3%	5%.
Customers with Net Benefit (%)	62%	76%	92%	94%.
Customers with No Impact (%)	36%	13%	6%	1%.
Weighted Average: *				
Customers with Net Cost (%)	1%	22%	2%	1%.
Customers with Net Benefit (%)	64%	77%	97%	99%.
Customers with No Impact (%)	35%	2%	0%	0%.

* Weighted by shares of each equipment class in total projected shipments in 2019.
** Rounding may cause some items to not total 100 percent.
† Values in parentheses are negative values.

First, DOE considered TSL 4, the most efficient level (max tech), which would save an estimated total of 17.1 quads of energy, an amount DOE considers significant. TSL 4 has an estimated NPV of customer benefit of $22.5 billion using a 7 percent discount rate, and $70.1 billion using a 3 percent discount rate.

The cumulative emissions reductions at TSL 4 are 11,565 million metric tons of CO_2, 1,477 thousand tons of NO_X, 4,243 thousand tons of SO_2, and 5.16 tons of Hg. The estimated monetary value of the CO_2 emissions reductions at TSL 4 ranges from $9 billion to $138 billion.[81]

At TSL 4, the average LCC savings is $6,711 for small CUAC, $7,508 for large CUAC, and $19,842 for very large CUAC. The median PBP is 4.7 years for small CUAC, 5.1 years for large CUAC, and 3.5 years for very large CUAC. The share of customers experiencing a net LCC benefit is 100 percent for small CUAC, 98 percent for large CUAC, and 94 percent for very large CUAC.

At TSL 4, the projected change in INPV ranges from a decrease of $438.16 million to decrease of $118.13 million. If the larger decrease is realized, TSL 4 could result in a net loss of 34.75 percent in INPV to manufacturers of covered small, large, and very large air-cooled commercial package air conditioning and heating equipment. Conversion costs are expected to total $210.96 million. Only 2% of industry product listings meet this proposed standard today. At this level, DOE recognizes that manufacturers could face technical resource constraints. Manufacturers stated they would require additional engineering expertise and additional test laboratory capacity. It is unclear whether manufacturers could complete the hiring of the necessary technical expertise and construction of the necessary test facilities in time to allow for the redesign of all products to meet max-tech by 2019. Furthermore, DOE

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[81] These results are based on emissions factors in AEO 2013, the most recent version available at the time of this analysis. Use of emissions factors in AEO 2014 would result in a significant decrease in cumulative emissions reductions for CO_2, SO_2, and Hg. For example, the estimated decrease for CO_2 emissions reductions is 36%. The monetized benefits from GHG reductions would likely decrease by a comparable amount. In the next phase of this rulemaking, DOE plans to use emissions factors based on the most recent AEO available, which may or may not be AEO 2014, depending on the timing of the issuance of the next rulemaking document.

recognizes that a standard set at max-tech could greatly limit product differentiation in the small, large, and very large air-cooled CUAC and CUHP market. By commoditizing a key differentiating feature, a standard set a max-tech would likely accelerate consolidation in the industry.

In view of the foregoing, DOE concludes that, at TSL 4 for small, large, and very large air-cooled commercial package air conditioning and heating equipment, the benefits of energy savings, positive NPV of total customer benefits, customer LCC savings, emission reductions and the estimated monetary value of the emissions reductions would be outweighed by the large reduction in industry value at TSL 4. Consequently, DOE has concluded that TSL 4 is not economically justified.

Next, DOE considered TSL 3, which would save an estimated total of 11.8 quads of energy, an amount DOE considers significant. TSL 3 has an estimated NPV of customer benefit of $16.5 billion using a 7 percent discount rate, and $50.8 billion using a 3 percent discount rate.

The cumulative emissions reductions at TSL 3 are 1,085 million metric tons of CO_2, 1,021 thousand tons of NO_X, 2,934 thousand tons of SO_2, and 3.57 tons of Hg. The estimated monetary value of the CO_2 emissions reductions at TSL 4 ranges from $6 billion to $96 billion.[82]

At TSL 3, the average LCC savings is $4,779 for small CUAC, $3,469 for large CUAC, and $16,477 for very large CUAC. The median PBP is 3.9 years for small CUAC, 6.6 years for large CUAC, and 2.5 years for very large CUAC.[83] The share of customers experiencing a net LCC benefit is 99 percent for small CUAC, 93 percent for large CUAC, and 92 percent for very large CUAC.

At TSL 3, the projected change in INPV ranges from a decrease of $311.58 million to decrease of $88.55 million. If the larger decrease is realized, TSL 3 could result in a net loss of 24.71 percent in INPV to manufacturers of covered small, large, and very large air-cooled commercial package air conditioning and heating equipment. Conversion costs are expected to total $120.90 million. 19% of industry product listings meet this standard level today.

After considering the analysis and weighing the benefits and the burdens, DOE has tentatively concluded that at TSL 3 for small, large, and very large air-cooled commercial package air conditioning and heating equipment, the benefits of energy savings, positive NPV of customer benefit, positive impacts on consumers (as indicated by positive average LCC savings, favorable PBPs, and the large percentage of customers who would experience LCC benefits), emission reductions, and the estimated monetary value of the emissions reductions would outweigh the potential reductions in INPV for manufacturers. The Secretary of Energy has concluded that TSL 3 would save a significant amount of energy and is technologically feasible and economically justified.

Based on the above considerations, DOE today proposes to adopt the energy conservation standards for small, large, and very large air-cooled commercial package air conditioning and heating equipment at TSL 3. Table V.22 presents the proposed energy conservation standards for small, large, and very large air-cooled commercial package air conditioning and heating equipment.

TABLE V.22—PROPOSED ENERGY CONSERVATION STANDARDS FOR SMALL, LARGE, AND VERY LARGE AIR-COOLED COMMERCIAL PACKAGE AIR CONDITIONING AND HEATING EQUIPMENT

Equipment type		Heating type	Proposed energy conservation standard
Small Commercial Packaged AC and HP (Air-Cooled)—≥65,000 Btu/h and <135,000 Btu/h Cooling Capacity.	AC	Electric Resistance Heating or No Heating.	14.8 IEER.
		All Other Types of Heating	14.6 IEER.
	HP	Electric Resistance Heating or No Heating.	14.1 IEER.
		All Other Types of Heating	3.5 COP.
Large Commercial Packaged AC and HP (Air-Cooled)—≥135,000 Btu/h and <240,000 Btu/h Cooling Capacity.	AC	Electric Resistance Heating or No Heating.	13.9 IEER.
		All Other Types of Heating	3.4 COP.
	HP	Electric Resistance Heating or No Heating.	14.2 IEER.
		All Other Types of Heating	
Very Large Commercial Packaged AC and HP (Air-Cooled)—≥240,000 Btu/h and <760,000 Btu/h Cooling Capacity.	AC	Electric Resistance Heating or No Heating.	14.0 IEER. 13.4 IEER
		All Other Types of Heating	3.3 COP.
	HP	Electric Resistance Heating or No Heating.	13.2 IEER.
		All Other Types of Heating	3.3 COP.

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[82] These results are based on emissions factors in *AEO 2013,* the most recent version available at the time of this analysis. Use of emissions factors in AEO 2014 would result in a significant decrease in cumulative emissions reductions for CO_2, SO_2, and Hg. For example, the estimated decrease for CO_2 emissions reductions is 36%. The monetized benefits from GHG reductions would likely decrease by a comparable amount. In the next phase of this rulemaking, DOE plans to use emissions factors based on the most recent *AEO* available, which may or may not be *AEO 2014,* depending on the timing of the issuance of the next rulemaking document.

[83] Large CUAC experiences relatively lower LCC savings and longer PBPs than either small and very large CUACs due to the design measures being utilized to achieve higher rated IEER in the Engineering Analysis. In the case of small and very large CUACs, increased efficiency at TSL 3 is attained in large part due to increased compressor staging, which results in significant improvements in part-load performance. In the case of large CUAC, increased efficiency is attained without increasing compressor staging, i.e., the baseline design has the same number of stages as the design at TSL 3. Although the other design measures for large CUAC increase the rated IEER of the product, part-load performance is not impacted significantly. Because CUAC equipment operates frequently in part-load, the TSL 3 design for large CUAC results in annual energy savings and operating cost savings that are lower relative to what is attained with the designs for the small and very large CUACs.

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

The benefits and costs of today's proposed standards, for equipment sold in 2019–2048, can also be expressed in terms of annualized values. The annualized monetary values are the sum of (1) the annualized national economic value of the benefits from consumer operation of equipment that meet the proposed standards (consisting primarily of operating cost savings from using less energy, minus increases in equipment purchase and installation costs, which is another way of representing consumer NPV), and (2) the annualized monetary value of the benefits of emission reductions, including CO_2 emission reductions.[84]

Although combining the values of operating savings and CO_2 emission reductions provides a useful perspective, two issues should be considered. First, the national operating savings are domestic U.S. customer monetary savings that occur as a result of market transactions while the value of CO_2 reductions is based on a global value. Second, the assessments of operating cost savings and CO_2 savings are performed with different methods that use different time frames for analysis. The national operating cost savings is measured for the lifetime of small, large, and very large air-cooled commercial package air conditioning and heating equipment shipped in 2019–2048. The SCC values, on the other hand, reflect the present value of some future climate-related impacts resulting from the emission of one ton of carbon dioxide in each year. These impacts continue well beyond 2100.

Estimates of annualized benefits and costs of the proposed standards for small, large, and very large air-cooled commercial package air conditioning and heating equipment are shown in Table V.23. The results under the primary estimate are as follows. Using a 7-percent discount rate for benefits and costs other than CO_2 reduction, for which DOE used a 3-percent discount rate along with the average SCC series that uses a 3-percent discount rate, the cost of the standards proposed in this rule is $430 million per year in increased equipment costs; while the estimated benefits are $2,177 million per year in reduced equipment operating costs, $1,744 million in CO_2 reductions, and $36.2 million in reduced NO_X emissions. In this case, the net benefit would amount to $3,558 million per year. Using a 3-percent discount rate for all benefits and costs and the average SCC series, the estimated cost of the standards proposed in this rule is $507 million per year in increased equipment costs; while the estimated benefits are $3,426 million per year in reduced operating costs, $1,774 million in CO_2 reductions, and $60.9 million in reduced NO_X emissions. In this case, the net benefit would amount to approximately $4,755 million per year.[85]

TABLE V.23—ANNUALIZED BENEFITS AND COSTS OF PROPOSED STANDARDS FOR SMALL, LARGE, AND VERY LARGE AIR-COOLED COMMERCIAL PACKAGE AIR CONDITIONING AND HEATING EQUIPMENT

	Discount rate	Primary estimate *	Low net benefits estimate *	High net benefits estimate *
	million 2013$/year			
Benefits				
Operating Cost Savings	7%	2,177	1,984	2,407
	3%	3,426	3,127	3,781
CO_2 Reduction Monetized Value ($12.0/t case) **.	5%	484	467	505
CO_2 Reduction Monetized Value ($40.5/t case) **.	3%	1,774	1,714	1,846
CO_2 Reduction Monetized Value ($62.4/t case) **.	2.5%	2,632	2,543	2,737
CO_2 Reduction Monetized Value ($119/t case) **.	3%	5,504	5,317	5,727
NO_X Reduction Monetized Value (at $2,684/ton) **.	7%	36.18	34.75	37.90
	3%	60.89	58.85	63.40
Total Benefits †	7% plus CO_2 range	2,698 to 7,718	2,486 to 7,336	2,950 to 8,172
	7%	3,988	3,733	4,291
	3% plus CO_2 range	3,972 to 8,991	3,653 to 8,503	4,349 to 9,572
	3%	5,262	4,900	5,691
Costs				
Incremental Product Costs	7%	430	350	485
	3%	507	433	550

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[84] DOE used a two-step calculation process to convert the time-series of costs and benefits into annualized values. First, DOE calculated a present value in 2013, the year used for discounting the NPV of total customer costs and savings, for the time-series of costs and benefits using discount rates of three and seven percent for all costs and benefits except for the value of CO_2 reductions. For the latter, DOE used a range of discount rates. From the present value, DOE then calculated the fixed annual payment over a 30-year period (2019 through 2048) that yields the same present value. The fixed annual payment is the annualized value. Although DOE calculated annualized values, this does not imply that the time-series of cost and benefits from which the annualized values were determined is a steady stream of payments.

[85] These results are based on emissions factors in *AEO 2013,* the most recent version available at the time of this analysis. Use of emissions factors in AEO 2014 would result in a significant decrease in cumulative emissions reductions for CO_2, SO_2, and Hg. For example, the estimated decrease for CO_2 emissions reductions is 36%. The monetized benefits from GHG reductions would likely decrease by a comparable amount. In the next phase of this rulemaking, DOE plans to use emissions factors based on the most recent *AEO* available, which may or may not be *AEO 2014,* depending on the timing of the issuance of the next rulemaking document.

TABLE V.23—ANNUALIZED BENEFITS AND COSTS OF PROPOSED STANDARDS FOR SMALL, LARGE, AND VERY LARGE AIR-COOLED COMMERCIAL PACKAGE AIR CONDITIONING AND HEATING EQUIPMENT—Continued

	Discount rate	Primary estimate *	Low net benefits estimate *	High net benefits estimate *
Net Benefits				
Total †	7% plus CO_2 range 7% 3% 3% plus CO_2 range	2,268 to 7,288 3,558 4,755 3,465 to 8,484	2,135 to 6,986 3,383 4,468 3,220 to 8,071	2,465 to 7,687 3,806 5,140 3,799 to 9,021

* This table presents the annualized costs and benefits associated with small, large, and very large air-cooled CUAC and CUHP shipped in 2019–2048. These results include benefits to customers which accrue after 2048 from the products purchased in 2019–2048. The results account for the incremental variable and fixed costs incurred by manufacturers due to the standard, some of which may be incurred in preparation for the rule. The Primary, Low Benefits, and High Benefits Estimates utilize projections of energy prices from the *AEO2013* Reference case, Low Economic Growth case, and High Economic Growth case, respectively. In addition, incremental product costs reflect no change for projected product price trends in the Primary Estimate, an increasing trend for projected product prices in the Low Benefits Estimate, and a decreasing trend for projected product prices in the High Benefits Estimate. The methods used to derive projected price trends are explained in section IV.F.

** The CO_2 values represent global monetized values of the SCC, in 2013$, in 2015 under several scenarios of the updated SCC values. The first three cases use the averages of SCC distributions calculated using 5%, 3%, and 2.5% discount rates, respectively. The fourth case represents the 95th percentile of the SCC distribution calculated using a 3% discount rate. The SCC time series incorporate an escalation factor. The value for NO_X is the average of the low and high values used in DOE's analysis.[86]

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

VI. Procedural Issues and Regulatory Review

A. Review Under Executive Orders 12866 and 13563

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

(1) There is a lack of customer information in the commercial space conditioning market, and the high costs of gathering and analyzing relevant information leads some customers to miss opportunities to make cost-effective investments in energy efficiency.

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

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

The proposed standards address these issues by setting minimum levels of energy efficiency, which remove from the market equipment that might be purchased by poorly informed customers or by customers who would not be paying the costs of operating the equipment. In the process of so doing, DOE assembles, analyzes, and receives informed comment on a large quantity of information that indicates that most customers would be better off purchasing equipment that meets the standards rather than less-efficient equipment. In cases in which the user of the equipment is not able to make the purchase decision, the standards help to ameliorate the problem of misaligned incentives between purchasers and users. Finally, the standards account to some extent for externalities that are not represented in market transactions.

In addition, DOE has determined that this regulatory action is an ''economically significant regulatory action'' under section 3(f)(1) (''significant regulatory action'') of Executive Order 12866, as it has an annual effect on the economy of 100 million or more. Accordingly, section 6(a)(3) of the Executive Order requires that DOE prepare a regulatory impact analysis (RIA) on this rule and that the Office of Information and Regulatory Affairs (OIRA) in the Office of Management and Budget (OMB) review this rule. DOE presented to OIRA for review the draft rule and other documents prepared for this rulemaking, including the RIA, and has included these documents in the rulemaking record. The assessments prepared pursuant to Executive Order 12866 can be found in the technical support document for this rulemaking.

DOE has also reviewed this proposal pursuant to Executive Order 13563, issued on January 18, 2011. 76 FR 3281 (Jan. 21, 2011). EO 13563 is supplemental to and explicitly reaffirms the principles, structures, and definitions governing regulatory review established in Executive Order 12866. To the extent permitted by law, agencies are required by Executive Order 13563 to: (1) propose or adopt a regulation only upon a reasoned determination that its benefits justify its costs (recognizing that some benefits and costs are difficult to quantify); (2) tailor regulations to impose the least burden on society, consistent with obtaining regulatory objectives, taking into account, among other things, and to the extent practicable, the costs of cumulative regulations; (3) select, in choosing among alternative regulatory approaches, those approaches that maximize net benefits (including potential economic, environmental, public health and safety, and other advantages; distributive impacts; and equity); (4) to the extent feasible, specify performance objectives, rather than specifying the behavior or manner of compliance that regulated entities must adopt; and (5) identify and assess

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[86] These results are based on emissions factors in *AEO 2013,* the most recent version available at the time of this analysis. Use of emissions factors in AEO 2014 would result in a significant decrease in cumulative emissions reductions for CO_2, SO_2, and Hg. For example, the estimated decrease for CO_2 emissions reductions is 36%. In the next phase of this rulemaking, DOE plans to use emissions factors based on the most recent *AEO* available, which may or may not be *AEO 2014,* depending on the timing of the issuance of the next rulemaking document.

available alternatives to direct regulation, including providing economic incentives to encourage the desired behavior, such as user fees or marketable permits, or providing information upon which choices can be made by the public.

DOE emphasizes as well that Executive Order 13563 requires agencies to use the best available techniques to quantify anticipated present and future benefits and costs as accurately as possible. In its guidance, the Office of Information and Regulatory Affairs has emphasized that such techniques may include identifying changing future compliance costs that might result from technological innovation or anticipated behavioral changes. (DOE also discusses cumulative regulatory burdens above in section V.B.2.e.) For the reasons stated in the preamble, DOE believes that this NOPR is consistent with these principles, including the requirement that, to the extent permitted by law, benefits justify costs and that net benefits are maximized.

B. Review Under the Regulatory Flexibility Act

The Regulatory Flexibility Act (5 U.S.C. 601 *et seq.*) requires preparation of 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 Executive Order 13272, ''Proper Consideration of Small Entities in Agency Rulemaking,'' 67 FR 53461 (August 16, 2002), DOE published procedures and policies on February 19, 2003, to ensure that the potential impacts of its rules on small entities are properly considered during the rulemaking process. 68 FR 7990. DOE has made its procedures and policies available on the Office of the General Counsel's Web site (*http://energy.gov/gc/office-general-counsel*). DOE has prepared the following IRFA for the products that are the subject of this rulemaking.

For manufacturers of small, large, and very large air-cooled CUAC and CUHP, the Small Business Administration (SBA) has set a size threshold, which defines those entities classified as ''small businesses'' for the purposes of the statute. DOE used the SBA's small business size standards to determine whether any small entities would be subject to the requirements of the rule. 65 FR 30836, 30848 (May 15, 2000), as amended at 65 FR 53533, 53544 (Sept. 5, 2000) and codified at 13 CFR part 121. The size standards are listed by North American Industry Classification System (NAICS) code and industry description and are available at *http://www.sba.gov/category/navigation-structure/contracting/contracting-officials/small-business-size-standards.* Manufacturing of small, large, and very large air-cooled CUAC and CUHP is classified under NAICS 333415, ''Air-Conditioning and Warm Air Heating Equipment and Commercial and Industrial Refrigeration Equipment Manufacturing.'' The SBA sets a threshold of 750 employees or less for an entity to be considered as a small business for this category.

1. Description and Estimated Number of Small Entities Regulated

To estimate the number of companies that could be small business manufacturers of equipment covered by this rulemaking, DOE conducted a market survey using available public information to identify potential small manufacturers. DOE's research involved examining industry trade association membership directories (including AHRI), public databases (*e.g.,* AHRI Directory,[87] the California Energy Commission Appliance Efficiency Database[88]), individual company Web sites, and market research tools (*e.g.,* Hoovers reports) to create a list of companies that manufacture or sell products covered by this rulemaking. DOE also asked stakeholders and industry representatives if they were aware of any other small manufacturers during manufacturer interviews and at DOE public meetings. DOE reviewed publicly-available data and contacted select companies on its list, as necessary, to determine whether they met the SBA's definition of a small business manufacturer of covered commercial packaged air conditioners. DOE screened out companies that do not offer products covered by this rulemaking, do not meet the definition of a ''small business,'' or are foreign owned and operated.

DOE initially identified at least 13 potential manufacturers of commercial packaged air conditioners sold in the U.S. DOE then determined that 10 were large manufacturers, manufacturers that are foreign owned and operated, or manufacturers that do not produce products covered by this rulemaking. DOE was able to determine that 3 manufacturers meet the SBA's definition of a ''small business'' and manufacture products covered by this rulemaking.

Before issuing this NOPR, DOE spoke with two of the small business manufacturers of commercial packaged air conditioners. DOE also obtained information about small business impacts while interviewing large manufacturers.

Based on DOE's research, one small manufacturer focused exclusively on the design and specification of equipment—but had no production assets of its own. All production was outsourced. The other small manufacturers performed all design and specification work but also owned domestic production facilities and employed production workers.

Issue 23: DOE requests additional information on the number of small businesses in the industry, the names of those small businesses, and their role in the market.

2. Description and Estimate of Compliance Requirements

The proposed standards for commercial packaged air conditioners could cause small manufacturers to be at a disadvantage relative to large manufacturers. One way in which small manufacturers could be at a disadvantage is that they may be disproportionately affected by product conversion costs. Product redesign, testing, and certification costs tend to be fixed and do not scale with sales volume. For each product model, small businesses must make investments in research and development to redesign their products, but because they have lower sales volumes, they must spread these costs across fewer units. Moreover, smaller manufacturers may experience higher testing costs relative to larger manufacturers as they may not possess their own test facility and therefore must outsource all testing at a higher per unit cost. In general, the small manufacturers had a number of equipment lines that was similar to that of larger competitors with similar market share. However, because small manufacturers have fewer engineers than large manufacturers, they may have greater difficulty bringing their portfolio of equipment in-line with an amended energy conservation standard within the allotted timeframe or may have to divert engineering resources from customer and new product initiatives for a longer period of time.

Furthermore, smaller manufacturers may lack the purchasing power of larger manufacturers. For example, since motor suppliers give discounts to manufacturers based on the number of motors they purchase, larger manufacturers may have a purchasing and pricing advantage because their higher volume demands. This

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[87] See *www.ahridirectory.org/ahriDirectory/pages/home.aspx.*

[88] See *http://www.energy.ca.gov/appliances/.*

purchasing power differential between high-volume and low-volume orders applies to other commercial packaged air conditioner components as well.

In order to meet the proposed standard, manufacturers may have to seek outside capital to cover expenses related to testing and product design equipment. Smaller firms typically have a higher cost of borrowing due to higher risk on the part of investors, largely attributed to lower cash flows and lower per unit profitability. In these cases, small manufacturers may observe higher costs of debt than larger manufacturers.

To estimate how small manufacturers would be potentially impacted, DOE compared required conversion costs at each TSL for a small manufacturer with on-site production and an average large manufacturer (see Table VI.1 and Table VI.2). In the following tables, TSL 3 represents the proposed standard.

TABLE VI.1—IMPACTS OF CONVERSION COSTS ON A SMALL MANUFACTURER

	Capital conversion cost as a percentage of annual capital expenditures	Product conversion cost as a percentage of annual R&D expense	Total conversion cost as a percentage of annual revenue	Total conversion cost as a percentage of annual EBIT
TSL 1	122	526	14	159
TSL 2	199	932	24	276
TSL 3	407	1948	49	573
TSL 4	430	3369	77	896

TABLE VI.2—IMPACTS OF CONVERSION COSTS ON A LARGE MANUFACTURER

	Capital conversion cost as a percentage of annual capital expenditures	Product conversion cost as a percentage of annual R&D expense	Total conversion cost as a percentage of annual revenue	Total conversion cost as a percentage of annual EBIT
TSL 1	42	213	5	62
TSL 2	105	287	9	100
TSL 3	279	536	19	216
TSL 4	310	898	26	307

At TSL 3, the level proposed in this NOPR, DOE estimates capital conversion costs of $2.32 million and product conversion costs of $7.04 million for an average small manufacturer that owns production facilities, compared to capital conversion costs of $9.08 million and product conversion costs of $11.05 million for an average large manufacturer.

At these levels, the amended standard could contribute to the consolidation of the industry. As noted in section V.B.2.a, the GRIM free cash flow results indicated that some manufacturers may need to access the capital markets in order to fund conversion costs directly related to an amended standard. These conversion costs would continue to be borne by the identified small manufacturers in spite of any outsourcing of manufacturing activities because they must still incur the necessary product conversion costs to design, test, certify, and market equipment complying with any new standards that DOE may promulgate. Given that small manufacturers tend to have less access to capital and that the necessary conversion costs are high relative to the size of a small business, it is possible the small manufacturers will choose to leave the industry or choose to be purchased by or merged with larger market players.

Since the proposed standard could cause small manufacturers to be at a disadvantage relative to large manufacturers, DOE cannot certify that the proposed standards would not have a significant impact on a significant number of small businesses, and consequently, DOE has prepared this IRFA analysis.

Issue 24: DOE requests data on the cost of capital for small manufacturers to better quantify how small manufacturers might be disadvantaged relative to large competitors.

Issue 25: DOE requests comment and data on the impact of the proposed standard on small business manufacturers, including any potential cumulative regulatory effects.

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

DOE is not aware of any rules or regulations that duplicate, overlap, or conflict with the rule being considered today.

4. Significant Alternatives to the Rule

The discussion above analyzes impacts on small businesses that would result from DOE's proposed rule. In addition to the other TSLs being considered, the proposed rulemaking TSD includes a regulatory impact analysis that discusses the following policy alternatives: (1) Consumer rebates; (2) consumer tax credits; (3) manufacturer tax credits; (4) voluntary energy efficiency targets; and (5) bulk government purchases. While these alternatives may mitigate to some varying extent the economic impacts on small entities compared to the standards, DOE determined that the energy savings of these alternatives are significantly smaller than those that would be expected to result from adoption of the proposed standard levels. Accordingly, DOE is declining to adopt any of these alternatives and is proposing the standards set forth in this rulemaking. (See chapter 17 of the NOPR TSD for further detail on the policy alternatives DOE considered.)

Issue 26: DOE request input on regulatory alternatives to consider that would lessen the impact of the rulemaking on small business.

C. Review Under the Paperwork Reduction Act

Manufacturers of small, large, and very large air-cooled commercial package air conditioning and heating equipment must certify to DOE that their products comply with any applicable energy conservation standards. In certifying compliance, manufacturers must test their products according to the DOE test procedures for small, large, and very large air-cooled commercial package air conditioning and heating equipment, including any amendments adopted for those test procedures. DOE has established regulations for the certification and recordkeeping requirements for all covered consumer products and commercial equipment, including small, large, and very large air-cooled commercial package air conditioning and heating equipment. 76 FR 12422 (March 7, 2011). The collection-of-information requirement for the certification and recordkeeping is subject to review and approval by OMB under the Paperwork Reduction Act (PRA). This requirement has been approved by OMB under OMB control number 1910–1400. Public reporting burden for the certification is estimated to average 20 hours per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information.

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

D. Review Under the National Environmental Policy Act of 1969

Pursuant to the National Environmental Policy Act (NEPA) of 1969, DOE has determined that the proposed rule fits within the category of actions included in Categorical Exclusion (CX) B5.1 and otherwise meets the requirements for application of a CX. See 10 CFR Part 1021, App. B, B5.1(b); 1021.410(b) and Appendix B, B(1)–(5). The proposed rule fits within the category of actions under CX B5.1 because it is a rulemaking that establishes energy conservation standards for consumer products or industrial equipment, and for which none of the exceptions identified in CX B5.1(b) apply. Therefore, DOE has made a CX determination for this rulemaking, and DOE does not need to prepare an Environmental Assessment or Environmental Impact Statement for this proposed rule. DOE's CX determination for this proposed rule is available at *http://cxnepa.energy.gov/.*

E. Review Under Executive Order 13132

Executive Order 13132, ''Federalism'' 64 FR 43255 (Aug. 10, 1999), imposes certain requirements on Federal agencies formulating and implementing policies or regulations that preempt State law or that have Federalism implications. The Executive Order requires agencies to examine the constitutional and statutory authority supporting any action that would limit the policymaking discretion of the States and to carefully assess the necessity for such actions. The Executive Order also requires agencies to have an accountable process to ensure meaningful and timely input by State and local officials in the development of regulatory policies that have Federalism implications. On March 14, 2000, DOE published a statement of policy describing the intergovernmental consultation process it will follow in the development of such regulations. 65 FR 13735. EPCA governs and prescribes Federal preemption of State regulations as to energy conservation for the products that are the subject of this proposed rule. States can petition DOE for exemption from such preemption to the extent, and based on criteria, set forth in EPCA. (42 U.S.C. 6297) No further action is required by Executive Order 13132.

F. Review Under Executive Order 12988

With respect to the review of existing regulations and the promulgation of new regulations, section 3(a) of Executive Order 12988, ''Civil Justice Reform,'' imposes on Federal agencies the general duty to adhere to the following requirements: (1) Eliminate drafting errors and ambiguity; (2) write regulations to minimize litigation; and (3) provide a clear legal standard for affected conduct rather than a general standard and promote simplification and burden reduction. 61 FR 4729 (Feb. 7, 1996). Section 3(b) of Executive Order 12988 specifically requires that Executive agencies make every reasonable effort to ensure that the regulation: (1) Clearly specifies the preemptive effect, if any; (2) clearly specifies any effect on existing Federal law or regulation; (3) provides a clear legal standard for affected conduct while promoting simplification and burden reduction; (4) specifies the retroactive effect, if any; (5) adequately defines key terms; and (6) addresses other important issues affecting clarity and general draftsmanship under any guidelines issued by the Attorney General. Section 3(c) of Executive Order 12988 requires Executive agencies to review regulations in light of applicable standards in section 3(a) and section 3(b) to determine whether they are met or it is unreasonable to meet one or more of them. DOE has completed the required review and determined that, to the extent permitted by law, this proposed rule meets the relevant standards of Executive Order 12988.

G. Review Under the Unfunded Mandates Reform Act of 1995

Title II of the Unfunded Mandates Reform Act of 1995 (UMRA) requires each Federal agency to assess the effects of Federal regulatory actions on State, local, and Tribal governments and the private sector. Public Law 104–4, sec. 201 (codified at 2 U.S.C. 1531). For a proposed regulatory action likely to result in a rule that may cause the expenditure by State, local, and Tribal governments, in the aggregate, or by the private sector of $100 million or more in any one year (adjusted annually for inflation), section 202 of UMRA requires a Federal agency to publish a written statement that estimates the resulting costs, benefits, and other effects on the national economy. (2 U.S.C. 1532(a), (b)) The UMRA also requires a Federal agency to develop an effective process to permit timely input by elected officers of State, local, and Tribal governments on a proposed ''significant intergovernmental mandate,'' and requires an agency plan for giving notice and opportunity for timely input to potentially affected small governments before establishing any requirements that might significantly or uniquely affect small governments. On March 18, 1997, DOE published a statement of policy on its process for intergovernmental consultation under UMRA. 62 FR 12820. DOE's policy statement is also available at *http://energy.gov/gc/office-general-counsel.*

Although this proposed rule does not contain a Federal intergovernmental mandate, it may require expenditures of $100 million or more on the private sector. Specifically, the proposed rule will likely result in a final rule that could require expenditures of $100 million or more. Such expenditures may include: (1) Investment in research and development and in capital expenditures by small, large, and very large air-cooled commercial package air conditioning and heating equipment 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 small, large, and very large air-cooled commercial package air conditioning and heating equipment, 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 the NOPR and the ''Regulatory Impact

Analysis'' section of the TSD for this proposed rule respond to those requirements.

Under section 205 of UMRA, the Department is obligated to identify and consider a reasonable number of regulatory alternatives before promulgating a rule for which a written statement under section 202 is required. 2 U.S.C. 1535(a). DOE is required to select from those alternatives the most cost-effective and least burdensome alternative that achieves the objectives of the proposed rule unless DOE publishes an explanation for doing otherwise, or the selection of such an alternative is inconsistent with law. This proposed rule would establish energy conservation standards for small, large, and very large air-cooled commercial package air conditioning and heating equipment 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 the ''Regulatory Impact Analysis'' section of the TSD for this proposed rule.

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

Section 654 of the Treasury and General Government Appropriations Act, 1999 (Pub. L. 105–277) requires Federal agencies to issue a Family Policymaking Assessment for any rule that may affect family well-being. This rule would not have any impact on the autonomy or integrity of the family as an institution. Accordingly, DOE has concluded that it is not necessary to prepare a Family Policymaking Assessment.

I. Review Under Executive Order 12630

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

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

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

Executive Order 13211, ''Actions Concerning Regulations That Significantly Affect Energy Supply, Distribution, or Use'' 66 FR 28355 (May 22, 2001), requires Federal agencies to prepare and submit to OIRA at OMB, a Statement of Energy Effects for any proposed significant energy action. A ''significant energy action'' is defined as any action by an agency that promulgates or is expected to lead to promulgation of a final rule, and that: (1) Is a significant regulatory action under Executive Order 12866, or any successor order; and (2) is likely to have a significant adverse effect on the supply, distribution, or use of energy, or (3) is designated by the Administrator of OIRA as a significant energy action. For any proposed significant energy action, the agency must give a detailed statement of any adverse effects on energy supply, distribution, or use should the proposal be implemented, and of reasonable alternatives to the action and their expected benefits on energy supply, distribution, and use.

DOE has tentatively concluded that this regulatory action, which sets forth proposed energy conservation standards for small, large, and very large air-cooled commercial package air conditioning and heating equipment, is not a significant energy action because the proposed standards are not likely to have a significant adverse effect on the supply, distribution, or use of energy, nor has it been designated as such by the Administrator at OIRA. Accordingly, DOE has not prepared a Statement of Energy Effects on the proposed rule.

L. Review Under the Information Quality Bulletin for Peer Review

On December 16, 2004, OMB, in consultation with the Office of Science and Technology Policy (OSTP), issued its Final Information Quality Bulletin for Peer Review (the Bulletin). 70 FR 2664 (Jan. 14, 2005). The Bulletin establishes that certain scientific information shall be peer reviewed by qualified specialists before it is disseminated by the Federal Government, including influential scientific information related to agency regulatory actions. The purpose of the bulletin is to enhance the quality and credibility of the Government's scientific information. Under the Bulletin, the energy conservation standards rulemaking analyses are ''influential scientific information,'' which the Bulletin defines as scientific information the agency reasonably can determine will have, or does have, a clear and substantial impact on important public policies or private sector decisions. 70 FR 2667.

In response to OMB's Bulletin, DOE conducted formal in-progress peer reviews of the energy conservation standards development process and analyses and has prepared a Peer Review Report pertaining to the energy conservation standards rulemaking analyses. Generation of this report involved a rigorous, formal, and documented evaluation using objective criteria and qualified and independent reviewers to make a judgment as to the technical/scientific/business merit, the actual or anticipated results, and the productivity and management effectiveness of programs and/or projects. The ''Energy Conservation Standards Rulemaking Peer Review Report'' dated February 2007 has been disseminated and is available at the following Web site: *www.eere.energy.gov/buildings/appliance_standards/peer_review.html.*

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 notice. If you plan to attend the public meeting, please notify Ms. Brenda Edwards at (202) 586–2945 or *brenda.edwards@ee.doe.gov.* As explained in the **ADDRESSES** section, foreign nationals visiting DOE Headquarters are subject to advance security screening procedures.

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 Web site at: *http://www.eere.energy.gov/buildings/appliance_standards/rulemaking.aspx/ruleid/59.* 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 notice. The request and advance copy of statements must be received at least one week before the public meeting and may be emailed, hand-delivered, or sent by mail. DOE prefers to receive requests and advance copies via email. Please include a telephone number to enable DOE staff to make follow-up contact, if needed.

C. Conduct of the Public Meeting

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

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

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

A transcript of the public meeting will be included in the docket, which can be viewed as described in the *Docket* section at the beginning of this notice. 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 notice.

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

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

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

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

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

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

Comments, data, and other information submitted to DOE electronically should be provided in PDF (preferred), Microsoft Word or Excel, WordPerfect, or text (ASCII) file format. Provide documents that are not secured, 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. According to 10 CFR 1004.11, any person submitting information that he or she believes to be confidential and exempt by law from public disclosure should submit via email, postal mail, or hand delivery/courier two well-marked copies: One copy of the document marked confidential including all the information believed to be confidential, and one copy of the document marked non-confidential with the information believed to be confidential deleted. Submit these documents via email or on a CD, if feasible. DOE will make its own determination about the confidential status of the information and treat it according to its determination.

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

It is DOE's policy that all comments may be included in the public docket, 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. Use of the IEER as the cooling efficiency metric and COP as the heating efficiency metric (for CUHP) for the proposed energy conservation standards, including additional data and input regarding the uncertainty of IEER test measurements. (See section III.A of this notice for additional information.)

2. Comment on whether the test procedure for air-cooled CUAC and CUHP should be amended to revise the weightings for the IEER metric to place a higher weighting value on the full-load efficiency. DOE also requests data to determine appropriate weighting factors for the full-load test condition and part-load test conditions (75 percent, 50 percent, and 25 percent of capacity). (See section III.A of this notice for additional information.)

3. DOE requests comments and detailed information regarding any design features, including dual-duct air conditioners, that DOE should consider for establishing separate equipment classes in this rulemaking. DOE requests that such information provide test data illustrating the additional challenges faced by models having such design features and a discussion of the customer utility aspects of the design feature. In particular, DOE requests detailed comments regarding the definition of such equipment classes, and any detailed information, such as test data, test conditions, key component design details, as well as other relevant information (e.g., fan power consumption) that may help DOE evaluate potential alternative equipment class standard levels. See section IV.A.2 of this notice for additional information.)

4. Comment and data regarding additional design options or variants of the considered design options that can increase the range of considered efficiency improvements, including design options that may not yet be found on the market. (See section IV.A.3 of this notice for additional information.)

5. The incremental and max-tech efficiency levels identified for the analyses, including whether the efficiency levels identified by DOE can be achieved using the technologies screened-in during the screening analysis (see section IV.B), and whether higher efficiencies are achievable using technologies that were screened-in during the screening analysis. Also, DOE seeks comment on the approach of extrapolating the efficiency levels from the small, large, and very large CUAC with electric resistance heating or no heating equipment classes to the remaining equipment classes using the IEER differentials in ASHRAE Standard 90.1–2010 draft addendum CL. In addition, input and data on the approach for determining the COP levels for the heat pump equipment classes using the relationship between IEER and COP. (See section IV.C.3 of this for additional information.)

6. Comments, information, and data that would inform adjustment of energy modeling input and/or results that would allow more accurate representation of the energy use impacts of design options using the modeling tools developed by the Center for Environmental Energy Engineering from the University of Maryland College Park. (See section IV.C.4 of this notice for additional information.)

7. Input and data on the estimated incremental manufacturing costs, including the extrapolation of incremental costs for equipment classes not fully analyzed, in particular for heat pump equipment classes. (See section IV.C.4 of this notice for additional information.)

8. Comments, information, and data that could be used to modify the proposed method for using laboratory and modeled IEER test data, which were developed in accordance to AHRI Standard 340/360–2007, to calculate the performance of CUAC equipment at part-load conditions. (See section IV.E.1 of this notice for additional information.)

9. Comments on the use of a "generalized building sample" to characterize the energy consumption of CUAC equipment in the commercial building stock. Specifically, whether there are any data or information that could improve the method for translating the results from the 1,033 simulated buildings to the generalized building sample. (See section IV.E.2 of this notice for additional information.)

10. Whether using RS Means cost data to develop maintenance, repair, and installation costs for CUAC and CUHP equipment is appropriate, and if not, what data should be used. (See section IV.F.6 of this notice for additional information.)

11. Comments, information and data on the equipment lifetimes developed for CUAC and CUHP equipment. Specifically, any information that would indicate whether the retirement functions yielding median lifetimes of 18.7 years and 15.4 years for CUAC and CUHP equipment, respectively, are reasonable. (See section IV.F.7 of this notice for additional information.)

12. Comments, information and data on the base case efficiency distributions of CUAC equipment. Given that historical market share efficiency data from 1999–2001 were used to inform a consumer choice model in the shipments analysis to develop estimated base case efficiency distributions in the compliance year (2019), DOE seeks more recent historical market share efficiency data would be useful for validating the estimated base case efficiency distributions. (See section IV.F.9 of this notice for additional information.)

13. Comments, information and data on the methods used to develop the two consumer choice models in the shipments analysis—i.e. one model for estimating the selection of CUAC and CUHP equipment by efficiency level and another model for the repair vs. replacement decision. With regards to the repair vs. replacement decision, the model is based on estimates of the cost of repair vs. the cost of new equipment. Field data for repair costs and how they vary with equipment first cost and age would allow DOE to refine its shipments forecasting by more precisely modeling the repair vs. replace decision sensitivity to the difference in repair and replacement equipment costs. (See section IV.G of this notice for additional information.)

14. Comments, information and data regarding the lifetime of repaired equipment. DOE's analysis considered

major repair consisting of replacement of the compressor and miscellaneous materials associated with the compressor; DOE estimated that repaired equipment would last as long as new replacement equipment. Information is requested to determine whether this estimate is reasonable. (See section IV.G of this notice for additional information.)

15. Comments, information, and data on the repair of CUACs and CUHPs in the ≥240,000 Btu/h and <760,000 Btu/h equipment classes. For this equipment, the shipments analysis estimated that any equipment experiencing their first failure would be repaired rather than replaced. Information is requested to determine whether this estimate is reasonable. (See section IV.G of this notice for additional information.)

16. Comments on its decision to not include a rebound effect for more-efficient CUAC and CUHP. (See section IV.H of this notice for additional information.)

17. Comments, information, and data that would inform adjustment of the DOE's estimate of $12.7M in conversion costs that occur in the base case. (See section IV.J.2.a of this notice for additional information.)

18. DOE solicits comment on the application of the new SCC values used to determine the social benefits of CO_2 emissions reductions over the rulemaking analysis period. In particular, the agency solicits comment on its derivation of SCC values after 2050, where the agency applied the average annual growth rate of the SCC estimates in 2040–2050 associated with each of the four sets of values. (See section IV.L of this notice for additional information.) Comments, information, and data on the capital conversion costs and product conversion costs estimated for each TSL. In particular, DOE seeks comment on the conversion costs at max-tech. (See section V.B.2.a of this notice for additional information.)

19. Comments, information, and data on capacity constraints at each TSL—including production capacity constraints, engineering resource constraints, and testing capacity constraints that are directly related to an amended standard for small, large, and very large CUAC and CUHP. In particular, DOE requests comment on whether the proposed effective allows for a sufficient conversion period to make the equipment design and facility updates necessary to meet an amended standard. (See section V.B.2.c of this notice for additional information.)

20. DOE requests comment on the identified regulations and their contribution to cumulative regulatory burden. Additionally, DOE requests feedback on product-specific regulations that take effect between 2016 and 2022 that were not listed, including identification of the specific regulations and data quantifying the associated burdens. (See section V.B.2.e of this notice for additional information.)

21. For this rulemaking, DOE analyzed the effects of potential standards on equipment purchased over a 30-year period, and it undertook a sensitivity analysis using 9 years rather than 30 years of product shipments. The choice of a 30-year period of shipments is consistent with the DOE analysis for other products and commercial equipment. 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 amended standards. DOE is seeking input on ways to refine the analytic timeline. (See section V.B.3.a of this notice for additional information.)

22. Comments, information, and data on the number of small businesses in the industry, the names of those small businesses, and their role in the market. (See section VI.B.1 of this notice for additional information.)

23. DOE requests data on the cost of capital for small manufacturers to better quantify how small manufacturers might be disadvantaged relative to large competitors. (See section VI.B.2 of this notice for additional information.)

24. DOE requests comment and data on the impact of the proposed standard on small business manufacturers, including any potential cumulative regulatory effects.

25. DOE also seeks comment on whether there are features or attributes of the more energy-efficient CUAC and CUHP that manufacturers would produce to meet the standards in this proposed rule that might affect how they would be used by consumers. DOE requests comment specifically on how any such effects should be weighed in the choice of standards for the final rule. (See section IV.A.3 of this notice for additional information.)

26. Input on regulatory alternatives to consider that would lessen the impact of the rulemaking on small business.

VIII. Approval of the Office of the Secretary

The Secretary of Energy has approved publication of this proposed rule.

List of Subjects in 10 CFR Part 431

Administrative practice and procedure, Confidential business information, Energy conservation, Household appliances, Imports, Intergovernmental relations, Reporting and recordkeeping requirements, and Small businesses.

Issued in Washington, DC, on September 18, 2014.

David T. Danielson,

Assistant Secretary, Energy Efficiency and Renewable Energy.

For the reasons set forth in the preamble, DOE proposes to amend part 431 of chapter II, subchapter D, of title 10 of the Code of Federal Regulations, as set forth below:

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

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

Authority: 42 U.S.C. 6291–6317.

■ 2. Section 431.97 is amended by:

■ a. Revising paragraph (b) including Tables 1 through 3;

■ b. Redesignating Tables 4 through 8 as Tables 5 through 9;

■ c. Adding new Table 4; and

■ c. Revising paragraph (c).

The revision and additions read as follows:

§ 431.97 Energy efficiency standards and their compliance dates.

* * * * *

(b) Each commercial air conditioner or heat pump (not including single package vertical air conditioners and single package vertical heat pumps, packaged terminal air conditioners and packaged terminal heat pumps, computer room air conditioners, and variable refrigerant flow systems) manufactured starting on the compliance date listed in the corresponding table must meet the applicable minimum energy efficiency standard level(s) set forth in Tables 1, 2, 3, and 4 of this section.

TABLE 1 TO § 431.97—MINIMUM COOLING EFFICIENCY STANDARDS FOR AIR-CONDITIONING AND HEATING EQUIPMENT

[Not including single package vertical air conditioners and single package vertical heat pumps, packaged terminal air conditioners and packaged terminal heat pumps, computer room air conditioners, and variable refrigerant flow multi-split air conditioners and heat pumps]

Equipment type	Cooling capacity	Sub-category	Heating type	Efficiency level	Compliance date: products manufactured on and after . . .
Small Commercial Packaged Air-Conditioning and Heating Equipment (Air-Cooled, 3 Phase).	<65,000 Btu/h	AC	All	SEER = 13	June 16, 2008.
		HP	All	SEER = 13	June 16, 2008.
Small Commercial Packaged Air-Conditioning and Heating Equipment (Air-Cooled).	≥65,000 Btu/h and <135,000 Btu/h.	AC	Electric Resistance Heating or No Heating.	EER = 11.2	January 1, 2010.[1]
			All Other Types of Heating.	EER = 11.0	January 1, 2010.[1]
		HP	Electric Resistance Heating or No Heating.	EER = 11.0	January 1, 2010.[1]
			All Other Types of Heating.	EER = 10.8	January 1, 2010.[1]
Large Commercial Packaged Air-Conditioning and Heating Equipment (Air-Cooled).	≥135,000 Btu/h and <240,000 Btu/h.	AC	Electric Resistance Heating or No Heating.	EER = 11.0	January 1, 2010.[1]
			All Other Types of Heating.	EER = 10.8	January 1, 2010.[1]
Heating Equipment (Air-Cooled)	>240,000 Btu/h	HP	Electric Resistance Heating or No Heating.	EER = 10.6	January 1, 2010.[1]
			All Other Types of Heating.	EER = 10.4	January 1, 2010.[1]
Very Large Commercial Packaged Air-Conditioning and Heating Equipment (Air-Cooled).	≥240,000 Btu/h and <760,000 Btu/h.	AC	Electric Resistance Heating or No Heating.	EER = 10.0	January 1, 2010.[1]
			All Other Types of Heating.	EER = 9.8	January 1, 2010.[1]
		HP	Electric Resistance Heating or No Heating.	EER = 9.5	January 1, 2010.[1]
			All Other Types of Heating.	EER = 9.3	January 1, 2010.[1]
Small Commercial Packaged Air-Conditioning and Heating Equipment (Water-Cooled, Evaporatively-Cooled, and Water-Source).	<17,000 Btu/h	AC	All	EER = 12.1	October 29, 2003.
	≥17,000 Btu/h and <65,000 Btu/h.	HP	All	EER = 11.2	October 29, 2003.
		AC	All	EER = 12.1	October 29, 2003.
		HP	All	EER = 12.0	October 29, 2003.
	≥65,000 Btu/h and <135,000 Btu/h.	AC	Electric Resistance Heating or No Heating.	EER = 11.5	October 29, 2003.[2]
			All Other Types of Heating.	EER = 11.3	October 29, 2003.[2]
		HP	All	EER = 12.0	October 29, 2003.[2]
Large Commercial Packaged Air-Conditioning and Heating Equipment (Water-Cooled, Evaporatively-Cooled, and Water-Source).	≥135,000 Btu/h and <240,000 Btu/h.	AC	All	EER = 11.0	October 29, 2004.[3]
		HP	All	EER = 11.0	October 29, 2004.[3]
Very Large Commercial Packaged Air-Conditioning and Heating Equipment (Water-Cooled, Evaporatively-Cooled, and Water-Source).	≥240,000 Btu/h and <760,000 Btu/h.	AC	Electric Resistance Heating or No Heating.	EER = 11.0	January 10, 2011.[3]
			All Other Types of Heating.	EER = 10.8	January 10, 2011.[3]
		HP	Electric Resistance Heating or No Heating.	EER = 11.0	January 10, 2011.[3]
			All Other Types of Heating.	EER = 10.8	January 10, 2011.[3]

[1] And manufactured before *[date 3 years after final rule* **Federal Register** *publication]*. See Table 3 of this section for updated efficiency standards.

[2] And manufactured before June 1, 2013. See Table 3 of this section for updated efficiency standards.

[3] And manufactured before June 1, 2014. See Table 3 of this section for updated efficiency standards.

TABLE 2 TO § 431.97—MINIMUM HEATING EFFICIENCY STANDARDS FOR AIR CONDITIONING AND HEATING EQUIPMENT

[Heat pumps]

Equipment type	Cooling capacity	Efficiency level	Compliance date: Products manufactured on and after . . .
Small Commercial Packaged Air-Conditioning and Heating Equipment (Air-Cooled, 3 Phase).	<65,000 Btu/h	HSPF = 7.7	June 16, 2008.
Small Commercial Packaged Air-Conditioning and Heating Equipment (Air-Cooled).	≥65,000 Btu/h and <135,000 Btu/h.	COP = 3.3	January 1, 2010.[1]
Large Commercial Packaged Air-Conditioning and Heating Equipment (Air-Cooled).	≥135,000 Btu/h and <240,000 Btu/h.	COP = 3.2	January 1, 2010.[1]
Very Large Commercial Packaged Air-Conditioning and Heating Equipment (Air-Cooled).	≥240,000 Btu/h and <760,000 Btu/h.	COP = 3.2	January 1, 2010.[1]
Small Commercial Packaged Air-Conditioning and Heating Equipment (Water-Source).	<135,000 Btu/h	COP = 4.2	October 29, 2003.

[1] And manufactured before *[date 3 years after final rule* FEDERAL REGISTER *publication].* See Table 4 of this section for updated heating efficiency standards.

TABLE 3 TO § 431.97—UPDATES TO THE MINIMUM COOLING EFFICIENCY STANDARDS FOR AIR-CONDITIONING AND HEATING EQUIPMENT

[Not including single package vertical air conditioners and single package vertical heat pumps, packaged terminal air conditioners and packaged terminal heat pumps, computer room air conditioners, and variable refrigerant flow multi-split air conditioners and heat pumps]

Equipment type	Cooling capacity	Sub-category	Heating type	Efficiency level	Compliance date: Products manufactured on and after . . .
Small Commercial Packaged Air-Conditioning and Heating Equipment (Air-Cooled).	≥65,000 Btu/h and <135,000 Btu/h.	AC	Electric Resistance Heating or No Heating.	IEER = 14.8	*[date 3 years after final rule* **Federal Register** *publication].*
			All Other Types of Heating.	IEER = 14.6	
		HP	Electric Resistance Heating or No Heating.	IEER = 14.1	*[date 3 years after final rule* **Federal Register** *publication].*
			All Other Types of Heating.	IEER = 113.9	
Large Commercial Packaged Air-Conditioning and Heating Equipment (Air-Cooled).	≥135,000 Btu/h and <240,000 Btu/h.	AC	Electric Resistance Heating or No Heating.	IEER = 14.2	*[date 3 years after final rule* **Federal Register** *publication].*
			All Other Types of Heating.	IEER = 14.0	
		HP	Electric Resistance Heating or No Heating.	IEER = 13.4	*[date 3 years after final rule* **Federal Register** *publication].*
			All Other Types of Heating.	IEER = 13.2	
Very Large Commercial Packaged Air-Conditioning and Heating Equipment (Air-Cooled).	≥240,000 Btu/h and <760,000 Btu/h.	AC	Electric Resistance Heating or No Heating.	IEER = 13.5	*[date 3 years after final rule* **Federal Register** *publication]*
			All Other Types of Heating.	IEER = 13.3	
		HP	Electric Resistance Heating or No Heating.	IEER = 12.5	*[date 3 years after final rule* **Federal Register** *publication]*
			All Other Types of Heating.	IEER = 12.3	
Small Commercial Packaged Air-Conditioning and Heating Equipment (Water-Cooled).	≥65,000 Btu/h and <135,000 Btu/h.		Electric Resistance Heating or No Heating.	EER = 12.1	June 1, 2013.
			All Other Types of Heating.	EER = 11.9	June 1, 2013.
Large Commercial Packaged Air-Conditioning and Heating Equipment (Water-Cooled).	≥135,000 Btu/h and <240,000 Btu/h.		Electric Resistance Heating or No Heating.	EER = 12.5	June 1, 2014.
			All Other Types of Heating.	EER = 12.3	June 1, 2014.
Very Large Commercial Packaged Air-Conditioning and Heating Equipment (Water-Cooled).	≥240,000 Btu/h and <760,000 Btu/h.		Electric Resistance Heating or No Heating.	EER = 12.4	June 1, 2014.
			All Other Types of Heating.	EER = 12.2	June 1, 2014.

TABLE 3 TO § 431.97—UPDATES TO THE MINIMUM COOLING EFFICIENCY STANDARDS FOR AIR-CONDITIONING AND HEATING EQUIPMENT—Continued

[Not including single package vertical air conditioners and single package vertical heat pumps, packaged terminal air conditioners and packaged terminal heat pumps, computer room air conditioners, and variable refrigerant flow multi-split air conditioners and heat pumps]

Equipment type	Cooling capacity	Sub-category	Heating type	Efficiency level	Compliance date: Products manufactured on and after . . .
Small Commercial Packaged Air-Conditioning and Heating Equipment (Evaporatively-Cooled).	≥65,000 Btu/h and <135,000 Btu/h.	....	Electric Resistance Heating or No Heating.	EER = 12.1	June 1, 2013.
			All Other Types of Heating.	EER = 11.9	June 1, 2013.
Large Commercial Packaged Air-Conditioning and Heating Equipment (Evaporatively-Cooled).	≥135,000 Btu/h and <240,000 Btu/h.	....	Electric Resistance Heating or No Heating.	EER = 12.0	June 1, 2014.
			All Other Types of Heating.	EER = 11.8	June 1, 2014.
Very Large Commercial Packaged Air-Conditioning and Heating Equipment (Evaporatively-Cooled).	≥240,000 Btu/h and <760,000 Btu/h.	....	Electric Resistance Heating or No Heating.	EER = 11.9	June 1, 2014.
			All Other Types of Heating.	EER = 11.7	June 1, 2014.

TABLE 4 TO § 431.97—UPDATES TO THE MINIMUM HEATING EFFICIENCY STANDARDS FOR AIR-COOLED AIR CONDITIONING AND HEATING EQUIPMENT

[Heat pumps]

Equipment type	Cooling capacity	Heating type	Efficiency level [1]	Compliance date: Products manufactured on and after . . .
Small Commercial Packaged Air-Conditioning and Heating Equipment (Air-Cooled).	≥65,000 Btu/h and <135,000 Btu/h.	Electric Resistance Heating or No Heating.	COP = 3.5 ...	*[date 3 years after final rule* **Federal Register** *publication].*
		All Other Types of Heating	COP = 3.4 ...	
Large Commercial Packaged Air-Conditioning and Heating Equipment (Air-Cooled).	≥135,000 Btu/h and <240,000 Btu/h.	Resistance Heating or No Heating.	COP = 3.3 ...	*[date 3 years after final rule* **Federal Register** *publication]*
		All Other Types of Heating		
Very Large Commercial Packaged Air-Conditioning and Heating Equipment (Air-Cooled).	≥240,000 Btu/h and <760,000 Btu/h.	Resistance Heating or No Heating.	COP = 3.2 ...	*[date 3 years after final rule* **Federal Register** *publication]*
		All Other Types of Heating		

[1] For units tested by AHRI Standards, all COP values must be rated at 47 °F outdoor dry-bulb temperature for air-cooled equipment.

(c) Each packaged terminal air conditioner (PTAC) and packaged terminal heat pump (PTHP) manufactured starting on January 1, 1994, but before October 8, 2012 (for standard size PTACs and PTHPs) and before October 7, 2010 (for non-standard size PTACs and PTHPs) must meet the applicable minimum energy efficiency standard level(s) set forth in Table 5 of this section. Each standard size PTAC and PTHP manufactured starting on October 8, 2012, and each non-standard size PTAC and PTHP manufactured starting on October 7, 2010, must meet the applicable minimum energy efficiency standard level(s) set forth in Table 6 of this section.

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